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# Flash

## PyTorch Lightning

Nov 05, 2021



## GETTING STARTED

<b>1</b>	<b>Quick Start</b>	<b>3</b>
<b>2</b>	<b>Installation</b>	<b>9</b>
<b>3</b>	<b>Flash Zero</b>	<b>11</b>
<b>4</b>	<b>Flash in Production</b>	<b>15</b>
<b>5</b>	<b>Training from scratch</b>	<b>17</b>
<b>6</b>	<b>Finetuning</b>	<b>19</b>
<b>7</b>	<b>Predictions (inference)</b>	<b>25</b>
<b>8</b>	<b>TorchScript JIT Support</b>	<b>27</b>
<b>9</b>	<b>Data</b>	<b>29</b>
<b>10</b>	<b>Registry</b>	<b>37</b>
<b>11</b>	<b>Flash Serve</b>	<b>39</b>
<b>12</b>	<b>Backbones and Heads</b>	<b>45</b>
<b>13</b>	<b>Optimization (Optimizers and Schedulers)</b>	<b>47</b>
<b>14</b>	<b>Image Classification</b>	<b>51</b>
<b>15</b>	<b>Multi-label Image Classification</b>	<b>57</b>
<b>16</b>	<b>Image Embedder</b>	<b>61</b>
<b>17</b>	<b>Object Detection</b>	<b>63</b>
<b>18</b>	<b>Keypoint Detection</b>	<b>67</b>
<b>19</b>	<b>Instance Segmentation</b>	<b>69</b>
<b>20</b>	<b>Semantic Segmentation</b>	<b>71</b>
<b>21</b>	<b>Style Transfer</b>	<b>77</b>
<b>22</b>	<b>Video Classification</b>	<b>79</b>

<b>23 Audio Classification</b>	<b>81</b>
<b>24 Speech Recognition</b>	<b>85</b>
<b>25 Tabular Classification</b>	<b>89</b>
<b>26 Tabular Forecasting</b>	<b>93</b>
<b>27 Text Classification</b>	<b>95</b>
<b>28 Multi-label Text Classification</b>	<b>99</b>
<b>29 Question Answering</b>	<b>103</b>
<b>30 Summarization</b>	<b>107</b>
<b>31 Translation</b>	<b>111</b>
<b>32 Point Cloud Segmentation</b>	<b>115</b>
<b>33 Point Cloud Object Detection</b>	<b>119</b>
<b>34 Graph Classification</b>	<b>123</b>
<b>35 Providers</b>	<b>125</b>
<b>36 BaaL</b>	<b>127</b>
<b>37 FiftyOne</b>	<b>129</b>
<b>38 IceVision</b>	<b>135</b>
<b>39 Learn2Learn</b>	<b>137</b>
<b>40 PyTorch Forecasting</b>	<b>141</b>
<b>41 VISSL</b>	<b>145</b>
<b>42 flash</b>	<b>147</b>
<b>43 flash.core</b>	<b>173</b>
<b>44 flash.core.data</b>	<b>187</b>
<b>45 flash.core.serve</b>	<b>203</b>
<b>46 flash.image</b>	<b>205</b>
<b>47 flash.audio</b>	<b>231</b>
<b>48 flash.pointcloud</b>	<b>235</b>
<b>49 flash.tabular</b>	<b>241</b>
<b>50 flash.text</b>	<b>251</b>
<b>51 flash.video</b>	<b>275</b>
<b>52 flash.graph</b>	<b>279</b>

<b>53 Introduction / Set-up</b>	<b>281</b>
<b>54 The Data</b>	<b>283</b>
<b>55 The Backbones</b>	<b>291</b>
<b>56 The Task</b>	<b>293</b>
<b>57 Optional Extras</b>	<b>297</b>
<b>58 The Example</b>	<b>299</b>
<b>59 The Tests</b>	<b>301</b>
<b>60 The Docs</b>	<b>305</b>
<b>61 Flash Governance   Persons of interest</b>	<b>307</b>
<b>62 Contributing</b>	<b>309</b>
<b>63 Changelog</b>	<b>313</b>
<b>64 Template</b>	<b>321</b>
<b>65 Indices and tables</b>	<b>323</b>
<b>Index</b>	<b>325</b>









## QUICK START

Flash is a high-level deep learning framework for fast prototyping, baselining, finetuning and solving deep learning problems. It features a set of tasks for you to use for inference and finetuning out of the box, and an easy to implement API to customize every step of the process for full flexibility.

Flash is built for beginners with a simple API that requires very little deep learning background, and for data scientists, Kagglers, applied ML practitioners and deep learning researchers that want a quick way to get a deep learning baseline with advanced features [PyTorch Lightning](#) offers.

## 1.1 Why Flash?

### 1.1.1 For getting started with Deep Learning

#### Easy to learn

If you are just getting started with deep learning, Flash offers common deep learning tasks you can use out-of-the-box in a few lines of code, no math, fancy nn.Modules or research experience required!

#### Easy to scale

Flash is built on top of [PyTorch Lightning](#), a powerful deep learning research framework for training models at scale. With the power of Lightning, you can train your flash tasks on any hardware: CPUs, GPUs or TPUs without any code changes.

#### Easy to upskill

If you want to create more complex and customized models, you can refactor any part of flash with PyTorch or [PyTorch Lightning](#) components to get all the flexibility you need. Lightning is just organized PyTorch with the unnecessary engineering details abstracted away.

- Flash (high-level)
- Lightning (mid-level)
- PyTorch (low-level)

When you need more flexibility you can build your own tasks or simply use Lightning directly.

## 1.1.2 For Deep learning research

### Quickest way to a baseline

[PyTorch Lightning](#) is designed to abstract away unnecessary boilerplate, while enabling maximal flexibility. In order to provide full flexibility, solving very common deep learning problems such as classification in Lightning still requires some boilerplate. It can still take quite some time to get a baseline model running on a new dataset or out of domain task. We created Flash to answer our users need for a super quick way to baseline for Lightning using proven backbones for common data patterns. Flash aims to be the easiest starting point for your research- start with a Flash Task to benchmark against, and override any part of flash with Lightning or PyTorch components on your way to SOTA research.

### Flexibility where you want it

Flash tasks are essentially LightningModules, and the Flash Trainer is a thin wrapper for the Lightning Trainer. You can use your own LightningModule instead of the Flash task, the Lightning Trainer instead of the flash trainer, etc. Flash helps you focus even more only on your research, and less on anything else.

### Standard best practices

Flash tasks implement the standard best practices for a variety of different models and domains, to save you time digging through different implementations. Flash abstracts even more details than Lightning, allowing deep learning experts to share their tips and tricks for solving scoped deep learning problems.

---

## 1.2 Tasks

Flash is comprised of a collection of Tasks. The Flash tasks are laser-focused objects designed to solve a well-defined type of problem, using state-of-the-art methods.

The Flash tasks contain all the relevant information to solve the task at hand- the number of class labels you want to predict, number of columns in your dataset, as well as details on the model architecture used such as loss function, optimizers, etc.

Here are examples of tasks:

```
from flash.text import TextClassifier
from flash.image import ImageClassifier
from flash.tabular import TabularClassifier
```

---

**Note:** Tasks are inflexible by definition! To get more flexibility, you can simply use [LightningModule](#) directly or modify an existing task in just a few lines.

---

## 1.3 Inference

Inference is the process of generating predictions from trained models. To use a task for inference:

1. Init your task with pretrained weights using a checkpoint (a checkpoint is simply a file that capture the exact value of all parameters used by a model). Local file or URL works.
2. Pass in the data to `flash.core.model.Task.predict()`.

Here's an example of inference:

```
# import our libraries
from flash.text import TextClassifier

# 1. Init the finetuned task from URL
model = TextClassifier.load_from_checkpoint("https://flash-weights.s3.amazonaws.com/0.5.
↪2/text_classification_model.pt")

# 2. Perform inference from list of sequences
predictions = model.predict(
    [
        "Turgid dialogue, feeble characterization - Harvey Keitel a judge?.",
        "The worst movie in the history of cinema.",
        "This guy has done a great job with this movie!",
    ]
)
print(predictions)
```

We get the following output:

```
["negative", "negative", "positive"]
```

## 1.4 Finetuning

Finetuning (or transfer-learning) is the process of tweaking a model trained on a large dataset, to your particular (likely much smaller) dataset. All Flash tasks have pre-trained backbones that are already trained on large datasets such as ImageNet. Finetuning on pretrained models decreases training time significantly.

To use a Task for finetuning:

1. Load your data and organize it using a `DataModule` customized for the task (example: `ImageClassificationData`).
2. Choose and initialize your Task which has state-of-the-art backbones built in (example: `ImageClassifier`).
3. Init a `flash.core.trainer.Trainer`.
4. Choose a finetune strategy (example: “freeze”) and call `flash.core.trainer.Trainer.finetune()` with your data.

5. Save your finetuned model.

Here's an example of finetuning.

```
from pytorch_lightning import seed_everything

import flash
from flash.core.classification import Labels
from flash.core.data.utils import download_data
from flash.image import ImageClassificationData, ImageClassifier

# set the random seeds.
seed_everything(42)

# 1. Download and organize the data
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
    test_folder="data/hymenoptera_data/test/",
)

# 2. Build the model using desired Task
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes)

# 3. Create the trainer (run one epoch for demo)
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count())

# 4. Finetune the model
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 5. Save the model!
trainer.save_checkpoint("image_classification_model.pt")
```

### 1.4.1 Using a finetuned model

Once you've finetuned, use the model to predict:

```
# Serialize predictions as labels, automatically inferred from the training data in part 1.
↪ 2.
model.serializer = Labels()

predictions = model.predict(
    [
        "data/hymenoptera_data/val/bees/65038344_52a45d090d.jpg",
        "data/hymenoptera_data/val/ants/2255445811_dabcdf7258.jpg",
    ]
)
```

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```
)  
print(predictions)
```

We get the following output:

```
['bees', 'ants']
```

Or you can use the saved model for prediction anywhere you want!

```
from flash.image import ImageClassifier  
  
# load finetuned checkpoint  
model = ImageClassifier.load_from_checkpoint("image_classification_model.pt")  
  
predictions = model.predict("path/to/your/own/image.png")
```

## 1.5 Training

When you have enough data, you're likely better off training from scratch instead of finetuning.

To train a task from scratch:

1. Load your data and organize it using a `DataModule` customized for the task (example: `ImageClassificationData`).
2. Choose and initialize your Task (setting `pretrained=False`) which has state-of-the-art backbones built in (example: `ImageClassifier`).
3. Init a `flash.core.trainer.Trainer` or a `pytorch_lightning.trainer.Trainer`.
4. Call `flash.core.trainer.Trainer.fit()` with your data set.
5. Save your trained model.

Here's an example:

```
from pytorch_lightning import seed_everything  
  
import flash  
from flash.core.classification import Labels  
from flash.core.data.utils import download_data  
from flash.image import ImageClassificationData, ImageClassifier  
  
# set the random seeds.  
seed_everything(42)  
  
# 1. Download and organize the data  
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")
```

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```
datamodule = ImageClassificationData.from_folders(  
    train_folder="data/hymenoptera_data/train/",  
    val_folder="data/hymenoptera_data/val/",  
    test_folder="data/hymenoptera_data/test/",  
)  
  
# 2. Build the model using desired Task  
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes,  
    ↪pretrained=False)  
  
# 3. Create the trainer (run one epoch for demo)  
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count())  
  
# 4. Train the model  
trainer.fit(model, datamodule=datamodule)  
  
# 5. Save the model!  
trainer.save_checkpoint("image_classification_model.pt")
```

---

## 1.6 A few Built-in Tasks

- *ImageClassification*
- *ImageEmbedder*
- *TextClassification*
- *SummarizationTask*
- *TranslationTask*
- *TabularClassification*

More tasks coming soon!

### 1.6.1 Contribute a task

The lightning + Flash team is hard at work building more tasks for common deep-learning use cases. But we're looking for incredible contributors like you to submit new tasks!

Join our [Slack](#) to get help becoming a contributor!

## INSTALLATION

### 2.1 Install with pip

```
pip install lightning-flash
```

Optionally, you can install Flash with extra packages for each domain.

For a single domain, use: `pip install 'lightning-flash[{DOMAIN}]'`.

```
pip install 'lightning-flash[image]'  
pip install 'lightning-flash[tabular]'  
pip install 'lightning-flash[text]'  
...
```

For multiple domains, use: `pip install 'lightning-flash[{DOMAIN_1, DOMAIN_2, ...}]'`.

```
pip install 'lightning-flash[audio,image]'  
...
```

For contributors, please install Flash with packages for testing Flash and building docs.

```
# Clone Flash repository locally  
git clone https://github.com/[your username]/lightning-flash.git  
cd lightning-flash  
  
# Install Flash in editable mode with extra packages for development  
pip install -e '.[dev]'
```

### 2.2 Install with conda

Flash is available via conda forge. Install it with:

```
conda install -c conda-forge lightning-flash
```

## 2.3 Install from source

You can install Flash from source without any domain specific dependencies with:

```
pip install 'git+https://github.com/PyTorchLightning/lightning-flash.git'
```

To install Flash with domain dependencies, use:

```
pip install 'git+https://github.com/PyTorchLightning/lightning-flash.git#egg=lightning-  
↪flash[image]'
```

You can again install dependencies for multiple domains by separating them with commas as above.



## FLASH ZERO

Flash Zero is a zero-code machine learning platform. Here's an image classification example to illustrate with one of the dozens tasks available.

### 3.1 Flash Zero in 3 steps

#### 3.1.1 1. Select your task

```
flash {TASK_NAME}
```

Here is the list of currently supported tasks.

audio_classification	Classify audio spectrograms.
graph_classification	Classify graphs.
image_classification	Classify images.
instance_segmentation	Segment object instances <b>in</b> images.
keypoint_detection	Detect keypoints <b>in</b> images.
object_detection	Detect objects <b>in</b> images.
pointcloud_detection	Detect objects <b>in</b> point clouds.
pointcloud_segmentation	Segment objects <b>in</b> point clouds.
question_answering	Extractive Question Answering.
semantic_segmentation	Segment objects <b>in</b> images.
speech_recognition	Speech recognition.
style_transfer	Image style transfer.
summarization	Summarize text.
tabular_classification	Classify tabular data.
text_classification	Classify text.
translation	Translate text.
video_classification	Classify videos.

### 3.1.2 2. Pass in your own data

```
flash image_classification from_folders --train_folder data/hymenoptera_data/train
```

### 3.1.3 3. Modify the model and training parameters

```
flash image_classification --trainer.max_epochs 10 --model.backbone resnet50 from_
↳ folders --train_folder data/hymenoptera_data/train
```

---

**Note:** The trainer and model arguments should be placed before the source subcommand. Here it is `from_folders`.

---

## 3.2 Other Examples

### 3.2.1 Image Object Detection

To train an Object Detector on [COCO 2017 dataset](#), you could use the following command:

```
flash object_detection from_coco --train_folder data/coco128/images/train2017/ --train_
↳ ann_file data/coco128/annotations/instances_train2017.json --val_split .3 --batch_size_
↳ 8 --num_workers 4
```

### 3.2.2 Image Object Segmentation

To train an Image Segmenter on [CARLA driving simulator dataset](#)

```
flash semantic_segmentation from_folders --train_folder data/CameraRGB --train_target_
↳ folder data/CameraSeg --num_classes 21
```

Below is an example where the head, the backbone and its pretrained weights are customized.

```
flash semantic_segmentation --model.head fpn --model.backbone efficientnet-b0 --model.
↳ pretrained advprop from_folders --train_folder data/CameraRGB --train_target_folder_
↳ data/CameraSeg --num_classes 21
```

### 3.2.3 Video Classification

To train a Video Classifier on the [Kinetics dataset](#), you could use the following command:

```
flash video_classification from_folders --train_folder data/kinetics/train/ --clip_
↳ duration 1 --num_workers 0
```

### 3.3 CLI options

Flash Zero is built on top of the [lightning CLI](#), so the trainer and model arguments can be configured either from the command line or from a config file. For example, to run the image classifier for 10 epochs with a *resnet50* backbone you can use:

```
flash image_classification --trainer.max_epochs 10 --model.backbone resnet50
```

To view all of the available options for a task, run:

```
flash image_classification --help
```

### 3.4 Using Your Own Data

Flash Zero works with your own data through subcommands. The available subcommands for each task are given at the bottom of their help pages (e.g. when running `flash image-classification --help`). You can then use the required subcommand to train on your own data. Let's look at an example using the Hymenoptera data from the [Image Classification](#) guide. First, download and unzip your data:

```
curl https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip -o hymenoptera_data
unzip hymenoptera_data.zip
```

Now train with Flash Zero:

```
flash image_classification from_folders --train_folder ./hymenoptera_data/train
```

### 3.5 Getting Help

To find all available tasks, you can run:

```
flash --help
```

This will output the following:

Commands:	
audio_classification	Classify audio spectrograms.
graph_classification	Classify graphs.
image_classification	Classify images.
instance_segmentation	Segment object instances <b>in</b> images.
keypoint_detection	Detect keypoints <b>in</b> images.
object_detection	Detect objects <b>in</b> images.
pointcloud_detection	Detect objects <b>in</b> point clouds.
pointcloud_segmentation	Segment objects <b>in</b> point clouds.
question_answering	Extractive Question Answering.
semantic_segmentation	Segment objects <b>in</b> images.
speech_recognition	Speech recognition.
style_transfer	Image style transfer.
summarization	Summarize text.
tabular_classification	Classify tabular data.

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text_classification	Classify text.
translation	Translate text.
video_classification	Classify videos.

To get more information about a specific task, you can do the following:

```
flash image_classification --help
```

You can view the help page for each subcommand. For example, to view the options for training an image classifier from folders, you can run:

```
flash image_classification from_folders --help
```

Finally, you can generate a *config.yaml* file from the client to ease parameters modification by running:

```
flash image_classification --print_config > config.yaml
```

## FLASH IN PRODUCTION

### 4.1 Flash Serve

Flash Serve makes model deployment simple.

#### 4.1.1 Server Side

```
from flash.image import SemanticSegmentation
from flash.image.segmentation.serialization import SegmentationLabels

model = SemanticSegmentation.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/semantic_segmentation_model.pt"
)
model.serializer = SegmentationLabels(visualize=False)
model.serve()
```

#### 4.1.2 Client Side

```
import base64
from pathlib import Path

import requests

import flash

with (Path(flash.ASSETS_ROOT) / "road.png").open("rb") as f:
    imgstr = base64.b64encode(f.read()).decode("UTF-8")

body = {"session": "UUID", "payload": {"inputs": {"data": imgstr}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)
print(resp.json())
```

Credits to @rlizzo, @hhsecond, @lantiga, @luiscape for building the Flash Serve Engine. Read all about it [here](#).



## TRAINING FROM SCRATCH

Some Flash tasks have been pretrained on large data sets. To accelerate your training, calling the `finetune()` method using a pretrained backbone will fine-tune the backbone to generate a model customized to your data set and desired task.

From the *Quick Start* guide.

To train a task from scratch:

1. Load your data and organize it using a `DataModule` customized for the task (example: `ImageClassificationData`).
2. Choose and initialize your Task (setting `pretrained=False`) which has state-of-the-art backbones built in (example: `ImageClassifier`).
3. Init a `flash.core.trainer.Trainer` or a `pytorch_lightning.trainer.Trainer`.
4. Call `flash.core.trainer.Trainer.fit()` with your data set.
5. Save your trained model.

Here's an example:

```
from pytorch_lightning import seed_everything

import flash
from flash.core.classification import Labels
from flash.core.data.utils import download_data
from flash.image import ImageClassificationData, ImageClassifier

# set the random seeds.
seed_everything(42)

# 1. Download and organize the data
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
    test_folder="data/hymenoptera_data/test/",
)
```

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```
# 2. Build the model using desired Task
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes,
↳pretrained=False)

# 3. Create the trainer (run one epoch for demo)
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count())

# 4. Train the model
trainer.fit(model, datamodule=datamodule)

# 5. Save the model!
trainer.save_checkpoint("image_classification_model.pt")
```

## 5.1 Training options

Flash tasks supports many advanced training functionalities out-of-the-box, such as:

- limit number of epochs

```
# train for 10 epochs
flash.Trainer(max_epochs=10)
```

- Training on GPUs

```
# train on 1 GPU
flash.Trainer(gpus=1)
```

- Training on multiple GPUs

```
# train on multiple GPUs
flash.Trainer(gpus=4)
```

```
# train on gpu 1, 3, 5 (3 gpus total)
flash.Trainer(gpus=[1, 3, 5])
```

- Using mixed precision training

```
# Multi GPU with mixed precision
flash.Trainer(gpus=2, precision=16)
```

- Training on TPUs

```
# Train on TPUs
flash.Trainer(tpu_cores=8)
```

You can add to the flash Trainer any argument from the Lightning trainer! Learn more about the Lightning Trainer [here](#).



## FINETUNING

Finetuning (or transfer-learning) is the process of tweaking a model trained on a large dataset, to your particular (likely much smaller) dataset.

---

### 6.1 Terminology

Here are common terms you need to be familiar with:

Table 1: Terminology

Term	Definition
Finetuning	The process of tweaking a model trained on a large dataset, to your particular (likely much smaller) dataset
Transfer learning	The common name for finetuning
Backbone	The neural network that was pretrained on a different dataset
Head	Another neural network (usually smaller) that maps the backbone to your particular dataset
Freeze	Disabling gradient updates to a model (ie: not learning)
Unfreeze	Enabling gradient updates to a model

---

### 6.2 Finetuning in Flash

From the *Quick Start* guide.

To use a Task for finetuning:

1. Load your data and organize it using a `DataModule` customized for the task (example: `ImageClassificationData`).
2. Choose and initialize your Task which has state-of-the-art backbones built in (example: `ImageClassifier`).
3. Init a `flash.core.trainer.Trainer`.
4. Choose a finetune strategy (example: “freeze”) and call `flash.core.trainer.Trainer.finetune()` with your data.
5. Save your finetuned model.

Here's an example of finetuning.

```
from pytorch_lightning import seed_everything

import flash
from flash.core.classification import Labels
from flash.core.data.utils import download_data
from flash.image import ImageClassificationData, ImageClassifier

# set the random seeds.
seed_everything(42)

# 1. Download and organize the data
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
    test_folder="data/hymenoptera_data/test/",
)

# 2. Build the model using desired Task
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes)

# 3. Create the trainer (run one epoch for demo)
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count())

# 4. Finetune the model
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 5. Save the model!
trainer.save_checkpoint("image_classification_model.pt")
```

### 6.2.1 Using a finetuned model

Once you've finetuned, use the model to predict:

```
# Serialize predictions as labels, automatically inferred from the training data in part 1.
→ 2.
model.serializer = Labels()

predictions = model.predict(
    [
        "data/hymenoptera_data/val/bees/65038344_52a45d090d.jpg",
        "data/hymenoptera_data/val/ants/2255445811_dabcdf7258.jpg",
    ]
)
print(predictions)
```

We get the following output:

```
['bees', 'ants']
```

Or you can use the saved model for prediction anywhere you want!

```
from flash.image import ImageClassifier

# load finetuned checkpoint
model = ImageClassifier.load_from_checkpoint("image_classification_model.pt")

predictions = model.predict("path/to/your/own/image.png")
```

## 6.3 Finetune strategies

Finetuning is very task specific. Each task encodes the best finetuning practices for that task. However, Flash gives you a few default strategies for finetuning.

Finetuning operates on two things, the model backbone and the head. The backbone is the neural network that was pre-trained. The head is another neural network that bridges between the backbone and your particular dataset.

### 6.3.1 no\_freeze

In this strategy, the backbone and the head are unfrozen from the beginning.

```
trainer.finetune(model, datamodule, strategy="no_freeze")
```

In pseudocode, this looks like:

```
backbone = Resnet50()
head = nn.Linear(...)

backbone.unfreeze()
head.unfreeze()

train(backbone, head)
```

### 6.3.2 freeze

The freeze strategy keeps the backbone frozen throughout.

```
trainer.finetune(model, datamodule, strategy="freeze")
```

The pseudocode looks like:

```
backbone = Resnet50()
head = nn.Linear(...)

# freeze backbone
backbone.freeze()
head.unfreeze()

train(backbone, head)
```

## 6.4 Advanced strategies

Every finetune strategy can also be customized.

### 6.4.1 freeze\_unfreeze

By default, in this strategy the backbone is frozen for 5 epochs then unfrozen:

```
trainer.finetune(model, datamodule, strategy="freeze_unfreeze")
```

Or we can customize it unfreeze the backbone after a different epoch. For example, to unfreeze after epoch 7:

```
from flash.core.finetuning import FreezeUnfreeze

trainer.finetune(model, datamodule, strategy=FreezeUnfreeze(unfreeze_epoch=7))
```

Under the hood, the pseudocode looks like:

```
backbone = Resnet50()
head = nn.Linear(...)

# freeze backbone
backbone.freeze()
head.unfreeze()

train(backbone, head, epochs=10)

# unfreeze after 10 epochs
backbone.unfreeze()

train(backbone, head)
```

### 6.4.2 unfreeze\_milestones

This strategy allows you to unfreeze part of the backbone at predetermined intervals

Here's an example where: - backbone starts frozen - at epoch 3 the last 2 layers unfreeze - at epoch 8 the full backbone unfreezes

```
from flash.core.finetuning import UnfreezeMilestones

trainer.finetune(model, datamodule, strategy=UnfreezeMilestones(unfreeze_milestones=(3, 8), num_layers=2))
```

Under the hood, the pseudocode looks like:

```

backbone = Resnet50()
head = nn.Linear(...)

# freeze backbone
backbone.freeze()
head.unfreeze()

train(backbone, head, epochs=3)

# unfreeze last 2 layers at epoch 3
backbone.unfreeze_last_layers(2)

train(backbone, head, epochs=8)

# unfreeze the full backbone
backbone.unfreeze()

```

## 6.5 Custom Strategy

For even more customization, create your own finetuning callback. Learn more about callbacks [here](#).

```

from flash.core.finetuning import FlashBaseFinetuning

# Create a finetuning callback
class FeatureExtractorFreezeUnfreeze(FlashBaseFinetuning):
    def __init__(self, unfreeze_epoch: int = 5, train_bn: bool = True):
        # this will set self.attr_names as ["backbone"]
        super().__init__("backbone", train_bn)
        self._unfreeze_epoch = unfreeze_epoch

    def finetune_function(self, pl_module, current_epoch, optimizer, opt_idx):
        # unfreeze any module you want by overriding this function

        # When ``current_epoch`` is 5, backbone will start to be trained.
        if current_epoch == self._unfreeze_epoch:
            self.unfreeze_and_add_param_group(
                pl_module.backbone,
                optimizer,
            )

# Pass the callback to trainer.finetune
trainer.finetune(model, datamodule, strategy=FeatureExtractorFreezeUnfreeze(unfreeze_
↪ epoch=5))

```



## PREDICTIONS (INFERENCE)

You can use Flash to get predictions on pretrained or finetuned models.

### 7.1 Predict on a single sample of data

You can pass in a sample of data (image file path, a string of text, etc) to the `predict()` method.

```
from flash.core.data.utils import download_data
from flash.image import ImageClassifier

# 1. Download the data set
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")

# 2. Load the model from a checkpoint
model = ImageClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/image_classification_model.pt"
)

# 3. Predict whether the image contains an ant or a bee
predictions = model.predict("data/hymenoptera_data/val/bees/65038344_52a45d090d.jpg")
print(predictions)
```

### 7.2 Predict on a csv file

```
from flash.core.data.utils import download_data
from flash.tabular import TabularClassifier

# 1. Download the data
download_data("https://pl-flash-data.s3.amazonaws.com/titanic.zip", "data/")

# 2. Load the model from a checkpoint
model = TabularClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/tabular_classification_model.pt"
)

# 3. Generate predictions from a csv file! Who would survive?
```

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```
predictions = model.predict("data/titanic/titanic.csv")
print(predictions)
```

## 7.3 Serializing predictions

To change how predictions are serialized you can attach a *Serializer* to your *Task*. For example, you can choose to serialize outputs as probabilities (for more options see the API reference below).

```
from flash.core.classification import Probabilities
from flash.core.data.utils import download_data
from flash.image import ImageClassifier

# 1. Download the data set
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")

# 2. Load the model from a checkpoint
model = ImageClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/image_classification_model.pt"
)

# 3. Attach the Serializer
model.serializer = Probabilities()

# 4. Predict whether the image contains an ant or a bee
predictions = model.predict("data/hymenoptera_data/val/bees/65038344_52a45d090d.jpg")
print(predictions)
# out: [[0.5926494598388672, 0.40735048055648804]]
```



## TORCHSCRIPT JIT SUPPORT

We test all of our tasks for compatibility with `torch.jit`. This table gives a breakdown of the supported features.

Task	<code>torch.jit.script()</code>	<code>torch.jit.trace()</code>	<code>torch.jit.save()</code>
<i>ImageClassifier</i>	Yes	Yes	Yes
<i>ObjectDetector</i>	Yes	No	Yes
<i>ImageEmbedder</i>	Yes	Yes	Yes
<i>SemanticSegmentation</i>	No	Yes	Yes
<i>StyleTransfer</i>	No	Yes	Yes
<i>TabularClassifier</i>	No	Yes	No
<i>TextClassifier</i>	No	Yes *	Yes
<i>SummarizationTask</i>	No	Yes	Yes
<i>TranslationTask</i>	No	Yes	Yes
<i>VideoClassifier</i>	No	Yes	Yes

\* with `strict=False`



## 9.1 Terminology

Here are common terms you need to be familiar with:

Table 1: Terminology

Term	Definition
<i>Deserializer</i>	The <i>Deserializer</i> provides a single <code>deserialize()</code> method.
<i>DataModule</i>	The <i>DataModule</i> contains the datasets, transforms and dataloaders.
<i>DataPipeline</i>	The <i>DataPipeline</i> is Flash internal object to manage <i>Deserializer</i> , <i>DataSource</i> , <i>Preprocess</i> , <i>Postprocess</i> , and <i>Serializer</i> objects.
<i>DataSource</i>	The <i>DataSource</i> provides <code>load_data()</code> and <code>load_sample()</code> hooks for creating data sets from metadata (such as folder names).
<i>Preprocess</i>	<p><b>The <i>Preprocess</i> provides a simple hook-based API to encapsulate your pre-processing logic.</b></p> <p>These hooks (such as <code>pre_tensor_transform()</code>) enable transformations to be applied to your data at every point along the pipeline (including on the device). The <i>DataPipeline</i> contains a system to call the right hooks when needed. The <i>Preprocess</i> hooks can be either overridden directly or provided as a dictionary of transforms (mapping hook name to callable transform).</p>
<i>Postprocess</i>	<p><b>The <i>Postprocess</i> provides a simple hook-based API to encapsulate your post-processing logic.</b></p> <p>The <i>Postprocess</i> hooks cover from model outputs to predictions export.</p>
<i>Serializer</i>	The <i>Serializer</i> provides a single <code>serialize()</code> method that is used to convert model outputs (after the <i>Postprocess</i> ) to the desired output format during prediction.

## 9.2 How to use out-of-the-box Flash DataModules

Flash provides several DataModules with helpers functions. Check out the *Image Classification* section (or the sections for any of our other tasks) to learn more.

## 9.3 Data Processing

Currently, it is common practice to implement a `torch.utils.data.Dataset` and provide it to a `torch.utils.data.DataLoader`. However, after model training, it requires a lot of engineering overhead to make inference on raw data and deploy the model in production environment. Usually, extra processing logic should be added to bridge the gap between training data and raw data.

The *DataSource* class can be used to generate data sets from multiple sources (e.g. folders, numpy, etc.), that can then all be transformed in the same way. The *Preprocess* and *Postprocess* classes can be used to manage the preprocessing and postprocessing transforms. The *Serializer* class provides the logic for converting *Postprocess* outputs to the desired predict format (e.g. classes, labels, probabilities, etc.).

By providing a series of hooks that can be overridden with custom data processing logic (or just targeted with transforms), Flash gives the user much more granular control over their data processing flow.

Here are the primary advantages:

- Making inference on raw data simple
- Make the code more readable, modular and self-contained
- Data Augmentation experimentation is simpler

To change the processing behavior only on specific stages for a given hook, you can prefix each of the *Preprocess* and *Postprocess* hooks by adding `train`, `val`, `test` or `predict`.

Check out *Preprocess* for some examples.

## 9.4 How to customize existing DataModules

Any Flash *DataModule* can be created directly from datasets using the *from\_datasets()* like this:

```
from flash import DataModule, Trainer

data_module = DataModule.from_datasets(train_dataset=MyDataset())
trainer = Trainer()
trainer.fit(model, data_module=data_module)
```

The *DataModule* provides additional classmethod helpers (`from_*`) for loading data from various sources. In each `from_*` method, the *DataModule* internally retrieves the correct *DataSource* to use from the *Preprocess*. Flash *AutoDataset* instances are created from the *DataSource* for train, val, test, and predict. The *DataModule* populates the *DataLoader* for each stage with the corresponding *AutoDataset*.

## 9.5 Customize preprocessing of DataModules

The *Preprocess* contains the processing logic related to a given task. Each *Preprocess* provides some default transforms through the *default\_transforms()* method. Users can easily override these by providing their own transforms to the *DataModule*. Here's an example:

```
from flash.core.data.transforms import ApplyToKeys
from flash.image import ImageClassificationData, ImageClassifier

transform = {"to_tensor_transform": ApplyToKeys("input", my_to_tensor_transform)}

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
    test_folder="data/hymenoptera_data/test/",
    train_transform=transform,
    val_transform=transform,
    test_transform=transform,
)
```

Alternatively, the user may directly override the hooks for their needs like this:

```
from typing import Any, Dict
from flash.image import ImageClassificationData, ImageClassifier, ImageClassificationPreprocess

class CustomImageClassificationPreprocess(ImageClassificationPreprocess):
    def to_tensor_transform(sample: Dict[str, Any]) -> Dict[str, Any]:
        sample["input"] = my_to_tensor_transform(sample["input"])
        return sample

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
    test_folder="data/hymenoptera_data/test/",
    preprocess=CustomImageClassificationPreprocess(),
)
```

## 9.6 Create your own Preprocess and DataModule

The example below shows a very simple `ImageClassificationPreprocess` with a single `ImageClassificationFoldersDataSource` and an `ImageClassificationDataModule`.

### 9.6.1 1. User-Facing API design

Designing an easy-to-use API is key. This is the first and most important step. We want the `ImageClassificationDataModule` to generate a dataset from folders of images arranged in this way.

Example:

```
train/dog/xxx.png
train/dog/xyx.png
train/dog/xxz.png
train/cat/123.png
train/cat/nsdf3.png
train/cat/asd932.png
```

Example:

```
dm = ImageClassificationDataModule.from_folders(
    train_folder="./data/train",
    val_folder="./data/val",
    test_folder="./data/test",
    predict_folder="./data/predict",
)

model = ImageClassifier(...)
trainer = Trainer(...)

trainer.fit(model, dm)
```

### 9.6.2 2. The DataSource

We start by implementing the `ImageClassificationFoldersDataSource`. The `load_data` method will produce a list of files and targets from the given directory. The `load_sample` method will load the given file as a `PIL.Image`. Here's the full `ImageClassificationFoldersDataSource`:

```
from PIL import Image
from torchvision.datasets.folder import make_dataset
from typing import Any, Dict
from flash.core.data.data_source import DataSource, DefaultDataKeys

class ImageClassificationFoldersDataSource(DataSource):
    def load_data(self, folder: str, dataset: Any) -> Iterable:
        # The dataset is optional but can be useful to save some metadata.

        # `metadata` contains the image path and its corresponding label
        # with the following structure:
```

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```

# [(image_path_1, label_1), ... (image_path_n, label_n)].
metadata = make_dataset(folder)

# for the train `AutoDataset`, we want to store the `num_classes`.
if self.training:
    dataset.num_classes = len(np.unique([m[1] for m in metadata]))

return [
    {
        DefaultDataKeys.INPUT: file,
        DefaultDataKeys.TARGET: target,
    }
    for file, target in metadata
]

def predict_load_data(self, predict_folder: str) -> Iterable:
    # This returns [image_path_1, ... image_path_m].
    return [{DefaultDataKeys.INPUT: file} for file in os.listdir(folder)]

def load_sample(self, sample: Dict[str, Any]) -> Dict[str, Any]:
    sample[DefaultDataKeys.INPUT] = Image.open(sample[DefaultDataKeys.INPUT])
    return sample

```

**Note:** We return samples as dictionaries using the `DefaultDataKeys` by convention. This is the recommended (although not required) way to represent data in Flash.

### 9.6.3 3. The Preprocess

Next, implement your custom `ImageClassificationPreprocess` with some default transforms and a reference to the data source:

```

from typing import Any, Callable, Dict, Optional
from flash.core.data.data_source import DefaultDataKeys, DefaultDataSources
from flash.core.data.process import Preprocess
import torchvision.transforms.functional as T

# Subclass `Preprocess`
class ImageClassificationPreprocess(Preprocess):
    def __init__(
        self,
        train_transform: Optional[Dict[str, Callable]] = None,
        val_transform: Optional[Dict[str, Callable]] = None,
        test_transform: Optional[Dict[str, Callable]] = None,
        predict_transform: Optional[Dict[str, Callable]] = None,
    ):
        super().__init__(
            train_transform=train_transform,
            val_transform=val_transform,
            test_transform=test_transform,

```

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```

        predict_transform=predict_transform,
        data_sources={
            DefaultDataSources.FOLDERS: ImageClassificationFoldersDataSource(),
        },
        default_data_source=DefaultDataSources.FOLDERS,
    )

    def get_state_dict(self) -> Dict[str, Any]:
        return **self.transforms

    @classmethod
    def load_state_dict(cls, state_dict: Dict[str, Any], strict: bool = False):
        return cls(**state_dict)

    def default_transforms(self) -> Dict[str, Callable]:
        return {"to_tensor_transform": ApplyToKeys(DefaultDataKeys.INPUT, T.to_tensor)}
```

## 9.6.4 4. The DataModule

Finally, let's implement the `ImageClassificationDataModule`. We get the `from_folders` classmethod for free as we've registered a `DefaultDataSources.FOLDERS` data source in our `ImageClassificationPreprocess`. All we need to do is attach our *Preprocess* class like this:

```

from flash import DataModule

class ImageClassificationDataModule(DataModule):

    # Set `preprocess_cls` with your custom `Preprocess`.
    preprocess_cls = ImageClassificationPreprocess
```

## 9.7 How it works behind the scenes

### 9.7.1 DataSource

---

**Note:** The `load_data()` and `load_sample()` will be used to generate an *AutoDataset* object.

---

Here is the *AutoDataset* pseudo-code.

```

class AutoDataset:
    def __init__(
        self,
        data: List[Any], # output of `DataSource.load_data`
        data_source: DataSource,
        running_stage: RunningStage,
    ):
```

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```

self.data = data
self.data_source = data_source

def __getitem__(self, index: int):
    return self.data_source.load_sample(self.data[index])

def __len__(self):
    return len(self.data)

```

## 9.7.2 Preprocess

**Note:** The `pre_tensor_transform()`, `to_tensor_transform()`, `post_tensor_transform()`, `collate()`, `per_batch_transform()` are injected as the `torch.utils.data.DataLoader.collate_fn` function of the `DataLoader`.

Here is the pseudo code using the preprocess hooks name. Flash takes care of calling the right hooks for each stage.

Example:

```

# This will be wrapped into a :class:`~flash.core.data.batch._Preprocessor`
def collate_fn(samples: Sequence[Any]) -> Any:

    # This will be wrapped into a :class:`~flash.core.data.batch._Sequential`
    for sample in samples:
        sample = pre_tensor_transform(sample)
        sample = to_tensor_transform(sample)
        sample = post_tensor_transform(sample)

    samples = type(samples)(samples)

    # if :func:`~flash.core.data.process.Preprocess.per_sample_transform_on_device` hook
    ↪ is overridden,
    # those functions below will be no-ops

    samples = collate(samples)
    samples = per_batch_transform(samples)
    return samples

dataloader = DataLoader(dataset, collate_fn=collate_fn)

```

**Note:** The `per_sample_transform_on_device`, `collate`, `per_batch_transform_on_device` are injected after the `LightningModule.transfer_batch_to_device` hook.

Here is the pseudo code using the preprocess hooks name. Flash takes care of calling the right hooks for each stage.

Example:

```

# This will be wrapped into a :class:`~flash.core.data.batch._Preprocessor`
def collate_fn(samples: Sequence[Any]) -> Any:

```

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```

# if ``per_batch_transform`` hook is overridden, those functions below will be no-ops
samples = [per_sample_transform_on_device(sample) for sample in samples]
samples = type(samples)(samples)
samples = collate(samples)

samples = per_batch_transform_on_device(samples)
return samples

# move the data to device
data = lightning_module.transfer_data_to_device(data)
data = collate_fn(data)
predictions = lightning_module(data)

```

### 9.7.3 Postprocess and Serializer

Once the predictions have been generated by the Flash *Task*, the Flash *DataPipeline* will execute the *Postprocess* hooks and the *Serializer* behind the scenes.

First, the *per\_batch\_transform()* hooks will be applied on the batch predictions. Then, the *uncollate()* will split the batch into individual predictions. Next, the *per\_sample\_transform()* will be applied on each prediction. Finally, the *serialize()* method will be called to serialize the predictions.

---

**Note:** The transform can be applied either on device or CPU.

---

Here is the pseudo-code:

Example:

```

# This will be wrapped into a :class:`~flash.core.data.batch._Postprocessor`
def uncollate_fn(batch: Any) -> Any:

    batch = per_batch_transform(batch)

    samples = uncollate(batch)

    samples = [per_sample_transform(sample) for sample in samples]
    # only if serializers are enabled.
    return [serialize(sample) for sample in samples]

predictions = lightning_module(data)
return uncollate_fn(predictions)

```

## REGISTRY

### 10.1 Available Registries

Registries are Flash internal key-value database to store a mapping between a name and a function.

In simple words, they are just advanced dictionary storing a function from a key string.

Registries help organize code and make the functions accessible all across the Flash codebase. Each Flash *Task* can have several registries as static attributes.

Currently, Flash uses internally registries only for backbones, but more components will be added.

#### 10.1.1 1. Imports

```
from functools import partial

from flash import Task
from flash.core.registry import FlashRegistry
```

#### 10.1.2 2. Init a Registry

It is good practice to associate one or multiple registry to a Task as follow:

```
# creating a custom `Task` with its own registry
class MyImageClassifier(Task):

    backbones = FlashRegistry("backbones")

    def __init__(
        self,
        backbone: str = "resnet18",
        pretrained: bool = True,
    ):
        ...

        self.backbone, self.num_features = self.backbones.
        ↪get(backbone)(pretrained=pretrained)
```

### 10.1.3 3. Adding new functions

Your custom functions can be registered within a *FlashRegistry* as a decorator or directly.

```
# Option 1: Used with partial.
def fn(backbone: str, pretrained: bool = True):
    # Create backbone and backbone output dimension (`num_features`)
    backbone, num_features = None, None
    return backbone, num_features

# HINT 1: Use `from functools import partial` if you want to store some arguments.
MyImageClassifier.backbones(fn=partial(fn, backbone="my_backbone"), name="username/
↳partial_backbone")

# Option 2: Using decorator.
@MyImageClassifier.backbones(name="username/decorated_backbone")
def fn(pretrained: bool = True):
    # Create backbone and backbone output dimension (`num_features`)
    backbone, num_features = None, None
    return backbone, num_features
```

### 10.1.4 4. Accessing registered functions

You can now access your function from your task!

```
# 3.b Optional: List available backbones
print(MyImageClassifier.available_backbones())

# 4. Build the model
model = MyImageClassifier(backbone="username/decorated_backbone")
```

Here's the output:

```
['username/decorated_backbone', 'username/partial_backbone']
```

### 10.1.5 5. Pre-registered backbones

Flash provides populated registries containing lots of available backbones.

Example:

```
from flash.image.backbones import OBJ_DETECTION_BACKBONES
from flash.image.classification.backbones import IMAGE_CLASSIFIER_BACKBONES

print(IMAGE_CLASSIFIER_BACKBONES.available_keys())
""" out:
['adv_inception_v3', 'cspdarknet53', 'cspdarknet53_iabn', 430+..., 'xception71']
"""
```

## FLASH SERVE

Flash Serve is a library to easily serve models in production.

### 11.1 Terminology

Here are common terms you need to be familiar with:

Table 1: Terminology

Term	Definition
de-serialization	Transform data encoded as text into tensors
inference function	A function taking the decoded tensors and forward them through the model to produce predictions.
serialization	Transform the predictions tensors back to a text encoding.
<code>ModelComponent</code>	The <code>ModelComponent</code> contains the de-serialization, inference and serialization functions.
<code>Servable</code>	The <code>Servable</code> is an helper track the asset file related to a model
<code>Composition</code>	The <code>Composition</code> defines the computations / endpoints to create & run
<code>expose()</code>	The <code>expose()</code> function is a python decorator used to augment the <code>ModelComponent</code> inference function with de-serialization, serialization.

### 11.2 Example

In this tutorial, we will serve a Resnet18 from the [PyTorchVision library](#) in 3 steps.

The entire tutorial can be found under `flash_examples/serve/generic`.

#### 11.2.1 Introduction

Traditionally, an inference pipeline is made out of 3 steps:

- **de-serialization:** Transform data encoded as text into tensors.
- **inference function:** A function taking the decoded tensors and forward them through the model to produce predictions.
- **serialization:** Transform the predictions tensors back as text.

In this example, we will implement only the inference function as Flash Serve already provides some built-in de-serialization and serialization functions with `Image`

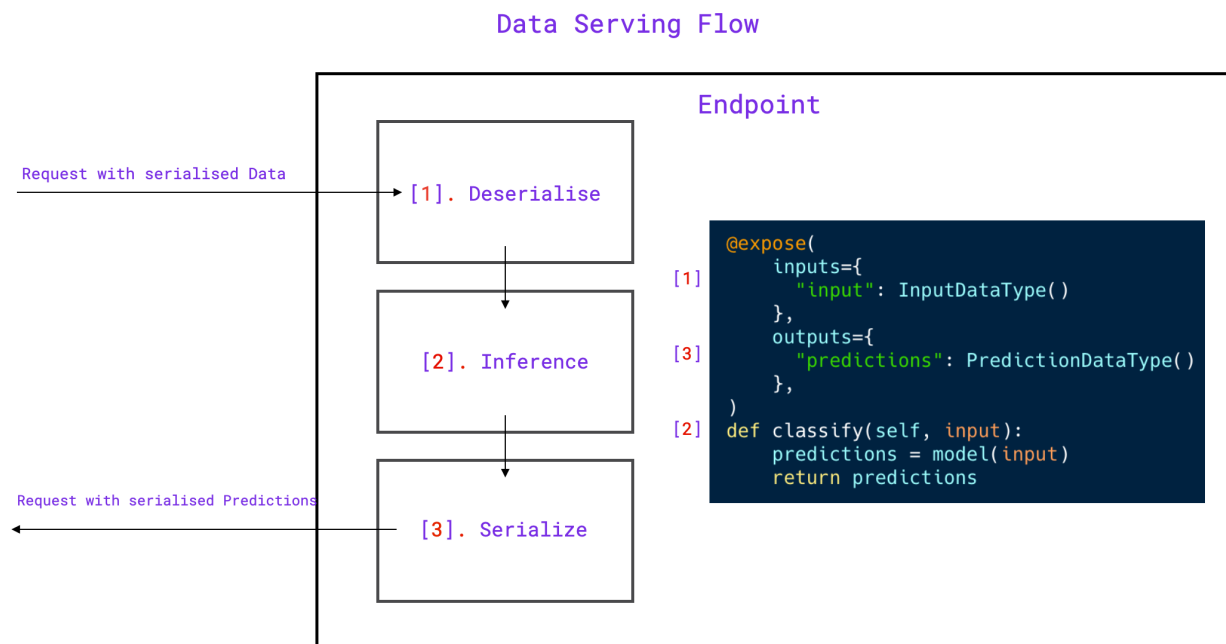
## 11.2.2 Step 1 - Create a ModelComponent

Inside `inference_serve.py`, we will implement a `ClassificationInference` class, which overrides `ModelComponent`.

First, we need make the following imports:

```
import torch
import torchvision

from flash.core.serve import Composition, Servable, ModelComponent, expose
from flash.core.serve.types import Image, Label
```



To implement `ClassificationInference`, we need to implement a method responsible for inference function and decorated with the `expose()` function.

The name of the inference method isn't constrained, but we will use `classify` as appropriate in this example.

Our `classify` function will take a tensor image, apply some normalization on it, and forward it through the model.

```
def classify(img):
    img = img.float() / 255
    mean = torch.tensor([[[0.485, 0.456, 0.406]]]).float()
    std = torch.tensor([[[0.229, 0.224, 0.225]]]).float()
    img = (img - mean) / std
    img = img.permute(0, 3, 2, 1)
    out = self.model(img)
    return out.argmax()
```

The `expose()` is a python decorator extending the decorated function with the de-serialization, serialization steps.

---

**Note:** Flash Serve was designed this way to enable several models to be chained together by removing the decorator.

---

The `expose()` function takes 2 arguments:

- **inputs:** Dictionary mapping the decorated function inputs to BaseType objects.
- **outputs:** Dictionary mapping the decorated function outputs to BaseType objects.

A BaseType is a python `dataclass` which implements a `serialize` and `deserialize` function.

---

**Note:** Flash Serve has already several BaseType built-in such as `Image` or `Text`.

---

```
class ClassificationInference(ModelComponent):
    def __init__(self, model: Servable):
        self.model = model

    @expose(
        inputs={"img": Image()},
        outputs={"prediction": Label(path="imagenet_labels.txt")},
    )
    def classify(self, img):
        img = img.float() / 255
        mean = torch.tensor([[[0.485, 0.456, 0.406]]]).float()
        std = torch.tensor([[[0.229, 0.224, 0.225]]]).float()
        img = (img - mean) / std
        img = img.permute(0, 3, 2, 1)
        out = self.model(img)
        return out.argmax()
```

### 11.2.3 Step 2 - Create a scripted Model

Using the `PyTorchVision` library, we create a `resnet18` and use `torch.jit.script` to script the model.

---

**Note:** TorchScript is a way to create serializable and optimizable models from PyTorch code. Any TorchScript program can be saved from a Python process and loaded in a process where there is no Python dependency.

---

```
model = torchvision.models.resnet18(pretrained=True).eval()
torch.jit.script(model).save("resnet.pt")
```

### 11.2.4 Step 3 - Serve the model

The `Servable` takes as argument the path to the TorchScripted model and then will be passed to our `ClassificationInference` class.

The `ClassificationInference` instance will be passed as argument to a `Composition` class.

Once the `Composition` class is instantiated, just call its `serve()` method.

```
resnet = Servable("resnet.pt")
comp = ClassificationInference(resnet)
composition = Composition(classification=comp)
composition.serve()
```

### 11.2.5 Launching the server.

#### In Terminal 1

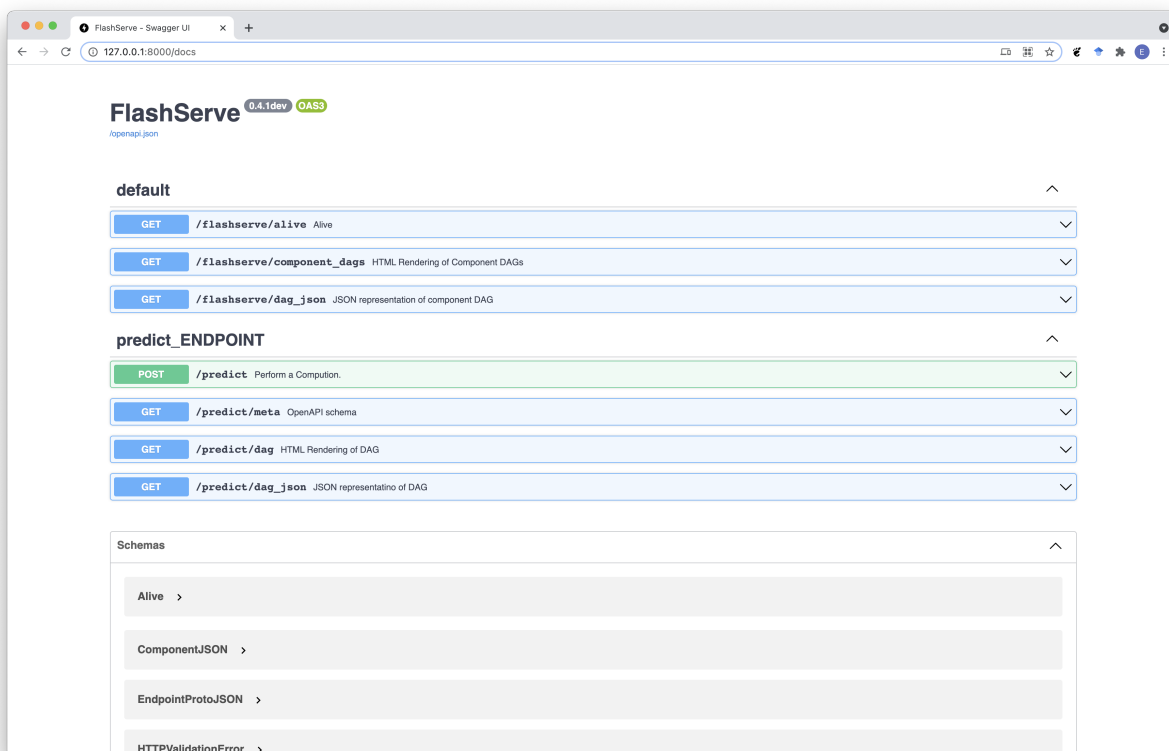
Just run:

```
python inference_server.py
```

And you should see this in your terminal

```
(.venv) → image_classification git:(master) ✕ python inference_server.py
INFO: Started server process [636]
INFO: Waiting for application startup.
INFO: Application startup complete.
INFO: Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to quit)
```

You should also see an Swagger UI already built for you at <http://127.0.0.1:8000/docs>





## In Terminal 2

Run this script from another terminal:

```
import base64
from pathlib import Path

import requests

with Path("fish.jpg").open("rb") as f:
    imgstr = base64.b64encode(f.read()).decode("UTF-8")

body = {"session": "UUID", "payload": {"img": {"data": imgstr}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)
print(resp.json())
# {'session': 'UUID', 'result': {'prediction': 'goldfish, Carassius auratus'}}
```

Credits to @rlizzo, @hhsecond, @lantiga, @luiscape for building Flash Serve Engine.



## BACKBONES AND HEADS

Backbones are the pre trained models that can be used with a task. The backbones or heads that are available can be found by using the `available_backbones` and `available_heads` methods.

To get the available backbones for a task like *ImageClassifier*, run:

```
from flash.image import ImageClassifier

# get the backbones available for ImageClassifier
backbones = ImageClassifier.available_backbones()

# print the backbones
print(backbones)
```

To get the available heads for a task like *SemanticSegmentation*, run:

```
from flash.image import SemanticSegmentation

# get the heads available for SemanticSegmentation
heads = SemanticSegmentation.available_heads()

# print the heads
print(heads)
```



## OPTIMIZATION (OPTIMIZERS AND SCHEDULERS)

Using optimizers and learning rate schedulers with Flash has become easier and cleaner than ever.

With the use of *Registry*, instantiation of an optimizer or a learning rate scheduler can be done with just a string.

### 13.1 Setting an optimizer to a task

Each task has a built-in method `available_optimizers()` which will list all the optimizers registered with Flash.

```
>>> from flash.core.classification import ClassificationTask
>>> ClassificationTask.available_optimizers()
['adadelata', ..., 'sgd']
```

To train / finetune a *Task* of your choice, just pass on a string.

```
from flash.image import ImageClassifier

model = ImageClassifier(num_classes=10, backbone="resnet18", optimizer="Adam", learning_
↳ rate=1e-4)
```

In order to customize specific parameters of the Optimizer, pass along a dictionary of kwargs with the string as a tuple.

```
from flash.image import ImageClassifier

model = ImageClassifier(num_classes=10, backbone="resnet18", optimizer=("Adam", {"amsgrad
↳ ": True}), learning_rate=1e-4)
```

An alternative to customizing an optimizer using a tuple is to pass it as a callable.

```
from functools import partial
from torch.optim import Adam
from flash.image import ImageClassifier

model = ImageClassifier(num_classes=10, backbone="resnet18", optimizer=partial(Adam,
↳ amsgrad=True), learning_rate=1e-4)
```

## 13.2 Setting a Learning Rate Scheduler

Each task has a built-in method `available_lr_schedulers()` which will list all the learning rate schedulers registered with Flash.

```
>>> from flash.core.classification import ClassificationTask
>>> ClassificationTask.available_lr_schedulers()
['lambdalr', ..., 'cosineannealingwarmrestarts']
```

To train / finetune a *Task* of your choice, just pass on a string.

```
from flash.image import ImageClassifier

model = ImageClassifier(
    num_classes=10, backbone="resnet18", optimizer="Adam", learning_rate=1e-4, lr_
    ↪ scheduler="constant_schedule"
)
```

**Note:** "constant\_schedule" and a few other lr schedulers will be available only if you have installed the transformers library from Hugging Face.

In order to customize specific parameters of the LR Scheduler, pass along a dictionary of kwargs with the string as a tuple.

```
from flash.image import ImageClassifier

model = ImageClassifier(
    num_classes=10,
    backbone="resnet18",
    optimizer="Adam",
    learning_rate=1e-4,
    lr_scheduler=("StepLR", {"step_size": 10}),
)
```

An alternative to customizing the LR Scheduler using a tuple is to pass it as a callable.

```
from functools import partial
from torch.optim.lr_scheduler import CyclicalLR
from flash.image import ImageClassifier

model = ImageClassifier(
    num_classes=10,
    backbone="resnet18",
    optimizer="Adam",
    learning_rate=1e-4,
    lr_scheduler=partial(CyclicalLR, step_size_up=1500, mode="exp_range", gamma=0.5),
)
```

Additionally, the `lr_scheduler` parameter also accepts the Lightning Scheduler configuration which can be passed on using a tuple.

The Lightning Scheduler configuration is a dictionary which contains the scheduler and its associated configuration. The default configuration is shown below.

```

lr_scheduler_config = {
    # REQUIRED: The scheduler instance
    "scheduler": lr_scheduler,
    # The unit of the scheduler's step size, could also be 'step'.
    # 'epoch' updates the scheduler on epoch end whereas 'step'
    # updates it after a optimizer update.
    "interval": "epoch",
    # How many epochs/steps should pass between calls to
    # `scheduler.step()`. 1 corresponds to updating the learning
    # rate after every epoch/step.
    "frequency": 1,
    # Metric to to monitor for schedulers like `ReduceLRonPlateau`
    "monitor": "val_loss",
    # If set to `True`, will enforce that the value specified 'monitor'
    # is available when the scheduler is updated, thus stopping
    # training if not found. If set to `False`, it will only produce a warning
    "strict": True,
    # If using the `LearningRateMonitor` callback to monitor the
    # learning rate progress, this keyword can be used to specify
    # a custom logged name
    "name": None,
}

```

When there are schedulers in which the `.step()` method is conditioned on a value, such as the `torch.optim.lr_scheduler.ReduceLRonPlateau` scheduler, Flash requires that the Lightning Scheduler configuration contains the keyword "monitor" set to the metric name that the scheduler should be conditioned on. Below is an example for this:

```

from flash.image import ImageClassifier

model = ImageClassifier(
    num_classes=10,
    backbone="resnet18",
    optimizer="Adam",
    learning_rate=1e-4,
    lr_scheduler=("reducelronplateau", {"mode": "max"}, {"monitor": "val_accuracy"}),
)

```

**Note:** Do not set the "scheduler" key in the Lightning Scheduler configuration, it will be overridden with an instance of the provided scheduler key.

## 13.3 Pre-Registering optimizers and scheduler recipes

Flash registry also provides the flexibility of registering functions. This feature is also provided in the Optimizer and Scheduler registry.

Using the `optimizers` and `lr_schedulers` decorator pertaining to each [Task](#), custom optimizer and LR scheduler recipes can be pre-registered.

```
import torch
from flash.image import ImageClassifier

@ImageClassifier.lr_schedulers
def my_flash_steplr_recipe(optimizer):
    return torch.optim.lr_scheduler.StepLR(optimizer, step_size=10)

model = ImageClassifier(backbone="resnet18", num_classes=2, optimizer="Adam", lr_
↪scheduler="my_flash_steplr_recipe")
```

## 13.4 Provider specific requirements

### 13.4.1 Schedulers

Certain LR Schedulers provided by Hugging Face require both `num_training_steps` and `num_warmup_steps`.

In order to use them in Flash, just provide `num_warmup_steps` as float between 0 and 1 which indicates the fraction of the training steps that will be used as warmup steps. Flash's *Trainer* will take care of computing the number of training steps and number of warmup steps based on the flags that are set in the Trainer.

```
from flash.image import ImageClassifier

model = ImageClassifier(
    backbone="resnet18",
    num_classes=2,
    optimizer="Adam",
    lr_scheduler=("cosine_schedule_with_warmup", {"num_warmup_steps": 0.1}),
)
```



## IMAGE CLASSIFICATION

### 14.1 The Task

The task of identifying what is in an image is called image classification. Typically, Image Classification is used to identify images containing a single object. The task predicts which ‘class’ the image most likely belongs to with a degree of certainty. A class is a label that describes what is in an image, such as ‘car’, ‘house’, ‘cat’ etc.

---

### 14.2 Example

Let’s look at the task of predicting whether images contain Ants or Bees using the hymenoptera dataset. The dataset contains `train` and `validation` folders, and then each folder contains a **bees** folder, with pictures of bees, and an **ants** folder with images of, you guessed it, ants.

```
hymenoptera_data
├── train
│   ├── ants
│   │   ├── 0013035.jpg
│   │   ├── 1030023514_aad5c608f9.jpg
│   │   └── ...
│   └── bees
│       ├── 1092977343_cb42b38d62.jpg
│       ├── 1093831624_fb5fbe2308.jpg
│       └── ...
└── val
    ├── ants
    │   ├── 10308379_1b6c72e180.jpg
    │   ├── 1053149811_f62a3410d3.jpg
    │   └── ...
    └── bees
        ├── 1032546534_06907fe3b3.jpg
        ├── 10870992_eebeeb3a12.jpg
        └── ...
```

Once we’ve downloaded the data using `download_data()`, we create the *ImageClassificationData*. We select a pre-trained backbone to use for our *ImageClassifier* and fine-tune on the hymenoptera data. We then use the trained *ImageClassifier* for inference. Finally, we save the model. Here’s the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.image import ImageClassificationData, ImageClassifier

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "./data")

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
)

# 2. Build the task
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Predict what's on a few images! ants or bees?
predictions = model.predict(
    [
        "data/hymenoptera_data/val/bees/65038344_52a45d090d.jpg",
        "data/hymenoptera_data/val/bees/590318879_68cf112861.jpg",
        "data/hymenoptera_data/val/ants/540543309_ddbb193ee5.jpg",
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("image_classification_model.pt")
```

---

## 14.3 Flash Zero

The image classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the hymenoptera example with:

```
flash image_classification
```

To view configuration options and options for running the image classifier with your own data, use:

```
flash image_classification --help
```

---

## 14.4 Loading Data

This section details the available ways to load your own data into the *ImageClassificationData*.

### 14.4.1 from\_folders

Construct the *ImageClassificationData* from folders.

The supported file extensions are: .jpg, .jpeg, .png, .ppm, .bmp, .pgm, .tif, .tiff, .webp, .npy.

For train, test, and val data, the folders are expected to contain a sub-folder for each class. Here's the required structure:

```
train_folder
├── class_1
│   ├── file1.jpg
│   ├── file2.jpg
│   └── ...
├── class_2
│   ├── file1.jpg
│   ├── file2.jpg
│   └── ...
└── ...
```

For prediction, the folder is expected to contain the files for inference, like this:

```
predict_folder
├── file1.jpg
├── file2.jpg
└── ...
```

Example:

```
data_module = ImageClassificationData.from_folders(
    train_folder = "./train_folder",
    predict_folder = "./predict_folder",
    ...
)
```

### 14.4.2 from\_files

Construct the *ImageClassificationData* from lists of files and corresponding lists of targets.

The supported file extensions are: .jpg, .jpeg, .png, .ppm, .bmp, .pgm, .tif, .tiff, .webp, .npy.

Example:

```
train_files = ["file1.jpg", "file2.jpg", "file3.jpg", ...]
train_targets = [0, 1, 0, ...]

datamodule = ImageClassificationData.from_files(
    train_files = train_files,
    train_targets = train_targets,
    ...
)
```

### 14.4.3 from\_datasets

Construct the *ImageClassificationData* from the given datasets for each stage.

Example:

```
from torch.utils.data.dataset import Dataset

train_dataset: Dataset = ...

datamodule = ImageClassificationData.from_datasets(
    train_dataset = train_dataset,
    ...
)
```

**Note:** The `__getitem__` of your datasets should return a dictionary with "input" and "target" keys which map to the input image (as a *PIL.Image*) and the target (as an int or list of ints) respectively.

## 14.5 Custom Transformations

Flash automatically applies some default image transformations and augmentations, but you may wish to customize these for your own use case. The base *Preprocess* defines 7 hooks for different stages in the data loading pipeline. To apply image augmentations you can directly import the `default_transforms` from `flash.image.classification.transforms` and then merge your custom image transformations with them using the `merge_transforms()` helper function. Here's an example where we load the default transforms and merge with custom *torchvision* transformations. We use the `post_tensor_transform` hook to apply the transformations after the image has been converted to a *torch.Tensor*.

```
from torchvision import transforms as T

import flash
from flash.core.data.data_source import DefaultDataKeys
from flash.core.data.transforms import ApplyToKeys, merge_transforms
from flash.image import ImageClassificationData, ImageClassifier
from flash.image.classification.transforms import default_transforms

post_tensor_transform = ApplyToKeys(
    DefaultDataKeys.INPUT,
    T.Compose([T.RandomHorizontalFlip(), T.ColorJitter(), T.RandomAutocontrast(), T.
↪ RandomPerspective()]),
)

new_transforms = merge_transforms(default_transforms((64, 64)), {"post_tensor_transform
↪ ": post_tensor_transform})

datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/", val_folder="data/hymenoptera_data/val/",
↪ train_transform=new_transforms
)
```

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```
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes)

trainer = flash.Trainer(max_epochs=1)
trainer.finetune(model, datamodule=datamodule, strategy="freeze")
```

## 14.6 Serving

The *ImageClassifier* is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```
from flash.image import ImageClassifier

model = ImageClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/image_classification_model.pt"
)
model.serve()
```

You can now perform inference from your client like this:

```
import base64
from pathlib import Path

import requests

import flash

with (Path(flash.ASSETS_ROOT) / "fish.jpg").open("rb") as f:
    imgstr = base64.b64encode(f.read()).decode("UTF-8")

body = {"session": "UUID", "payload": {"inputs": {"data": imgstr}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)
print(resp.json())
```



## MULTI-LABEL IMAGE CLASSIFICATION

### 15.1 The Task

Multi-label classification is the task of assigning a number of labels from a fixed set to each data point, which can be in any modality (images in this case). Multi-label image classification is supported by the *ImageClassifier* via the `multi-label` argument.

---

### 15.2 Example

Let's look at the task of trying to predict the movie genres from an image of the movie poster. The data we will use is a subset of the awesome movie poster genre prediction data set from the paper "Movie Genre Classification based on Poster Images with Deep Neural Networks" by Wei-Ta Chu and Hung-Jui Guo, resized to 128 by 128. Take a look at their paper (and please consider citing their paper if you use the data) here: [www.cs.ccu.edu.tw/~wtchu/projects/MoviePoster/](http://www.cs.ccu.edu.tw/~wtchu/projects/MoviePoster/). The data set contains `train` and `validation` folders, and then each folder contains images and a `metadata.csv` which stores the labels. Here's an overview:

```
movie_posters
├── train
│   ├── metadata.csv
│   ├── tt0084058.jpg
│   ├── tt0084867.jpg
│   └── ...
└── val
    ├── metadata.csv
    ├── tt0200465.jpg
    ├── tt0326965.jpg
    └── ...
```

Once we've downloaded the data using `download_data()`, we need to create the *ImageClassificationData*. We first create a function (`load_data`) to extract the list of images and associated labels which can then be passed to `from_files()`. We select a pre-trained backbone to use for our *ImageClassifier* and fine-tune on the posters data. We then use the trained *ImageClassifier* for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
```

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```

from flash.image import ImageClassificationData, ImageClassifier

# 1. Create the DataModule
# Data set from the paper "Movie Genre Classification based on Poster Images with Deep_
↳Neural Networks".
# More info here: https://www.cs.ccu.edu.tw/~wtchu/projects/MoviePoster/
download_data("https://pl-flash-data.s3.amazonaws.com/movie_posters.zip")

datamodule = ImageClassificationData.from_csv(
    "Id",
    ["Action", "Romance", "Crime", "Thriller", "Adventure"],
    train_file="data/movie_posters/train/metadata.csv",
    val_file="data/movie_posters/val/metadata.csv",
    image_size=(128, 128),
)

# 2. Build the task
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes, multi_
↳label=True)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Predict the genre of a few movies!
predictions = model.predict(
    [
        "data/movie_posters/predict/tt0085318.jpg",
        "data/movie_posters/predict/tt0089461.jpg",
        "data/movie_posters/predict/tt0097179.jpg",
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("image_classification_multi_label_model.pt")

```

## 15.3 Flash Zero

The multi-label image classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the movie posters example with:

```
flash image_classification from_movie_posters
```

To view configuration options and options for running the image classifier with your own data, use:

```
flash image_classification --help
```



## 15.4 Serving

The *ImageClassifier* is servable. For more information, see *Image Classification*.



## IMAGE EMBEDDER

### 16.1 The Task

Image embedding encodes an image into a vector of features which can be used for a downstream task. This could include: clustering, similarity search, or classification.

The *ImageEmbedder* internally relies on *VISSL*.

---

### 16.2 Example

Let's see how to configure a training strategy for the *ImageEmbedder* task. A vanilla *DataModule* object be created using standard Datasets as shown below. Then the user can configure the *ImageEmbedder* task with *training\_strategy*, *backbone*, *head* and *pretraining\_transform*. There are options provided to send additional arguments to config selections. This task can now be sent to the *fit()* method of *Trainer*.

---

**Note:** A lot of VISSL loss functions use hard-coded `torch.distributed` methods. The user is suggested to use `accelerator=ddp` even with a single GPU. Only `barlow_twins` training strategy works on the CPU. All other loss functions are configured to work on GPUs.

---

```
import torch
from torchvision.datasets import CIFAR10

import flash
from flash.core.data.utils import download_data
from flash.image import ImageClassificationData, ImageEmbedder

# 1. Download the data and prepare the datamodule
datamodule = ImageClassificationData.from_datasets(
    train_dataset=CIFAR10(".", download=True),
    batch_size=16,
)

# 2. Build the task
embedder = ImageEmbedder(
    backbone="resnet",
    training_strategy="barlow_twins",
```

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```
head="simclr_head",
pretraining_transform="barlow_twins_transform",
training_strategy_kwargs={"latent_embedding_dim": 128},
pretraining_transform_kwargs={"size_crops": [196]},
)

# 3. Create the trainer and pre-train the encoder
# use accelerator='ddp' when using GPU(s),
# i.e. flash.Trainer(max_epochs=3, gpus=1, accelerator='ddp')
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.fit(embedder, datamodule=datamodule)

# 4. Save the model!
trainer.save_checkpoint("image_embedder_model.pt")

# 5. Download the downstream prediction dataset and generate embeddings
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "data/")

embeddings = embedder.predict(
    [
        "data/hymenoptera_data/predict/153783656_85f9c3ac70.jpg",
        "data/hymenoptera_data/predict/2039585088_c6f47c592e.jpg",
    ]
)

# list of embeddings for images sent to the predict function
print(embeddings)
```

## OBJECT DETECTION

### 17.1 The Task

Object detection is the task of identifying objects in images and their associated classes and bounding boxes.

The *ObjectDetector* and *ObjectDetectionData* classes internally rely on *IceVision*.

---

### 17.2 Example

Let's look at object detection with the COCO 128 data set, which contains 91 object classes. This is a subset of COCO train2017 with only 128 images. The data set is organized following the COCO format. Here's an outline:

```
coco128
├── annotations
│   └── instances_train2017.json
├── images
│   └── train2017
│       ├── 00000000000009.jpg
│       ├── 00000000000025.jpg
│       └── ...
└── labels
    └── train2017
        ├── 00000000000009.txt
        ├── 00000000000025.txt
        └── ...
```

Once we've downloaded the data using `download_data()`, we can create the *ObjectDetectionData*. We select a pre-trained RetinaNet to use for our *ObjectDetector* and fine-tune on the COCO 128 data. We then use the trained *ObjectDetector* for inference. Finally, we save the model. Here's the full example:

```
import flash
from flash.core.data.utils import download_data
from flash.image import ObjectDetectionData, ObjectDetector

# 1. Create the DataModule
# Dataset Credit: https://www.kaggle.com/ultralytics/coco128
download_data("https://github.com/zhiqwang/yolov5-rt-stack/releases/download/v0.3.0/
↪coco128.zip", "data/")
```

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```
datamodule = ObjectDetectionData.from_coco(
    train_folder="data/coco128/images/train2017/",
    train_ann_file="data/coco128/annotations/instances_train2017.json",
    val_split=0.1,
    image_size=128,
)

# 2. Build the task
model = ObjectDetector(head="efficientdet", backbone="d0", num_classes=datamodule.num_
↪ classes, image_size=128)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=1)
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Detect objects in a few images!
predictions = model.predict(
    [
        "data/coco128/images/train2017/00000000000625.jpg",
        "data/coco128/images/train2017/00000000000626.jpg",
        "data/coco128/images/train2017/00000000000629.jpg",
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("object_detection_model.pt")
```

## 17.3 Flash Zero

The object detector can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash object_detection
```

To view configuration options and options for running the object detector with your own data, use:

```
flash object_detection --help
```

## 17.4 Custom Transformations

Flash automatically applies some default image / mask transformations and augmentations, but you may wish to customize these for your own use case. The base *Preprocess* defines 7 hooks for different stages in the data loading pipeline. For object-detection tasks, you can leverage the transformations from *Albumentations* with the *IceVisionTransformAdapter*.

```
import albumentations as alb
from icevision.tfms import A

from flash.core.integrations.icevision.transforms import IceVisionTransformAdapter
from flash.image import ObjectDetectionData

train_transform = {
    "pre_tensor_transform": transforms.IceVisionTransformAdapter(
        [*A.resize_and_pad(128), A.Normalize(), A.Flip(0.4), alb.
↪ RandomBrightnessContrast()]
    )
}

datamodule = ObjectDetectionData.from_coco(
    train_folder="data/coco128/images/train2017/",
    train_ann_file="data/coco128/annotations/instances_train2017.json",
    val_split=0.1,
    image_size=128,
    train_transform=train_transform,
)
```





## KEYPOINT DETECTION

### 18.1 The Task

Keypoint detection is the task of identifying keypoints in images and their associated classes.

The *KeypointDetector* and *KeypointDetectionData* classes internally rely on *IceVision*.

---

### 18.2 Example

Let's look at keypoint detection with *BIWI Sample Keypoints (center of face)* from *IceData*. Once we've downloaded the data, we can create the *KeypointDetectionData*. We select a *keypoint\_rcnn* with a *resnet18\_fpn* backbone to use for our *KeypointDetector* and fine-tune on the BIWI data. We then use the trained *KeypointDetector* for inference. Finally, we save the model. Here's the full example:

```
import flash
from flash.core.utilities.imports import example_requires
from flash.image import KeypointDetectionData, KeypointDetector

example_requires("image")

import icedata # noqa: E402

# 1. Create the DataModule
data_dir = icedata.biwi.load_data()

datamodule = KeypointDetectionData.from_folders(
    train_folder=data_dir,
    val_split=0.1,
    parser=icedata.biwi.parser,
)

# 2. Build the task
model = KeypointDetector(
    head="keypoint_rcnn",
    backbone="resnet18_fpn",
    num_keypoints=1,
    num_classes=datamodule.num_classes,
)
```

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```
# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=1)
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Detect objects in a few images!
predictions = model.predict(
    [
        str(data_dir / "biwi_sample/images/0.jpg"),
        str(data_dir / "biwi_sample/images/1.jpg"),
        str(data_dir / "biwi_sample/images/10.jpg"),
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("keypoint_detection_model.pt")
```

---

## 18.3 Flash Zero

The keypoint detector can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash keypoint_detection
```

To view configuration options and options for running the keypoint detector with your own data, use:

```
flash keypoint_detection --help
```

## INSTANCE SEGMENTATION

### 19.1 The Task

Instance segmentation is the task of segmenting objects images and determining their associated classes.

The *InstanceSegmentation* and *InstanceSegmentationData* classes internally rely on *IceVision*.

---

### 19.2 Example

Let's look at instance segmentation with [The Oxford-IIIT Pet Dataset](#) from *IceData*. Once we've downloaded the data, we can create the *InstanceSegmentationData*. We select a *mask\_rcnn* with a *resnet18\_fpn* backbone to use for our *InstanceSegmentation* and fine-tune on the pets data. We then use the trained *InstanceSegmentation* for inference. Finally, we save the model. Here's the full example:

```
from functools import partial

import flash
from flash.core.utilities.imports import example_requires
from flash.image import InstanceSegmentation, InstanceSegmentationData

example_requires("image")

import icedata # noqa: E402

# 1. Create the DataModule
data_dir = icedata.pets.load_data()

datamodule = InstanceSegmentationData.from_folders(
    train_folder=data_dir,
    val_split=0.1,
    parser=partial(icedata.pets.parser, mask=True),
)

# 2. Build the task
model = InstanceSegmentation(
    head="mask_rcnn",
    backbone="resnet18_fpn",
    num_classes=datamodule.num_classes,
```

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```
)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=1)
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Detect objects in a few images!
predictions = model.predict(
    [
        str(data_dir / "images/yorkshire_terrier_9.jpg"),
        str(data_dir / "images/yorkshire_terrier_12.jpg"),
        str(data_dir / "images/yorkshire_terrier_13.jpg"),
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("instance_segmentation_model.pt")
```

## 19.3 Flash Zero

The instance segmentation task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash instance_segmentation
```

To view configuration options and options for running the instance segmentation task with your own data, use:

```
flash instance_segmentation --help
```

## SEMANTIC SEGMENTATION

### 20.1 The Task

Semantic Segmentation, or image segmentation, is the task of performing classification at a pixel-level, meaning each pixel will be associated to a given class. See more: <https://paperswithcode.com/task/semantic-segmentation>

---

### 20.2 Example

Let's look at an example using a data set generated with the [CARLA](#) driving simulator. The data was generated as part of the [Kaggle Lyft Udacity Challenge](#). The data contains one folder of images and another folder with the corresponding segmentation masks. Here's the structure:

```
data
├── CameraRGB
│   ├── F61-1.png
│   ├── F61-2.png
│   └── ...
└── CameraSeg
    ├── F61-1.png
    ├── F61-2.png
    └── ...
```

Once we've downloaded the data using `download_data()`, we create the `SemanticSegmentationData`. We select a pre-trained `mobilenet_v3_large` backbone with an `fpn` head to use for our `SemanticSegmentation` task and fine-tune on the CARLA data. We then use the trained `SemanticSegmentation` for inference. You can check the available pretrained weights for the backbones like this `SemanticSegmentation.available_pretrained_weights("resnet18")`. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.image import SemanticSegmentation, SemanticSegmentationData

# 1. Create the DataModule
# The data was generated with the CARLA self-driving simulator as part of the Kaggle
# Lyft Udacity Challenge.
# More info here: https://www.kaggle.com/kumaresanmanickavelu/lyft-udacity-challenge
```

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```
download_data(  
    "https://github.com/ongchinkiat/LyftPerceptionChallenge/releases/download/v0.1/carla-  
    ↪capture-20180513A.zip",  
    "./data",  
)  
  
datamodule = SemanticSegmentationData.from_folders(  
    train_folder="data/CameraRGB",  
    train_target_folder="data/CameraSeg",  
    val_split=0.1,  
    image_size=(256, 256),  
    num_classes=21,  
)  
  
# 2. Build the task  
model = SemanticSegmentation(  
    backbone="mobilenetv3_large_100",  
    head="fpn",  
    num_classes=datamodule.num_classes,  
)  
  
# 3. Create the trainer and finetune the model  
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())  
trainer.finetune(model, datamodule=datamodule, strategy="freeze")  
  
# 4. Segment a few images!  
predictions = model.predict(  
    [  
        "data/CameraRGB/F61-1.png",  
        "data/CameraRGB/F62-1.png",  
        "data/CameraRGB/F63-1.png",  
    ]  
)  
print(predictions)  
  
# 5. Save the model!  
trainer.save_checkpoint("semantic_segmentation_model.pt")
```

## 20.3 Flash Zero

The semantic segmentation task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash semantic_segmentation
```

To view configuration options and options for running the semantic segmentation task with your own data, use:

```
flash semantic_segmentation --help
```

## 20.4 Loading Data

This section details the available ways to load your own data into the *SemanticSegmentationData*.

### 20.4.1 from\_folders

Construct the *SemanticSegmentationData* from folders.

The supported file extensions are: .jpg, .jpeg, .png, .ppm, .bmp, .pgm, .tif, .tiff, .webp.

For train, test, and val data, we expect a folder containing inputs and another folder containing the masks. Here's the required structure:

```
train_folder
├── inputs
│   ├── file1.jpg
│   ├── file2.jpg
│   └── ...
└── masks
    ├── file1.jpg
    ├── file2.jpg
    └── ...
```

For prediction, the folder is expected to contain the files for inference, like this:

```
predict_folder
├── file1.jpg
├── file2.jpg
└── ...
```

Example:

```
data_module = SemanticSegmentationData.from_folders(
    train_folder = "./train_folder/inputs",
    train_target_folder = "./train_folder/masks",
    predict_folder = "./predict_folder",
    ...
)
```

### 20.4.2 from\_files

Construct the *SemanticSegmentationData* from lists of input images and corresponding list of target images.

The supported file extensions are: .jpg, .jpeg, .png, .ppm, .bmp, .pgm, .tif, .tiff, .webp.

Example:

```
train_files = ["file1.jpg", "file2.jpg", "file3.jpg", ...]
train_targets = ["mask1.jpg", "mask2.jpg", "mask3.jpg", ...]

datamodule = SemanticSegmentationData.from_files(
    train_files = train_files,
    train_targets = train_targets,
```

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```

    ...
)

```

### 20.4.3 from\_datasets

Construct the *SemanticSegmentationData* from the given datasets for each stage.

Example:

```

from torch.utils.data.dataset import Dataset

train_dataset: Dataset = ...

datamodule = SemanticSegmentationData.from_datasets(
    train_dataset = train_dataset,
    ...
)

```

**Note:** The `__getitem__` of your datasets should return a dictionary with "input" and "target" keys which map to the input and target images as tensors.

## 20.5 Serving

The *SemanticSegmentation* task is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```

from flash.image import SemanticSegmentation
from flash.image.segmentation.serialization import SegmentationLabels

model = SemanticSegmentation.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/semantic_segmentation_model.pt"
)
model.serializer = SegmentationLabels(visualize=False)
model.serve()

```

You can now perform inference from your client like this:

```

import base64
from pathlib import Path

import requests

import flash

with (Path(flash.ASSETS_ROOT) / "road.png").open("rb") as f:
    imgstr = base64.b64encode(f.read()).decode("UTF-8")

```

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```
body = {"session": "UUID", "payload": {"inputs": {"data": imgstr}}}  
resp = requests.post("http://127.0.0.1:8000/predict", json=body)  
print(resp.json())
```



## STYLE TRANSFER

### 21.1 The Task

The Neural Style Transfer Task is an optimization method which extract the style from an image and apply it another image while preserving its content. The goal is that the output image looks like the content image, but “painted” in the style of the style reference image.



The *StyleTransfer* and *StyleTransferData* classes internally rely on *pystiche*.

---

### 21.2 Example

Let’s look at transferring the style from *The Starry Night* onto the images from the COCO 128 data set from the *Object Detection* Guide. Once we’ve downloaded the data using `download_data()`, we create the *StyleTransferData*. Next, we create our *StyleTransfer* task with the desired style image and fit on the COCO 128 images. We then use the trained *StyleTransfer* for inference. Finally, we save the model. Here’s the full example:

```
import os

import torch

import flash
from flash.core.data.utils import download_data
from flash.image.style_transfer import StyleTransfer, StyleTransferData

# 1. Create the DataModule
download_data("https://github.com/zhiqwang/yolov5-rt-stack/releases/download/v0.3.0/
↳ coco128.zip", "./data")

datamodule = StyleTransferData.from_folders(train_folder="data/coco128/images/train2017")
```

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```
# 2. Build the task
model = StyleTransfer(os.path.join(flash.ASSETS_ROOT, "starry_night.jpg"))

# 3. Create the trainer and train the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.fit(model, datamodule=datamodule)

# 4. Apply style transfer to a few images!
predictions = model.predict(
    [
        "data/coco128/images/train2017/0000000000625.jpg",
        "data/coco128/images/train2017/0000000000626.jpg",
        "data/coco128/images/train2017/0000000000629.jpg",
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("style_transfer_model.pt")
```

---

## 21.3 Flash Zero

The style transfer task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash style_transfer
```

To view configuration options and options for running the style transfer task with your own data, use:

```
flash style_transfer --help
```

## VIDEO CLASSIFICATION

### 22.1 The Task

Typically, Video Classification refers to the task of producing a label for actions identified in a given video. The task is to predict which *class* the video clip belongs to.

Lightning Flash *VideoClassifier* and *VideoClassificationData* classes internally rely on *PyTorchVideo*.

---

### 22.2 Example

Let's develop a model to classifying video clips of Humans performing actions (such as: **archery** , **bowling**, etc.). We'll use data from the *Kinetics dataset*. Here's an outline of the folder structure:

```
video_dataset
├── train
│   ├── archery
│   │   ├── -1q7jA3DXQM_000005_000015.mp4
│   │   ├── -5NN5hdIwTc_000036_000046.mp4
│   │   └── ...
│   ├── bowling
│   │   ├── -5ExwuF5IUI_000030_000040.mp4
│   │   ├── -7sTNNI1Bcg_000075_000085.mp4
│   │   └── ...
│   └── ...
├── val
│   ├── archery
│   │   ├── 0S-P4lr_c7s_000022_000032.mp4
│   │   ├── 2x1lIrgKxYo_000589_000599.mp4
│   │   └── ...
│   ├── bowling
│   │   ├── 1W7HNDBA4pA_000002_000012.mp4
│   │   ├── 4JxH3S5JwMs_000003_000013.mp4
│   │   └── ...
│   └── ...
```

Once we've downloaded the data using `download_data()`, we create the *VideoClassificationData*. We select a pre-trained backbone to use for our *VideoClassifier* and fine-tune on the Kinetics data. The backbone can be any model from the *PyTorchVideo Model Zoo*. We then use the trained *VideoClassifier* for inference. Finally, we save the model. Here's the full example:

```
import os

import torch

import flash
from flash.core.data.utils import download_data
from flash.video import VideoClassificationData, VideoClassifier

# 1. Create the DataModule
# Find more datasets at https://pytorchvideo.readthedocs.io/en/latest/data.html
download_data("https://pl-flash-data.s3.amazonaws.com/kinetics.zip", "./data")

datamodule = VideoClassificationData.from_folders(
    train_folder=os.path.join(os.getcwd(), "data/kinetics/train"),
    val_folder=os.path.join(os.getcwd(), "data/kinetics/val"),
    clip_sampler="uniform",
    clip_duration=1,
    decode_audio=False,
)

# 2. Build the task
model = VideoClassifier(backbone="x3d_xs", num_classes=datamodule.num_classes,
    pretrained=False)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Make a prediction
predictions = model.predict(os.path.join(os.getcwd(), "data/kinetics/predict"))
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("video_classification.pt")
```

---

## 22.3 Flash Zero

The video classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash video_classification
```

To view configuration options and options for running the video classifier with your own data, use:

```
flash video_classification --help
```

## AUDIO CLASSIFICATION

### 23.1 The Task

The task of identifying what is in an audio file is called audio classification. Typically, Audio Classification is used to identify audio files containing sounds or words. The task predicts which ‘class’ the sound or words most likely belongs to with a degree of certainty. A class is a label that describes the sounds in an audio file, such as ‘children\_playing’, ‘jackhammer’, ‘siren’ etc.

---

### 23.2 Example

Let’s look at the task of predicting whether audio file contains sounds of an airconditioner, carhorn, childrenplaying, dogbark, drilling, engineidling, gunshot, jackhammer, siren, or street\_music using the UrbanSound8k spectrogram images dataset. The dataset contains **train**, **val** and **test** folders, and then each folder contains a **airconditioner** folder, with spectrograms generated from air-conditioner sounds, **siren** folder with spectrograms generated from siren sounds and the same goes for the other classes.

```
urban8k_images
├── train
│   ├── air_conditioner
│   ├── car_horn
│   ├── children_playing
│   ├── dog_bark
│   ├── drilling
│   ├── engine_idling
│   ├── gun_shot
│   ├── jackhammer
│   ├── siren
│   └── street_music
└── test
    ├── air_conditioner
    ├── car_horn
    ├── children_playing
    ├── dog_bark
    ├── drilling
    ├── engine_idling
    ├── gun_shot
    └── jackhammer
```

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```

├── siren
├── street_music
├── val
│   ├── air_conditioner
│   ├── car_horn
│   ├── children_playing
│   ├── dog_bark
│   ├── drilling
│   ├── engine_idling
│   ├── gun_shot
│   ├── jackhammer
│   ├── siren
│   └── street_music
└── ...

```

Once we've downloaded the data using `download_data()`, we create the `AudioClassificationData`. We select a pre-trained backbone to use for our `ImageClassifier` and fine-tune on the UrbanSound8k spectrogram images data. We then use the trained `ImageClassifier` for inference. Finally, we save the model. Here's the full example:

```

import torch

import flash
from flash.audio import AudioClassificationData
from flash.core.data.utils import download_data
from flash.core.finetuning import FreezeUnfreeze
from flash.image import ImageClassifier

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/urban8k_images.zip", "./data")

datamodule = AudioClassificationData.from_folders(
    train_folder="data/urban8k_images/train",
    val_folder="data/urban8k_images/val",
    spectrogram_size=(64, 64),
)

# 2. Build the model.
model = ImageClassifier(backbone="resnet18", num_classes=datamodule.num_classes)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.finetune(model, datamodule=datamodule, strategy=FreezeUnfreeze(unfreeze_epoch=1))

# 4. Predict what's on few images! air_conditioner, children_playing, siren e.t.c
predictions = model.predict(
    [
        "data/urban8k_images/test/air_conditioner/13230-0-0-5.wav.jpg",
        "data/urban8k_images/test/children_playing/9223-2-0-15.wav.jpg",
        "data/urban8k_images/test/jackhammer/22883-7-10-0.wav.jpg",
    ]
)

```

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```
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("audio_classification_model.pt")
```

## 23.3 Flash Zero

The audio classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash audio_classification
```

To view configuration options and options for running the audio classifier with your own data, use:

```
flash audio_classification --help
```

## 23.4 Loading Data

This section details the available ways to load your own data into the *AudioClassificationData*.

### 23.4.1 from\_folders

Construct the *AudioClassificationData* from folders.

The supported file extensions are: .jpg, .jpeg, .png, .ppm, .bmp, .pgm, .tif, .tiff, .webp, .npy.

For train, test, and val data, the folders are expected to contain a sub-folder for each class. Here's the required structure:

```
train_folder
├── class_1
│   ├── file1.jpg
│   ├── file2.jpg
│   └── ...
└── class_2
    ├── file1.jpg
    ├── file2.jpg
    └── ...
```

For prediction, the folder is expected to contain the files for inference, like this:

```
predict_folder
├── file1.jpg
├── file2.jpg
└── ...
```

Example:

```
data_module = AudioClassificationData.from_folders(  
    train_folder = "./train_folder",  
    predict_folder = "./predict_folder",  
    ...  
)
```

### 23.4.2 from\_files

Construct the *AudioClassificationData* from lists of files and corresponding lists of targets.

The supported file extensions are: .jpg, .jpeg, .png, .ppm, .bmp, .pgm, .tif, .tiff, .webp, .npy.

Example:

```
train_files = ["file1.jpg", "file2.jpg", "file3.jpg", ...]  
train_targets = [0, 1, 0, ...]  
  
datamodule = AudioClassificationData.from_files(  
    train_files = train_files,  
    train_targets = train_targets,  
    ...  
)
```

### 23.4.3 from\_datasets

Construct the *AudioClassificationData* from the given datasets for each stage.

Example:

```
from torch.utils.data.dataset import Dataset  
  
train_dataset: Dataset = ...  
  
datamodule = AudioClassificationData.from_datasets(  
    train_dataset = train_dataset,  
    ...  
)
```

---

**Note:** The `__getitem__` of your datasets should return a dictionary with "input" and "target" keys which map to the input spectrogram image (as a NumPy array) and the target (as an int or list of ints) respectively.

---

## SPEECH RECOGNITION

### 24.1 The Task

Speech recognition is the task of classifying audio into a text transcription. We rely on [Wav2Vec](#) as our backbone, fine-tuned on labeled transcriptions for speech to text. Wav2Vec is pre-trained on thousand of hours of unlabeled audio, providing a strong baseline when fine-tuning to downstream tasks such as Speech Recognition.

---

### 24.2 Example

Let's fine-tune the model onto our own labeled audio transcription data:

Here's the structure our CSV file:

```
file,text
"/path/to/file_1.wav","what was said in file 1."
"/path/to/file_2.wav","what was said in file 2."
"/path/to/file_3.wav","what was said in file 3."
...
```

Alternatively, here is the structure of our JSON file:

```
{"file": "/path/to/file_1.wav", "text": "what was said in file 1."}
{"file": "/path/to/file_2.wav", "text": "what was said in file 2."}
{"file": "/path/to/file_3.wav", "text": "what was said in file 3."}
```

Once we've downloaded the data using `download_data()`, we create the *SpeechRecognitionData*. We select a pre-trained Wav2Vec backbone to use for our *SpeechRecognition* and finetune on a subset of the *TIMIT corpus*. The backbone can be any Wav2Vec model from [HuggingFace transformers](#). Next, we use the trained *SpeechRecognition* for inference and save the model. Here's the full example:

```
import torch

import flash
from flash.audio import SpeechRecognition, SpeechRecognitionData
from flash.core.data.utils import download_data

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/timit_data.zip", "./data")
```

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```
datamodule = SpeechRecognitionData.from_json(  
    input_fields="file",  
    target_fields="text",  
    train_file="data/timit/train.json",  
    test_file="data/timit/test.json",  
)  
  
# 2. Build the task  
model = SpeechRecognition(backbone="facebook/wav2vec2-base-960h")  
  
# 3. Create the trainer and finetune the model  
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count())  
trainer.finetune(model, datamodule=datamodule, strategy="no_freeze")  
  
# 4. Predict on audio files!  
predictions = model.predict(["data/timit/example.wav"])  
print(predictions)  
  
# 5. Save the model!  
trainer.save_checkpoint("speech_recognition_model.pt")
```

## 24.3 Flash Zero

The speech recognition task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash speech_recognition
```

To view configuration options and options for running the speech recognition task with your own data, use:

```
flash speech_recognition --help
```

## 24.4 Serving

The *SpeechRecognition* is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```
from flash.audio import SpeechRecognition  
  
model = SpeechRecognition.load_from_checkpoint(  
    "https://flash-weights.s3.amazonaws.com/0.5.2/speech_recognition_model.pt"  
)  
model.serve()
```

You can now perform inference from your client like this:

```
import base64
from pathlib import Path

import requests

import flash

with (Path(flash.ASSETS_ROOT) / "example.wav").open("rb") as f:
    audio_str = base64.b64encode(f.read()).decode("UTF-8")

body = {"session": "UUID", "payload": {"inputs": {"data": audio_str}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)

print(resp.json())
```



## TABULAR CLASSIFICATION

### 25.1 The Task

Tabular classification is the task of assigning a class to samples of structured or relational data. The *TabularClassifier* task can be used for classification of samples in more than two classes (multi-class classification).

---

### 25.2 Example

Let's look at training a model to predict if passenger survival on the Titanic using the classic Kaggle data set. The data is provided in CSV files that look like this:

```
PassengerId,Survived,Pclass,Name,Sex,Age,SibSp,Parch,Ticket,Fare,Cabin,Embarked
1,0,3,"Braund, Mr. Owen Harris",male,22,1,0,A/5 21171,7.25,,S
3,1,3,"Heikkinen, Miss. Laina",female,26,0,0,STON/O2. 3101282,7.925,,S
5,0,3,"Allen, Mr. William Henry",male,35,0,0,373450,8.05,,S
6,0,3,"Moran, Mr. James",male,,0,0,330877,8.4583,,Q
...
```

Once we've downloaded the data using `download_data()`, we can create the `TabularData` from our CSV files using the `from_csv()` method. From the [API reference](#), we need to provide:

- **cat\_cols**- A list of the names of columns that contain categorical data (strings or integers).
- **num\_cols**- A list of the names of columns that contain numerical continuous data (floats).
- **target**- The name of the column we want to predict.
- **train\_csv**- A CSV file containing the training data converted to a Pandas DataFrame

Next, we create the *TabularClassifier* and finetune on the Titanic data. We then use the trained *TabularClassifier* for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.tabular import TabularClassificationData, TabularClassifier

# 1. Create the DataModule
```

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```
download_data("https://pl-flash-data.s3.amazonaws.com/titanic.zip", "./data")

datamodule = TabularClassificationData.from_csv(
    ["Sex", "Age", "SibSp", "Parch", "Ticket", "Cabin", "Embarked"],
    "Fare",
    target_fields="Survived",
    train_file="data/titanic/titanic.csv",
    val_split=0.1,
)

# 2. Build the task
model = TabularClassifier.from_data(datamodule)

# 3. Create the trainer and train the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.fit(model, datamodule=datamodule)

# 4. Generate predictions from a CSV
predictions = model.predict("data/titanic/titanic.csv")
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("tabular_classification_model.pt")
```

## 25.3 Flash Zero

The tabular classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash tabular_classifier
```

To view configuration options and options for running the tabular classifier with your own data, use:

```
flash tabular_classifier --help
```

## 25.4 Serving

The *TabularClassifier* is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```
from flash.core.classification import Labels
from flash.tabular import TabularClassifier

model = TabularClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/tabular_classification_model.pt"
)
model.serializer = Labels(["Did not survive", "Survived"])
model.serve()
```



You can now perform inference from your client like this:

```
import pandas as pd
import requests

from flash.core.data.utils import download_data

# 1. Download the data
download_data("https://pl-flash-data.s3.amazonaws.com/titanic.zip", "data/")

df = pd.read_csv("./data/titanic/predict.csv")
text = str(df.to_csv())
body = {"session": "UUID", "payload": {"inputs": {"data": text}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)
print(resp.json())
```



## TABULAR FORECASTING

### 26.1 The Task

Tabular (or timeseries) forecasting is the task of using historical data to predict future trends in a time varying quantity such as: stock prices, temperature, etc. The *TabularForecaster* and *TabularForecastingData* enable timeseries forecasting in Flash using PyTorch Forecasting.

---

### 26.2 Example

Let's look at training the NBeats model on some synthetic data with seasonal changes. The data could represent many naturally occurring timeseries such as energy demand which fluctuates throughout the day but is also expected to change with the season. This example is a reimplementation of the [NBeats tutorial from the PyTorch Forecasting docs](#) in Flash. The NBeats model takes no additional inputs unlike other more complex models such as the [Temporal Fusion Transformer](#).

Once we've created, we can create the *TabularData* from our *DataFrame* using the *from\_data\_frame()* method. To this method, we provide any configuration arguments that should be used when internally constructing the *TimeSeriesDataSet*.

Next, we create the *TabularForecaster* and train on the data. We then use the trained *TabularForecaster* for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.utilities.imports import example_requires
from flash.tabular.forecasting import TabularForecaster, TabularForecastingData

example_requires("tabular")

import pandas as pd # noqa: E402
from pytorch_forecasting.data import NaNLabelEncoder # noqa: E402
from pytorch_forecasting.data.examples import generate_ar_data # noqa: E402

# Example based on this tutorial: https://pytorch-forecasting.readthedocs.io/en/latest/
# ↪ tutorials/ar.html
# 1. Create the DataModule
data = generate_ar_data(seasonality=10.0, timesteps=400, n_series=100, seed=42)
```

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```

data["date"] = pd.Timestamp("2020-01-01") + pd.to_timedelta(data.time_idx, "D")

max_prediction_length = 20

training_cutoff = data["time_idx"].max() - max_prediction_length

datamodule = TabularForecastingData.from_data_frame(
    time_idx="time_idx",
    target="value",
    categorical_encoders={"series": NaLabelEncoder().fit(data.series)},
    group_ids=["series"],
    # only unknown variable is "value" - and N-Beats can also not take any additional
    ↪ variables
    time_varying_unknown_reals=["value"],
    max_encoder_length=60,
    max_prediction_length=max_prediction_length,
    train_data_frame=data[lamba x: x.time_idx <= training_cutoff],
    val_data_frame=data,
    batch_size=32,
)

# 2. Build the task
model = TabularForecaster(
    datamodule.parameters,
    backbone="n_beats",
    backbone_kwargs={"widths": [32, 512], "backcast_loss_ratio": 0.1},
)

# 3. Create the trainer and train the model
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count(), gradient_clip_
    ↪ val=0.01)
trainer.fit(model, datamodule=datamodule)

# 4. Generate predictions
predictions = model.predict(data)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("tabular_forecasting_model.pt")

```

**Note:** Read more about *our integration with PyTorch Forecasting* to see how to use your Flash model with their built-in plotting capabilities.

## TEXT CLASSIFICATION

### 27.1 The Task

Text classification is the task of assigning a piece of text (word, sentence or document) an appropriate class, or category. The categories depend on the chosen data set and can range from topics.

---

### 27.2 Example

Let's train a model to classify text as expressing either positive or negative sentiment. We will be using the IMDB data set, that contains a `train.csv` and `valid.csv`. Here's the structure:

```
review,sentiment
"Japanese indie film with humor ... ",positive
"Isaac Florentine has made some ...",negative
"After seeing the low-budget ...",negative
"I've seen the original English version ...",positive
"Hunters chase what they think is a man through ...",negative
...
```

Once we've downloaded the data using `download_data()`, we create the `TextClassificationData`. We select a pre-trained backbone to use for our `TextClassifier` and finetune on the IMDB data. The backbone can be any BERT classification model from [HuggingFace/transformers](#).

---

**Note:** When changing the backbone, make sure you pass in the same backbone to the `TextClassifier` and the `TextClassificationData`!

---

Next, we use the trained `TextClassifier` for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.text import TextClassificationData, TextClassifier

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/imdb.zip", "./data/")
```

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```
datamodule = TextClassificationData.from_csv(
    "review",
    "sentiment",
    train_file="data/imdb/train.csv",
    val_file="data/imdb/valid.csv",
    backbone="prajjwal1/bert-tiny",
)

# 2. Build the task
model = TextClassifier(backbone=datamodule.backbone, num_classes=datamodule.num_classes)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Classify a few sentences! How was the movie?
predictions = model.predict(
    [
        "Turgid dialogue, feeble characterization - Harvey Keitel a judge?.",
        "The worst movie in the history of cinema.",
        "I come from Bulgaria where it 's almost impossible to have a tornado.",
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("text_classification_model.pt")
```

## 27.3 Flash Zero

The text classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash text_classification
```

To view configuration options and options for running the text classifier with your own data, use:

```
flash text_classification --help
```

## 27.4 Serving

The *TextClassifier* is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```
from flash.text import TextClassifier

model = TextClassifier.load_from_checkpoint("https://flash-weights.s3.amazonaws.com/0.5.
↳2/text_classification_model.pt")
model.serve()
```

You can now perform inference from your client like this:

```
import requests

text = "Best movie ever"
body = {"session": "UUID", "payload": {"inputs": {"data": text}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)

print(resp.json())
```

## 27.5 Accelerate Training & Inference with Torch ORT

**Torch ORT** converts your model into an optimized ONNX graph, speeding up training & inference when using NVIDIA or AMD GPUs. Enabling Torch ORT requires a single flag passed to the *TextClassifier* once installed. See installation instructions [here](#).

**Note:** Not all Transformer models are supported. See [this table](#) for supported models + branches containing fixes for certain models.

```
...

model = TextClassifier(backbone="facebook/bart-large", num_classes=datamodule.num_
↳classes, enable_ort=True)
```





## MULTI-LABEL TEXT CLASSIFICATION

### 28.1 The Task

Multi-label classification is the task of assigning a number of labels from a fixed set to each data point, which can be in any modality (text in this case). Multi-label text classification is supported by the *TextClassifier* via the `multi-label` argument.

---

### 28.2 Example

Let's look at the task of classifying comment toxicity. The data we will use in this example is from the kaggle toxic comment classification challenge by jigsaw: [www.kaggle.com/c/jigsaw-toxic-comment-classification-challenge](https://www.kaggle.com/c/jigsaw-toxic-comment-classification-challenge). The data is stored in CSV files with this structure:

```
"id","comment_text","toxic","severe_toxic","obscene","threat","insult","identity_hate"
"0000997932d777bf","...",0,0,0,0,0,0
"0002bcb3da6cb337","...",1,1,1,0,1,0
"0005c987bdfc9d4b","...",1,0,0,0,0,0
...
```

Once we've downloaded the data using `download_data()`, we create the *TextClassificationData*. We select a pre-trained backbone to use for our *TextClassifier* and finetune on the toxic comments data. The backbone can be any BERT classification model from [HuggingFace/transformers](https://huggingface.co/transformers).

---

**Note:** When changing the backbone, make sure you pass in the same backbone to the *TextClassifier* and the *TextClassificationData*!

---

Next, we use the trained *TextClassifier* for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.text import TextClassificationData, TextClassifier

# 1. Create the DataModule
# Data from the Kaggle Toxic Comment Classification Challenge:
```

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```

# https://www.kaggle.com/c/jigsaw-toxic-comment-classification-challenge
download_data("https://pl-flash-data.s3.amazonaws.com/jigsaw_toxic_comments.zip", "./data
↪")

datamodule = TextClassificationData.from_csv(
    "comment_text",
    ["toxic", "severe_toxic", "obscene", "threat", "insult", "identity_hate"],
    train_file="data/jigsaw_toxic_comments/train.csv",
    val_split=0.1,
    backbone="unitary/toxic-bert",
)

# 2. Build the task
model = TextClassifier(
    backbone="unitary/toxic-bert",
    num_classes=datamodule.num_classes,
    multi_label=True,
)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count())
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Generate predictions for a few comments!
predictions = model.predict(
    [
        "No, he is an arrogant, self serving, immature idiot. Get it right.",
        "U SUCK HANNAH MONTANA",
        "Would you care to vote? Thx.",
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("text_classification_multi_label_model.pt")

```

## 28.3 Flash Zero

The multi-label text classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash text_classification from_toxic
```

To view configuration options and options for running the text classifier with your own data, use:

```
flash text_classification --help
```

## 28.4 Serving

The *TextClassifier* is servable. For more information, see *Text Classification*.



## QUESTION ANSWERING

### 29.1 The Task

Question Answering is the task of being able to answer questions pertaining to some known context. For example, given a context about some historical figure, any question pertaining to the context should be answerable. In our case the article would be our input context and question, and the answer would be the output sequence from the model.

---

**Note:** We currently only support Extractive Question Answering, like the task performed using the SQUAD like datasets.

---

### 29.2 Example

Let's look at an example. We'll use the SQUAD 2.0 dataset, which contains `train-v2.0.json` and `dev-v2.0.json`. Each JSON file looks like this:

```
{
  "answers": {
    "answer_start": [94, 87, 94, 94],
    "text": ["10th and 11th centuries", "in the 10th and 11th centuries",
↪ "10th and 11th centuries", "10th and 11th centuries"]
  },
  "context": "\"The Normans (Norman: Nourmands; French: Normands; Latin:↪
↪Normanni) were the people who in the 10th and 11th centuries gave thei...",
  "id": "56ddde6b9a695914005b9629",
  "question": "When were the Normans in Normandy?",
  "title": "Normans"
}
...
```

In the above, the `context` key represents the context used for the question and answer, the `question` key represents the question being asked with respect to the context, the `answer` key stores the answer(s) for the question. `id` and `title` are used for unique identification and grouping concepts together respectively. Once we've downloaded the data using `download_data()`, we create the [QuestionAnsweringData](#). We select a pre-trained backbone to use for our [QuestionAnsweringTask](#) and finetune on the SQUAD 2.0 data. The backbone can be any Question Answering model from [HuggingFace/transformers](#).

**Note:** When changing the backbone, make sure you pass in the same backbone to the `QuestionAnsweringData` and the `QuestionAnsweringTask`!

Next, we use the trained `QuestionAnsweringTask` for inference. Finally, we save the model. Here's the full example:

```
from flash import Trainer
from flash.core.data.utils import download_data
from flash.text import QuestionAnsweringData, QuestionAnsweringTask

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/squad_tiny.zip", "./data/")

datamodule = QuestionAnsweringData.from_squad_v2(
    train_file="./data/squad_tiny/train.json",
    val_file="./data/squad_tiny/val.json",
)

# 2. Build the task
model = QuestionAnsweringTask()

# 3. Create the trainer and finetune the model
trainer = Trainer(max_epochs=3, limit_train_batches=1, limit_val_batches=1)
trainer.finetune(model, datamodule=datamodule)

# 4. Answer some Questions!
predictions = model.predict(
    {
        "id": ["56ddde6b9a695914005b9629", "56ddde6b9a695914005b9628"],
        "context": [
            """
            The Normans (Norman: Nourmands; French: Normands; Latin: Normanni) were the
            ↪people who in the 10th
            and 11th centuries gave their name to Normandy, a region in France. They were
            ↪descended from Norse
            ("Norman" comes from "Norseman") raiders and pirates from Denmark, Iceland and
            ↪Norway who, under
            their leader Rollo, agreed to swear fealty to King Charles III of West Francia.
            ↪Through generations
            of assimilation and mixing with the native Frankish and Roman-Gaulish
            ↪populations, their
            descendants would gradually merge with the Carolingian-based cultures of West
            ↪Francia. The distinct
            cultural and ethnic identity of the Normans emerged initially in the first half
            ↪of the 10th
            century, and it continued to evolve over the succeeding centuries.
            """,
            """
            The Normans (Norman: Nourmands; French: Normands; Latin: Normanni) were the
            ↪people who in the 10th
            and 11th centuries gave their name to Normandy, a region in France. They were
            ↪descended from Norse
            ("Norman" comes from "Norseman") raiders and pirates from Denmark, Iceland and
            ↪Norway who, under
```

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```

        their leader Rollo, agreed to swear fealty to King Charles III of West Francia.
    ↳Through generations
        of assimilation and mixing with the native Frankish and Roman-Gaulish
    ↳populations, their
        descendants would gradually merge with the Carolingian-based cultures of West
    ↳Francia. The distinct
        cultural and ethnic identity of the Normans emerged initially in the first half
    ↳of the 10th
        century, and it continued to evolve over the succeeding centuries.
        """
    ],
    "question": ["When were the Normans in Normandy?", "In what country is Normandy
    ↳located?"],
    }
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("question_answering_on_sqaud_v2.pt")

```

## 29.3 Accelerate Training & Inference with Torch ORT

**Torch ORT** converts your model into an optimized ONNX graph, speeding up training & inference when using NVIDIA or AMD GPUs. Enabling Torch ORT requires a single flag passed to the `QuestionAnsweringTask` once installed. See installation instructions [here](#).

**Note:** Not all Transformer models are supported. See [this table](#) for supported models + branches containing fixes for certain models.

```

...

model = QuestionAnsweringTask(backbone="distilbert-base-uncased", max_answer_length=30,
    ↳enable_ort=True)

```





## SUMMARIZATION

### 30.1 The Task

Summarization is the task of summarizing text from a larger document/article into a short sentence/description. For example, taking a web article and describing the topic in a short sentence. This task is a subset of [Sequence to Sequence tasks](#), which require the model to generate a variable length sequence given an input sequence. In our case the article would be our input sequence, and the short description/sentence would be the output sequence from the model.

---

### 30.2 Example

Let's look at an example. We'll use the XSUM dataset, which contains a `train.csv` and `valid.csv`. Each CSV file looks like this:

```
input,target
"The researchers have sequenced the genome of a strain of bacterium that causes the_
↳virulent infection...", "A team of UK scientists hopes to shed light on the mysteries_
↳of bleeding canker, a disease that is threatening the nation's horse chestnut trees."
"Knight was shot in the leg by an unknown gunman at Miami's Shore Club where West was_
↳holding a pre-MTV Awards...", "Hip hop star Kanye West is being sued by Death Row_
↳Records founder Suge Knight over a shooting at a beach party in August 2005.
...
```

In the above, the input column represents the long articles/documents, and the target is the short description used as the target. Once we've downloaded the data using `download_data()`, we create the [SummarizationData](#). We select a pre-trained backbone to use for our [SummarizationTask](#) and finetune on the XSUM data. The backbone can be any Seq2Seq summarization model from [HuggingFace/transformers](#).

---

**Note:** When changing the backbone, make sure you pass in the same backbone to the [SummarizationData](#) and the [SummarizationTask](#)!

---

Next, we use the trained [SummarizationTask](#) for inference. Finally, we save the model. Here's the full example:

```
from flash import Trainer
from flash.core.data.utils import download_data
from flash.text import SummarizationData, SummarizationTask
```

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```

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/xsum.zip", "./data/")

datamodule = SummarizationData.from_csv(
    "input",
    "target",
    train_file="data/xsum/train.csv",
    val_file="data/xsum/valid.csv",
)

# 2. Build the task
model = SummarizationTask()

# 3. Create the trainer and finetune the model
trainer = Trainer(max_epochs=3)
trainer.finetune(model, datamodule=datamodule)

# 4. Summarize some text!
predictions = model.predict(
    """
    Camilla bought a box of mangoes with a Brixton Â£10 note, introduced last year to
    ↪ try to keep the money of local
    people within the community. The couple were surrounded by shoppers as they walked
    ↪ along Electric Avenue.
    They came to Brixton to see work which has started to revitalise the borough.
    It was Charles' first visit to the area since 1996, when he was accompanied by the
    ↪ former
    South African president Nelson Mandela. Greengrocer Derek Chong, who has run a stall
    ↪ on Electric Avenue
    for 20 years, said Camilla had been "'nice and pleasant'" when she purchased the
    ↪ fruit.
    "'She asked me what was nice, what would I recommend, and I said we've got some nice
    ↪ mangoes.
    She asked me were they ripe and I said yes - they're from the Dominican Republic.'"
    Mr Chong is one of 170 local retailers who accept the Brixton Pound.
    Customers exchange traditional pound coins for Brixton Pounds and then spend them at
    ↪ the market
    or in participating shops.
    During the visit, Prince Charles spent time talking to youth worker Marcus West, who
    ↪ works with children
    nearby on an estate off Coldharbour Lane. Mr West said:
    "'He's on the level, really down-to-earth. They were very cheery. The prince is a
    ↪ lovely man.'"
    He added: "'I told him I was working with young kids and he said, 'Keep up all the
    ↪ good work.''"
    Prince Charles also visited the Railway Hotel, at the invitation of his charity The
    ↪ Prince's Regeneration Trust.
    The trust hopes to restore and refurbish the building,
    where once Jimi Hendrix and The Clash played, as a new community and business centre.
    ↪ "
    """
)

```

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```
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("summarization_model_xsum.pt")
```

### 30.3 Flash Zero

The summarization task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash summarization
```

To view configuration options and options for running the summarization task with your own data, use:

```
flash summarization --help
```

### 30.4 Serving

The *SummarizationTask* is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```
from flash.text import SummarizationTask

model = SummarizationTask.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/summarization_model_xsum.pt"
)
model.serve()
```

You can now perform inference from your client like this:

```
import requests

text = """
Camilla bought a box of mangoes with a Brixton £10 note, introduced last year to try to
↳keep the money of local
people within the community.The couple were surrounded by shoppers as they walked along
↳Electric Avenue.
They came to Brixton to see work which has started to revitalise the borough.
It was Charles' first visit to the area since 1996, when he was accompanied by the former
South African president Nelson Mandela.Green grocer Derek Chong, who has run a stall on
↳Electric Avenue
for 20 years, said Camilla had been "nice and pleasant" when she purchased the fruit.
""She asked me what was nice, what would I recommend, and I said we've got some nice
↳mangoes.
She asked me were they ripe and I said yes - they're from the Dominican Republic.""
Mr Chong is one of 170 local retailers who accept the Brixton Pound.
```

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```
Customers exchange traditional pound coins for Brixton Pounds and then spend them at the↵  
↵market  
or in participating shops.  
During the visit, Prince Charles spent time talking to youth worker Marcus West, who↵  
↵works with children  
nearby on an estate off Coldharbour Lane. Mr West said:  
""He's on the level, really down-to-earth. They were very cheery. The prince is a lovely↵  
↵man.""  
He added: ""I told him I was working with young kids and he said, 'Keep up all the good↵  
↵work.'""  
Prince Charles also visited the Railway Hotel, at the invitation of his charity The↵  
↵Prince's Regeneration Trust.  
The trust hopes to restore and refurbish the building,  
where once Jimi Hendrix and The Clash played, as a new community and business centre."  
""  
body = {"session": "UUID", "payload": {"inputs": {"data": text}}}  
resp = requests.post("http://127.0.0.1:8000/predict", json=body)  
  
print(resp.json())
```

## 30.5 Accelerate Training & Inference with Torch ORT

**Torch ORT** converts your model into an optimized ONNX graph, speeding up training & inference when using NVIDIA or AMD GPUs. Enabling Torch ORT requires a single flag passed to the `SummarizationTask` once installed. See installation instructions [here](#).

**Note:** Not all Transformer models are supported. See [this table](#) for supported models + branches containing fixes for certain models.

```
...  
  
model = SummarizationTask(backbone="t5-large", num_classes=datamodule.num_classes,↵  
↵enable_ort=True)
```

## TRANSLATION

### 31.1 The Task

Translation is the task of translating text from a source language to another, such as English to Romanian. This task is a subset of [Sequence to Sequence tasks](#), which requires the model to generate a variable length sequence given an input sequence. In our case, the task will take an English sequence as input, and output the same sequence in Romanian.

---

### 31.2 Example

Let's look at an example. We'll use [WMT16 English/Romanian](#), a dataset of English to Romanian samples, based on the [Europarl corpora](#). The data set contains a `train.csv` and `valid.csv`. Each CSV file looks like this:

```
input,target
"Written statements and oral questions (tabling): see Minutes","Declarații scrise și
→întrebări orale (depunere): consultați procesul-verbal"
"Closure of sitting","Ridicarea ședinței"
...
```

In the above the input/target columns represent the English and Romanian translation respectively. Once we've downloaded the data using `download_data()`, we create the [TranslationData](#). We select a pre-trained backbone to use for our [TranslationTask](#) and finetune on the WMT16 data. The backbone can be any Seq2Seq translation model from [HuggingFace/transformers](#).

---

**Note:** When changing the backbone, make sure you pass in the same backbone to the [TranslationData](#) and the [TranslationTask](#)!

---

Next, we use the trained [TranslationTask](#) for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.text import TranslationData, TranslationTask

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/wmt_en_ro.zip", "./data")
```

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```
datamodule = TranslationData.from_csv(  
    "input",  
    "target",  
    train_file="data/wmt_en_ro/train.csv",  
    val_file="data/wmt_en_ro/valid.csv",  
    backbone="Helsinki-NLP/opus-mt-en-ro",  
)  
  
# 2. Build the task  
model = TranslationTask(backbone="Helsinki-NLP/opus-mt-en-ro")  
  
# 3. Create the trainer and finetune the model  
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())  
trainer.finetune(model, datamodule=datamodule)  
  
# 4. Translate something!  
predictions = model.predict(  
    [  
        "BBC News went to meet one of the project's first graduates.",  
        "A recession has come as quickly as 11 months after the first rate hike and as  
→ long as 86 months.",  
        "Of course, it's still early in the election cycle.",  
    ]  
)  
print(predictions)  
  
# 5. Save the model!  
trainer.save_checkpoint("translation_model_en_ro.pt")
```

## 31.3 Flash Zero

The translation task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash translation
```

To view configuration options and options for running the translation task with your own data, use:

```
flash translation --help
```

## 31.4 Serving

The *TranslationTask* is servable. This means you can call `.serve` to serve your *Task*. Here's an example:

```
from flash.text import TranslationTask

model = TranslationTask.load_from_checkpoint("https://flash-weights.s3.amazonaws.com/0.5.
↪2/translation_model_en_ro.pt")
model.serve()
```

You can now perform inference from your client like this:

```
import requests

text = "Some English text"
body = {"session": "UUID", "payload": {"inputs": {"data": text}}}
resp = requests.post("http://127.0.0.1:8000/predict", json=body)

print(resp.json())
```

## 31.5 Accelerate Training & Inference with Torch ORT

**Torch ORT** converts your model into an optimized ONNX graph, speeding up training & inference when using NVIDIA or AMD GPUs. Enabling Torch ORT requires a single flag passed to the *TranslationTask* once installed. See installation instructions [here](#).

**Note:** Not all Transformer models are supported. See [this table](#) for supported models + branches containing fixes for certain models.

```
...

model = TranslationTask(backbone="t5-large", num_classes=datamodule.num_classes, enable_
↪ort=True)
```





## POINT CLOUD SEGMENTATION

### 32.1 The Task

A Point Cloud is a set of data points in space, usually describes by  $x$ ,  $y$  and  $z$  coordinates.

PointCloud Segmentation is the task of performing classification at a point-level, meaning each point will associated to a given class. The current integration builds on top [Open3D-ML](#).

---

### 32.2 Example

Let's look at an example using a data set generated from the [KITTI Vision Benchmark](#). The data are a tiny subset of the original dataset and contains sequences of point clouds. The data contains multiple folder, one for each sequence and a meta.yaml file describing the classes and their official associated color map. A sequence should contain one folder for scans and one folder for labels, plus a pose.txt to re-align the sequence if required. Here's the structure:

```
data
├── meta.yaml
├── 00
│   ├── scans
│   │   ├── 00000.bin
│   │   ├── 00001.bin
│   │   └── ...
│   ├── labels
│   │   ├── 00000.label
│   │   ├── 00001.label
│   │   └── ...
│   └── pose.txt
├── ...
└── XX
    ├── scans
    │   ├── 00000.bin
    │   ├── 00001.bin
    │   └── ...
    ├── labels
    │   ├── 00000.label
    │   ├── 00001.label
```

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```
| ...  
|— pose.txt
```

Learn more: <http://www.semantic-kitti.org/dataset.html>

Once we've downloaded the data using `download_data()`, we create the `PointCloudSegmentationData`. We select a pre-trained `randlanet_semantic_kitti` backbone for our `PointCloudSegmentation` task. We then use the trained `PointCloudSegmentation` for inference. Finally, we save the model. Here's the full example:

```
import torch

import flash
from flash.core.data.utils import download_data
from flash.pointcloud import PointCloudSegmentation, PointCloudSegmentationData

# 1. Create the DataModule
# Dataset Credit: http://www.semantic-kitti.org/
download_data("https://pl-flash-data.s3.amazonaws.com/SemanticKittiTiny.zip", "data/")

datamodule = PointCloudSegmentationData.from_folders(
    train_folder="data/SemanticKittiTiny/train",
    val_folder="data/SemanticKittiTiny/val",
)

# 2. Build the task
model = PointCloudSegmentation(backbone="randlanet_semantic_kitti", num_
    ↳ classes=datamodule.num_classes)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(
    max_epochs=1, limit_train_batches=1, limit_val_batches=1, num_sanity_val_steps=0,
    ↳ gpus=torch.cuda.device_count()
)
trainer.fit(model, datamodule)

# 4. Predict what's within a few PointClouds?
predictions = model.predict(
    [
        "data/SemanticKittiTiny/predict/0000000.bin",
        "data/SemanticKittiTiny/predict/0000001.bin",
    ]
)

# 5. Save the model!
trainer.save_checkpoint("pointcloud_segmentation_model.pt")
```

## 32.3 Flash Zero

The point cloud segmentation task can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash pointcloud_segmentation
```

To view configuration options and options for running the point cloud segmentation task with your own data, use:

```
flash pointcloud_segmentation --help
```



## POINT CLOUD OBJECT DETECTION

### 33.1 The Task

A Point Cloud is a set of data points in space, usually describes by  $x$ ,  $y$  and  $z$  coordinates.

PointCloud Object Detection is the task of identifying 3D objects in point clouds and their associated classes and 3D bounding boxes.

The current integration builds on top [Open3D-ML](#).

---

### 33.2 Example

Let's look at an example using a data set generated from the [KITTI Vision Benchmark](#). The data are a tiny subset of the original dataset and contains sequences of point clouds.

**The data contains:**

- one folder for scans
- one folder for scan calibrations
- one folder for labels
- a meta.yaml file describing the classes and their official associated color map.

Here's the structure:

```
data
├── meta.yaml
├── train
│   ├── scans
│   │   ├── 00000.bin
│   │   ├── 00001.bin
│   │   └── ...
│   ├── calibs
│   │   ├── 00000.txt
│   │   ├── 00001.txt
│   │   └── ...
│   └── labels
│       ├── 00000.txt
│       └── 00001.txt
```

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```

...
├── val
│   ├── ...
│   └── predict
│       ├── scans
│       │   ├── 000000.bin
│       │   └── 000001.bin
│       ├── calibs
│       │   ├── 000000.txt
│       │   └── 000001.txt
│       └── meta.yaml

```

Learn more: <http://www.semantic-kitti.org/dataset.html>

Once we've downloaded the data using `download_data()`, we create the `PointCloudObjectDetectorData`. We select a pre-trained `randlanet_semantic_kitti` backbone for our `PointCloudObjectDetector` task. We then use the trained `PointCloudObjectDetector` for inference. Finally, we save the model. Here's the full example:

```

import torch

import flash
from flash.core.data.utils import download_data
from flash.pointcloud import PointCloudObjectDetector, PointCloudObjectDetectorData

# 1. Create the DataModule
# Dataset Credit: http://www.semantic-kitti.org/
download_data("https://pl-flash-data.s3.amazonaws.com/KITTI_tiny.zip", "data/")

datamodule = PointCloudObjectDetectorData.from_folders(
    train_folder="data/KITTI_Tiny/Kitti/train",
    val_folder="data/KITTI_Tiny/Kitti/val",
)

# 2. Build the task
model = PointCloudObjectDetector(backbone="pointpillars_kitti", num_classes=datamodule.
    ↪ num_classes)

# 3. Create the trainer and finetune the model
trainer = flash.Trainer(
    max_epochs=1, limit_train_batches=1, limit_val_batches=1, num_sanity_val_steps=0, ↪
    ↪ gpus=torch.cuda.device_count()
)
trainer.fit(model, datamodule)

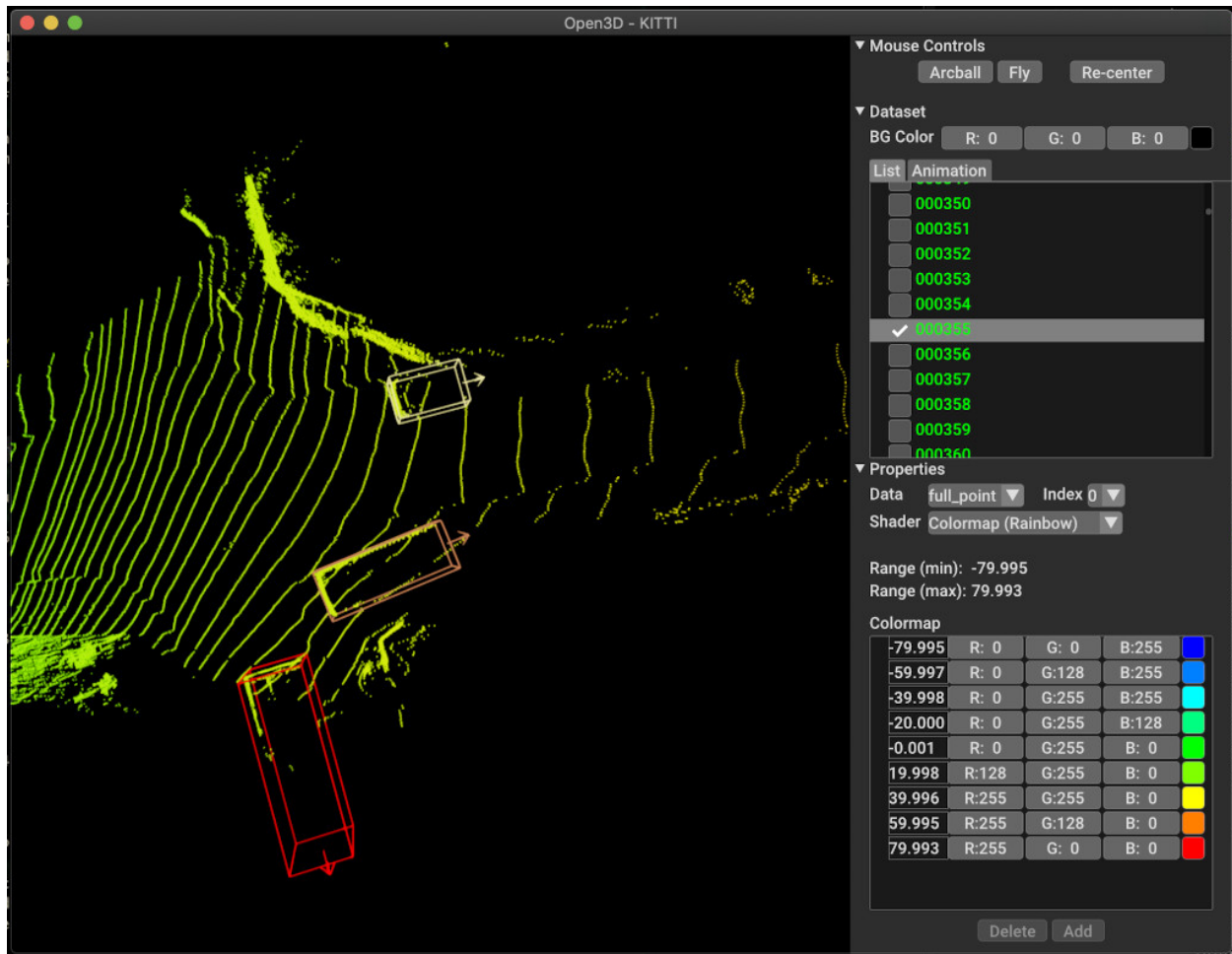
# 4. Predict what's within a few PointClouds?
predictions = model.predict(
    [
        "data/KITTI_Tiny/Kitti/predict/scans/0000000.bin",
        "data/KITTI_Tiny/Kitti/predict/scans/0000001.bin",
    ]
)

```

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```
# 5. Save the model!
trainer.save_checkpoint("pointcloud_detection_model.pt")
```



### 33.3 Flash Zero

The point cloud object detector can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash pointcloud_detection
```

To view configuration options and options for running the point cloud object detector with your own data, use:

```
flash pointcloud_detection --help
```





## GRAPH CLASSIFICATION

### 34.1 The Task

This task consist on classifying graphs. The task predicts which ‘class’ the graph belongs to. A class is a label that indicates the kind of graph. For example, a label may indicate whether one molecule interacts with another.

The *GraphClassifier* and *GraphClassificationData* classes internally rely on *pytorch-geometric*.

---

### 34.2 Example

Let’s look at the task of classifying graphs from the KKI data set from *TU Dortmund University*.

Once we’ve created the *TUDataset*, we create the *GraphClassificationData*. We then create our *GraphClassifier* and train on the KKI data. Next, we use the trained *GraphClassifier* for inference. Finally, we save the model. Here’s the full example:

```
import torch

import flash
from flash.core.utilities.imports import example_requires
from flash.graph import GraphClassificationData, GraphClassifier

example_requires("graph")

from torch_geometric.datasets import TUDataset # noqa: E402

# 1. Create the DataModule
dataset = TUDataset(root="data", name="KKI")

datamodule = GraphClassificationData.from_datasets(
    train_dataset=dataset,
    val_split=0.1,
)

# 2. Build the task
model = GraphClassifier(num_features=datamodule.num_features, num_classes=datamodule.num_
↪classes)
```

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```
# 3. Create the trainer and fit the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.fit(model, datamodule=datamodule)

# 4. Classify some graphs!
predictions = model.predict(dataset[:3])
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("graph_classification.pt")
```

---

## 34.3 Flash Zero

The graph classifier can be used directly from the command line with zero code using *Flash Zero*. You can run the above example with:

```
flash graph_classification
```

To view configuration options and options for running the graph classifier with your own data, use:

```
flash graph_classification --help
```

## PROVIDERS

Flash is a framework integrator. We rely on many open source frameworks for our tasks, visualizations and backbones. Here's a list of some of the providers we use for backbones and heads within Flash (check them out and star their repos to spread the open source love!):

- [airctic/IceVision \(https://github.com/airctic/icevision\)](https://github.com/airctic/icevision)
- [Facebook Research/dino \(https://github.com/facebookresearch/dino\)](https://github.com/facebookresearch/dino)
- [Facebook Research/PyTorchVideo \(https://github.com/facebookresearch/pytorchvideo\)](https://github.com/facebookresearch/pytorchvideo)
- [Facebook Research/vissl \(https://github.com/facebookresearch/vissl\)](https://github.com/facebookresearch/vissl)
- [Hugging Face/transformers \(https://github.com/huggingface/transformers\)](https://github.com/huggingface/transformers)
- [Intelligent Systems Lab Org/Open3D-ML \(https://github.com/isl-org/Open3D-ML\)](https://github.com/isl-org/Open3D-ML)
- [jdb78/PyTorch-Forecasting \(https://github.com/jdb78/pytorch-forecasting\)](https://github.com/jdb78/pytorch-forecasting)
- [learnables/learn2learn \(https://github.com/learnables/learn2learn\)](https://github.com/learnables/learn2learn)
- [OpenMMLab/MMDetection \(https://github.com/open-mmlab/mmdetection\)](https://github.com/open-mmlab/mmdetection)
- [pystiche/pystiche \(https://github.com/pystiche/pystiche\)](https://github.com/pystiche/pystiche)
- [PyTorch/fairseq \(https://github.com/pytorch/fairseq\)](https://github.com/pytorch/fairseq)
- [PyTorch/torchvision \(https://github.com/pytorch/vision\)](https://github.com/pytorch/vision)
- [qubvel/segmentation\\_models.pytorch \(https://github.com/qubvel/segmentation\\_models.pytorch\)](https://github.com/qubvel/segmentation_models.pytorch)
- [rwightman/efficientdet-pytorch \(https://github.com/rwightman/efficientdet-pytorch\)](https://github.com/rwightman/efficientdet-pytorch)
- [rwightman/pytorch-image-models \(https://github.com/rwightman/pytorch-image-models\)](https://github.com/rwightman/pytorch-image-models)
- [Ultralytics/YOLOV5 \(https://github.com/ultralytics/yolov5\)](https://github.com/ultralytics/yolov5)

You can also read our guides for some of our larger integrations:

- *FiftyOne*



## BAAL

The framework [Bayesian Active Learning \(BaaL\)](#) is an active learning library developed at [ElementAI](#).

Active Learning is a sub-field in AI, focusing on adding a human in the learning loop. The most uncertain samples will be labelled by the human to accelerate the model training cycle.

With its integration within Flash, the Active Learning process is simpler than ever before.

```
import torch

import flash
from flash.core.classification import Probabilities
from flash.core.data.utils import download_data
from flash.image import ImageClassificationData, ImageClassifier
from flash.image.classification.integrations.baal import ActiveLearningDataModule, \
    ActiveLearningLoop

# 1. Create the DataModule
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip", "./data")

# Implement the research use-case where we mask labels from labelled dataset.
datamodule = ActiveLearningDataModule(
    ImageClassificationData.from_folders(train_folder="data/hymenoptera_data/train/", \
    batch_size=2),
    initial_num_labels=5,
    val_split=0.1,
)

# 2. Build the task
head = torch.nn.Sequential(
    torch.nn.Dropout(p=0.1),
    torch.nn.Linear(512, datamodule.num_classes),
)
model = ImageClassifier(backbone="resnet18", head=head, num_classes=datamodule.num_
    classes, serializer=Probabilities())

# 3.1 Create the trainer
trainer = flash.Trainer(max_epochs=3)

# 3.2 Create the active learning loop and connect it to the trainer
active_learning_loop = ActiveLearningLoop(label_epoch_frequency=1)
```

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```
active_learning_loop.connect(trainer.fit_loop)
trainer.fit_loop = active_learning_loop

# 3.3 Finetune
trainer.finetune(model, datamodule=datamodule, strategy="freeze")

# 4. Predict what's on a few images! ants or bees?
predictions = model.predict("data/hymenoptera_data/val/bees/65038344_52a45d090d.jpg")
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("image_classification_model.pt")
```

## FIFTYONE

We have collaborated with the team at [Voxel51](#) to integrate their tool, [FiftyOne](#), into Lightning Flash.

FiftyOne is an open-source tool for building high-quality datasets and computer vision models. The FiftyOne API and App enable you to visualize datasets and interpret models faster and more effectively.

This integration allows you to view predictions generated by your tasks in the [FiftyOne App](#), as well as easily incorporate [FiftyOne Datasets](#) into your tasks. All image and video tasks are supported!

### 37.1 Installation

In order to utilize this integration, you will need to [install FiftyOne](#):

```
pip install fiftyone
```

### 37.2 Visualizing Flash predictions

This section shows you how to augment your existing Lightning Flash workflows with a couple of lines of code that let you visualize predictions in FiftyOne. You can visualize predictions for classification, object detection, and semantic segmentation tasks. Doing so is as easy as updating your model to use one of the following serializers:

- `FiftyOneLabels(return_filepath=True)`
- `FiftyOneSegmentationLabels(return_filepath=True)`
- `FiftyOneDetectionLabels(return_filepath=True)`

The `visualize()` function then lets you visualize your predictions in the [FiftyOne App](#). This function accepts a list of dictionaries containing [FiftyOne Label](#) objects and filepaths, which is exactly the output of the FiftyOne serializers when the `return_filepath=True` option is specified.

```
from itertools import chain

import torch

import flash
from flash.core.classification import FiftyOneLabels, Labels
from flash.core.data.utils import download_data
from flash.core.finetuning import FreezeUnfreeze
from flash.core.integrations.fiftyone import visualize
from flash.image import ImageClassificationData, ImageClassifier
```

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```

# 1 Download data
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip")

# 2 Load data
datamodule = ImageClassificationData.from_folders(
    train_folder="data/hymenoptera_data/train/",
    val_folder="data/hymenoptera_data/val/",
    test_folder="data/hymenoptera_data/test/",
    predict_folder="data/hymenoptera_data/predict/",
)

# 3 Fine tune a model
model = ImageClassifier(
    backbone="resnet18",
    num_classes=datamodule.num_classes,
    serializer=Labels(),
)
trainer = flash.Trainer(
    max_epochs=1,
    gpus=torch.cuda.device_count(),
    limit_train_batches=1,
    limit_val_batches=1,
)
trainer.finetune(
    model,
    datamodule=datamodule,
    strategy=FreezeUnfreeze(unfreeze_epoch=1),
)
trainer.save_checkpoint("image_classification_model.pt")

# 4 Predict from checkpoint
model = ImageClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/image_classification_model.pt"
)
model.serializer = FiftyOneLabels(return_filepath=True) # output FiftyOne format
predictions = trainer.predict(model, datamodule=datamodule)
predictions = list(chain.from_iterable(predictions)) # flatten batches

# 5 Visualize predictions in FiftyOne App
# Optional: pass `wait=True` to block execution until App is closed
session = visualize(predictions)

```

The `visualize()` function can be used in all of the following environments:

- **Local Python shell:** The App will launch in a new tab in your default web browser
- **Remote Python shell:** Pass the `remote=True` option and then follow the instructions printed to your remote shell to open the App in your browser on your local machine
- **Jupyter notebook:** The App will launch in the output of your current cell
- **Google Colab:** The App will launch in the output of your current cell
- **Python script:** Pass the `wait=True` option to block execution of your script until the App is closed



See [this page](#) for more information about using the FiftyOne App in different environments.

## 37.3 Using FiftyOne datasets

The above workflow is great for visualizing model predictions. However, if you store your data in a FiftyOne Dataset initially, then you can also visualize ground truth annotations. This allows you to perform more complex analysis with [views](#) into your data and [evaluation](#) of your model results.

The `from_fiftyone()` method allows you to load your FiftyOne datasets directly into a `DataModule` to be used for training, testing, or inference.

```
from itertools import chain

import fiftyone as fo
import torch

import flash
from flash.core.classification import FiftyOneLabels, Labels
from flash.core.data.utils import download_data
from flash.core.finetuning import FreezeUnfreeze
from flash.image import ImageClassificationData, ImageClassifier

# 1 Download data
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip")

# 2 Load data into FiftyOne
train_dataset = fo.Dataset.from_dir(
    dataset_dir="data/hymenoptera_data/train/",
    dataset_type=fo.types.ImageClassificationDirectoryTree,
)
val_dataset = fo.Dataset.from_dir(
    dataset_dir="data/hymenoptera_data/val/",
    dataset_type=fo.types.ImageClassificationDirectoryTree,
)
test_dataset = fo.Dataset.from_dir(
    dataset_dir="data/hymenoptera_data/test/",
    dataset_type=fo.types.ImageClassificationDirectoryTree,
)

# 3 Load data into Flash
datamodule = ImageClassificationData.from_fiftyone(
    train_dataset=train_dataset,
    val_dataset=val_dataset,
    test_dataset=test_dataset,
)

# 4 Fine tune model
model = ImageClassifier(
    backbone="resnet18",
    num_classes=datamodule.num_classes,
    serializer=Labels(),
)
```

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```

trainer = flash.Trainer(
    max_epochs=1,
    gpus=torch.cuda.device_count(),
    limit_train_batches=1,
    limit_val_batches=1,
)
trainer.finetune(
    model,
    datamodule=datamodule,
    strategy=FreezeUnfreeze(unfreeze_epoch=1),
)
trainer.save_checkpoint("image_classification_model.pt")

# 5 Predict from checkpoint on data with ground truth
model = ImageClassifier.load_from_checkpoint(
    "https://flash-weights.s3.amazonaws.com/0.5.2/image_classification_model.pt"
)
model.serializer = FiftyOneLabels(return_filepath=False) # output FiftyOne format
datamodule = ImageClassificationData.from_fiftyone(predict_dataset=test_dataset)
predictions = trainer.predict(model, datamodule=datamodule)
predictions = list(chain.from_iterable(predictions)) # flatten batches

# 6 Add predictions to dataset
test_dataset.set_values("predictions", predictions)

# 7 Evaluate your model
results = test_dataset.evaluate_classifications("predictions", gt_field="ground_truth",
    eval_key="eval")
results.print_report()
plot = results.plot_confusion_matrix()
plot.show()

# 8 Visualize results in the App
session = fo.launch_app(test_dataset)

# Optional: block execution until App is closed
session.wait()

```

## 37.4 Visualizing embeddings

FiftyOne provides the methods for [dimensionality reduction](#) and [interactive plotting](#). When combined with *embedding tasks* in Flash, you can accomplish powerful workflows like clustering, similarity search, pre-annotation, and more in only a few lines of code.

```

import fiftyone as fo
import fiftyone.brain as fob
import numpy as np

from flash.core.data.utils import download_data
from flash.image import ImageEmbedder

```

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```

# 1 Download data
download_data("https://pl-flash-data.s3.amazonaws.com/hymenoptera_data.zip")

# 2 Load data into FiftyOne
dataset = fo.Dataset.from_dir(
    "data/hymenoptera_data/test/",
    fo.types.ImageClassificationDirectoryTree,
)

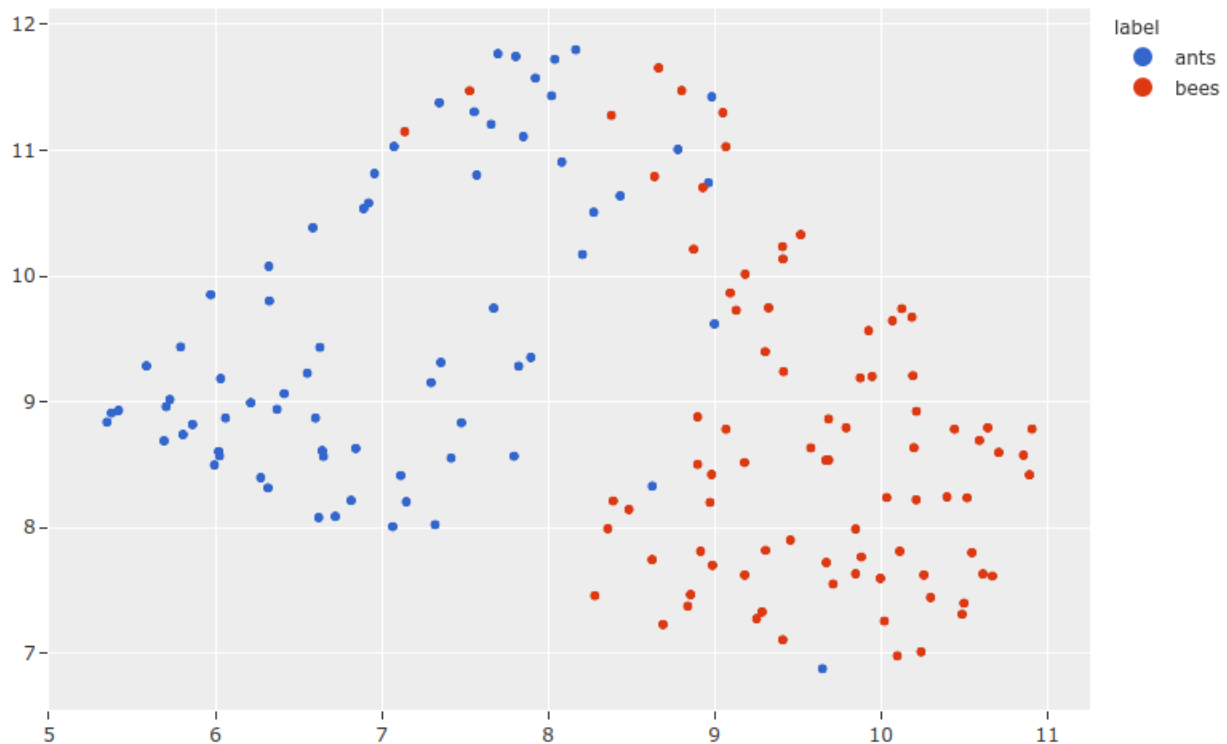
# 3 Load model
embedder = ImageEmbedder(backbone="resnet101")

# 4 Generate embeddings
filepaths = dataset.values("filepath")
embeddings = np.stack(embedder.predict(filepaths))

# 5 Visualize in FiftyOne App
results = fob.compute_visualization(dataset, embeddings=embeddings)
session = fo.launch_app(dataset)
plot = results.visualize(labels="ground_truth.label")
plot.show()

# Optional: block execution until App is closed
session.wait()

```





## ICEVISION

IceVision from airtic is an awesome computer vision framework which offers a curated collection of hundreds of high-quality pre-trained models for: object detection, keypoint detection, and instance segmentation. In Flash, we've integrated the IceVision framework to provide: data loading, augmentation, backbones, and heads. We use IceVision components in our: *object detection*, *instance segmentation*, and *keypoint detection* tasks. Take a look at their [documentation](#) and star [IceVision on GitHub](#) to spread the open source love!

### 38.1 IceData

The [IceData library](#) is a community driven dataset hub for IceVision. All of the datasets in IceData can be used out of the box with flash using our `.from_folders` methods and the `parser` argument. Take a look at our [Keypoint Detection](#) page for an example.

### 38.2 Albumentations with IceVision and Flash

IceVision provides two utilities for using the [albumentations library](#) with their models: - the `Adapter` helper class for adapting an any albumentations transform to work with IceVision records, - the `aug_tfms` utility function that returns a standard augmentation recipe to get the most out of your model.

In Flash, we use the `aug_tfms` as default transforms for the: *object detection*, *instance segmentation*, and *keypoint detection* tasks. You can also provide custom transforms from albumentations using the `IceVisionTransformAdapter` (which relies on the IceVision Adapter underneath). Here's an example:

```
import albumentations as A

from flash.core.integrations.icevision.transforms import IceVisionTransformAdapter
from flash.image import ObjectDetectionData

train_transform = {
    "pre_tensor_transform": IceVisionTransformAdapter([A.HorizontalFlip(), A.
↪ Normalize()]),
}

datamodule = ObjectDetectionData.from_coco(
    ...,
    train_transform=train_transform,
)
```



## LEARN2LEARN

`Learn2Learn` is a software library for meta-learning research by *Sébastien M. R. Arnold and al.* (Aug 2020)

### 39.1 What is Meta-Learning and why you should care?

Humans can distinguish between new objects with little or no training data. However, machine learning models often require thousands, millions, billions of annotated data samples to achieve good performance while extrapolating their learned knowledge on unseen objects.

A machine learning model which could learn or learn to learn from only few new samples (K-shot learning) would have tremendous applications once deployed in production. In an extreme case, a model performing 1-shot or 0-shot learning could be the source of new kind of AI applications.

Meta-Learning is a sub-field of AI dedicated to the study of few-shot learning algorithms. This is often characterized as teaching deep learning models to learn with only a few labeled data. The goal is to repeatedly learn from K-shot examples during training that match the structure of the final K-shot used in production. It is important to note that the K-shot example seen in production are very likely to be completely out-of-distribution with new objects.

### 39.2 How does Meta-Learning work?

In meta-learning, the model is trained over multiple meta tasks. A meta task is the smallest unit of data and it represents the data available to the model once in its deployment environment. By doing so, we can optimise the model and get higher results.

For image classification, a meta task is comprised of shot + query elements for each class. The shots samples are used to adapt the parameters and the queries ones to update the original model weights. The classes used in the validation and testing shouldn't be present within the training dataset, as the goal is to optimise the model performance on out-of-distribution (OOD) data with little label data.

When training the model with the meta-learning algorithm, the model will average its gradients over `meta_batch_size` meta tasks before performing an optimizer step. Traditionally, an meta epoch is composed of multiple meta batch.

## 39.3 Use Meta-Learning with Flash

With its integration within Flash, Meta Learning has never been simpler. Flash takes care of all the hard work: the tasks sampling, meta optimizer update, distributed training, etc...

**Note:** The users requires to provide a training dataset and testing dataset with no overlapping classes. Flash doesn't support this feature out-of-the box.

Once done, the users are left to play the hyper-parameters associated with the meta-learning algorithm.

Here is an example using `miniImageNet` dataset containing 100 classes divided into 64 training, 16 validation, and 20 test classes.

```
# adapted from https://github.com/learnables/learn2learn/blob/master/examples/vision/
↳ protonet_miniimagenet.py#L154

import warnings

import kornia.augmentation as Ka
import kornia.geometry as Kg
import learn2learn as l2l
import torch
import torchvision
from torch import nn

import flash
from flash.core.data.data_source import DefaultDataKeys
from flash.core.data.transforms import ApplyToKeys, kornia_collate
from flash.image import ImageClassificationData, ImageClassifier

warnings.simplefilter("ignore")

# download MiniImagenet
train_dataset = l2l.vision.datasets.MiniImagenet(root="data", mode="train",
↳ download=True)
val_dataset = l2l.vision.datasets.MiniImagenet(root="data", mode="validation",
↳ download=True)
test_dataset = l2l.vision.datasets.MiniImagenet(root="data", mode="test", download=True)

train_transform = {
    "to_tensor_transform": nn.Sequential(
        ApplyToKeys(DefaultDataKeys.INPUT, torchvision.transforms.ToTensor()),
        ApplyToKeys(DefaultDataKeys.TARGET, torch.as_tensor),
    ),
    "post_tensor_transform": ApplyToKeys(
        DefaultDataKeys.INPUT,
        Kg.Resize((196, 196)),
        # SPATIAL
        Ka.RandomHorizontalFlip(p=0.25),
        Ka.RandomRotation(degrees=90.0, p=0.25),
        Ka.RandomAffine(degrees=1 * 5.0, shear=1 / 5, translate=1 / 20, p=0.25),
        Ka.RandomPerspective(distortion_scale=1 / 25, p=0.25),
```

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```

    # PIXEL-LEVEL
    Ka.ColorJitter(brightness=1 / 30, p=0.25), # brightness
    Ka.ColorJitter(saturation=1 / 30, p=0.25), # saturation
    Ka.ColorJitter(contrast=1 / 30, p=0.25), # contrast
    Ka.ColorJitter(hue=1 / 30, p=0.25), # hue
    Ka.RandomMotionBlur(kernel_size=2 * (4 // 3) + 1, angle=1, direction=1.0, p=0.
→25),
    Ka.RandomErasing(scale=(1 / 100, 1 / 50), ratio=(1 / 20, 1), p=0.25),
),
"collate": kornia_collate,
"per_batch_transform_on_device": ApplyToKeys(
    DefaultDataKeys.INPUT,
    Ka.RandomHorizontalFlip(p=0.25),
),
}

# construct datamodule
datamodule = ImageClassificationData.from_tensors(
    train_data=train_dataset.x,
    train_targets=torch.from_numpy(train_dataset.y.astype(int)),
    val_data=val_dataset.x,
    val_targets=torch.from_numpy(val_dataset.y.astype(int)),
    test_data=test_dataset.x,
    test_targets=torch.from_numpy(test_dataset.y.astype(int)),
    num_workers=4,
    train_transform=train_transform,
)

model = ImageClassifier(
    backbone="resnet18",
    training_strategy="prototypicalnetworks",
    training_strategy_kwargs={
        "epoch_length": 10 * 16,
        "meta_batch_size": 4,
        "num_tasks": 200,
        "test_num_tasks": 2000,
        "ways": datamodule.num_classes,
        "shots": 1,
        "test_ways": 5,
        "test_shots": 1,
        "test_queries": 15,
    },
    optimizer=torch.optim.Adam,
    optimizer_kwargs={"lr": 0.001},
)

trainer = flash.Trainer(
    max_epochs=200,
    gpus=2,
    accelerator="ddp_shared",
    precision=16,
)

```

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```
trainer.finetune(model, datamodule=datamodule, strategy="no_freeze")
```

You can read their paper [Learn2Learn: A Library for Meta-Learning Research](#).

And don't forget to cite [Learn2Learn](#) repository in your academic publications. Find their Biblex on their repository.

## PYTORCH FORECASTING

PyTorch Forecasting provides the models and data loading for the *Tabular Forecasting* task in Flash. As with all of our tasks, you won't typically interact with the components from PyTorch Forecasting directly. However, PyTorch Forecasting provides some built-in plotting and analysis methods that are different for each model which cannot be used directly with the *TabularForecaster*. Instead, you can access the PyTorch Forecasting model object using the `pytorch_forecasting_model` attribute. In addition, we provide the `convert_predictions()` utility to convert predictions from the Flash format into the expected format. With these, you can train your model and perform inference using Flash but still make use of the plotting and analysis tools built in to PyTorch Forecasting.

Here's an example, plotting the predictions and interpretation analysis from the NBeats model trained in the *Tabular Forecasting* documentation:

```
import torch

import flash
from flash.core.integrations.pytorch_forecasting import convert_predictions
from flash.core.utilities.imports import example_requires
from flash.tabular.forecasting import TabularForecaster, TabularForecastingData

example_requires(["tabular", "matplotlib"])

import matplotlib.pyplot as plt # noqa: E402
import pandas as pd # noqa: E402
from pytorch_forecasting.data import NaLabelEncoder # noqa: E402
from pytorch_forecasting.data.examples import generate_ar_data # noqa: E402

# Example based on this tutorial: https://pytorch-forecasting.readthedocs.io/en/latest/tutorials/ar.html
# 1. Create the DataModule
data = generate_ar_data(seasonality=10.0, timesteps=400, n_series=100, seed=42)
data["date"] = pd.Timestamp("2020-01-01") + pd.to_timedelta(data.time_idx, "D")

max_prediction_length = 20

training_cutoff = data["time_idx"].max() - max_prediction_length

datamodule = TabularForecastingData.from_data_frame(
    time_idx="time_idx",
    target="value",
    categorical_encoders={"series": NaLabelEncoder().fit(data.series)},
    group_ids=["series"],
    # only unknown variable is "value" - and N-Beats can also not take any additional
    ↪ variables
```

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```

time_varying_unknown_reals=["value"],
max_encoder_length=60,
max_prediction_length=max_prediction_length,
train_data_frame=data[lambdax: x.time_idx <= training_cutoff],
val_data_frame=data,
batch_size=32,
)

# 2. Build the task
model = TabularForecaster(
    datamodule.parameters,
    backbone="n_beats",
    backbone_kwargs={"widths": [32, 512], "backcast_loss_ratio": 0.1},
)

# 3. Create the trainer and train the model
trainer = flash.Trainer(max_epochs=1, gpus=torch.cuda.device_count(), gradient_clip_val=0.01)
trainer.fit(model, datamodule=datamodule)

# 4. Generate predictions
predictions = model.predict(data)
print(predictions)

# Plot with PyTorch Forecasting!
predictions, inputs = convert_predictions(predictions)

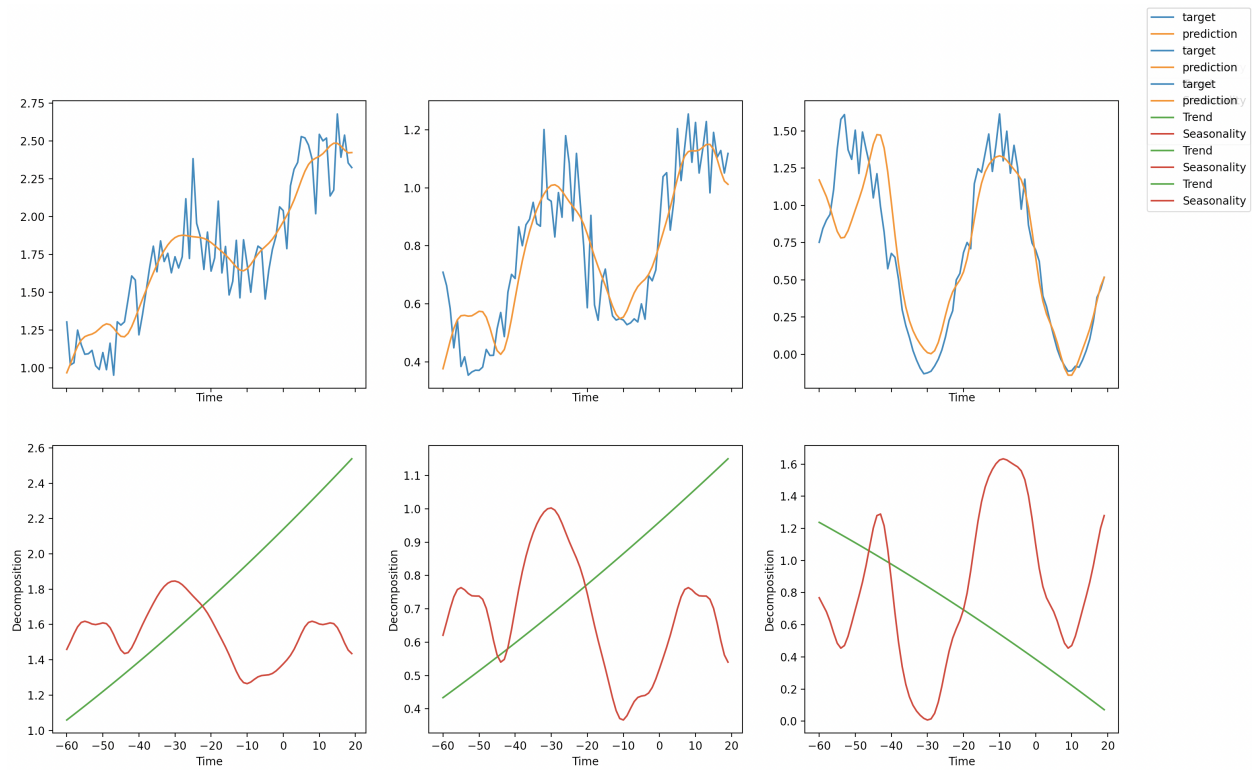
fig, axs = plt.subplots(2, 3, sharex="col")

for idx in range(3):
    model.pytorch_forecasting_model.plot_interpretation(inputs, predictions, idx=idx,
    ax=[axs[0][idx], axs[1][idx]])

plt.show()

```

Here's the visualization:





VISSL is a library from Facebook AI Research for state-of-the-art self-supervised learning. We integrate VISSL models and algorithms into Flash with the *image embedder* task.

## 41.1 Using VISSL with Flash

The ImageEmbedder task in Flash can be configured with different backbones, projection heads, image transforms and loss functions so that you can train your feature extractor using a SOTA SSL method.

```
from flash.image import ImageEmbedder

embedder = ImageEmbedder(
    backbone="resnet",
    training_strategy="barlow_twins",
    head="simclr_head",
    pretraining_transform="barlow_twins_transform",
    training_strategy_kwargs={"latent_embedding_dim": 256, "dims": [2048, 2048, 256]},
    pretraining_transform_kwargs={"size_crops": [196]},
)
```

The user can pass arguments to the training strategy, image transforms and backbones using the optional dictionary arguments the ImageEmbedder task accepts. The training strategies club together the projection head, the loss function as well as VISSL hooks for a particular algorithm and the arguments to customize these can be passed via `training_strategy_kwargs`. As an example, in the above code block, the `latent_embedding_dim` is an argument to the BarlowTwins loss function from VISSL, while the `dims` argument configures the projection head to output 256 dim vectors for the loss function.

If you find VISSL integration in Flash useful for your research, please don't forget to cite us and the VISSL library. You can find our bibtex on [Flash](#) and VISSL's bibtex on their [github](#) page.





<i>DataSource</i>	The <i>DataSource</i> class encapsulates two hooks: <i>load_data</i> and <i>load_sample</i> .
<i>DataModule</i>	A basic <i>DataModule</i> class for all Flash tasks.
<i>FlashCallback</i>	<i>FlashCallback</i> is an extension of <i>pytorch_lightning.callbacks.Callback</i> .
<i>Preprocess</i>	The <i>Preprocess</i> encapsulates all the data processing logic that should run before the data is passed to the model.
<i>Postprocess</i>	The <i>Postprocess</i> encapsulates all the data processing logic that should run after the model.
<i>Serializer</i>	A <i>Serializer</i> encapsulates a single <i>serialize</i> method which is used to convert the model output into the desired output format when predicting.
<i>Task</i>	A general Task.
<i>Trainer</i>	

---

## 42.1 DataSource

**class** `flash.core.data.data_source.DataSource`

The *DataSource* class encapsulates two hooks: *load\_data* and *load\_sample*.

The *to\_datasets()* method can then be used to automatically construct data sets from the hooks.

**generate\_dataset**(*data*, *running\_stage*)

Generate a single dataset with the given input to *load\_data()* for the given *running\_stage*.

**Parameters**

- **data** *(Optional[~DATA\_TYPE])* – The input to *load\_data()* to use to create the dataset.
- **running\_stage** *(RunningStage)* – The *running\_stage* for this dataset.

**Return type** *Union[AutoDataset, IterableAutoDataset, None]*

**Returns** The constructed *BaseAutoDataset*.

**static load\_data**(*data*, *dataset=None*)

Given the *data* argument, the *load\_data* hook produces a sequence or iterable of samples or sample metadata. The *data* argument can be anything, but this method should return a sequence or iterable of mappings from string (e.g. “input”, “target”, “bbox”, etc.) to data (e.g. a target value) or metadata (e.g. a

filename). Where possible, any heavy data loading should be performed in `load_sample()`. If the output is an iterable rather than a sequence (that is, it doesn't have length) then the generated dataset will be an `IterableDataset`.

#### Parameters

- **data** `(~DATA_TYPE)` – The data required to load the sequence or iterable of samples or sample metadata.
- **dataset** `(Optional[Any])` – Overriding methods can optionally include the dataset argument. Any attributes set on the dataset (e.g. `num_classes`) will also be set on the generated dataset.

**Return type** `Union[Sequence[Mapping[str, Any]], Iterable[Mapping[str, Any]]]`

**Returns** A sequence or iterable of samples or sample metadata to be used as inputs to `load_sample()`.

Example:

```
# data: "."
# output: [{"input": "./cat/1.png", "target": 1}, ..., {"input": "./dog/10.png",
↪ "target": 0}]

output: Sequence[Mapping[str, Any]] = load_data(data)
```

**static load\_sample**(*sample, dataset=None*)

Given an element from the output of a call to `load_data()`, this hook should load a single data sample. The keys and values in the `sample` argument will be same as the keys and values in the outputs of `load_data()`.

#### Parameters

- **sample** `(Mapping[str, Any])` – An element (sample or sample metadata) from the output of a call to `load_data()`.
- **dataset** `(Optional[Any])` – Overriding methods can optionally include the dataset argument. Any attributes set on the dataset (e.g. `num_classes`) will also be set on the generated dataset.

**Return type** `Any`

**Returns** The loaded sample as a mapping with string keys (e.g. “input”, “target”) that can be processed by the `pre_tensor_transform()`.

Example:

```
# sample: {"input": "./cat/1.png", "target": 1}
# output: {"input": PIL.Image, "target": 1}

output: Mapping[str, Any] = load_sample(sample)
```

**to\_datasets**(*train\_data=None, val\_data=None, test\_data=None, predict\_data=None*)

Construct data sets (of type `BaseAutoDataset`) from this data source by calling `load_data()` with each of the `*_data` arguments. If an argument is given as `None` then no dataset will be created for that stage (train, val, test, predict).

#### Parameters

- **train\_data** `(Optional[~DATA_TYPE])` – The input to `load_data()` to use to create the train dataset.

- **val\_data** (Optional[~DATA\_TYPE]) – The input to `load_data()` to use to create the validation dataset.
- **test\_data** (Optional[~DATA\_TYPE]) – The input to `load_data()` to use to create the test dataset.
- **predict\_data** (Optional[~DATA\_TYPE]) – The input to `load_data()` to use to create the predict dataset.

**Return type** `Tuple[Optional[BaseAutoDataset], ...]`

**Returns** A tuple of `train_dataset`, `val_dataset`, `test_dataset`, `predict_dataset`. If any `*_data` argument is not passed to this method then the corresponding `*_dataset` will be `None`.

## 42.2 DataModule

```
class flash.core.data.data_module.DataModule(train_dataset=None, val_dataset=None,
                                             test_dataset=None, predict_dataset=None,
                                             data_source=None, preprocess=None,
                                             postprocess=None, data_fetcher=None, val_split=None,
                                             batch_size=4, num_workers=0, sampler=None)
```

A basic DataModule class for all Flash tasks. This class includes references to a [DataSource](#), [Preprocess](#), [Postprocess](#), and a [BaseDataFetcher](#).

### Parameters

- **train\_dataset** (Optional[Dataset]) – Dataset for training. Defaults to `None`.
- **val\_dataset** (Optional[Dataset]) – Dataset for validating model performance during training. Defaults to `None`.
- **test\_dataset** (Optional[Dataset]) – Dataset to test model performance. Defaults to `None`.
- **predict\_dataset** (Optional[Dataset]) – Dataset for predicting. Defaults to `None`.
- **data\_source** (Optional[DataSource]) – The [DataSource](#) that was used to create the datasets.
- **preprocess** (Optional[Preprocess]) – The [Preprocess](#) to use when constructing the [DataPipeline](#). If `None`, a [DefaultPreprocess](#) will be used.
- **postprocess** (Optional[Postprocess]) – The [Postprocess](#) to use when constructing the [DataPipeline](#). If `None`, a plain [Postprocess](#) will be used.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The [BaseDataFetcher](#) to attach to the [Preprocess](#). If `None`, the output from `configure_data_fetcher()` will be used.
- **val\_split** (Optional[float]) – An optional float which gives the relative amount of the training dataset to use for the validation dataset.
- **batch\_size** (int) – The batch size to be used by the [DataLoader](#). Defaults to 1.
- **num\_workers** (int) – The number of workers to use for parallelized loading. Defaults to `None` which equals the number of available CPU threads, or 0 for Windows or Darwin platform.
- **sampler** (Optional[Type[Sampler]]) – A sampler following the [Sampler](#) type. Will be passed to the [DataLoader](#) for the training dataset. Defaults to `None`.

**available\_data\_sources()**

Get the list of available data source names for use with this [DataModule](#).

**Return type** [Sequence\[str\]](#)

**Returns** The list of data source names.

**static configure\_data\_fetcher(\*args, \*\*kwargs)**

This function is used to configure a [BaseDataFetcher](#).

Override with your custom one.

**Return type** [BaseDataFetcher](#)

**property data\_fetcher:** [flash.core.data.callback.BaseDataFetcher](#)

This property returns the data fetcher.

**Return type** [BaseDataFetcher](#)

**property data\_pipeline:** [flash.core.data.data\\_pipeline.DataPipeline](#)

Property that returns the full data pipeline including the data source, preprocessing and postprocessing.

**Return type** [DataPipeline](#)

**property data\_source:** [Optional\[flash.core.data.data\\_source.DataSource\]](#)

Property that returns the data source.

**Return type** [Optional\[DataSource\]](#)

**classmethod from\_csv**(*input\_fields*, *target\_fields=None*, *train\_file=None*, *val\_file=None*, *test\_file=None*, *predict\_file=None*, *train\_transform=None*, *val\_transform=None*, *test\_transform=None*, *predict\_transform=None*, *data\_fetcher=None*, *preprocess=None*, *val\_split=None*, *batch\_size=4*, *num\_workers=0*, *sampler=None*, *\*\*preprocess\_kwargs*)

Creates a [DataModule](#) object from the given CSV files using the [DataSource](#) of name CSV from the passed or constructed [Preprocess](#).

**Parameters**

- **input\_fields** [\(Union\[str, Sequence\[str\]\]\)](#) – The field or fields (columns) in the CSV file to use for the input.
- **target\_fields** [\(Union\[str, Sequence\[str\], None\]\)](#) – The field or fields (columns) in the CSV file to use for the target.
- **train\_file** [\(Optional\[str\]\)](#) – The CSV file containing the training data.
- **val\_file** [\(Optional\[str\]\)](#) – The CSV file containing the validation data.
- **test\_file** [\(Optional\[str\]\)](#) – The CSV file containing the testing data.
- **predict\_file** [\(Optional\[str\]\)](#) – The CSV file containing the data to use when predicting.
- **train\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.

- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The `sampler` to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the *preprocess*. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_csv(
    "input",
    "target",
    train_file="train_data.csv",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

**classmethod** `from_data_source`(*data\_source*, *train\_data*=None, *val\_data*=None, *test\_data*=None, *predict\_data*=None, *train\_transform*=None, *val\_transform*=None, *test\_transform*=None, *predict\_transform*=None, *data\_fetcher*=None, *preprocess*=None, *val\_split*=None, *batch\_size*=4, *num\_workers*=0, *sampler*=None, *\*\*preprocess\_kwargs*)

Creates a *DataModule* object from the given inputs to *load\_data()* (*train\_data*, *val\_data*, *test\_data*, *predict\_data*). The data source will be resolved from the instantiated *Preprocess* using *data\_source\_of\_name()*.

**Parameters**

- **data\_source** (str) – The name of the data source to use for the *load\_data()*.
- **train\_data** (Optional[Any]) – The input to *load\_data()* to use when creating the train dataset.
- **val\_data** (Optional[Any]) – The input to *load\_data()* to use when creating the validation dataset.
- **test\_data** (Optional[Any]) – The input to *load\_data()* to use when creating the test dataset.
- **predict\_data** (Optional[Any]) – The input to *load\_data()* to use when creating the predict dataset.

- **train\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The `sampler` to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the *preprocess*. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_data_source(
    DefaultDataSources.FOLDERS,
    train_data="train_folder",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

```
classmethod from_datasets(train_dataset=None, val_dataset=None, test_dataset=None,
                          predict_dataset=None, train_transform=None, val_transform=None,
                          test_transform=None, predict_transform=None, data_fetcher=None,
                          preprocess=None, val_split=None, batch_size=4, num_workers=0,
                          sampler=None, **preprocess_kwargs)
```

Creates a *DataModule* object from the given datasets using the *DataSource* of name DATASETS from the passed or constructed *Preprocess*.

**Parameters**

- **train\_dataset** (Optional[Dataset]) – Dataset used during training.
- **val\_dataset** (Optional[Dataset]) – Dataset used during validating.
- **test\_dataset** (Optional[Dataset]) – Dataset used during testing.

- **predict\_dataset** (Optional[Dataset]) – Dataset used during predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_datasets(
    train_dataset=train_dataset,
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

```
classmethod from_fiftyone(cls, train_dataset=None, val_dataset=None, test_dataset=None,
                           predict_dataset=None, train_transform=None, val_transform=None,
                           test_transform=None, predict_transform=None, data_fetcher=None,
                           preprocess=None, val_split=None, batch_size=4, num_workers=0,
                           **preprocess_kwargs)
```

Creates a *DataModule* object from the given FiftyOne Datasets using the *DataSource* of name FIFTYONE from the passed or constructed *Preprocess*.

**Parameters**

- **train\_dataset** (None) – The `fiftyone.core.collections.SampleCollection` containing the train data.
- **val\_dataset** (None) – The `fiftyone.core.collections.SampleCollection` containing the validation data.

- **test\_dataset** (None) – The `fiftyone.core.collections.SampleCollection` containing the test data.
- **predict\_dataset** (None) – The `fiftyone.core.collections.SampleCollection` containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
train_dataset = fo.Dataset.from_dir(
    "/path/to/dataset",
    dataset_type=fo.types.ImageClassificationDirectoryTree,
)
data_module = DataModule.from_fiftyone(
    train_data = train_dataset,
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

**classmethod from\_files**(*train\_files=None, train\_targets=None, val\_files=None, val\_targets=None, test\_files=None, test\_targets=None, predict\_files=None, train\_transform=None, val\_transform=None, test\_transform=None, predict\_transform=None, data\_fetcher=None, preprocess=None, val\_split=None, batch\_size=4, num\_workers=0, sampler=None, \*\*preprocess\_kwargs*)

Creates a *DataModule* object from the given sequences of files using the *DataSource* of name *FILES* from the passed or constructed *Preprocess*.

**Parameters**



- **train\_files** (Optional[Sequence[str]]) – A sequence of files to use as the train inputs.
- **train\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per train file) to use as the train targets.
- **val\_files** (Optional[Sequence[str]]) – A sequence of files to use as the validation inputs.
- **val\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per validation file) to use as the validation targets.
- **test\_files** (Optional[Sequence[str]]) – A sequence of files to use as the test inputs.
- **test\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per test file) to use as the test targets.
- **predict\_files** (Optional[Sequence[str]]) – A sequence of files to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

```
classmethod from_folders(train_folder=None, val_folder=None, test_folder=None,
                        predict_folder=None, train_transform=None, val_transform=None,
                        test_transform=None, predict_transform=None, data_fetcher=None,
                        preprocess=None, val_split=None, batch_size=4, num_workers=0,
                        sampler=None, **preprocess_kwargs)
```

Creates a *DataModule* object from the given folders using the *DataSource* of name FOLDERS from the passed or constructed *Preprocess*.

**Parameters**

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The `sampler` to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the *preprocess*. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

```
classmethod from_json(input_fields, target_fields=None, train_file=None, val_file=None, test_file=None,
                      predict_file=None, train_transform=None, val_transform=None,
                      test_transform=None, predict_transform=None, data_fetcher=None,
                      preprocess=None, val_split=None, batch_size=4, num_workers=0,
                      sampler=None, field=None, **preprocess_kwargs)
```

Creates a *DataModule* object from the given JSON files using the *DataSource* of name `JSON` from the passed or constructed *Preprocess*.

#### Parameters

- **input\_fields** (Union[str, Sequence[str]]) – The field or fields in the JSON objects to use for the input.
- **target\_fields** (Union[str, Sequence[str], None]) – The field or fields in the JSON objects to use for the target.
- **train\_file** (Optional[str]) – The JSON file containing the training data.
- **val\_file** (Optional[str]) – The JSON file containing the validation data.
- **test\_file** (Optional[str]) – The JSON file containing the testing data.

- **predict\_file** (Optional[str]) – The JSON file containing the data to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **field** (Optional[str]) – To specify the field that holds the data in the JSON file.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_json(
    "input",
    "target",
    train_file="train_data.json",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)

# In the case where the data is of the form:
# {
#     "version": 0.0.x,
#     "data": [
#         {
#             "input_field" : "input_data",
#             "target_field" : "target_output"
#         },
#         ...
#     ]
# }
```

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```
# }

data_module = DataModule.from_json(
    "input",
    "target",
    train_file="train_data.json",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
    feild="data"
)
```

```
classmethod from_labelstudio(export_json=None, train_export_json=None, val_export_json=None,
                             test_export_json=None, predict_export_json=None, data_folder=None,
                             train_data_folder=None, val_data_folder=None,
                             test_data_folder=None, predict_data_folder=None,
                             train_transform=None, val_transform=None, test_transform=None,
                             predict_transform=None, data_fetcher=None, preprocess=None,
                             val_split=None, batch_size=4, num_workers=None,
                             **preprocess_kwargs)
```

Creates a [DataModule](#) object from the given export file and data directory using the [DataSource](#) of name FOLDERS from the passed or constructed [Preprocess](#).

#### Parameters

- **export\_json** *(Optional[str])* – path to label studio export file
- **train\_export\_json** *(Optional[str])* – path to label studio export file for train set,
- **export\_json if specified** *(overrides)* –
- **val\_export\_json** *(Optional[str])* – path to label studio export file for validation
- **test\_export\_json** *(Optional[str])* – path to label studio export file for test
- **predict\_export\_json** *(Optional[str])* – path to label studio export file for predict
- **data\_folder** *(Optional[str])* – path to label studio data folder
- **train\_data\_folder** *(Optional[str])* – path to label studio data folder for train data set,
- **data\_folder if specified** *(overrides)* –
- **val\_data\_folder** *(Optional[str])* – path to label studio data folder for validation data
- **test\_data\_folder** *(Optional[str])* – path to label studio data folder for test data
- **predict\_data\_folder** *(Optional[str])* – path to label studio data folder for predict data
- **train\_transform** *(Optional[Dict[str, Callable]])* – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** *(Optional[Dict[str, Callable]])* – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** *(Optional[Dict[str, Callable]])* – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.

- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (Optional[int]) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_labelstudio(
    export_json='project.json',
    data_folder='label-studio/media/upload',
    val_split=0.8,
)
```

**classmethod from\_numpy**(train\_data=None, train\_targets=None, val\_data=None, val\_targets=None, test\_data=None, test\_targets=None, predict\_data=None, train\_transform=None, val\_transform=None, test\_transform=None, predict\_transform=None, data\_fetcher=None, preprocess=None, val\_split=None, batch\_size=4, num\_workers=0, sampler=None, \*\*preprocess\_kwargs)

Creates a *DataModule* object from the given numpy array using the *DataSource* of name NUMPY from the passed or constructed *Preprocess*.

#### Parameters

- **train\_data** (Optional[Collection[ndarray]]) – A numpy array to use as the train inputs.
- **train\_targets** (Optional[Collection[Any]]) – A sequence of targets (one per train input) to use as the train targets.
- **val\_data** (Optional[Collection[ndarray]]) – A numpy array to use as the validation inputs.
- **val\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per validation input) to use as the validation targets.
- **test\_data** (Optional[Collection[ndarray]]) – A numpy array to use as the test inputs.
- **test\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per test input) to use as the test targets.
- **predict\_data** (Optional[Collection[ndarray]]) – A numpy array to use when predicting.

- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The `sampler` to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the *preprocess*. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_numpy(
    train_files=np.random.rand(3, 128),
    train_targets=[1, 0, 1],
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

```
classmethod from_tensors(train_data=None, train_targets=None, val_data=None, val_targets=None,
                        test_data=None, test_targets=None, predict_data=None,
                        train_transform=None, val_transform=None, test_transform=None,
                        predict_transform=None, data_fetcher=None, preprocess=None,
                        val_split=None, batch_size=4, num_workers=0, sampler=None,
                        **preprocess_kwargs)
```

Creates a *DataModule* object from the given tensors using the *DataSource* of name *TENSOR* from the passed or constructed *Preprocess*.

#### Parameters

- **train\_data** (Optional[Collection[Tensor]]) – A tensor or collection of tensors to use as the train inputs.
- **train\_targets** (Optional[Collection[Any]]) – A sequence of targets (one per train input) to use as the train targets.

- **val\_data** (Optional[Collection[Tensor]]) – A tensor or collection of tensors to use as the validation inputs.
- **val\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per validation input) to use as the validation targets.
- **test\_data** (Optional[Collection[Tensor]]) – A tensor or collection of tensors to use as the test inputs.
- **test\_targets** (Optional[Sequence[Any]]) – A sequence of targets (one per test input) to use as the test targets.
- **predict\_data** (Optional[Collection[Tensor]]) – A tensor or collection of tensors to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_tensors(
    train_files=torch.rand(3, 128),
    train_targets=[1, 0, 1],
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

**property multi\_label:** Optional[bool]

Property that returns the number of labels of the datamodule if a multilabel task.

**Return type** Optional[bool]



**property num\_classes:** `Optional[int]`

Property that returns the number of classes of the datamodule if a multiclass task.

Return type `Optional[int]`

**property postprocess:** `flash.core.data.process.Postprocess`

Property that returns the postprocessing class used on the input data.

Return type `Postprocess`

**postprocess\_cls**

alias of `flash.core.data.process.Postprocess`

**property predict\_dataset:** `Optional[torch.utils.data.Dataset]`

This property returns the predict dataset.

Return type `Optional[Dataset]`

**property preprocess:** `flash.core.data.process.Preprocess`

Property that returns the preprocessing class used on input data.

Return type `Preprocess`

**show\_predict\_batch**(*hooks\_names='load\_sample', reset=True*)

This function is used to visualize a batch from the predict dataloader.

Return type `None`

**show\_test\_batch**(*hooks\_names='load\_sample', reset=True*)

This function is used to visualize a batch from the test dataloader.

Return type `None`

**show\_train\_batch**(*hooks\_names='load\_sample', reset=True*)

This function is used to visualize a batch from the train dataloader.

Return type `None`

**show\_val\_batch**(*hooks\_names='load\_sample', reset=True*)

This function is used to visualize a batch from the validation dataloader.

Return type `None`

**property test\_dataset:** `Optional[torch.utils.data.Dataset]`

This property returns the test dataset.

Return type `Optional[Dataset]`

**property train\_dataset:** `Optional[torch.utils.data.Dataset]`

This property returns the train dataset.

Return type `Optional[Dataset]`

**property val\_dataset:** `Optional[torch.utils.data.Dataset]`

This property returns the validation dataset.

Return type `Optional[Dataset]`



## 42.3 FlashCallback

**class** flash.core.data.callback.FlashCallback(\*args, \*\*kwargs)

FlashCallback is an extension of `pytorch_lightning.callbacks.Callback`.

A callback is a self-contained program that can be reused across projects. Flash and Lightning have a callback system to execute callbacks when needed. Callbacks should capture any NON-ESSENTIAL logic that is NOT required for your lightning module to run.

Same as PyTorch Lightning, Callbacks can be provided directly to the Trainer:

```
trainer = Trainer(callbacks=[MyCustomCallback()])
```

**on\_collate**(*batch*, *running\_stage*)

Called once collate has been applied to a sequence of samples.

Return type `None`

**on\_load\_sample**(*sample*, *running\_stage*)

Called once a sample has been loaded using `load_sample`.

Return type `None`

**on\_per\_batch\_transform**(*batch*, *running\_stage*)

Called once `per_batch_transform` has been applied to a batch.

Return type `None`

**on\_per\_batch\_transform\_on\_device**(*batch*, *running\_stage*)

Called once `per_batch_transform_on_device` has been applied to a sample.

Return type `None`

**on\_per\_sample\_transform\_on\_device**(*sample*, *running\_stage*)

Called once `per_sample_transform_on_device` has been applied to a sample.

Return type `None`

**on\_post\_tensor\_transform**(*sample*, *running\_stage*)

Called once `post_tensor_transform` has been applied to a sample.

Return type `None`

**on\_pre\_tensor\_transform**(*sample*, *running\_stage*)

Called once `pre_tensor_transform` has been applied to a sample.

Return type `None`

**on\_to\_tensor\_transform**(*sample*, *running\_stage*)

Called once `to_tensor_transform` has been applied to a sample.

Return type `None`

## 42.4 Preprocess

```
class flash.core.data.process.Preprocess(train_transform=None, val_transform=None,
                                         test_transform=None, predict_transform=None,
                                         data_sources=None, deserializer=None,
                                         default_data_source=None)
```

The *Preprocess* encapsulates all the data processing logic that should run before the data is passed to the model. It is particularly useful when you want to provide an end to end implementation which works with 4 different stages: train, validation, test, and inference (predict).

The *Preprocess* supports the following hooks:

- **pre\_tensor\_transform:** Performs transforms on a single data sample. Example:

```
* Input: Receive a PIL Image and its label.
* Action: Rotate the PIL Image.
* Output: Return the rotated PIL image and its label.
```

- **to\_tensor\_transform:** Converts a single data sample to a tensor / data structure containing tensors. Example:

```
* Input: Receive the rotated PIL Image and its label.
* Action: Convert the rotated PIL Image to a tensor.
* Output: Return the tensored image and its label.
```

- **post\_tensor\_transform:** Performs transform on a single tensor sample. Example:

```
* Input: Receive the tensored image and its label.
* Action: Flip the tensored image randomly.
* Output: Return the tensored image and its label.
```

- **per\_batch\_transform:** Performs transforms on a batch. In this example, we decided not to override the hook.

- **per\_sample\_transform\_on\_device:** Performs transform on a sample already on a GPU or TPU. Example:

```
* Input: Receive a tensored image on device and its label.
* Action: Apply random transforms.
* Output: Return an augmented tensored image on device and its label.
```

- **collate:** Converts a sequence of data samples into a batch. Defaults to `torch.utils.data._utils.collate.default_collate`. Example:

```
* Input: Receive a list of augmented tensored images and their respective
↔ labels.
```

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- \* Action: Collate the `list` of images into batch.
- \* Output: Return a batch of images `and` their labels.

- **per\_batch\_transform\_on\_device:** Performs transform on a batch already on GPU or TPU. Example:

- \* Input: Receive a batch of images `and` their labels.
- \* Action: Apply normalization on the batch by subtracting the mean `and` dividing by the standard deviation `from ImageNet`.
- \* Output: Return a normalized augmented batch of images `and` their labels.

**Note:** The `per_sample_transform_on_device` and `per_batch_transform` are mutually exclusive as it will impact performances.

Data processing can be configured by overriding hooks or through transforms. The preprocess transforms are given as a mapping from hook names to callables. Default transforms can be configured by overriding the `default_transforms` or `{train, val, test, predict}_default_transforms` methods. These can then be overridden by the user with the `{train, val, test, predict}_transform` arguments to the `Preprocess`. All of the hooks can be used in the transform mappings.

Example:

```
class CustomPreprocess(Preprocess):

    def default_transforms() -> Mapping[str, Callable]:
        return {
            "to_tensor_transform": transforms.ToTensor(),
            "collate": torch.utils.data._utils.collate.default_collate,
        }

    def train_default_transforms() -> Mapping[str, Callable]:
        return {
            "pre_tensor_transform": transforms.RandomHorizontalFlip(),
            "to_tensor_transform": transforms.ToTensor(),
            "collate": torch.utils.data._utils.collate.default_collate,
        }
```

When overriding hooks for particular stages, you can prefix with `train`, `val`, `test` or `predict`. For example, you can achieve the same as the above example by implementing `train_pre_tensor_transform` and `train_to_tensor_transform`.

Example:

```
class CustomPreprocess(Preprocess):

    def train_pre_tensor_transform(self, sample: PIL.Image) -> PIL.Image:
        return transforms.RandomHorizontalFlip()(sample)

    def to_tensor_transform(self, sample: PIL.Image) -> torch.Tensor:
```

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```

    return transforms.ToTensor()(sample)

def collate(self, samples: List[torch.Tensor]) -> torch.Tensor:
    return torch.utils.data._utils.collate.default_collate(samples)

```

Each hook is aware of the Trainer running stage through booleans. These are useful for adapting functionality for a stage without duplicating code.

Example:

```

class CustomPreprocess(Preprocess):

    def pre_tensor_transform(self, sample: PIL.Image) -> PIL.Image:

        if self.training:
            # logic for training

        elif self.validating:
            # logic for validation

        elif self.testing:
            # logic for testing

        elif self.predicting:
            # logic for predicting

```

**available\_data\_sources()**

Get the list of available data source names for use with this *Preprocess*.

**Return type** *Sequence[str]*

**Returns** The list of data source names.

**collate**(*samples*, *metadata=None*)

Transform to convert a sequence of samples to a collated batch.

**Return type** *Any*

**data\_source\_of\_name**(*data\_source\_name*)

Get the *DataSource* of the given name from the *Preprocess*.

**Parameters** *data\_source\_name* (*str*) – The name of the data source to look up.

**Return type** *DataSource*

**Returns** The *DataSource* of the given name.

**Raises** *MisconfigurationException* – If the requested data source is not configured by this *Preprocess*.

**static default\_transforms()**

The default transforms to use.

Will be overridden by transforms passed to the `__init__`.

**Return type** *Optional[Dict[str, Callable]]*

**per\_batch\_transform**(*batch*)

Transforms to apply to a whole batch (if possible use this for efficiency).

---

**Note:** This option is mutually exclusive with `per_sample_transform_on_device()`, since if both are specified, uncollation has to be applied.

---

**Return type** `Any`

**per\_batch\_transform\_on\_device**(*batch*)

Transforms to apply to a whole batch (if possible use this for efficiency).

---

**Note:** This function won't be called within the dataloader workers, since to make that happen each of the workers would have to create it's own CUDA-context which would pollute GPU memory (if on GPU).

---

**Return type** `Any`

**per\_sample\_transform\_on\_device**(*sample*)

Transforms to apply to the data before the collation (per-sample basis).

---

**Note:** This option is mutually exclusive with `per_batch_transform()`, since if both are specified, uncollation has to be applied.

---



---

**Note:** This function won't be called within the dataloader workers, since to make that happen each of the workers would have to create it's own CUDA-context which would pollute GPU memory (if on GPU).

---

**Return type** `Any`

**post\_tensor\_transform**(*sample*)

Transforms to apply on a tensor.

**Return type** `Tensor`

**pre\_tensor\_transform**(*sample*)

Transforms to apply on a single object.

**Return type** `Any`

**to\_tensor\_transform**(*sample*)

Transforms to convert single object to a tensor.

**Return type** `Tensor`

**property transforms:** `Dict[str, Optional[Dict[str, Callable]]]`

The transforms currently being used by this *Preprocess*.

**Return type** `Dict[str, Optional[Dict[str, Callable]]]`

## 42.5 Postprocess

**class** `flash.core.data.process.Postprocess`(*save\_path=None*)

The *Postprocess* encapsulates all the data processing logic that should run after the model.

**static** `per_batch_transform`(*batch*)

Transforms to apply on a whole batch before uncollation to individual samples.

Can involve both CPU and Device transforms as this is not applied in separate workers.

**Return type** *Any*

**static** `per_sample_transform`(*sample*)

Transforms to apply to a single sample after splitting up the batch.

Can involve both CPU and Device transforms as this is not applied in separate workers.

**Return type** *Any*

**static** `save_data`(*data, path*)

Saves all data together to a single path.

**Return type** *None*

**static** `save_sample`(*sample, path*)

Saves each sample individually to a given path.

**Return type** *None*

**static** `uncollate`(*batch*)

Uncollates a batch into single samples.

Tries to preserve the type wherever possible.

**Return type** *Any*

## 42.6 Serializer

**class** `flash.core.data.process.Serializer`

A *Serializer* encapsulates a single `serialize` method which is used to convert the model output into the desired output format when predicting.

**disable**()

Disable serialization.

**enable**()

Enable serialization.

**static** `serialize`(*sample*)

Serialize the given sample into the desired output format.

**Parameters** `sample` *Any* – The output from the *Postprocess*.

**Return type** *Any*

**Returns** The serialized output.

## 42.7 Task

```
class flash.core.model.Task(model=None, loss_fn=None, learning_rate=5e-05, optimizer='Adam',
                           lr_scheduler=None, metrics=None, deserializer=None, preprocess=None,
                           postprocess=None, serializer=None)
```

A general Task.

### Parameters

- **model** (Optional[Module]) – Model to use for the task.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training.
- **learning\_rate** (float) – Learning rate to use for training, defaults to 5e-5.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the *torchmetrics* package, a custom metric inheriting from *torchmetrics.Metric*, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature *metric(preds, target)* and return a single scalar tensor.
- **deserializer** (Union[Deserializer, Mapping[str, Deserializer], None]) – Either a single *Deserializer* or a mapping of these to deserialize the input
- **preprocess** (Optional[Preprocess]) – *Preprocess* to use as the default for this task.
- **postprocess** (Optional[Postprocess]) – *Postprocess* to use as the default for this task.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – Either a single *Serializer* or a mapping of these to serialize the output e.g. convert the model output into the desired output format when predicting.

**static apply\_filtering**(y, y\_hat)

This function is used to filter some labels or predictions which aren't conform.

**Return type** Tuple[Tensor, Tensor]

**build\_data\_pipeline**(data\_source=None, deserializer=None, data\_pipeline=None)

Build a *DataPipeline* incorporating available *Preprocess* and *Postprocess* objects. These will be overridden in the following resolution order (lowest priority first):

- Lightning Datamodule, either attached to the *Trainer* or to the *Task*.
- *Task* defaults given to *Task.\_\_init\_\_()*.
- *Task* manual overrides by setting *data\_pipeline*.
- *DataPipeline* passed to this method.

### Parameters

- **data\_source** (Optional[str]) – A string that indicates the format of the data source to use which will override the current data source format used.
- **deserializer** (Optional[Deserializer]) – deserializer to use

- **data\_pipeline** (Optional[DataPipeline]) – Optional highest priority source of *Preprocess* and *Postprocess*.

**Return type** Optional[DataPipeline]

**Returns** The fully resolved *DataPipeline*.

**configure\_optimizers()**

Implement how optimizer and optionally learning rate schedulers should be configured.

**Return type** Union[Optimizer, Tuple[List[Optimizer], List[LRScheduler]]]

**get\_num\_training\_steps()**

Total training steps inferred from datamodule and devices.

**Return type** int

**predict**(x, data\_source=None, deserializer=None, data\_pipeline=None)

Predict function for raw data or processed data.

**Parameters**

- **x** (Any) – Input to predict. Can be raw data or processed data. If str, assumed to be a folder of data.
- **data\_source** (Optional[str]) – A string that indicates the format of the data source to use which will override the current data source format used
- **deserializer** (Optional[Deserializer]) – A single *Deserializer* to deserialize the input
- **data\_pipeline** (Optional[DataPipeline]) – Use this to override the current data pipeline

**Return type** Any

**Returns** The post-processed model predictions

**step**(batch, batch\_idx, metrics)

Implement the core logic for the training/validation/test step. By default this includes:

- Inference on the current batch
- Calculating the loss
- Calculating relevant metrics

Override for custom behavior.

**Parameters**

- **batch** (Any) – The output of your dataloader. Can either be a single Tensor or a list of Tensors.
- **batch\_idx** (int) – Integer displaying index of this batch
- **metrics** (ModuleDict) – A module dict containing metrics for calculating relevant training statistics

**Return type** Any

**Returns** A dict containing both the loss and relevant metrics



## 42.8 Trainer

**class** `flash.core.trainer.Trainer(*args, serve_sanity_check=False, **kwargs)`

**classmethod** `add_argparse_args(*args, **kwargs)`

See `pytorch_lightning.utilities.argparse.add_argparse_args()`.

**Return type** `ArgumentParser`

**finetune**(*model*, *train\_dataloader=None*, *val\_dataloaders=None*, *datamodule=None*, *strategy=None*)

Runs the full optimization routine. Same as `pytorch_lightning.Trainer.fit()`, but unfreezes layers of the backbone throughout training layers of the backbone throughout training.

### Parameters

- **model** `//` (`LightningModule`) – Model to fit.
- **train\_dataloader** `//` (`Optional[DataLoader]`) – A PyTorch DataLoader with training samples. If the model has a predefined `train_dataloader` method this will be skipped.
- **val\_dataloaders** `//` (`Union[DataLoader, List[DataLoader], None]`) – Either a single PyTorch DataLoader or a list of them, specifying validation samples. If the model has a predefined `val_dataloaders` method this will be skipped
- **datamodule** `//` (`Optional[LightningDataModule]`) – A instance of `LightningDataModule`.
- **strategy** `//` (`Union[str, BaseFinetuning, None]`) – Should either be a string or a finetuning callback subclassing `pytorch_lightning.callbacks.BaseFinetuning`.

Default strategies can be enabled with these strings:

- "no\_freeze",
- "freeze",
- "freeze\_unfreeze",
- "unfreeze\_milestones".

**fit**(*model*, *train\_dataloader=None*, *val\_dataloaders=None*, *datamodule=None*)

Runs the full optimization routine. Same as `pytorch_lightning.Trainer.fit()`

### Parameters

- **datamodule** `//` (`Optional[LightningDataModule]`) – A instance of `LightningDataModule`.
- **model** `//` (`LightningModule`) – Model to fit.
- **train\_dataloader** `//` (`Optional[DataLoader]`) – A PyTorch DataLoader with training samples. If the model has a predefined `train_dataloader` method this will be skipped.
- **val\_dataloaders** `//` (`Union[DataLoader, List[DataLoader], None]`) – Either a single PyTorch DataLoader or a list of them, specifying validation samples. If the model has a predefined `val_dataloaders` method this will be skipped

**classmethod** `from_argparse_args(args, **kwargs)`

Modified version of `pytorch_lightning.utilities.argparse.from_argparse_args()` which populates `valid_kwargs` from `pytorch_lightning.Trainer`.

**Return type** `Trainer`

**request\_dataloader**(\*args, \*\*kwargs)

Handles downloading data in the GPU or TPU case.

**Return type** `Union[DataLoader, List[DataLoader]]`

**Returns** The dataloader

## FLASH.CORE

- *flash.core.adapter*
- *flash.core.classification*
- *flash.core.finetuning*
- *flash.core.integrations.fiftyone*
- *flash.core.integrations.icevision*
- *flash.core.integrations.pytorch\_forecasting*
- *flash.core.model*
- *flash.core.registry*
- *flash.core.optimizers*
- *Utilities*

### 43.1 flash.core.adapter

<i>Adapter</i>	The <b>Adapter</b> is a lightweight interface that can be used to encapsulate the logic from a particular provider within a <i>Task</i> .
<i>AdapterTask</i>	The <b>AdapterTask</b> is a <i>Task</i> which wraps an <i>Adapter</i> and forwards all of the hooks.

#### 43.1.1 Adapter

**class** flash.core.adapter.**Adapter**(\*args: Any, \*\*kwargs: Any)

The **Adapter** is a lightweight interface that can be used to encapsulate the logic from a particular provider within a *Task*.

**abstract classmethod** **from\_task**(task, \*\*kwargs)

Instantiate the adapter from the given *Task*.

This includes resolution / creation of backbones / heads and any other provider specific options.

### 43.1.2 AdapterTask

**class** flash.core.adapter.AdapterTask(adapter, \*\*kwargs)

The AdapterTask is a *Task* which wraps an *Adapter* and forwards all of the hooks.

**Parameters**

- **adapter** *¶* (*Adapter*) – The *Adapter* to wrap.
- **kwargs** *¶* – Keyword arguments to be passed to the base *Task*.

## 43.2 flash.core.classification

<i>Classes</i>	A <i>Serializer</i> which applies an argmax to the model outputs (either logits or probabilities) and converts to a list.
<i>ClassificationSerializer</i>	A base class for classification serializers.
<i>ClassificationTask</i>	
<i>FiftyOneLabels</i>	A <i>Serializer</i> which converts the model outputs to FiftyOne classification format.
<i>Labels</i>	A <i>Serializer</i> which converts the model outputs (either logits or probabilities) to the label of the argmax classification.
<i>Logits</i>	A <i>Serializer</i> which simply converts the model outputs (assumed to be logits) to a list.
<i>PredsClassificationSerializer</i>	A <i>ClassificationSerializer</i> which gets the PREDs from the sample.
<i>Probabilities</i>	A <i>Serializer</i> which applies a softmax to the model outputs (assumed to be logits) and converts to a list.

### 43.2.1 Classes

**class** flash.core.classification.Classes(multi\_label=False, threshold=0.5)

A *Serializer* which applies an argmax to the model outputs (either logits or probabilities) and converts to a list.

**Parameters**

- **multi\_label** *¶* (*bool*) – If true, treats outputs as multi label logits.
- **threshold** *¶* (*float*) – The threshold to use for multi\_label classification.

### 43.2.2 ClassificationSerializer

**class** flash.core.classification.**ClassificationSerializer**(*multi\_label=False*)

A base class for classification serializers.

**Parameters** *multi\_label* (bool) – If true, treats outputs as multi label logits.

### 43.2.3 ClassificationTask

**class** flash.core.classification.**ClassificationTask**(\*args, num\_classes=None, loss\_fn=None, metrics=None, multi\_label=False, serializer=None, \*\*kwargs)

### 43.2.4 FiftyOneLabels

**class** flash.core.classification.**FiftyOneLabels**(labels=None, multi\_label=False, threshold=None, store\_logits=False, return\_filepath=False)

A *Serializer* which converts the model outputs to FiftyOne classification format.

**Parameters**

- *labels* (Optional[List[str]]) – A list of labels, assumed to map the class index to the label for that class. If *labels* is not provided, will attempt to get them from the *LabelsState*.
- *multi\_label* (bool) – If true, treats outputs as multi label logits.
- *threshold* (Optional[float]) – A threshold to use to filter candidate labels. In the single label case, predictions below this threshold will be replaced with None
- *store\_logits* (bool) – Boolean determining whether to store logits in the FiftyOne labels
- *return\_filepath* (bool) – Boolean determining whether to return a dict containing filepath and FiftyOne labels (True) or only a list of FiftyOne labels (False)

### 43.2.5 Labels

**class** flash.core.classification.**Labels**(labels=None, multi\_label=False, threshold=0.5)

A *Serializer* which converts the model outputs (either logits or probabilities) to the label of the argmax classification.

**Parameters**

- *labels* (Optional[List[str]]) – A list of labels, assumed to map the class index to the label for that class. If *labels* is not provided, will attempt to get them from the *LabelsState*.
- *multi\_label* (bool) – If true, treats outputs as multi label logits.
- *threshold* (float) – The threshold to use for multi\_label classification.

### 43.2.6 Logits

**class** flash.core.classification.**Logits**(*multi\_label=False*)

A *Serializer* which simply converts the model outputs (assumed to be logits) to a list.

### 43.2.7 PredsClassificationSerializer

**class** flash.core.classification.**PredsClassificationSerializer**(*multi\_label=False*)

A *ClassificationSerializer* which gets the PREDS from the sample.

### 43.2.8 Probabilities

**class** flash.core.classification.**Probabilities**(*multi\_label=False*)

A *Serializer* which applies a softmax to the model outputs (assumed to be logits) and converts to a list.

## 43.3 flash.core.finetuning

---

*FlashBaseFinetuning*

FlashBaseFinetuning can be used to create a custom Flash Finetuning Callback.

---

*FreezeUnfreeze*

---

*NoFreeze*

---

*UnfreezeMilestones*

---

### 43.3.1 FlashBaseFinetuning

**class** flash.core.finetuning.**FlashBaseFinetuning**(*attr\_names='backbone', train\_bn=True*)

FlashBaseFinetuning can be used to create a custom Flash Finetuning Callback.

Override `finetune_function()` to put your unfreeze logic.

### 43.3.2 FreezeUnfreeze

```
class flash.core.finetuning.FreezeUnfreeze(attr_names='backbone', train_bn=True,
                                           unfreeze_epoch=10)
```

### 43.3.3 NoFreeze

```
class flash.core.finetuning.NoFreeze(*args, **kwargs)
```

### 43.3.4 UnfreezeMilestones

```
class flash.core.finetuning.UnfreezeMilestones(attr_names='backbone', train_bn=True,
                                                unfreeze_milestones=(5, 10), num_layers=5)
```

## 43.4 flash.core.integrations.fiftyone

---

*visualize*

Visualizes predictions from a model with a FiftyOne Serializer in the [FiftyOne App](#).

---

### 43.4.1 flash.core.integrations.fiftyone.utils.visualize

```
flash.core.integrations.fiftyone.utils.visualize(predictions, filepaths=None,
                                                  label_field='predictions', wait=False, **kwargs)
```

Visualizes predictions from a model with a FiftyOne Serializer in the [FiftyOne App](#).

This method can be used in all of the following environments:

- **Local Python shell:** The App will launch in a new tab in your default web browser.
- **Remote Python shell:** Pass the `remote=True` option to this method and then follow the instructions printed to your remote shell to open the App in your browser on your local machine.
- **Jupyter notebook:** The App will launch in the output of your current cell.
- **Google Colab:** The App will launch in the output of your current cell.
- **Python script:** Pass the `wait=True` option to block execution of your script until the App is closed.

See [this page](#) for more information about using the FiftyOne App in different environments.

#### Parameters

- **predictions** *(Union[List[None], List[Dict[str, None]])]* – Can be either a list of FiftyOne labels that will be matched with the corresponding `filepaths`, or a list of dictionaries with “filepath” and “predictions” keys that contains the filepaths and predictions.
- **filepaths** *(Optional[List[str]])* – A list of filepaths to images or videos corresponding to the provided `predictions`.
- **label\_field** *(Optional[str])* – The name of the label field in which to store the predictions in the FiftyOne dataset.
- **wait** *(Optional[bool])* – Whether to block execution until the FiftyOne App is closed.
- **\*\*kwargs** – Optional keyword arguments for `fiftyone.core.session.launch_app`.

**Return type** `None`

**Returns** a `fiftyone.core.session.Session`

## 43.5 flash.core.integrations.icevision

---

*IceVisionTransformAdapter*

**type** `_sphinx_paramlinks_flash.core.integrations.icevision.transf`  
`List[Callable]`

---

*default\_transforms*

The default transforms from IceVision.

---

*train\_default\_transforms*

The default augmentations from IceVision.

---

### 43.5.1 flash.core.integrations.icevision.transforms.IceVisionTransformAdapter

**class** `flash.core.integrations.icevision.transforms.IceVisionTransformAdapter`(*transform*)

**Parameters** `transform` (`List[Callable]`) – list of transformation functions to apply

`__init__`(*transform*)

#### Methods

---

`__init__`(*transform*)

---

`forward`(*x*)

---

### 43.5.2 flash.core.integrations.icevision.transforms.default\_transforms

`flash.core.integrations.icevision.transforms.default_transforms`(*image\_size*)

The default transforms from IceVision.

**Return type** `Dict[str, Callable]`

### 43.5.3 flash.core.integrations.icevision.transforms.train\_default\_transforms

`flash.core.integrations.icevision.transforms.train_default_transforms`(*image\_size*)

The default augmentations from IceVision.

**Return type** `Dict[str, Callable]`



## 43.6 flash.core.integrations.pytorch\_forecasting

---

*convert\_predictions*

**rtype** Tuple[Dict[str, Any], List]

---

### 43.6.1 flash.core.integrations.pytorch\_forecasting.transforms.convert\_predictions

flash.core.integrations.pytorch\_forecasting.transforms.**convert\_predictions**(*predictions*)

**Return type** Tuple[Dict[str, Any], List]

## 43.7 flash.core.model

<i>BenchmarkConvergenceCI</i>	Specialized callback only used during testing Keeps track metrics during training.
<i>CheckDependenciesMeta</i>	
<i>ModuleWrapperBase</i>	The <code>ModuleWrapperBase</code> is a base for classes which wrap a <code>LightningModule</code> or an instance of <code>ModuleWrapperBase</code> .
<i>DatasetProcessor</i>	The <code>DatasetProcessor</code> mixin provides hooks for classes which need custom logic for producing the data loaders for each running stage given the corresponding dataset.
<i>Task</i>	A general Task.

### 43.7.1 BenchmarkConvergenceCI

**class** flash.core.model.**BenchmarkConvergenceCI**(\*args: Any, \*\*kwargs: Any)  
 Specialized callback only used during testing Keeps track metrics during training.

### 43.7.2 CheckDependenciesMeta

```
class flash.core.model.CheckDependenciesMeta(*args, **kwargs)
```

### 43.7.3 ModuleWrapperBase

```
class flash.core.model.ModuleWrapperBase
```

The `ModuleWrapperBase` is a base for classes which wrap a `LightningModule` or an instance of `ModuleWrapperBase`.

This class ensures that trainer attributes are forwarded to any wrapped or nested `LightningModule` instances so that nested calls to `.log` are handled correctly. The `ModuleWrapperBase` is also stateful, meaning that a `DataPipelineState` can be attached. Attached state will be forwarded to any nested `ModuleWrapperBase` instances.

### 43.7.4 DatasetProcessor

```
class flash.core.model.DatasetProcessor
```

The `DatasetProcessor` mixin provides hooks for classes which need custom logic for producing the data loaders for each running stage given the corresponding dataset.

## 43.8 flash.core.registry

<i>FlashRegistry</i>	This class is used to register function or <code>functools.partial</code> class to a registry.
<i>ExternalRegistry</i>	The <code>ExternalRegistry</code> is a <code>FlashRegistry</code> that can point to an external provider via a getter function.
<i>ConcatRegistry</i>	The <code>ConcatRegistry</code> can be used to concatenate multiple registries of different types together.

### 43.8.1 FlashRegistry

```
class flash.core.registry.FlashRegistry(name, verbose=False)
```

This class is used to register function or `functools.partial` class to a registry.

```
get(key, with_metadata=False, strict=True, **metadata)
```

This function is used to gather matches from the registry:

#### Parameters

- **key** *(str)* – Name of the registered function.
- **with\_metadata** *(bool)* – Whether to include the associated metadata in the return value.
- **strict** *(bool)* – Whether to return all matches or just one.
- **metadata** – Metadata used to filter against existing registry item's metadata.

**Return type** `Union[Callable, Dict[str, Any], List[Dict[str, Any]], List[Callable]]`

### 43.8.2 ExternalRegistry

**class** flash.core.registry.**ExternalRegistry**(*getter, name, providers=None, verbose=False*)

The ExternalRegistry is a FlashRegistry that can point to an external provider via a getter function.

#### Parameters

- **getter** (Callable) – A function whose first argument is a key that can optionally take additional args and kwargs.
- **providers** (Union[Provider, List[Provider], None]) – The provider(/s) of entries in this registry.

**available\_keys**()

Since we don't know the available keys, just give a generic message.

**Return type** List[str]

**get**(*key, with\_metadata=False, strict=True, \*\*metadata*)

Returns a partial of the getter with the first argument as the given key and wrapped to print the providers.

**Return type** Union[Callable, Dict[str, Any], List[Dict[str, Any]], List[Callable]]

### 43.8.3 ConcatRegistry

**class** flash.core.registry.**ConcatRegistry**(\*registries)

The ConcatRegistry can be used to concatenate multiple registries of different types together.

## 43.9 flash.core.optimizers

<i>LARS</i>	Extends SGD in PyTorch with LARS scaling from the paper <a href="#">Large batch training of Convolutional Networks</a> .
<i>LAMB</i>	Extends ADAM in pytorch to incorporate LAMB algorithm from the paper: <a href="#">Large batch optimization for deep learning: Training BERT in 76 minutes</a> .
<i>LinearWarmupCosineAnnealingLR</i>	Sets the learning rate of each parameter group to follow a linear warmup schedule between warmup_start_lr and base_lr followed by a cosine annealing schedule between base_lr and eta_min.

### 43.9.1 LARS

**class** flash.core.optimizers.**LARS**(*params, lr=torch.optim.optimizer.required, momentum=0, dampening=0, weight\_decay=0, nesterov=False, trust\_coefficient=0.001, eps=1e-08*)

Extends SGD in PyTorch with LARS scaling from the paper [Large batch training of Convolutional Networks](#).

#### Parameters

- **params** (iterable) – iterable of parameters to optimize or dicts defining parameter groups
- **lr** (float) – learning rate
- **momentum** (float, optional) – momentum factor (default: 0)
- **weight\_decay** (float, optional) – weight decay (L2 penalty) (default: 0)

- **dampening** *(float, optional)* – dampening for momentum (default: 0)
- **nesterov** *(bool, optional)* – enables Nesterov momentum (default: False)
- **trust\_coefficient** *(float, optional)* – trust coefficient for computing LR (default: 0.001)
- **eps** *(float, optional)* – eps for division denominator (default: 1e-8)

### Example

```
>>> model = nn.Linear(10, 1)
>>> optimizer = LARS(model.parameters(), lr=0.1, momentum=0.9)
>>> optimizer.zero_grad()
>>> # loss_fn(model(input), target).backward()
>>> optimizer.step()
```

**Note:** The application of momentum in the SGD part is modified according to the PyTorch standards. LARS scaling fits into the equation in the following fashion.

$$\begin{aligned} g_{t+1} &= \text{lars\_lr} * (\beta * p_t + g_{t+1}), \\ v_{t+1} &= \mu * v_t + g_{t+1}, \\ p_{t+1} &= p_t - \text{lr} * v_{t+1}, \end{aligned}$$

where  $p$ ,  $g$ ,  $v$ ,  $\mu$  and  $\beta$  denote the parameters, gradient, velocity, momentum, and weight decay respectively. The  $\text{lars\_lr}$  is defined by Eq. 6 in the paper. The Nesterov version is analogously modified.

**Warning:** Parameters with weight decay set to 0 will automatically be excluded from layer-wise LR scaling. This is to ensure consistency with papers like SimCLR and BYOL.

**step**(*closure=None*)

Performs a single optimization step.

**Parameters** **closure** *(callable, optional)* – A closure that reevaluates the model and returns the loss.

## 43.9.2 LAMB

**class** flash.core.optimizers.LAMB(*params, lr=0.001, betas=(0.9, 0.999), eps=1e-06, weight\_decay=0, exclude\_from\_layer\_adaptation=False, amsgrad=False*)

Extends ADAM in pytorch to incorporate LAMB algorithm from the paper: [Large batch optimization for deep learning: Training BERT in 76 minutes](#).

### Parameters

- **params** *(iterable)* – iterable of parameters to optimize or dicts defining parameter groups
- **lr** *(float)* – learning rate
- **betas** *(Tuple[float, float], optional)* – coefficients used for computing running averages of gradient and its square (default: (0.9, 0.999))
- **eps** *(float, optional)* – term added to the denominator to improve numerical stability (default: 1e-8)

- **weight\_decay** (float, optional) – weight decay (L2 penalty) (default: 0)
- **exclude\_from\_layer\_adaptation** (bool, optional) – layers which do not need LAMB layer adaptation (default: False)
- **amsgrad** (boolean, optional) – whether to use the AMSGrad variant of this algorithm from the paper [On the Convergence of Adam and Beyond](#) (default: False)

### Example

```
>>> model = nn.Linear(10, 1)
>>> optimizer = LAMB(model.parameters(), lr=0.1)
>>> optimizer.zero_grad()
>>> # loss_fn(model(input), target).backward()
>>> optimizer.step()
```

**Warning:** Since the default weight decay for LAMB is set to 0., we do not club together 0. weight decay and exclusion from layer adaptation like LARS. This would cause the optimizer to exclude all layers from layer adaptation.

**step**(closure=None)

Performs a single optimization step.

**Parameters** **closure** (callable, optional) – A closure that reevaluates the model and returns the loss.

### 43.9.3 LinearWarmupCosineAnnealingLR

**class** flash.core.optimizers.LinearWarmupCosineAnnealingLR(optimizer, warmup\_epochs, max\_epochs, warmup\_start\_lr=0.0, eta\_min=0.0, last\_epoch=-1)

Sets the learning rate of each parameter group to follow a linear warmup schedule between warmup\_start\_lr and base\_lr followed by a cosine annealing schedule between base\_lr and eta\_min.

**Warning:** It is recommended to call `step()` for [LinearWarmupCosineAnnealingLR](#) after each iteration as calling it after each epoch will keep the starting lr at warmup\_start\_lr for the first epoch which is 0 in most cases.

**Warning:** passing epoch to `step()` is being deprecated and comes with an EPOCH\_DEPRECATION\_WARNING. It calls the `_get_closed_form_lr()` method for this scheduler instead of `get_lr()`. Though this does not change the behavior of the scheduler, when passing epoch param to `step()`, the user should call the `step()` function before calling train and validation methods.

### Example

```
>>> layer = nn.Linear(10, 1)
>>> optimizer = Adam(layer.parameters(), lr=0.02)
>>> scheduler = LinearWarmupCosineAnnealingLR(optimizer, warmup_epochs=10, max_
↳ epochs=40)
>>> #
>>> # the default case
>>> for epoch in range(40):
...     # train(...)
...     # validate(...)
...     scheduler.step()
>>> #
>>> # passing epoch param case
>>> for epoch in range(40):
...     scheduler.step(epoch)
...     # train(...)
...     # validate(...)
```

#### `get_lr()`

Compute learning rate using chainable form of the scheduler.

**Return type** `List[float]`

## 43.10 Utilities

<code>from_argparse_args</code>	Modified version of <code>pytorch_lightning.utilities.argparse.from_argparse_args()</code> which populates <code>valid_kwargs</code> from <code>pytorch_lightning.Trainer</code> .
<code>get_callable_name</code>	<b>rtype</b> <code>str</code>
<code>get_callable_dict</code>	<b>rtype</b> <code>Union[Dict, Mapping]</code>
<code>predict_context</code>	This decorator is used as context manager to put model in eval mode before running predict and reset to train after.

### 43.10.1 flash.core.trainer.from\_argparse\_args

`flash.core.trainer.from_argparse_args(cls, args, **kwargs)`

Modified version of `pytorch_lightning.utilities.argparse.from_argparse_args()` which populates `valid_kwargs` from `pytorch_lightning.Trainer`.

### 43.10.2 flash.core.utilities.apply\_func.get\_callable\_name

`flash.core.utilities.apply_func.get_callable_name(fn_or_class)`

Return type `str`

### 43.10.3 flash.core.utilities.apply\_func.get\_callable\_dict

`flash.core.utilities.apply_func.get_callable_dict(fn)`

Return type `Union[Dict, Mapping]`

### 43.10.4 flash.core.model.predict\_context

`flash.core.model.predict_context(func)`

This decorator is used as context manager to put model in eval mode before running predict and reset to train after.

Return type `Callable`





## FLASH.CORE.DATA

- *flash.core.data.auto\_dataset*
- *flash.core.data.base\_viz*
- *flash.core.data.batch*
- *flash.core.data.callback*
- *flash.core.data.data\_module*
- *flash.core.data.data\_pipeline*
- *flash.core.data.data\_source*
- *flash.core.data.process*
- *flash.core.data.properties*
- *flash.core.data.splits*
- *flash.core.data.transforms*
- *flash.core.data.utils*

### 44.1 flash.core.data.auto\_dataset

<i>AutoDataset</i>	The <code>AutoDataset</code> is a <code>BaseAutoDataset</code> and a <code>Dataset</code> .
<i>BaseAutoDataset</i>	The <code>BaseAutoDataset</code> class wraps the output of a call to <code>load_data()</code> and a <code>DataSource</code> and provides the <code>_call_load_sample</code> method to call <code>load_sample()</code> with the correct <code>CurrentRunningStageFuncContext</code> for the current <code>running_stage</code> .
<i>IterableAutoDataset</i>	The <code>IterableAutoDataset</code> is a <code>BaseAutoDataset</code> and a <code>IterableDataset</code> .

### 44.1.1 AutoDataset

**class** flash.core.data.auto\_dataset.**AutoDataset**(data, data\_source, running\_stage)

The AutoDataset is a BaseAutoDataset and a Dataset.

The data argument must be a Sequence (it must have a length).

### 44.1.2 BaseAutoDataset

**class** flash.core.data.auto\_dataset.**BaseAutoDataset**(data, data\_source, running\_stage)

The BaseAutoDataset class wraps the output of a call to `load_data()` and a DataSource and provides the `_call_load_sample` method to call `load_sample()` with the correct `CurrentRunningStageFuncContext` for the current running\_stage. Inheriting classes are responsible for extracting samples from data to be given to `_call_load_sample`.

#### Parameters

- **data** `⚡` (~DATA\_TYPE) – The output of a call to `load_data()`.
- **data\_source** `⚡` (DataSource) – The DataSource which has the load\_sample method.
- **running\_stage** `⚡` (RunningStage) – The current running stage.

### 44.1.3 IterableAutoDataset

**class** flash.core.data.auto\_dataset.**IterableAutoDataset**(data, data\_source, running\_stage)

The IterableAutoDataset is a BaseAutoDataset and a IterableDataset.

The data argument must be an Iterable.

## 44.2 flash.core.data.base\_viz

---

*BaseVisualization*

This Base Class is used to create visualization tool on top of *Preprocess* hooks.

---

### 44.2.1 BaseVisualization

**class** flash.core.data.base\_viz.**BaseVisualization**(enabled=False)

This Base Class is used to create visualization tool on top of *Preprocess* hooks.

Override any of the show\_{preprocess\_hook\_name} to receive the associated data and visualize them.

Example:

```
from flash.image import ImageClassificationData
from flash.core.data.base_viz import BaseVisualization

class CustomBaseVisualization(BaseVisualization):

    def show_load_sample(self, samples: List[Any], running_stage):
        # plot samples
```

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```

def show_pre_tensor_transform(self, samples: List[Any], running_stage):
    # plot samples

def show_to_tensor_transform(self, samples: List[Any], running_stage):
    # plot samples

def show_post_tensor_transform(self, samples: List[Any], running_stage):
    # plot samples

def show_collate(self, batch: List[Any], running_stage):
    # plot batch

def show_per_batch_transform(self, batch: List[Any], running_stage):
    # plot batch

class CustomImageClassificationData(ImageClassificationData):

    @staticmethod
    def configure_data_fetcher(*args, **kwargs) -> BaseDataFetcher:
        return CustomBaseVisualization(*args, **kwargs)

dm = CustomImageClassificationData.from_folders(
    train_folder="./data/train",
    val_folder="./data/val",
    test_folder="./data/test",
    predict_folder="./data/predict")

# visualize a ``train`` batch
dm.show_train_batches()

# visualize next ``train`` batch
dm.show_train_batches()

# visualize a ``val`` batch
dm.show_val_batches()

# visualize a ``test`` batch
dm.show_test_batches()

# visualize a ``predict`` batch
dm.show_predict_batches()

```

---

**Note:** If the user wants to plot all different transformation stages at once, override the show function directly.

---

Example:

```

class CustomBaseVisualization(BaseVisualization):

    def show(self, batch: Dict[str, Any], running_stage: RunningStage):
        print(batch)
        # out

```

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```
{
    'load_sample': [...],
    'pre_tensor_transform': [...],
    'to_tensor_transform': [...],
    'post_tensor_transform': [...],
    'collate': [...],
    'per_batch_transform': [...],
}
```

**Note:** As the *Preprocess* hooks are injected within the threaded workers of the DataLoader, the data won't be accessible when using `num_workers > 0`.

**show(batch, running\_stage, func\_names\_list)**

Override this function when you want to visualize a composition.

**Return type** `None`

**show\_collate(batch, running\_stage)**

Override to visualize preprocess `collate` output data.

**Return type** `None`

**show\_load\_sample(samples, running\_stage)**

Override to visualize preprocess `load_sample` output data.

**show\_per\_batch\_transform(batch, running\_stage)**

Override to visualize preprocess `per_batch_transform` output data.

**Return type** `None`

**show\_per\_batch\_transform\_on\_device(batch, running\_stage)**

Override to visualize preprocess `per_batch_transform_on_device` output data.

**Return type** `None`

**show\_per\_sample\_transform\_on\_device(samples, running\_stage)**

Override to visualize preprocess `per_sample_transform_on_device` output data.

**Return type** `None`

**show\_post\_tensor\_transform(samples, running\_stage)**

Override to visualize preprocess `post_tensor_transform` output data.

**show\_pre\_tensor\_transform(samples, running\_stage)**

Override to visualize preprocess `pre_tensor_transform` output data.

**show\_to\_tensor\_transform(samples, running\_stage)**

Override to visualize preprocess `to_tensor_transform` output data.

## 44.3 flash.core.data.batch

---

*default\_uncollate*

This function is used to uncollate a batch into samples.

---

### 44.3.1 flash.core.data.batch.default\_uncollate

`flash.core.data.batch.default_uncollate(batch)`

This function is used to uncollate a batch into samples. .. rubric:: Examples

```
>>> a, b = default_uncollate(torch.rand((2,1)))
```

## 44.4 flash.core.data.callback

---

*BaseDataFetcher*  
*ControlFlow*

This class is used to profile *Preprocess* hook outputs.

---

*FlashCallback*

FlashCallback is an extension of `pytorch_lightning.callbacks.Callback`.

---

### 44.4.1 BaseDataFetcher

**class** `flash.core.data.callback.BaseDataFetcher(enabled=False)`

This class is used to profile *Preprocess* hook outputs.

By default, the callback won't profile the data being processed as it may lead to OOMError.

Example:

```
from flash.core.data.callback import BaseDataFetcher
from flash.core.data.data_module import DataModule
from flash.core.data.data_source import DataSource
from flash.core.data.process import Preprocess

class CustomPreprocess(Preprocess):

    def __init__(**kwargs):
        super().__init__(
            data_sources = {"inputs": DataSource()},
            **kwargs,
        )

class PrintData(BaseDataFetcher):

    def print(self):
        print(self.batches)

class CustomDataModule(DataModule):
```

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```

preprocess_cls = CustomPreprocess

@staticmethod
def configure_data_fetcher():
    return PrintData()

@classmethod
def from_inputs(
    cls,
    train_data: Any,
    val_data: Any,
    test_data: Any,
    predict_data: Any,
) -> "CustomDataModule":
    return cls.from_data_source(
        "inputs",
        train_data=train_data,
        val_data=val_data,
        test_data=test_data,
        predict_data=predict_data,
        batch_size=5,
    )

dm = CustomDataModule.from_inputs(range(5), range(5), range(5), range(5))
data_fetcher = dm.data_fetcher

# By default, the ``data_fetcher`` is disabled to prevent OOM.
# The ``enable`` context manager will activate it.
with data_fetcher.enable():

    # This will fetch the first val dataloader batch.
    _ = next(iter(dm.val_dataloader()))

data_fetcher.print()
# out:
{
    'train': {},
    'test': {},
    'val': {
        'load_sample': [0, 1, 2, 3, 4],
        'pre_tensor_transform': [0, 1, 2, 3, 4],
        'to_tensor_transform': [0, 1, 2, 3, 4],
        'post_tensor_transform': [0, 1, 2, 3, 4],
        'collate': [tensor([0, 1, 2, 3, 4])],
        'per_batch_transform': [tensor([0, 1, 2, 3, 4])]},
    'predict': {}
}
data_fetcher.reset()
data_fetcher.print()
# out:
{
    'train': {},

```

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```
'test': {},
'val': {},
'predict': {}
}
```

**enable()**

This function is used to enable to BaseDataFetcher.

#### 44.4.2 ControlFlow

**class** flash.core.data.callback.**ControlFlow**(*callbacks*)

### 44.5 flash.core.data.data\_module

---

*DataModule*

A basic DataModule class for all Flash tasks.

---

### 44.6 flash.core.data.data\_pipeline

---

*DataPipeline*

DataPipeline holds the engineering logic to connect *Preprocess* and/or *Postprocess* objects to the DataModule, Flash Task and Trainer.

---

*DataPipelineState*

A class to store and share all process states once a *DataPipeline* has been initialized.

---

#### 44.6.1 DataPipeline

**class** flash.core.data.data\_pipeline.**DataPipeline**(*data\_source=None, preprocess=None, postprocess=None, deserializer=None, serializer=None*)

DataPipeline holds the engineering logic to connect *Preprocess* and/or *Postprocess* objects to the DataModule, Flash Task and Trainer.

Example:

```
class CustomPreprocess(Preprocess):
    pass

class CustomPostprocess(Postprocess):
    pass

custom_data_pipeline = DataPipeline(CustomPreprocess(), CustomPostprocess())

# And it can attached to both the datamodule and model.

datamodule.data_pipeline = custom_data_pipeline
model.data_pipeline = custom_data_pipeline
```

**initialize**(*data\_pipeline\_state=None*)

Creates the *DataPipelineState* and gives the reference to the: *Preprocess*, *Postprocess*, and *Serializer*. Once this has been called, any attempt to add new state will give a warning.

**Return type** *DataPipelineState*

## 44.6.2 DataPipelineState

**class** `flash.core.data.data_pipeline.DataPipelineState`

A class to store and share all process states once a *DataPipeline* has been initialized.

**get\_state**(*state\_type*)

Get the *ProcessState* of the given type from the *DataPipelineState*.

**Return type** `Optional[ProcessState]`

**set\_state**(*state*)

Add the given *ProcessState* to the *DataPipelineState*.

## 44.7 flash.core.data.data\_source

<i>DatasetDataSource</i>	The <i>DatasetDataSource</i> implements default behaviours for data sources which expect the input to <i>load_data()</i> to be a <code>torch.utils.data.dataset.Dataset</code> .
<i>DataSource</i>	The <i>DataSource</i> class encapsulates two hooks: <i>load_data</i> and <i>load_sample</i> .
<i>DefaultDataKeys</i>	The <i>DefaultDataKeys</i> enum contains the keys that are used by built-in data sources to refer to inputs and targets.
<i>DefaultDataSources</i>	The <i>DefaultDataSources</i> enum contains the data source names used by all of the default <i>from_*</i> methods in <i>DataModule</i> .
<i>FiftyOneDataSource</i>	The <i>FiftyOneDataSource</i> expects the input to <i>load_data()</i> to be a <code>fiftyone.core.collections.SampleCollection</code> .
<i>ImageLabelsMap</i>	
<i>LabelsState</i>	A <i>ProcessState</i> containing labels, a mapping from class index to label.
<i>MockDataset</i>	The <i>MockDataset</i> catches any metadata that is attached through <code>__setattr__</code> .
<i>NumpyDataSource</i>	The <i>NumpyDataSource</i> is a <i>SequenceDataSource</i> which expects the input to <i>load_data()</i> to be a sequence of <code>np.ndarray</code> objects.
<i>PathsDataSource</i>	The <i>PathsDataSource</i> implements default behaviours for data sources which expect the input to <i>load_data()</i> to be either a directory with a subdirectory for each class or a tuple containing list of files and corresponding list of targets.

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Table 7 – continued from previous page

<i>SequenceDataSource</i>	The <code>SequenceDataSource</code> implements default behaviours for data sources which expect the input to <code>load_data()</code> to be a sequence of tuples ((input, target) where target can be None).
<i>TensorDataSource</i>	The <code>TensorDataSource</code> is a <code>SequenceDataSource</code> which expects the input to <code>load_data()</code> to be a sequence of <code>torch.Tensor</code> objects.

### 44.7.1 DatasetDataSource

**class** `flash.core.data.data_source.DatasetDataSource`

The `DatasetDataSource` implements default behaviours for data sources which expect the input to `load_data()` to be a `torch.utils.data.dataset.Dataset`

**Parameters** `labels` – Optionally pass the labels as a mapping from class index to label string. These will then be set as the `LabelsState`.

### 44.7.2 DefaultDataKeys

**class** `flash.core.data.data_source.DefaultDataKeys(*args, **kwargs)`

The `DefaultDataKeys` enum contains the keys that are used by built-in data sources to refer to inputs and targets.

### 44.7.3 DefaultDataSources

**class** `flash.core.data.data_source.DefaultDataSources(*args, **kwargs)`

The `DefaultDataSources` enum contains the data source names used by all of the default `from_*` methods in `DataModule`.

### 44.7.4 FiftyOneDataSource

**class** `flash.core.data.data_source.FiftyOneDataSource(label_field='ground_truth')`

The `FiftyOneDataSource` expects the input to `load_data()` to be a `fiftyone.core.collections.SampleCollection`.

### 44.7.5 ImageLabelsMap

**class** `flash.core.data.data_source.ImageLabelsMap(labels_map)`

### 44.7.6 LabelsState

**class** flash.core.data.data\_source.LabelsState(labels)

A *ProcessState* containing labels, a mapping from class index to label.

### 44.7.7 MockDataset

**class** flash.core.data.data\_source.MockDataset

The MockDataset catches any metadata that is attached through `__setattr__`.

This is passed to `load_data()` so that attributes can be set on the generated data set.

### 44.7.8 NumpyDataSource

**class** flash.core.data.data\_source.NumpyDataSource(labels=None)

The NumpyDataSource is a SequenceDataSource which expects the input to `load_data()` to be a sequence of np.ndarray objects.

### 44.7.9 PathsDataSource

**class** flash.core.data.data\_source.PathsDataSource(extensions=None, loader=None, labels=None)

The PathsDataSource implements default behaviours for data sources which expect the input to `load_data()` to be either a directory with a subdirectory for each class or a tuple containing list of files and corresponding list of targets.

#### Parameters

- **extensions** *Optional[Tuple[str, ...]]* – The file extensions supported by this data source (e.g. ("jpg", "png")).
- **labels** *Optional[Sequence[str]]* – Optionally pass the labels as a mapping from class index to label string. These will then be set as the *LabelsState*.

**static find\_classes**(dir)

Finds the class folders in a dataset. Ensures that no class is a subdirectory of another.

**Parameters** **dir** *(str)* – Root directory path.

**Returns** (classes, class\_to\_idx) where classes are relative to (dir), and class\_to\_idx is a dictionary.

**Return type** tuple

### 44.7.10 SequenceDataSource

**class** flash.core.data.data\_source.SequenceDataSource(labels=None)

The SequenceDataSource implements default behaviours for data sources which expect the input to `load_data()` to be a sequence of tuples ((input, target) where target can be None).

**Parameters** **labels** *Optional[Sequence[str]]* – Optionally pass the labels as a mapping from class index to label string. These will then be set as the *LabelsState*.

### 44.7.11 TensorDataSource

**class** `flash.core.data.data_source.TensorDataSource(labels=None)`

The TensorDataSource is a SequenceDataSource which expects the input to `load_data()` to be a sequence of `torch.Tensor` objects.

<code>has_file_allowed_extension</code>	Checks if a file is an allowed extension.
<code>has_len</code>	<b>rtype</b> <code>bool</code>
<code>make_dataset</code>	Generates a list of samples of a form (path_to_sample, class).

### 44.7.12 flash.core.data.data\_source.has\_file\_allowed\_extension

`flash.core.data.data_source.has_file_allowed_extension(filename, extensions)`

Checks if a file is an allowed extension.

**Parameters**

- **filename** *(string)* – path to a file
- **extensions** *(tuple of strings)* – extensions to consider (lowercase)

**Returns** True if the filename ends with one of given extensions

**Return type** `bool`

### 44.7.13 flash.core.data.data\_source.has\_len

`flash.core.data.data_source.has_len(data)`

**Return type** `bool`

### 44.7.14 flash.core.data.data\_source.make\_dataset

`flash.core.data.data_source.make_dataset(directory, class_to_idx, extensions=None, is_valid_file=None)`

Generates a list of samples of a form (path\_to\_sample, class).

**Parameters**

- **directory** *(str)* – root dataset directory
- **class\_to\_idx** *(Dict[str, int])* – dictionary mapping class name to class index
- **extensions** *(optional)* – A list of allowed extensions. Either extensions or `is_valid_file` should be passed. Defaults to None.
- **is\_valid\_file** *(optional)* – A function that takes path of a file and checks if the file is a valid file (used to check of corrupt files) both extensions and `is_valid_file` should not be passed. Defaults to None.

**Raises** `ValueError` – In case `extensions` and `is_valid_file` are None or both are not None.

**Returns** samples of a form (path\_to\_sample, class)

**Return type** List[Tuple[str, int]]

## 44.8 flash.core.data.process

---

<i>BasePreprocess</i>	
<i>DefaultPreprocess</i>	
<i>DeserializerMapping</i>	Deserializer Mapping.
<i>Deserializer</i>	Deserializer.
<i>Postprocess</i>	The <i>Postprocess</i> encapsulates all the data processing logic that should run after the model.
<i>Preprocess</i>	The <i>Preprocess</i> encapsulates all the data processing logic that should run before the data is passed to the model.
<i>SerializerMapping</i>	If the model output is a dictionary, then the <i>SerializerMapping</i> enables each entry in the dictionary to be passed to it's own <i>Serializer</i> .
<i>Serializer</i>	A <i>Serializer</i> encapsulates a single serialize method which is used to convert the model output into the desired output format when predicting.

---

### 44.8.1 BasePreprocess

**class** flash.core.data.process.BasePreprocess

**abstract** get\_state\_dict()

Override this method to return state\_dict.

**Return type** Dict[str, Any]

**abstract classmethod** load\_state\_dict(state\_dict, strict=False)

Override this method to load from state\_dict.

### 44.8.2 DefaultPreprocess

```
class flash.core.data.process.DefaultPreprocess(train_transform=None, val_transform=None,
                                              test_transform=None, predict_transform=None,
                                              data_sources=None, default_data_source=None)
```

### 44.8.3 DeserializerMapping

```
class flash.core.data.process.DeserializerMapping(deserializers)
    Deserializer Mapping.
```

### 44.8.4 Deserializer

```
class flash.core.data.process.Deserializer
    Deserializer.
```

### 44.8.5 SerializerMapping

```
class flash.core.data.process.SerializerMapping(serializers)
    If the model output is a dictionary, then the SerializerMapping enables each entry in the dictionary to be
    passed to it's own Serializer.
```

## 44.9 flash.core.data.properties

---

*ProcessState*

Base class for all process states.

---

*Properties*

---

### 44.9.1 ProcessState

```
class flash.core.data.properties.ProcessState
    Base class for all process states.
```

## 44.9.2 Properties

```
class flash.core.data.properties.Properties
```

## 44.10 flash.core.data.splits

<i>SplitDataset</i>	SplitDataset is used to create Dataset Subset using indices.
---------------------	--

### 44.10.1 SplitDataset

```
class flash.core.data.splits.SplitDataset(dataset, indices=None, use_duplicated_indices=False)
```

SplitDataset is used to create Dataset Subset using indices.

#### Parameters

- **dataset** *Any* – A dataset to be splitted
- **indices** *Optional[List[int]]* – List of indices to expose from the dataset
- **use\_duplicated\_indices** *bool* – Whether to allow duplicated indices.

Example:

```
split_ds = SplitDataset(dataset, indices=[10, 14, 25])

split_ds = SplitDataset(dataset, indices=[10, 10, 10, 14, 25], use_duplicated_
↪ indices=True)
```

## 44.11 flash.core.data.transforms

<i>ApplyToKeys</i>	The ApplyToKeys class is an <code>nn.Sequential</code> which applies the given transforms to the given keys from the input.
<i>KorniaParallelTransforms</i>	The KorniaParallelTransforms class is an <code>nn.Sequential</code> which will apply the given transforms to each input (to <code>.forward</code> ) in parallel, whilst sharing the random state ( <code>._params</code> ).

### 44.11.1 ApplyToKeys

```
class flash.core.data.transforms.ApplyToKeys(keys, *args)
```

The ApplyToKeys class is an `nn.Sequential` which applies the given transforms to the given keys from the input. When a single key is given, a single value will be passed to the transforms. When multiple keys are given, the corresponding values will be passed to the transforms as a list.

#### Parameters

- **keys** *Union[str, Sequence[str]]* – The key (`str`) or sequence of keys

(Sequence[str]) to extract and forward to the transforms.

- **args** – The transforms, passed to the `nn.Sequential` super constructor.

### 44.11.2 KorniaParallelTransforms

**class** `flash.core.data.transforms.KorniaParallelTransforms(*args: Any, **kwargs: Any)`

The `KorniaParallelTransforms` class is an `nn.Sequential` which will apply the given transforms to each input (to `.forward`) in parallel, whilst sharing the random state (`._params`). This should be used when multiple elements need to be augmented in the same way (e.g. an image and corresponding segmentation mask).

**Parameters** **args** – The transforms, passed to the `nn.Sequential` super constructor.

<code>merge_transforms</code>	Utility function to merge two transform dictionaries.
<code>kornia_collate</code>	Kornia transforms add batch dimension which need to be removed.

### 44.11.3 flash.core.data.transforms.merge\_transforms

`flash.core.data.transforms.merge_transforms(base_transforms, additional_transforms)`

Utility function to merge two transform dictionaries. For each hook, the `additional_transforms` will be called after the `base_transforms`.

**Parameters**

- **base\_transforms** (`Dict[str, Callable]`) – The base transforms dictionary.
- **additional\_transforms** (`Dict[str, Callable]`) – The dictionary of additional transforms to be appended to the `base_transforms`.

**Return type** `Dict[str, Callable]`

**Returns** The new dictionary of transforms.

### 44.11.4 flash.core.data.transforms.kornia\_collate

`flash.core.data.transforms.kornia_collate(samples)`

Kornia transforms add batch dimension which need to be removed.

This function removes that dimension and then applies `torch.utils.data._utils.collate.default_collate`.

**Return type** `Dict[str, Any]`

## 44.12 flash.core.data.utils

---

`CurrentFuncContext`

---

`CurrentRunningStageContext`

---

continues on next page

Table 14 – continued from previous page

<i>CurrentRunningStageFuncContext</i>	
<i>FuncModule</i>	This class is used to wrap a callable within a nn.Module and apply the wrapped function in <code>__call__</code>

### 44.12.1 CurrentFuncContext

```
class flash.core.data.utils.CurrentFuncContext(current_fn, obj)
```

### 44.12.2 CurrentRunningStageContext

```
class flash.core.data.utils.CurrentRunningStageContext(running_stage, obj, reset=True)
```

### 44.12.3 CurrentRunningStageFuncContext

```
class flash.core.data.utils.CurrentRunningStageFuncContext(running_stage, current_fn, obj)
```

### 44.12.4 FuncModule

```
class flash.core.data.utils.FuncModule(func)
```

This class is used to wrap a callable within a nn.Module and apply the wrapped function in `__call__`

<i>convert_to_modules</i>	
<i>download_data</i>	Download file with progressbar.

### 44.12.5 flash.core.data.utils.convert\_to\_modules

```
flash.core.data.utils.convert_to_modules(transforms)
```

### 44.12.6 flash.core.data.utils.download\_data

```
flash.core.data.utils.download_data(url, path='data/', verbose=False)
```

Download file with progressbar.

```
# Code taken from: https://gist.github.com/ruxi/5d6803c116ec1130d484a4ab8c00c603 # __author__ =
"github.com/ruxi" # __license__ = "MIT"
```

```
Usage: download_file('http://web4host.net/5MB.zip')
```

Return type `None`



## FLASH.CORE.SERVE

<i>ModelComponent</i>	alias of <i>object</i>
<i>Composition</i>	Create a composition which define computations / endpoints to create & run.
<i>Endpoint</i>	An endpoint maps a route and request/response payload to components.
<i>Servable</i>	ModuleWrapperBase around a model object to enable serving at scale.
<i>expose</i>	Expose a function/method via a web API for serving model inference.

### 45.1 flash.core.serve.component.ModelComponent

`flash.core.serve.component.ModelComponent`  
alias of *object*

### 45.2 flash.core.serve.composition.Composition

**class** `flash.core.serve.composition.Composition`(\*, *DEBUG=False*, *TESTING=False*, \*\**kwargs*)  
Create a composition which define computations / endpoints to create & run.

Any number of components are accepted, which may have arbitrary connections between them. The final path through the component/connection DAG is determined by the root/terminal node position as specified by endpoint input/outputs keys.

If only ONE component is provided, there is no need to create an Endpoint object. The library will generate a fully connected input/output endpoint for the one component with the *route* name set by the name of the method the *@expose* decorator is applied to.

**Parameters** *kwargs*¶ (*Union*[*object*, *Endpoint*]) – Assignment of human readable names to *ModelComponent* and *Endpoint* instances. If more than one *ModelComponent* is passed, an *Endpoint* is needed as well.

**Warning:**

- This is a Work In Progress interface!

## 45.3 flash.core.serve.core.Endpoint

**class** flash.core.serve.core.**Endpoint**(route, inputs, outputs)

An endpoint maps a route and request/response payload to components.

### Parameters

- **route** (str) – The API route name to construct as the servicing POST endpoint.
- **inputs** (Dict[str, str]) – The full name of a component input. Typically specified by just passing in the component parameter attribute (ie. ``component.inputs.foo``).
- **outputs** (Dict[str, str]) – The full name of a component output. Typically specified by just passing in the component parameter attribute (ie. ``component.outputs.bar``).

## 45.4 flash.core.serve.core.Servable

**class** flash.core.serve.core.**Servable**(\*args, download\_path=None, script\_loader\_cls=<class 'flash.core.serve.core.FlashServeScriptLoader'>)

ModuleWrapperBase around a model object to enable serving at scale.

Create a Servable from either (LM, LOCATION) or (LOCATION,)

### Parameters

- **\*args** – A model class and path to the asset file (url or local file path) OR a singular path to a torchscript asset which can be loaded without the model class definition.
- **download\_path** (Optional[Path]) – Optional url to download a model from.

## 45.5 flash.core.serve.decorators.expose

flash.core.serve.decorators.**expose**(inputs, outputs)

Expose a function/method via a web API for serving model inference.

The @**expose** decorator has two arguments, inputs and outputs, which describe how the inputs to predict are decoded from the request and how the outputs of predict are encoded to a response.

Must decorate one (and only one) method when used within a subclass of **ModelComponent**.

### Parameters

- **inputs** (Dict[str, BaseType]) – accepts a dictionary mapping keys to decorated method parameter names (must be one to one mapping) with values corresponding to an instantiated specification of a Flash Serve Data Type (ie. **Number()**, **Image()**, **Text()**, etc...)
- **outputs** (Dict[str, BaseType]) – accepts a dictionary mapping outputs of the decorated method to keys and data type (similar to inputs). However, unlike **inputs** the output keys are less strict in their names. IF the method returns a dictionary, the keys must match one-to-one. However, if the method returns a sorted sequence (list / tuple) the keys can be arbitrary, so long as no reserved names are used (primarily python keywords). For result sequences, the order in which keys are defined maps to the appropriate element index in the result (ie. key 0 -> sequence[0], key 1 -> sequence[1], etc.)

- *Classification*
- *Object Detection*
- *Keypoint Detection*
- *Instance Segmentation*
- *Embedding*
- *Segmentation*
- *Style Transfer*
- *flash.image.data*

## 46.1 Classification

<i>ImageClassifier</i>	The <code>ImageClassifier</code> is a Task for classifying images.
<i>ImageClassificationData</i>	Data module for image classification tasks.
<i>ImageClassificationPreprocess</i>	Preprocessing of data of image classification.
<i>classification.data</i>	Process and show the image batch and its associated label using matplotlib.
<i>MatplotlibVisualization</i>	

### 46.1.1 ImageClassifier

```
class flash.image.classification.model.ImageClassifier(num_classes=None, backbone='resnet18',  
                                                       backbone_kwargs=None, head=None,  
                                                       pretrained=True, loss_fn=None,  
                                                       optimizer='Adam', lr_scheduler=None,  
                                                       metrics=None, learning_rate=0.001,  
                                                       multi_label=False, serializer=None,  
                                                       training_strategy='default',  
                                                       training_strategy_kwargs=None)
```

The `ImageClassifier` is a Task for classifying images. For more details, see [Image Classification](#). The `ImageClassifier` also supports multi-label classification with `multi_label=True`. For more details, see [Multi-label Image Classification](#).

You can register custom backbones to use with the ImageClassifier:

```
from torch import nn
import torchvision
from flash.image import ImageClassifier

# This is useful to create new backbone and make them accessible from
# ImageClassifier
@ImageClassifier.backbones(name="resnet18")
def fn_resnet(pretrained: bool = True):
    model = torchvision.models.resnet18(pretrained)
    # remove the last two layers & turn it into a Sequential model
    backbone = nn.Sequential(*list(model.children())[:-2])
    num_features = model.fc.in_features
    # backbones need to return the num_features to build the head
    return backbone, num_features
```

### Parameters

- **num\_classes** (Optional[int]) – Number of classes to classify.
- **backbone** (Union[str, Tuple[Module, int]]) – A string or (model, num\_features) tuple to use to compute image features, defaults to "resnet18".
- **pretrained** (Union[bool, str]) – A bool or string to specify the pretrained weights of the backbone, defaults to True which loads the default supervised pretrained weights.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training, defaults to `torch.nn.functional.cross_entropy()`.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the `torchmetrics` package, a custom metric inheriting from `torchmetrics.Metric`, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature `metric(preds, target)` and return a single scalar tensor. Defaults to `torchmetrics.Accuracy`.
- **learning\_rate** (float) – Learning rate to use for training, defaults to 1e-3.
- **multi\_label** (bool) – Whether the targets are multi-label or not.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – A instance of `Serializer` or a mapping consisting of such to use when serializing prediction outputs.
- **training\_strategy** (Optional[str]) – string indicating the training strategy. Adjust if you want to use `learn2learn` for doing meta-learning research
- **training\_strategy\_kwargs** (Optional[Dict[str, Any]]) – Additional kwargs for setting the training strategy

### 46.1.2 ImageClassificationData

```
class flash.image.classification.data.ImageClassificationData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None,
                                                             postprocess=None,
                                                             data_fetcher=None,
                                                             val_split=None, batch_size=4,
                                                             num_workers=0, sampler=None)
```

Data module for image classification tasks.

```
classmethod from_csv(input_field, target_fields=None, train_file=None, train_images_root=None,
                     train_resolver=None, val_file=None, val_images_root=None, val_resolver=None,
                     test_file=None, test_images_root=None, test_resolver=None, predict_file=None,
                     predict_images_root=None, predict_resolver=None, train_transform=None,
                     val_transform=None, test_transform=None, predict_transform=None,
                     data_fetcher=None, preprocess=None, val_split=None, batch_size=4,
                     num_workers=0, sampler=None, **preprocess_kwargs)
```

Creates a [ImageClassificationData](#) object from the given CSV files using the [DataSource](#) of name CSV from the passed or constructed [Preprocess](#).

#### Parameters

- **input\_field** (str) – The field (column) in the CSV file to use for the input.
- **target\_fields** (Union[str, Sequence[str], None]) – The field or fields (columns) in the CSV file to use for the target.
- **train\_file** (Optional[str]) – The CSV file containing the training data.
- **train\_images\_root** (Optional[str]) – The directory containing the train images. If None, the directory containing the train\_file will be used.
- **train\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the train\_images\_root and IDs from the input\_field column.
- **val\_file** (Optional[str]) – The CSV file containing the validation data.
- **val\_images\_root** (Optional[str]) – The directory containing the validation images. If None, the directory containing the val\_file will be used.
- **val\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the val\_images\_root and IDs from the input\_field column.
- **test\_file** (Optional[str]) – The CSV file containing the testing data.
- **test\_images\_root** (Optional[str]) – The directory containing the test images. If None, the directory containing the test\_file will be used.
- **test\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the test\_images\_root and IDs from the input\_field column.
- **predict\_file** (Optional[str]) – The CSV file containing the data to use when predicting.
- **predict\_images\_root** (Optional[str]) – The directory containing the predict images. If None, the directory containing the predict\_file will be used.

- **predict\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the `predict_images_root` and IDs from the `input_field` column.
- **train\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the *preprocess*. Will only be used if `preprocess = None`.

Return type *DataModule*

Returns The constructed data module.

```
classmethod from_data_frame(input_field, target_fields=None, train_data_frame=None,
                           train_images_root=None, train_resolver=None, val_data_frame=None,
                           val_images_root=None, val_resolver=None, test_data_frame=None,
                           test_images_root=None, test_resolver=None, predict_data_frame=None,
                           predict_images_root=None, predict_resolver=None,
                           train_transform=None, val_transform=None, test_transform=None,
                           predict_transform=None, data_fetcher=None, preprocess=None,
                           val_split=None, batch_size=4, num_workers=0, sampler=None,
                           **preprocess_kwargs)
```

Creates a *ImageClassificationData* object from the given pandas DataFrame objects.

#### Parameters

- **input\_field** (str) – The field (column) in the pandas DataFrame to use for the input.
- **target\_fields** (Union[str, Sequence[str], None]) – The field or fields (columns) in the pandas DataFrame to use for the target.
- **train\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the training data.

- **train\_images\_root** (Optional[str]) – The directory containing the train images. If None, values in the `input_field` will be assumed to be the full file paths.
- **train\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the `train_images_root` and IDs from the `input_field` column.
- **val\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the validation data.
- **val\_images\_root** (Optional[str]) – The directory containing the validation images. If None, the directory containing the `val_file` will be used.
- **val\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the `val_images_root` and IDs from the `input_field` column.
- **test\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the testing data.
- **test\_images\_root** (Optional[str]) – The directory containing the test images. If None, the directory containing the `test_file` will be used.
- **test\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the `test_images_root` and IDs from the `input_field` column.
- **predict\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the data to use when predicting.
- **predict\_images\_root** (Optional[str]) – The directory containing the predict images. If None, the directory containing the `predict_file` will be used.
- **predict\_resolver** (Optional[Callable[[str, str], str]]) – The function to use to resolve filenames given the `predict_images_root` and IDs from the `input_field` column.
- **train\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.

- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** `DataModule`

**Returns** The constructed data module.

**preprocess\_cls**

alias of `flash.image.classification.data.ImageClassificationPreprocess`

**set\_block\_viz\_window**(value)

Setter method to switch on/off matplotlib to pop up windows.

**Return type** `None`

### 46.1.3 ImageClassificationPreprocess

```
class flash.image.classification.data.ImageClassificationPreprocess(train_transform=None,
                                                                    val_transform=None,
                                                                    test_transform=None,
                                                                    predict_transform=None,
                                                                    image_size=(196, 196),
                                                                    deserializer=None,
                                                                    **data_source_kwargs)
```

Preprocessing of data of image classification.

**Args::** train\_transform: `m val_transform: test_transform: predict_transform: image_size: tuple with the (height, width) of the images deserializer: data_source_kwargs: Additional kwargs for the data source initializer`

### 46.1.4 MatplotlibVisualization

```
class flash.image.classification.data.MatplotlibVisualization(enabled=False)
```

Process and show the image batch and its associated label using matplotlib.

<code>flash.image.classification.transforms.default_transforms</code>	The default transforms for image classification: resize the image, convert the image and target to a tensor, collate the batch, and apply normalization.
<code>flash.image.classification.transforms.train_default_transforms</code>	During training, we apply the default transforms with additional <code>RandomHorizontalFlip</code> .

### 46.1.5 flash.image.classification.transforms.default\_transforms

```
flash.image.classification.transforms.default_transforms(image_size)
```

The default transforms for image classification: resize the image, convert the image and target to a tensor, collate the batch, and apply normalization.

**Return type** `Dict[str, Callable]`



### 46.1.6 flash.image.classification.transforms.train\_default\_transforms

`flash.image.classification.transforms.train_default_transforms(image_size)`

During training, we apply the default transforms with additional `RandomHorizontalFlip`.

**Return type** `Dict[str, Callable]`

## 46.2 Object Detection

<code>ObjectDetector</code>	The <code>ObjectDetector</code> is a Task for detecting objects in images.
<code>ObjectDetectionData</code>	
<code>detection.data.FiftyOneParser</code>	
<code>detection.data.ObjectDetectionFiftyOneDataSource</code>	
<code>detection.data.ObjectDetectionPreprocess</code>	
<code>detection.serialization.FiftyOneDetectionLabels</code>	A <code>Serializer</code> which converts model outputs to Fifty-One detection format.

### 46.2.1 ObjectDetector

**class** `flash.image.detection.model.ObjectDetector`(`num_classes`, `backbone`='resnet18\_fpn',  
`head`='retinanet', `pretrained`=True,  
`optimizer`='Adam', `lr_scheduler`=None,  
`learning_rate`=0.005, `serializer`=None, **\*\*kwargs**)

The `ObjectDetector` is a Task for detecting objects in images. For more details, see [Object Detection](#).

#### Parameters

- **num\_classes** (int) – the number of classes for detection, including background
- **model** – a string of `:attr`_models``. Defaults to 'fasterrcnn'.
- **backbone** (Optional[str]) – Pretrained backbone CNN architecture. Constructs a model with a ResNet-50-FPN backbone when no backbone is specified.
- **fpn** – If True, creates a Feature Pyramid Network on top of Resnet based CNNs.
- **pretrained** (bool) – if true, returns a model pre-trained on COCO train2017
- **pretrained\_backbone** – if true, returns a model with backbone pre-trained on Imagenet
- **trainable\_backbone\_layers** – number of trainable resnet layers starting from final block. Only applicable for *fasterrcnn*.
- **loss** – the function(s) to update the model with. Has no effect for torchvision detection models.
- **metrics** – The provided metrics. All metrics here will be logged to progress bar and the respective logger. Changing this argument currently has no effect.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.

- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **pretrained** – Whether the model from torchvision should be loaded with it's pretrained weights. Has no effect for custom models.
- **learning\_rate** (float) – The learning rate to use for training
- **serializer** (Union[Serializer, Mapping[str, Serializer], None) – A instance of *Serializer* or a mapping consisting of such to use when serializing prediction outputs.
- **kwargs** (Any) – additional kwargs necessary for initializing the backbone task

### 46.2.2 ObjectDetectionData

```
class flash.image.detection.data.ObjectDetectionData(train_dataset=None, val_dataset=None,
                                                    test_dataset=None, predict_dataset=None,
                                                    data_source=None, preprocess=None,
                                                    postprocess=None, data_fetcher=None,
                                                    val_split=None, batch_size=4,
                                                    num_workers=0, sampler=None)
```

```
classmethod from_coco(train_folder=None, train_ann_file=None, val_folder=None, val_ann_file=None,
                     test_folder=None, test_ann_file=None, predict_folder=None,
                     train_transform=None, val_transform=None, test_transform=None,
                     predict_transform=None, data_fetcher=None, preprocess=None, val_split=None,
                     batch_size=4, num_workers=0, **preprocess_kwargs)
```

Creates a *ObjectDetectionData* object from the given data folders and annotation files in the COCO format.

#### Parameters

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **train\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **val\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **test\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.

- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = ObjectDetectionData.from_coco(
    train_folder="train_folder",
    train_ann_file="annotations.json",
)
```

**classmethod from\_via**(train\_folder=None, train\_ann\_file=None, val\_folder=None, val\_ann\_file=None, test\_folder=None, test\_ann\_file=None, predict\_folder=None, train\_transform=None, val\_transform=None, test\_transform=None, predict\_transform=None, data\_fetcher=None, preprocess=None, val\_split=None, batch\_size=4, num\_workers=0, \*\*preprocess\_kwargs)

Creates a *ObjectDetectionData* object from the given data folders and annotation files in the VIA format.

**Parameters**

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **train\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **val\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **test\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.

- **batch\_size** (int) – The batch\_size argument to pass to the *DataModule*.
- **num\_workers** (int) – The num\_workers argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if preprocess = None.

**Returns** The constructed data module.

Examples:

```
data_module = ObjectDetectionData.from_via(
    train_folder="train_folder",
    train_ann_file="annotations.json",
)
```

**classmethod from\_voc**(train\_folder=None, train\_ann\_file=None, val\_folder=None, val\_ann\_file=None, test\_folder=None, test\_ann\_file=None, predict\_folder=None, train\_transform=None, val\_transform=None, test\_transform=None, predict\_transform=None, data\_fetcher=None, preprocess=None, val\_split=None, batch\_size=4, num\_workers=0, \*\*preprocess\_kwargs)

Creates a *ObjectDetectionData* object from the given data folders and annotation files in the VOC format.

#### Parameters

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **train\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **val\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **test\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, cls.preprocess\_cls will be constructed and used.
- **val\_split** (Optional[float]) – The val\_split argument to pass to the *DataModule*.
- **batch\_size** (int) – The batch\_size argument to pass to the *DataModule*.
- **num\_workers** (int) – The num\_workers argument to pass to the *DataModule*.

- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = ObjectDetectionData.from_voc(
    train_folder="train_folder",
    train_ann_file="annotations.json",
)
```

### 46.2.3 FiftyOneParser

```
class flash.image.detection.data.FiftyOneParser(data, class_map, label_field, iscrowd)
```

### 46.2.4 ObjectDetectionFiftyOneDataSource

```
class flash.image.detection.data.ObjectDetectionFiftyOneDataSource(label_field='ground_truth',
                                                                    iscrowd='iscrowd')
```

### 46.2.5 ObjectDetectionPreprocess

```
class flash.image.detection.data.ObjectDetectionPreprocess(train_transform=None,
                                                            val_transform=None,
                                                            test_transform=None,
                                                            predict_transform=None,
                                                            image_size=(128, 128), parser=None,
                                                            **data_source_kwargs)
```

### 46.2.6 FiftyOneDetectionLabels

```
class flash.image.detection.serialization.FiftyOneDetectionLabels(labels=None,
                                                                    threshold=None,
                                                                    return_filepath=False)
```

A *Serializer* which converts model outputs to FiftyOne detection format.

#### Parameters

- **labels** (Optional[List[str]]) – A list of labels, assumed to map the class index to the label for that class. If `labels` is not provided, will attempt to get them from the *LabelsState*.
- **threshold** (Optional[float]) – a score threshold to apply to candidate detections.
- **return\_filepath** (bool) – Boolean determining whether to return a dict containing filepath and FiftyOne labels (True) or only a list of FiftyOne labels (False)

## 46.3 Keypoint Detection

<i>KeypointDetector</i>	The <code>ObjectDetector</code> is a Task for detecting objects in images.
<i>KeypointDetectionData</i>	
<i>keypoint_detection.data.</i>	
<i>KeypointDetectionPreprocess</i>	

### 46.3.1 KeypointDetector

```
class flash.image.keypoint_detection.model.KeypointDetector(num_keypoints, num_classes=2,
                                                            backbone='resnet18_fpn',
                                                            head='keypoint_rcnn',
                                                            pretrained=True, optimizer='Adam',
                                                            lr_scheduler=None,
                                                            learning_rate=0.0005,
                                                            serializer=None, **kwargs)
```

The `ObjectDetector` is a Task for detecting objects in images. For more details, see [Object Detection](#).

#### Parameters

- **num\_classes** (int) – the number of classes for detection, including background
- **model** – a string of :attr`\_models`. Defaults to 'fasterrcnn'.
- **backbone** (Optional[str]) – Pretained backbone CNN architecture. Constructs a model with a ResNet-50-FPN backbone when no backbone is specified.
- **fpn** – If True, creates a Feature Pyramid Network on top of Resnet based CNNs.
- **pretrained** (bool) – if true, returns a model pre-trained on COCO train2017
- **pretrained\_backbone** – if true, returns a model with backbone pre-trained on Imagenet
- **trainable\_backbone\_layers** – number of trainable resnet layers starting from final block. Only applicable for *fasterrcnn*.
- **loss** – the function(s) to update the model with. Has no effect for torchvision detection models.
- **metrics** – The provided metrics. All metrics here will be logged to progress bar and the respective logger. Changing this argument currently has no effect.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **pretrained** – Whether the model from torchvision should be loaded with it's pretrained weights. Has no effect for custom models.
- **learning\_rate** (float) – The learning rate to use for training

### 46.3.2 KeypointDetectionData

```
class flash.image.keypoint_detection.data.KeypointDetectionData(train_dataset=None,
                                                                val_dataset=None,
                                                                test_dataset=None,
                                                                predict_dataset=None,
                                                                data_source=None,
                                                                preprocess=None,
                                                                postprocess=None,
                                                                data_fetcher=None,
                                                                val_split=None, batch_size=4,
                                                                num_workers=0,
                                                                sampler=None)
```

```
classmethod from_coco(train_folder=None, train_ann_file=None, val_folder=None, val_ann_file=None,
                      test_folder=None, test_ann_file=None, predict_folder=None,
                      train_transform=None, val_transform=None, test_transform=None,
                      predict_transform=None, data_fetcher=None, preprocess=None, val_split=None,
                      batch_size=4, num_workers=0, **preprocess_kwargs)
```

Creates a [KeypointDetectionData](#) object from the given data folders and annotation files in the COCO format.

#### Parameters

- **train\_folder** `(Optional[str])` – The folder containing the train data.
- **train\_ann\_file** `(Optional[str])` – The COCO format annotation file.
- **val\_folder** `(Optional[str])` – The folder containing the validation data.
- **val\_ann\_file** `(Optional[str])` – The COCO format annotation file.
- **test\_folder** `(Optional[str])` – The folder containing the test data.
- **test\_ann\_file** `(Optional[str])` – The COCO format annotation file.
- **predict\_folder** `(Optional[str])` – The folder containing the predict data.
- **train\_transform** `(Optional[Dict[str, Callable]])` – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** `(Optional[Dict[str, Callable]])` – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** `(Optional[Dict[str, Callable]])` – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** `(Optional[Dict[str, Callable]])` – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** `(Optional[BaseDataFetcher])` – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** `(Optional[Preprocess])` – The [Preprocess](#) to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** `(Optional[float])` – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** `(int)` – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** `(int)` – The `num_workers` argument to pass to the [DataModule](#).

- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = KeypointDetectionData.from_coco(
    train_folder="train_folder",
    train_ann_file="annotations.json",
)
```

### 46.3.3 KeypointDetectionPreprocess

```
class flash.image.keypoint_detection.data.KeypointDetectionPreprocess(
    train_transform=None,
    val_transform=None,
    test_transform=None,
    predict_transform=None,
    image_size=(128, 128),
    parser=None)
```

## 46.4 Instance Segmentation

<i>InstanceSegmentation</i>	The InstanceSegmentation is a Task for detecting objects in images.
<i>InstanceSegmentationData</i>	
<i>instance_segmentation.data.</i>	
<i>InstanceSegmentationPreprocess</i>	

### 46.4.1 InstanceSegmentation

```
class flash.image.instance_segmentation.model.InstanceSegmentation(
    num_classes,
    backbone='resnet18_fpn',
    head='mask_rcnn',
    pretrained=True,
    optimizer='Adam',
    lr_scheduler=None,
    learning_rate=0.0005,
    serializer=None, **kwargs)
```

The InstanceSegmentation is a Task for detecting objects in images. For more details, see [Object Detection](#).

#### Parameters

- **num\_classes** (int) – the number of classes for detection, including background
- **model** – a string of :attr:`\_models`. Defaults to 'fasterrcnn'.
- **backbone** (Optional[str]) – Pretained backbone CNN architecture. Constructs a model with a ResNet-50-FPN backbone when no backbone is specified.
- **fpn** – If True, creates a Feature Pyramid Network on top of Resnet based CNNs.



- **pretrained** (bool) – if true, returns a model pre-trained on COCO train2017
- **pretrained\_backbone** – if true, returns a model with backbone pre-trained on Imagenet
- **trainable\_backbone\_layers** – number of trainable resnet layers starting from final block. Only applicable for *fasterrcnn*.
- **loss** – the function(s) to update the model with. Has no effect for torchvision detection models.
- **metrics** – The provided metrics. All metrics here will be logged to progress bar and the respective logger. Changing this argument currently has no effect.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **pretrained** – Whether the model from torchvision should be loaded with it's pretrained weights. Has no effect for custom models.
- **learning\_rate** (float) – The learning rate to use for training

#### 46.4.2 InstanceSegmentationData

```
class flash.image.instance_segmentation.data.InstanceSegmentationData(
    train_dataset=None,
    val_dataset=None,
    test_dataset=None,
    predict_dataset=None,
    data_source=None,
    preprocess=None,
    postprocess=None,
    data_fetcher=None,
    val_split=None,
    batch_size=4,
    num_workers=0,
    sampler=None)
```

```
classmethod from_coco(
    train_folder=None, train_ann_file=None, val_folder=None, val_ann_file=None,
    test_folder=None, test_ann_file=None, predict_folder=None,
    train_transform=None, val_transform=None, test_transform=None,
    predict_transform=None, data_fetcher=None, preprocess=None, val_split=None,
    batch_size=4, num_workers=0, **preprocess_kwargs)
```

Creates a *InstanceSegmentationData* object from the given data folders and annotation files in the COCO format.

##### Parameters

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **train\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **val\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **test\_ann\_file** (Optional[str]) – The COCO format annotation file.

- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = InstanceSegmentationData.from_coco(
    train_folder="train_folder",
    train_ann_file="annotations.json",
)
```

**classmethod from\_voc**(*train\_folder=None, train\_ann\_file=None, val\_folder=None, val\_ann\_file=None, test\_folder=None, test\_ann\_file=None, predict\_folder=None, train\_transform=None, val\_transform=None, test\_transform=None, predict\_transform=None, data\_fetcher=None, preprocess=None, val\_split=None, batch\_size=4, num\_workers=0, \*\*preprocess\_kwargs*)

Creates a *InstanceSegmentationData* object from the given data folders and annotation files in the VOC format.

#### Parameters

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **train\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **val\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **test\_ann\_file** (Optional[str]) – The COCO format annotation file.
- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.

- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = InstanceSegmentationData.from_voc(
    train_folder="train_folder",
    train_ann_file="annotations.json",
)
```

### 46.4.3 InstanceSegmentationPreprocess

```
class flash.image.instance_segmentation.data.InstanceSegmentationPreprocess(
    train_transform=None,
    val_transform=None,
    test_transform=None,
    pre-
    dict_transform=None,
    im-
    age_size=(128,
    128),
    parser=None)
```

## 46.5 Embedding

---

*ImageEmbedder*

The *ImageEmbedder* is a Task for obtaining feature vectors (embeddings) from images.

---

## 46.5.1 ImageEmbedder

```
class flash.image.embedding.model.ImageEmbedder(training_strategy, head, pretraining_transform,
                                                backbone='resnet', pretrained=False,
                                                optimizer='Adam', lr_scheduler=None,
                                                learning_rate=0.001, backbone_kwargs=None,
                                                training_strategy_kwargs=None,
                                                pretraining_transform_kwargs=None)
```

The ImageEmbedder is a Task for obtaining feature vectors (embeddings) from images. For more details, see *Image Embedder*.

### Parameters

- **training\_strategy** (str) – Training strategy from VISSL, select between ‘simclr’, ‘swav’, ‘dino’, ‘moco’, or ‘barlow\_twins’.
- **head** (str) – projection head used for task, select between ‘simclr\_head’, ‘swav\_head’, ‘dino\_head’, ‘moco\_head’, or ‘barlow\_twins\_head’.
- **pretraining\_transform** (str) – transform applied to input image for pre-training SSL model. Select between ‘simclr\_transform’, ‘swav\_transform’, ‘dino\_transform’, ‘moco\_transform’, or ‘barlow\_twins\_transform’.
- **backbone** (str) – VISSL backbone, defaults to resnet.
- **pretrained** (bool) – Use a pretrained backbone, defaults to False.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **learning\_rate** (float) – Learning rate to use for training, defaults to 1e-3.
- **backbone\_kwargs** (Optional[Dict[str, Any]]) – arguments to be passed to VISSL backbones, i.e. vision\_transformer and resnet.
- **training\_strategy\_kwargs** (Optional[Dict[str, Any]]) – arguments passed to VISSL loss function, projection head and training hooks.
- **pretraining\_transform\_kwargs** (Optional[Dict[str, Any]]) – arguments passed to VISSL transforms.

## 46.6 Segmentation

<i>SemanticSegmentation</i>	SemanticSegmentation is a Task for semantic segmentation of images.
<i>SemanticSegmentationData</i>	Data module for semantic segmentation tasks.
<i>SemanticSegmentationPreprocess</i>	
<i>segmentation.data</i> .	
<i>SegmentationMatplotlibVisualization</i>	Process and show the image batch and its associated label using matplotlib.
<i>segmentation.data</i> .	
<i>SemanticSegmentationNumpyDataSource</i>	

continues on next page

Table 7 – continued from previous page

<code>segmentation.data.</code> <code>SemanticSegmentationTensorDataSource</code>	
<code>segmentation.data.</code> <code>SemanticSegmentationPathsDataSource</code>	
<code>segmentation.data.</code> <code>SemanticSegmentationFiftyOneDataSource</code>	
<code>segmentation.data.</code> <code>SemanticSegmentationDeserializer</code>	
<code>segmentation.model.</code> <code>SemanticSegmentationPostprocess</code>	
<code>segmentation.serialization.</code> <code>FiftyOneSegmentationLabels</code>	A <a href="#">Serializer</a> which converts the model outputs to FiftyOne segmentation format.
<code>segmentation.serialization.</code> <code>SegmentationLabels</code>	A <a href="#">Serializer</a> which converts the model outputs to the label of the argmax classification per pixel in the image for semantic segmentation tasks.

### 46.6.1 SemanticSegmentation

```
class flash.image.segmentation.model.SemanticSegmentation(num_classes, backbone='resnet50',
                                                           backbone_kwargs=None, head='fpn',
                                                           head_kwargs=None, pretrained=True,
                                                           loss_fn=None, optimizer='Adam',
                                                           lr_scheduler=None, metrics=None,
                                                           learning_rate=0.001, multi_label=False,
                                                           serializer=None, postprocess=None)
```

`SemanticSegmentation` is a Task for semantic segmentation of images. For more details, see [Semantic Segmentation](#).

#### Parameters

- **num\_classes** (int) – Number of classes to classify.
- **backbone** (Union[str, Module]) – A string or model to use to compute image features.
- **backbone\_kwargs** (Optional[Dict]) – Additional arguments for the backbone configuration.
- **head** (str) – A string or (model, num\_features) tuple to use to compute image features.
- **head\_kwargs** (Optional[Dict]) – Additional arguments for the head configuration.
- **pretrained** (Union[bool, str]) – Use a pretrained backbone.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the `torchmetrics` package, a custom metric inheriting from `torchmetrics.Metric`, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature `metric(preds, target)` and return a single scalar tensor. Defaults to `torchmetrics.IOU`.
- **learning\_rate** (float) – Learning rate to use for training.

- **multi\_label** (bool) – Whether the targets are multi-label or not.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The *Serializer* to use when serializing prediction outputs.
- **postprocess** (Optional[Postprocess]) – *Postprocess* use for post processing samples.

## 46.6.2 SemanticSegmentationData

```
class flash.image.segmentation.data.SemanticSegmentationData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None,
                                                             postprocess=None,
                                                             data_fetcher=None, val_split=None,
                                                             batch_size=4, num_workers=0,
                                                             sampler=None)
```

Data module for semantic segmentation tasks.

```
classmethod from_folders(train_folder=None, train_target_folder=None, val_folder=None,
                        val_target_folder=None, test_folder=None, test_target_folder=None,
                        predict_folder=None, train_transform=None, val_transform=None,
                        test_transform=None, predict_transform=None, data_fetcher=None,
                        preprocess=None, val_split=None, batch_size=4, num_workers=0,
                        num_classes=None, labels_map=None, **preprocess_kwargs)
```

Creates a *SemanticSegmentationData* object from the given data folders and corresponding target folders.

### Parameters

- **train\_folder** (Optional[str]) – The folder containing the train data.
- **train\_target\_folder** (Optional[str]) – The folder containing the train targets (targets must have the same file name as their corresponding inputs).
- **val\_folder** (Optional[str]) – The folder containing the validation data.
- **val\_target\_folder** (Optional[str]) – The folder containing the validation targets (targets must have the same file name as their corresponding inputs).
- **test\_folder** (Optional[str]) – The folder containing the test data.
- **test\_target\_folder** (Optional[str]) – The folder containing the test targets (targets must have the same file name as their corresponding inputs).
- **predict\_folder** (Optional[str]) – The folder containing the predict data.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.

- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **num\_classes** (Optional[int]) – Number of classes within the segmentation mask.
- **labels\_map** (Optional[Dict[int, Tuple[int, int, int]]]) – Mapping between a `class_id` and its corresponding color.
- **preprocess\_kwargs** – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = SemanticSegmentationData.from_folders(
    train_folder="train_folder",
    train_target_folder="train_masks",
)
```

**set\_block\_viz\_window**(value)

Setter method to switch on/off matplotlib to pop up windows.

**Return type** None

### 46.6.3 SemanticSegmentationPreprocess

```
class flash.image.segmentation.data.SemanticSegmentationPreprocess(
    train_transform=None,
    val_transform=None,
    test_transform=None,
    predict_transform=None,
    image_size=(128, 128),
    deserializer=None,
    num_classes=None,
    labels_map=None,
    **data_source_kwargs)
```

#### 46.6.4 SegmentationMatplotlibVisualization

**class** flash.image.segmentation.data.SegmentationMatplotlibVisualization(labels\_map)  
Process and show the image batch and its associated label using matplotlib.

#### 46.6.5 SemanticSegmentationNumpyDataSource

**class** flash.image.segmentation.data.SemanticSegmentationNumpyDataSource(labels=None)

#### 46.6.6 SemanticSegmentationTensorDataSource

**class** flash.image.segmentation.data.SemanticSegmentationTensorDataSource(labels=None)

#### 46.6.7 SemanticSegmentationPathsDataSource

**class** flash.image.segmentation.data.SemanticSegmentationPathsDataSource

#### 46.6.8 SemanticSegmentationFiftyOneDataSource

**class** flash.image.segmentation.data.SemanticSegmentationFiftyOneDataSource(label\_field='ground\_truth')

#### 46.6.9 SemanticSegmentationDeserializer

**class** flash.image.segmentation.data.SemanticSegmentationDeserializer

#### 46.6.10 SemanticSegmentationPostprocess

**class** flash.image.segmentation.model.SemanticSegmentationPostprocess(save\_path=None)

#### 46.6.11 FiftyOneSegmentationLabels

**class** flash.image.segmentation.serialization.FiftyOneSegmentationLabels(labels\_map=None,  
visualize=False, re-  
turn\_filepath=False)

A *Serializer* which converts the model outputs to FiftyOne segmentation format.

##### Parameters

- **labels\_map** *(Optional[Dict[int, Tuple[int, int, int]])* – A dictionary that map the labels ids to pixel intensities.
- **visualize** *(bool)* – whether to visualize the image labels.
- **return\_filepath** *(bool)* – Boolean determining whether to return a dict containing filepath and FiftyOne labels (True) or only a list of FiftyOne labels (False).



### 46.6.12 SegmentationLabels

**class** `flash.image.segmentation.serialization.SegmentationLabels`(*labels\_map=None*,  
*visualize=False*)

A *Serializer* which converts the model outputs to the label of the argmax classification per pixel in the image for semantic segmentation tasks.

#### Parameters

- **labels\_map** (Optional[Dict[int, Tuple[int, int, int]]]) – A dictionary that map the labels ids to pixel intensities.
- **visualize** (bool) – Whether to visualize the image labels.

**static labels\_to\_image**(*img\_labels*, *labels\_map*)

Function that given an image with labels ids and their pixels intensity mapping, creates a RGB representation for visualisation purposes.

**Return type** `Tensor`

<code>segmentation.transforms.default_transforms</code>	The default transforms for semantic segmentation: resize the image and mask, collate the batch, and apply normalization.
<code>segmentation.transforms.prepare_target</code>	Convert the target mask to long and remove the channel dimension.
<code>segmentation.transforms.train_default_transforms</code>	During training, we apply the default transforms with additional <code>RandomHorizontalFlip</code> and <code>ColorJitter</code> .

### 46.6.13 flash.image.segmentation.transforms.default\_transforms

`flash.image.segmentation.transforms.default_transforms`(*image\_size*)

The default transforms for semantic segmentation: resize the image and mask, collate the batch, and apply normalization.

**Return type** `Dict[str, Callable]`

### 46.6.14 flash.image.segmentation.transforms.prepare\_target

`flash.image.segmentation.transforms.prepare_target`(*tensor*)

Convert the target mask to long and remove the channel dimension.

**Return type** `Tensor`

### 46.6.15 flash.image.segmentation.transforms.train\_default\_transforms

`flash.image.segmentation.transforms.train_default_transforms`(*image\_size*)

During training, we apply the default transforms with additional `RandomHorizontalFlip` and `ColorJitter`.

**Return type** `Dict[str, Callable]`

## 46.7 Style Transfer

<i>StyleTransfer</i>	StyleTransfer is a Task for transferring the style from one image onto another.
<i>StyleTransferData</i>	
<i>StyleTransferPreprocess</i>	

### 46.7.1 StyleTransfer

```
class flash.image.style_transfer.model.StyleTransfer(style_image=None, model=None,
                                                    backbone='vgg16', content_layer='relu2_2',
                                                    content_weight=100000.0,
                                                    style_layers=['relu1_2', 'relu2_2', 'relu3_3',
                                                                    'relu4_3'], style_weight=10000000000.0,
                                                    optimizer='Adam', lr_scheduler=None,
                                                    learning_rate=0.001, serializer=None)
```

StyleTransfer is a Task for transferring the style from one image onto another. For more details, see [Style Transfer](#).

#### Parameters

- **style\_image** (Union[str, Tensor, None]) – Image or path to an image to derive the style from.
- **model** (Optional[Module]) – The model by the style transfer task.
- **backbone** (str) – A string or model to use to compute the style loss from.
- **content\_layer** (str) – Which layer from the backbone to extract the content loss from.
- **content\_weight** (float) – The weight associated with the content loss. A lower value will lose content over style.
- **style\_layers** (Union[Sequence[str], str]) – Layers from the backbone to derive the style loss from.
- **style\_weight** (float) – The weight associated with the style loss. A lower value will lose style over content.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **learning\_rate** (float) – Learning rate to use for training, defaults to 1e-3.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The [Serializer](#) to use when serializing prediction outputs.

### 46.7.2 StyleTransferData

```
class flash.image.style_transfer.data.StyleTransferData(train_dataset=None, val_dataset=None,
                                                         test_dataset=None, predict_dataset=None,
                                                         data_source=None, preprocess=None,
                                                         postprocess=None, data_fetcher=None,
                                                         val_split=None, batch_size=4,
                                                         num_workers=0, sampler=None)
```

### 46.7.3 StyleTransferPreprocess

```
class flash.image.style_transfer.data.StyleTransferPreprocess(train_transform=None,
                                                             val_transform=None,
                                                             test_transform=None,
                                                             predict_transform=None,
                                                             image_size=256)
```

---

*raise\_not\_supported*

**rtype** NoReturn

---

### 46.7.4 flash.image.style\_transfer.utils.raise\_not\_supported

```
flash.image.style_transfer.utils.raise_not_supported(phase)
```

**Return type** NoReturn

## 46.8 flash.image.data

---

*ImageDeserializer*

---

*ImageFiftyOneDataSource*

---

*ImageNumpyDataSource*

---

*ImagePathsDataSource*

---

*ImageTensorDataSource*

---

### **46.8.1 ImageDeserializer**

```
class flash.image.data.ImageDeserializer
```

### **46.8.2 ImageFiftyOneDataSource**

```
class flash.image.data.ImageFiftyOneDataSource(label_field='ground_truth')
```

### **46.8.3 ImageNumpyDataSource**

```
class flash.image.data.ImageNumpyDataSource(labels=None)
```

### **46.8.4 ImagePathsDataSource**

```
class flash.image.data.ImagePathsDataSource
```

### **46.8.5 ImageTensorDataSource**

```
class flash.image.data.ImageTensorDataSource(labels=None)
```

- *Classification*
- *Speech Recognition*

## 47.1 Classification

---

<i>AudioClassificationData</i>	Data module for audio classification.
<i>AudioClassificationPreprocess</i>	

---

### 47.1.1 AudioClassificationData

```
class flash.audio.classification.data.AudioClassificationData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None,
                                                             postprocess=None,
                                                             data_fetcher=None,
                                                             val_split=None, batch_size=4,
                                                             num_workers=0, sampler=None)
```

Data module for audio classification.

### 47.1.2 AudioClassificationPreprocess

```
class flash.audio.classification.data.AudioClassificationPreprocess(train_transform=None,
                                                                    val_transform=None,
                                                                    test_transform=None,
                                                                    predict_transform=None,
                                                                    spectrogram_size=(128,
                                                                    128),
                                                                    time_mask_param=None,
                                                                    freq_mask_param=None,
                                                                    deserializer=None)
```

## 47.2 Speech Recognition

<a href="#"><i>SpeechRecognitionData</i></a>	Data Module for text classification tasks.
<a href="#"><i>SpeechRecognition</i></a>	The <code>SpeechRecognition</code> task is a Task for converting speech to text.
<a href="#"><i>speech_recognition.data.SpeechRecognitionPreprocess</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionBackboneState</i></a>	The <code>SpeechRecognitionBackboneState</code> stores the backbone in use by the <a href="#"><i>SpeechRecognitionPostprocess</i></a>
<a href="#"><i>speech_recognition.data.SpeechRecognitionPostprocess</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionCSVDataSource</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionJSONDataSource</i></a>	
<a href="#"><i>speech_recognition.data.BaseSpeechRecognition</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionFileDataSource</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionPathsDataSource</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionDatasetDataSource</i></a>	
<a href="#"><i>speech_recognition.data.SpeechRecognitionDeserializer</i></a>	

### 47.2.1 SpeechRecognitionData

```
class flash.audio.speech_recognition.data.SpeechRecognitionData(train_dataset=None,
                                                                val_dataset=None,
                                                                test_dataset=None,
                                                                predict_dataset=None,
                                                                data_source=None,
                                                                preprocess=None,
                                                                postprocess=None,
                                                                data_fetcher=None,
                                                                val_split=None, batch_size=4,
                                                                num_workers=0,
                                                                sampler=None)
```

Data Module for text classification tasks.

## 47.2.2 SpeechRecognition

```
class flash.audio.speech_recognition.model.SpeechRecognition(backbone='facebook/wav2vec2-base-960h', optimizer='Adam', lr_scheduler=None, learning_rate=1e-05, serializer=None)
```

The SpeechRecognition task is a Task for converting speech to text. For more details, see [Speech Recognition](#).

### Parameters

- **backbone** (str) – Any speech recognition model from [HuggingFace/transformers](#).
- **learning\_rate** (float) – Learning rate to use for training, defaults to 1e-5.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The [Serializer](#) to use when serializing prediction outputs.

## 47.2.3 SpeechRecognitionPreprocess

```
class flash.audio.speech_recognition.data.SpeechRecognitionPreprocess(train_transform=None, val_transform=None, test_transform=None, predict_transform=None, sampling_rate=16000)
```

## 47.2.4 SpeechRecognitionBackboneState

```
class flash.audio.speech_recognition.data.SpeechRecognitionBackboneState(backbone)
```

The `SpeechRecognitionBackboneState` stores the backbone in use by the [SpeechRecognitionPostprocess](#)

## 47.2.5 SpeechRecognitionPostprocess

```
class flash.audio.speech_recognition.data.SpeechRecognitionPostprocess
```

## 47.2.6 SpeechRecognitionCSVDataSource

```
class flash.audio.speech_recognition.data.SpeechRecognitionCSVDataSource(sampling_rate)
```

### **47.2.7 SpeechRecognitionJSONDataSource**

```
class flash.audio.speech_recognition.data.SpeechRecognitionJSONDataSource(sampling_rate)
```

### **47.2.8 BaseSpeechRecognition**

```
class flash.audio.speech_recognition.data.BaseSpeechRecognition
```

### **47.2.9 SpeechRecognitionFileDataSource**

```
class flash.audio.speech_recognition.data.SpeechRecognitionFileDataSource(sampling_rate,  
                                                                           filetype=None)
```

### **47.2.10 SpeechRecognitionPathsDataSource**

```
class flash.audio.speech_recognition.data.SpeechRecognitionPathsDataSource(sampling_rate)
```

### **47.2.11 SpeechRecognitionDatasetDataSource**

```
class flash.audio.speech_recognition.data.SpeechRecognitionDatasetDataSource(sampling_rate)
```

### **47.2.12 SpeechRecognitionDeserializer**

```
class flash.audio.speech_recognition.data.SpeechRecognitionDeserializer(sampling_rate)
```



## FLASH.POINTCLOUD

- Segmentation
  - Object Detection

### 48.1 Segmentation

<i>PointCloudSegmentation</i>	The <code>PointCloudClassifier</code> is a <i>ClassificationTask</i> that classifies pointcloud data.
<i>PointCloudSegmentationData</i>	
<i>segmentation.data.</i>	
<i>PointCloudSegmentationPreprocess</i>	
<i>segmentation.data.</i>	
<i>PointCloudSegmentationFoldersDataSource</i>	
<i>segmentation.data.</i>	
<i>PointCloudSegmentationDatasetDataSource</i>	

#### 48.1.1 PointCloudSegmentation

```
class flash.pointcloud.segmentation.model.PointCloudSegmentation(num_classes,
                                                                    backbone='RandLANet',
                                                                    backbone_kwargs=None,
                                                                    head=None,
                                                                    loss_fn=torch.nn.functional.cross_entropy,
                                                                    optimizer='Adam',
                                                                    lr_scheduler=None,
                                                                    metrics=None,
                                                                    learning_rate=0.01,
                                                                    multi_label=False,
                                                                    serializer=<flash.pointcloud.segmentation.model.PointCloudSegmentationSerializer object>)
```

The `PointCloudClassifier` is a *ClassificationTask* that classifies pointcloud data.

#### Parameters

- `num_features` – The number of features (elements) in the input data.

- **num\_classes** (int) – The number of classes (outputs) for this *Task*.
- **backbone** (Union[str, Tuple[Module, int]]) – The backbone name (or a tuple of nn.Module, output size) to use.
- **backbone\_kwargs** (Optional[Dict]) – Any additional kwargs to pass to the backbone constructor.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – The loss function to use. If None, a default will be selected by the *ClassificationTask* depending on the multi\_label argument.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Any metrics to use with this *Task*. If None, a default will be selected by the *ClassificationTask* depending on the multi\_label argument.
- **learning\_rate** (float) – The learning rate for the optimizer.
- **multi\_label** (bool) – If True, this will be treated as a multi-label classification problem.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The *Serializer* to use for prediction outputs.

**forward**(x)

First call the backbone, then the model head.

**Return type** Tensor

### 48.1.2 PointCloudSegmentationData

```
class flash.pointcloud.segmentation.data.PointCloudSegmentationData(
    train_dataset=None,
    val_dataset=None,
    test_dataset=None,
    predict_dataset=None,
    data_source=None,
    preprocess=None,
    postprocess=None,
    data_fetcher=None,
    val_split=None,
    batch_size=4,
    num_workers=0,
    sampler=None)
```

### 48.1.3 PointCloudSegmentationPreprocess

```
class flash.pointcloud.segmentation.data.PointCloudSegmentationPreprocess(train_transform=None,
                                                                           val_transform=None,
                                                                           test_transform=None,
                                                                           pre-
                                                                           dict_transform=None,
                                                                           image_size=(196,
                                                                           196),
                                                                           deserializer=None)
```

### 48.1.4 PointCloudSegmentationFoldersDataSource

```
class flash.pointcloud.segmentation.data.PointCloudSegmentationFoldersDataSource
```

### 48.1.5 PointCloudSegmentationDatasetDataSource

```
class flash.pointcloud.segmentation.data.PointCloudSegmentationDatasetDataSource
```

## 48.2 Object Detection

---

*PointCloudObjectDetector*

The `PointCloudObjectDetector` is a *ClassificationTask* that classifies pointcloud data.

---

*PointCloudObjectDetectorData*

---

*detection.data.PointCloudObjectDetectorPreprocess*

---

*detection.data.PointCloudObjectDetectorFoldersDataSource*

---

*detection.data.PointCloudObjectDetectorDatasetDataSource*

---

### 48.2.1 PointCloudObjectDetector

```
class flash.pointcloud.detection.model.PointCloudObjectDetector(num_classes,
                                                                  backbone='pointpillars_kitti',
                                                                  backbone_kwargs=None,
                                                                  head=None, loss_fn=None,
                                                                  optimizer='Adam',
                                                                  lr_scheduler=None,
                                                                  metrics=None,
                                                                  learning_rate=0.01, serial-
                                                                  izer=<flash.pointcloud.detection.model.PointCloud
                                                                  object>, lambda_loss_cls=1.0,
                                                                  lambda_loss_bbox=1.0,
                                                                  lambda_loss_dir=1.0)
```

The `PointCloudObjectDetector` is a *ClassificationTask* that classifies pointcloud data.

**Parameters**

- **num\_features** – The number of features (elements) in the input data.
- **num\_classes** (int) – The number of classes (outputs) for this *Task*.
- **backbone** (Union[str, Tuple[Module, int]]) – The backbone name (or a tuple of nn.Module, output size) to use.
- **backbone\_kwargs** (Optional[Dict]) – Any additional kwargs to pass to the backbone constructor.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – The loss function to use. If None, a default will be selected by the *ClassificationTask* depending on the multi\_label argument.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Any metrics to use with this *Task*. If None, a default will be selected by the *ClassificationTask* depending on the multi\_label argument.
- **learning\_rate** (float) – The learning rate for the optimizer.
- **multi\_label** – If True, this will be treated as a multi-label classification problem.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The *Serializer* to use for prediction outputs.
- **lambda\_loss\_cls** (float) – The value to scale the loss classification.
- **lambda\_loss\_bbox** (float) – The value to scale the bounding boxes loss.
- **lambda\_loss\_dir** (float) – The value to scale the bounding boxes direction loss.

**forward(x)**

First call the backbone, then the model head.

**Return type** *Tensor*

**48.2.2 PointCloudObjectDetectorData**

```
class flash.pointcloud.detection.data.PointCloudObjectDetectorData(
    train_dataset=None,
    val_dataset=None,
    test_dataset=None,
    predict_dataset=None,
    data_source=None,
    preprocess=None,
    postprocess=None,
    data_fetcher=None,
    val_split=None,
    batch_size=4,
    num_workers=0,
    sampler=None)
```

```

classmethod from_folders(train_folder=None, val_folder=None, test_folder=None,
                        predict_folder=None, train_transform=None, val_transform=None,
                        test_transform=None, predict_transform=None, data_fetcher=None,
                        preprocess=None, val_split=None, batch_size=4, num_workers=0,
                        sampler=None, scans_folder_name='scans', labels_folder_name='labels',
                        calibrations_folder_name='calibs', data_format='kitti',
                        **preprocess_kwargs)

```

Creates a [DataModule](#) object from the given folders using the [DataSource](#) of name FOLDERS from the passed or constructed [Preprocess](#).

#### Parameters

- **train\_folder** [\(Optional\[str\]\)](#) – The folder containing the train data.
- **val\_folder** [\(Optional\[str\]\)](#) – The folder containing the validation data.
- **test\_folder** [\(Optional\[str\]\)](#) – The folder containing the test data.
- **predict\_folder** [\(Optional\[str\]\)](#) – The folder containing the predict data.
- **train\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** [\(Optional\[Dict\[str, Callable\]\]\)](#) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** [\(Optional\[BaseDataFetcher\]\)](#) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** [\(Optional\[Preprocess\]\)](#) – The [Preprocess](#) to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** [\(Optional\[float\]\)](#) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** [\(int\)](#) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** [\(int\)](#) – The `num_workers` argument to pass to the [DataModule](#).
- **sampler** [\(Optional\[Type\[Sampler\]\]\)](#) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** [\(Any\)](#) – Additional keyword arguments to use when constructing the `preprocess`. Will only be used if `preprocess = None`.
- **scans\_folder\_name** [\(Optional\[str\]\)](#) – The name of the pointcloud scan folder
- **labels\_folder\_name** [\(Optional\[str\]\)](#) – The name of the pointcloud scan labels folder
- **calibrations\_folder\_name** [\(Optional\[str\]\)](#) – The name of the pointcloud scan calibration folder
- **data\_format** [\(Optional\[BaseDataFormat\]\)](#) – Format in which the data are stored.

**Return type** [DataModule](#)

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_folders(  
    train_folder="train_folder",  
    train_transform={  
        "to_tensor_transform": torch.as_tensor,  
    },  
)
```

### 48.2.3 PointCloudObjectDetectorPreprocess

```
class flash.pointcloud.detection.data.PointCloudObjectDetectorPreprocess(train_transform=None,  
                                                                           val_transform=None,  
                                                                           test_transform=None,  
                                                                           pre-  
                                                                           dict_transform=None,  
                                                                           deserializer=None,  
                                                                           **data_source_kwargs)
```

### 48.2.4 PointCloudObjectDetectorFoldersDataSource

```
class flash.pointcloud.detection.data.PointCloudObjectDetectorFoldersDataSource(data_format=None,  
                                                                                  im-  
                                                                                  age_size=(375,  
                                                                                  1242),  
                                                                                  **loader_kwargs)
```

### 48.2.5 PointCloudObjectDetectorDatasetDataSource

```
class flash.pointcloud.detection.data.PointCloudObjectDetectorDatasetDataSource(**kwargs)
```

## FLASH.TABULAR

- *Classification*
- *Regression*
- *Forecasting*
- *flash.tabular.data*

### 49.1 Classification

---

*TabularClassifier*

The `TabularClassifier` is a Task for classifying tabular data.

---

*TabularClassificationData*

---

#### 49.1.1 TabularClassifier

```
class flash.tabular.classification.model.TabularClassifier(num_features, num_classes,
                                                           embedding_sizes=None,
                                                           loss_fn=torch.nn.functional.cross_entropy,
                                                           optimizer='Adam', lr_scheduler=None,
                                                           metrics=None, learning_rate=0.01,
                                                           multi_label=False, serializer=None,
                                                           **tabnet_kwargs)
```

The `TabularClassifier` is a Task for classifying tabular data. For more details, see [Tabular Classification](#).

##### Parameters

- **num\_features** (int) – Number of columns in table (not including target column).
- **num\_classes** (int) – Number of classes to classify.
- **embedding\_sizes** (Optional[List[Tuple[int, int]]]) – List of (num\_classes, emb\_dim) to form categorical embeddings.
- **loss\_fn** (Callable) – Loss function for training, defaults to cross entropy.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.

- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the *torchmetrics* package, a custom metric inheriting from *torchmetrics.Metric*, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature *metric(preds, target)* and return a single scalar tensor. Defaults to *torchmetrics.Accuracy*.
- **learning\_rate** (float) – Learning rate to use for training.
- **multi\_label** (bool) – Whether the targets are multi-label or not.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The *Serializer* to use when serializing prediction outputs.
- **\*\*tabnet\_kwargs** – Optional additional arguments for the TabNet model, see *pytorch-tabnet*.

### 49.1.2 TabularClassificationData

```
class flash.tabular.classification.data.TabularClassificationData(train_dataset=None,
                                                                val_dataset=None,
                                                                test_dataset=None,
                                                                predict_dataset=None,
                                                                data_source=None,
                                                                preprocess=None,
                                                                postprocess=None,
                                                                data_fetcher=None,
                                                                val_split=None, batch_size=4,
                                                                num_workers=0,
                                                                sampler=None)
```

## 49.2 Regression

---

*TabularRegressor*

The *TabularRegressor* is a Task for regression tabular data.

---

*TabularRegressionData*

---

### 49.2.1 TabularRegressor

```
class flash.tabular.regression.model.TabularRegressor(num_features, embedding_sizes=None,
                                                       loss_fn=torch.nn.functional.mse_loss,
                                                       optimizer='Adam', lr_scheduler=None,
                                                       metrics=None, learning_rate=0.01,
                                                       serializer=None, **tabnet_kwargs)
```

The *TabularRegressor* is a Task for regression tabular data.

#### Parameters

- **num\_features** (int) – Number of columns in table (not including target column).



- **embedding\_sizes** (Optional[List[Tuple[int, int]]]) – List of (num\_classes, emb\_dim) to form categorical embeddings.
- **loss\_fn** (Callable) – Loss function for training, defaults to cross entropy.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the *torchmetrics* package, a custom metric inheriting from *torchmetrics.Metric*, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature *metric(preds, target)* and return a single scalar tensor.
- **learning\_rate** (float) – Learning rate to use for training.
- **multi\_label** – Whether the targets are multi-label or not.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The *Serializer* to use when serializing prediction outputs.
- **\*\*tabnet\_kwargs** – Optional additional arguments for the TabNet model, see *pytorch-tabnet*.

## 49.2.2 TabularRegressionData

```
class flash.tabular.regression.data.TabularRegressionData(
    train_dataset=None, val_dataset=None,
    test_dataset=None,
    predict_dataset=None,
    data_source=None, preprocess=None,
    postprocess=None, data_fetcher=None,
    val_split=None, batch_size=4,
    num_workers=0, sampler=None)
```

## 49.3 Forecasting

---

*TabularForecaster*

---

*TabularForecastingData*

Data module for the tabular forecasting task.

---

*forecasting.data.TabularForecastingPreprocess*

---

*forecasting.data.TabularForecastingDataFrameDataSource*

---

*forecasting.data.TimeSeriesDataSetParameters* A *PreprocessState* containing labels, a mapping from class index to label.

---

### 49.3.1 TabularForecaster

```
class flash.tabular.forecasting.model.TabularForecaster(parameters, backbone,
                                                         backbone_kwargs=None, loss_fn=None,
                                                         optimizer='Adam', lr_scheduler=None,
                                                         metrics=None, learning_rate=0.004)
```

**property** `pytorch_forecasting_model`: `pytorch_lightning.LightningModule`

This property provides access to the `LightningModule` object that is wrapped by Flash for backbones provided by PyTorch Forecasting.

This can be used with `convert_predictions()` to access the visualization features built in to PyTorch Forecasting.

**Return type** `LightningModule`

### 49.3.2 TabularForecastingData

```
class flash.tabular.forecasting.data.TabularForecastingData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None, postprocess=None,
                                                             data_fetcher=None, val_split=None,
                                                             batch_size=4, num_workers=0,
                                                             sampler=None)
```

Data module for the tabular forecasting task.

```
classmethod from_data_frame(time_idx=None, target=None, group_ids=None, parameters=None,
                             train_data_frame=None, val_data_frame=None, test_data_frame=None,
                             predict_data_frame=None, train_transform=None, val_transform=None,
                             test_transform=None, predict_transform=None, data_fetcher=None,
                             preprocess=None, val_split=None, batch_size=4, num_workers=None,
                             **preprocess_kwargs)
```

Creates a `TabularForecastingData` object from the given data frames.

---

**Note:** The `time_idx`, `target`, and `group_ids` do not need to be provided if `parameters` are passed instead. These can be obtained from the `parameters` attribute of the `TabularForecastingData` object that contains your training data.

---

#### Parameters

- `time_idx` (Optional[str]) –
- `target` (Union[str, List[str], None]) – Column denoting the target or list of columns denoting the target.
- `group_ids` (Optional[List[str]]) – List of column names identifying a time series. This means that the `group_ids` identify a sample together with the `time_idx`. If you have only one timeseries, set this to the name of column that is constant.
- `parameters` (Optional[Dict[str, Any]]) – Parameters to use for the timeseries if `time_idx`, `target`, and `group_ids` are not provided (e.g. when loading data for inference or validation).

- **train\_data\_frame** (Optional[object]) – The pandas DataFrame containing the training data.
- **val\_data\_frame** (Optional[object]) – The pandas DataFrame containing the validation data.
- **test\_data\_frame** (Optional[object]) – The pandas DataFrame containing the testing data.
- **predict\_data\_frame** (Optional[object]) – The pandas DataFrame containing the data to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps *Preprocess* hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps *Preprocess* hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (Optional[int]) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = TabularForecastingData.from_data_frame(
    time_idx="time_idx",
    target="value",
    group_ids=["series"],
    train_data_frame=train_data,
)
```

**property parameters:** Optional[Dict[str, Any]]

The parameters dictionary from the *TimeSeriesDataSet* object created from the train data when constructing the *TabularForecastingData* object.

**Return type** Optional[Dict[str, Any]]

### 49.3.3 TabularForecastingPreprocess

```
class flash.tabular.forecasting.data.TabularForecastingPreprocess(train_transform=None,
                                                                  val_transform=None,
                                                                  test_transform=None,
                                                                  predict_transform=None,
                                                                  deserializer=None,
                                                                  **data_source_kwargs)
```

### 49.3.4 TabularForecastingDataFrameDataSource

```
class flash.tabular.forecasting.data.TabularForecastingDataFrameDataSource(time_idx=None,
                                                                            target=None,
                                                                            group_ids=None,
                                                                            parameters=None,
                                                                            **data_source_kwargs)
```

### 49.3.5 TimeSeriesDataSetParametersState

```
class flash.tabular.forecasting.data.TimeSeriesDataSetParametersState(time_series_dataset_parameters)
    A ProcessState containing labels, a mapping from class index to label.
```

## 49.4 flash.tabular.data

<i>TabularData</i>	Data module for tabular tasks.
<i>TabularDataFrameDataSource</i>	
<i>TabularCSVDataSource</i>	
<i>TabularDeserializer</i>	
<i>TabularPreprocess</i>	
<i>TabularPostprocess</i>	

### 49.4.1 TabularData

```
class flash.tabular.data.TabularData(train_dataset=None, val_dataset=None, test_dataset=None,
                                     predict_dataset=None, data_source=None, preprocess=None,
                                     postprocess=None, data_fetcher=None, val_split=None,
                                     batch_size=4, num_workers=0, sampler=None)
```

Data module for tabular tasks.

**property embedding\_sizes:** *list*

Recommended embedding sizes.

**Return type** *list*

```
classmethod from_csv(categorical_fields, numerical_fields, target_fields=None, train_file=None,
                    val_file=None, test_file=None, predict_file=None, train_transform=None,
                    val_transform=None, test_transform=None, predict_transform=None,
                    data_fetcher=None, preprocess=None, val_split=None, batch_size=4,
                    num_workers=0, sampler=None, **preprocess_kwargs)
```

Creates a [TabularData](#) object from the given CSV files.

#### Parameters

- **categorical\_fields** (Union[str, List[str], None]) – The field or fields (columns) in the CSV file containing categorical inputs.
- **numerical\_fields** (Union[str, List[str], None]) – The field or fields (columns) in the CSV file containing numerical inputs.
- **target\_fields** (Optional[str]) – The field or fields (columns) in the CSV file to use for the target.
- **train\_file** (Optional[str]) – The CSV file containing the training data.
- **val\_file** (Optional[str]) – The CSV file containing the validation data.
- **test\_file** (Optional[str]) – The CSV file containing the testing data.
- **predict\_file** (Optional[str]) – The CSV file containing the data to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** (int) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** (int) – The `num_workers` argument to pass to the [DataModule](#).
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** [DataModule](#)

**Returns** The constructed data module.

Examples:

```
data_module = TabularData.from_csv(
    "categorical_input",
    "numerical_input",
    "target",
    train_file="train_data.csv",
)
```

```
classmethod from_data_frame(categorical_fields, numerical_fields, target_fields=None,
                             train_data_frame=None, val_data_frame=None, test_data_frame=None,
                             predict_data_frame=None, train_transform=None, val_transform=None,
                             test_transform=None, predict_transform=None, data_fetcher=None,
                             preprocess=None, val_split=None, batch_size=4, num_workers=0,
                             sampler=None, **preprocess_kwargs)
```

Creates a [TabularData](#) object from the given data frames.

#### Parameters

- **categorical\_fields** (Union[str, List[str], None]) – The field or fields (columns) in the CSV file containing categorical inputs.
- **numerical\_fields** (Union[str, List[str], None]) – The field or fields (columns) in the CSV file containing numerical inputs.
- **target\_fields** (Optional[str]) – The field or fields (columns) in the CSV file to use for the target.
- **train\_data\_frame** (Optional[object]) – The pandas DataFrame containing the training data.
- **val\_data\_frame** (Optional[object]) – The pandas DataFrame containing the validation data.
- **test\_data\_frame** (Optional[object]) – The pandas DataFrame containing the testing data.
- **predict\_data\_frame** (Optional[object]) – The pandas DataFrame containing the data to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** (Optional[Preprocess]) – The [Preprocess](#) to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** (int) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** (int) – The `num_workers` argument to pass to the [DataModule](#).

- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the train\_data\_loader.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if preprocess = None.

**Returns** The constructed data module.

Examples:

```
data_module = TabularData.from_data_frame(
    "categorical_input",
    "numerical_input",
    "target",
    train_data_frame=train_data,
)
```

#### 49.4.2 TabularDataFrameDataSource

```
class flash.tabular.data.TabularDataFrameDataSource(cat_cols=None, num_cols=None,
                                                    target_col=None, mean=None, std=None,
                                                    codes=None, target_codes=None,
                                                    classes=None, is_regression=True)
```

#### 49.4.3 TabularCSVDataSource

```
class flash.tabular.data.TabularCSVDataSource(cat_cols=None, num_cols=None, target_col=None,
                                              mean=None, std=None, codes=None,
                                              target_codes=None, classes=None, is_regression=True)
```

#### 49.4.4 TabularDeserializer

```
class flash.tabular.data.TabularDeserializer(cat_cols=None, num_cols=None, target_col=None,
                                             mean=None, std=None, codes=None,
                                             target_codes=None, classes=None, is_regression=True)
```

#### 49.4.5 TabularPreprocess

```
class flash.tabular.data.TabularPreprocess(train_transform=None, val_transform=None,
                                           test_transform=None, predict_transform=None,
                                           cat_cols=None, num_cols=None, target_col=None,
                                           mean=None, std=None, codes=None, target_codes=None,
                                           classes=None, is_regression=True, deserializer=None)
```

### 49.4.6 TabularPostprocess

```
class flash.tabular.data.TabularPostprocess(save_path=None)
```



## FLASH.TEXT

- *Classification*
- *Question Answering*
- *Summarization*
- *Translation*
- *General Seq2Seq*

### 50.1 Classification

<code>TextClassifier</code>	The <code>TextClassifier</code> is a Task for classifying text.
<code>TextClassificationData</code>	Data Module for text classification tasks.
<code>classification.data.</code>	
<code>TextClassificationPostprocess</code>	
<code>classification.data.</code>	
<code>TextClassificationPreprocess</code>	
<code>classification.data.TextDeserializer</code>	
<code>classification.data.TextDataSource</code>	
<code>classification.data.TextCSVDataSource</code>	
<code>classification.data.TextJSONDataSource</code>	
<code>classification.data.</code>	
<code>TextDataFrameDataSource</code>	
<code>classification.data.TextParquetDataSource</code>	
<code>classification.data.</code>	
<code>TextHuggingFaceDatasetDataSource</code>	
<code>classification.data.TextListDataSource</code>	

### 50.1.1 TextClassifier

```
class flash.text.classification.model.TextClassifier(num_classes, backbone='prajjwal1/bert-tiny',
                                                    loss_fn=None, optimizer='Adam',
                                                    lr_scheduler=None, metrics=None,
                                                    learning_rate=0.01, multi_label=False,
                                                    serializer=None, enable_ort=False)
```

The `TextClassifier` is a Task for classifying text. For more details, see [Text Classification](#). The `TextClassifier` also supports multi-label classification with `multi_label=True`. For more details, see [Multi-label Text Classification](#).

#### Parameters

- **num\_classes** (int) – Number of classes to classify.
- **backbone** (str) – A model to use to compute text features can be any BERT model from HuggingFace/transformersimage .
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the `torchmetrics` package, a custom metric inheriting from `torchmetrics.Metric`, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature `metric(preds, target)` and return a single scalar tensor. Defaults to `torchmetrics.Accuracy`.
- **learning\_rate** (float) – Learning rate to use for training, defaults to `1e-3`
- **multi\_label** (bool) – Whether the targets are multi-label or not.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – The `Serializer` to use when serializing prediction outputs.
- **enable\_ort** (bool) – Enable Torch ONNX Runtime Optimization: <https://onnxruntime.ai/docs/#onnx-runtime-for-training>

### 50.1.2 TextClassificationData

```
class flash.text.classification.data.TextClassificationData(train_dataset=None,
                                                            val_dataset=None,
                                                            test_dataset=None,
                                                            predict_dataset=None,
                                                            data_source=None,
                                                            preprocess=None, postprocess=None,
                                                            data_fetcher=None, val_split=None,
                                                            batch_size=4, num_workers=0,
                                                            sampler=None)
```

Data Module for text classification tasks.

```

classmethod from_data_frame(input_field, target_fields, train_data_frame=None, val_data_frame=None,
                             test_data_frame=None, predict_data_frame=None,
                             train_transform=None, val_transform=None, test_transform=None,
                             predict_transform=None, data_fetcher=None, preprocess=None,
                             val_split=None, batch_size=4, num_workers=0, sampler=None,
                             **preprocess_kwargs)

```

Creates a [TextClassificationData](#) object from the given pandas DataFrame objects.

#### Parameters

- **input\_field** (str) – The field (column) in the pandas DataFrame to use for the input.
- **target\_fields** (Union[str, Sequence[str]]) – The field or fields (columns) in the pandas DataFrame to use for the target.
- **train\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the training data.
- **val\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the validation data.
- **test\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the testing data.
- **predict\_data\_frame** (Optional[DataFrame]) – The pandas DataFrame containing the data to use when predicting.
- **train\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** (Optional[Preprocess]) – The [Preprocess](#) to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** (int) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** (int) – The `num_workers` argument to pass to the [DataModule](#).
- **sampler** (Optional[Type[Sampler]]) – The `sampler` to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the [preprocess](#). Will only be used if `preprocess = None`.

**Return type** [DataModule](#)

**Returns** The constructed data module.

```
classmethod from_hf_datasets(input_field, target_fields, train_hf_dataset=None, val_hf_dataset=None,
                             test_hf_dataset=None, predict_hf_dataset=None,
                             train_transform=None, val_transform=None, test_transform=None,
                             predict_transform=None, data_fetcher=None, preprocess=None,
                             val_split=None, batch_size=4, num_workers=0, sampler=None,
                             **preprocess_kwargs)
```

Creates a [TextClassificationData](#) object from the given Hugging Face datasets Dataset objects.

#### Parameters

- **input\_field** (str) – The field (column) in the pandas Dataset to use for the input.
- **target\_fields** (Union[str, Sequence[str]]) – The field or fields (columns) in the pandas Dataset to use for the target.
- **train\_hf\_dataset** (Optional[Sequence[Mapping[str, Any]]]) – The pandas Dataset containing the training data.
- **val\_hf\_dataset** (Optional[Sequence[Mapping[str, Any]]]) – The pandas Dataset containing the validation data.
- **test\_hf\_dataset** (Optional[Sequence[Mapping[str, Any]]]) – The pandas Dataset containing the testing data.
- **predict\_hf\_dataset** (Optional[Sequence[Mapping[str, Any]]]) – The pandas Dataset containing the data to use when predicting.
- **train\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** (int) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** (int) – The `num_workers` argument to pass to the [DataModule](#).
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the train\_dataloader.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Return type** [DataModule](#)

**Returns** The constructed data module.

```
classmethod from_lists(train_data=None, train_targets=None, val_data=None, val_targets=None,
                      test_data=None, test_targets=None, predict_data=None, train_transform=None,
                      val_transform=None, test_transform=None, predict_transform=None,
                      data_fetcher=None, preprocess=None, val_split=None, batch_size=4,
                      num_workers=0, sampler=None, **preprocess_kwargs)
```

Creates a [TextClassificationData](#) object from the given Python lists.

### Parameters

- **train\_data** (Optional[List[str]]) – A list of sentences to use as the train inputs.
- **train\_targets** (Union[List[Any], List[List[Any]], None]) – A list of targets to use as the train targets. For multi-label classification, the targets should be provided as a list of lists, where each inner list contains the targets for a sample.
- **val\_data** (Optional[List[str]]) – A list of sentences to use as the validation inputs.
- **val\_targets** (Union[List[Any], List[List[Any]], None]) – A list of targets to use as the validation targets. For multi-label classification, the targets should be provided as a list of lists, where each inner list contains the targets for a sample.
- **test\_data** (Optional[List[str]]) – A list of sentences to use as the test inputs.
- **test\_targets** (Union[List[Any], List[List[Any]], None]) – A list of targets to use as the test targets. For multi-label classification, the targets should be provided as a list of lists, where each inner list contains the targets for a sample.
- **predict\_data** (Optional[List[str]]) – A list of sentences to use when predicting.
- **train\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** (Union[Callable, List, Dict[str, Callable], None]) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the [DataModule](#). If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** (int) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** (int) – The `num_workers` argument to pass to the [DataModule](#).
- **sampler** (Optional[Type[Sampler]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

Return type [DataModule](#)

**Returns** The constructed data module.

```
classmethod from_parquet(input_field, target_fields=None, train_file=None, val_file=None,
                          test_file=None, predict_file=None, train_transform=None,
                          val_transform=None, test_transform=None, predict_transform=None,
                          data_fetcher=None, preprocess=None, val_split=None, batch_size=4,
                          num_workers=0, sampler=None, **preprocess_kwargs)
```

Creates a [DataModule](#) object from the given PARQUET files using the [DataSource](#) of name PARQUET from the passed or constructed [Preprocess](#).

#### Parameters

- **input\_fields** – The field or fields (columns) in the PARQUET file to use for the input.
- **target\_fields** ([Union](#)[[str](#), [Sequence](#)[[str](#)], [None](#)]) – The field or fields (columns) in the PARQUET file to use for the target.
- **train\_file** ([Optional](#)[[str](#)]) – The PARQUET file containing the training data.
- **val\_file** ([Optional](#)[[str](#)]) – The PARQUET file containing the validation data.
- **test\_file** ([Optional](#)[[str](#)]) – The PARQUET file containing the testing data.
- **predict\_file** ([Optional](#)[[str](#)]) – The PARQUET file containing the data to use when predicting.
- **train\_transform** ([Optional](#)[[Dict](#)[[str](#), [Callable](#)]]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** ([Optional](#)[[Dict](#)[[str](#), [Callable](#)]]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.
- **test\_transform** ([Optional](#)[[Dict](#)[[str](#), [Callable](#)]]) – The dictionary of transforms to use during testing which maps [Preprocess](#) hook names to callable transforms.
- **predict\_transform** ([Optional](#)[[Dict](#)[[str](#), [Callable](#)]]) – The dictionary of transforms to use during predicting which maps [Preprocess](#) hook names to callable transforms.
- **data\_fetcher** ([Optional](#)[[BaseDataFetcher](#)]) – The [BaseDataFetcher](#) to pass to the [DataModule](#).
- **preprocess** ([Optional](#)[[Preprocess](#)]) – The [Preprocess](#) to pass to the [DataModule](#). If [None](#), `cls.preprocess_cls` will be constructed and used.
- **val\_split** ([Optional](#)[[float](#)]) – The `val_split` argument to pass to the [DataModule](#).
- **batch\_size** ([int](#)) – The `batch_size` argument to pass to the [DataModule](#).
- **num\_workers** ([int](#)) – The `num_workers` argument to pass to the [DataModule](#).
- **sampler** ([Optional](#)[[Type](#)[[Sampler](#)]]) – The sampler to use for the `train_dataloader`.
- **preprocess\_kwargs** ([Any](#)) – Additional keyword arguments to use when constructing the [preprocess](#). Will only be used if `preprocess = None`.

**Return type** [DataModule](#)

**Returns** The constructed data module.

Examples:

```
data_module = DataModule.from_parquet(
    "input",
    "target",
    train_file="train_data.parquet",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
)
```

### 50.1.3 TextClassificationPostprocess

```
class flash.text.classification.data.TextClassificationPostprocess(save_path=None)
```

### 50.1.4 TextClassificationPreprocess

```
class flash.text.classification.data.TextClassificationPreprocess(train_transform=None,
                                                                val_transform=None,
                                                                test_transform=None,
                                                                predict_transform=None,
                                                                backbone='prajjwal1/bert-
                                                                tiny',
                                                                max_length=128)
```

**collate**(*samples*)

Override to convert a set of samples to a batch.

**Return type** `Tensor`

### 50.1.5 TextDeserializer

```
class flash.text.classification.data.TextDeserializer(backbone, max_length, use_fast=True,
                                                    **kwargs)
```

### 50.1.6 TextDataSource

```
class flash.text.classification.data.TextDataSource(backbone, max_length=128)
```

**load\_data**(*data*, *dataset=None*)

Loads data into HuggingFace datasets.Dataset.

**Return type** `Sequence[Mapping[str, Any]]`

### 50.1.7 TextCSVDataSource

```
class flash.text.classification.data.TextCSVDataSource(backbone, max_length=128)
```

### 50.1.8 TextJSONDataSource

```
class flash.text.classification.data.TextJSONDataSource(backbone, max_length=128)
```

### 50.1.9 TextDataFrameDataSource

```
class flash.text.classification.data.TextDataFrameDataSource(backbone, max_length=128)
```

### 50.1.10 TextParquetDataSource

```
class flash.text.classification.data.TextParquetDataSource(backbone, max_length=128)
```

### 50.1.11 TextHuggingFaceDatasetDataSource

```
class flash.text.classification.data.TextHuggingFaceDatasetDataSource(backbone,
                                                                       max_length=128)
```

### 50.1.12 TextListDataSource

```
class flash.text.classification.data.TextListDataSource(backbone, max_length=128)
```

## 50.2 Question Answering

<i>QuestionAnsweringTask</i>	The <code>QuestionAnsweringTask</code> is a Task for extractive question answering.
<i>QuestionAnsweringData</i>	Data module for QuestionAnswering task.
<i>question_answering.data. QuestionAnsweringBackboneState</i>	The <code>QuestionAnsweringBackboneState</code> stores the backbone in use by the <i>QuestionAnsweringPreprocess</i>
<i>question_answering.data. QuestionAnsweringCSVDataSource</i>	
<i>question_answering.data. QuestionAnsweringDataSource</i>	
<i>question_answering.data. QuestionAnsweringDictionaryDataSource</i>	
<i>question_answering.data. QuestionAnsweringFileDataSource</i>	
<i>question_answering.data. QuestionAnsweringJSONDataSource</i>	
<i>question_answering.data. QuestionAnsweringPostprocess</i>	

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Table 2 – continued from previous page

---

```
question_answering.data.  
QuestionAnsweringPreprocess  
question_answering.data.SQuADDataSource
```

---

### 50.2.1 QuestionAnsweringTask

```
class flash.text.question_answering.model.QuestionAnsweringTask(backbone='distilbert-base-uncased', loss_fn=None, optimizer='Adam', lr_scheduler=None, metrics=None, learning_rate=5e-05, enable_ort=False, n_best_size=20, version_2_with_negative=True, max_answer_length=30, null_score_diff_threshold=0.0, use_stemmer=True, rouge_newline_sep=True)
```

The `QuestionAnsweringTask` is a Task for extractive question answering. For more details, see *question\_answering*.

You can change the backbone to any question answering model from [HuggingFace/transformers](https://huggingface.co/transformers) using the `backbone` argument.

---

**Note:** When changing the backbone, make sure you pass in the same backbone to the Task and the `DataModule` object! Since this is a QuestionAnswering task, make sure you use a QuestionAnswering model.

---

#### Parameters

- **backbone** (str) – backbone model to use for the task.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Defaults to calculating the ROUGE metric. Changing this argument currently has no effect.
- **learning\_rate** (float) – Learning rate to use for training, defaults to  $3e-4$
- **enable\_ort** (bool) – Enable Torch ONNX Runtime Optimization: <https://onnxruntime.ai/docs/#onnx-runtime-for-training>
- **n\_best\_size** (int) – The total number of n-best predictions to generate when looking for an answer.
- **version\_2\_with\_negative** (bool) – If true, some of the examples do not have an answer.

- **max\_answer\_length** (int) – The maximum length of an answer that can be generated. This is needed because the start and end predictions are not conditioned on one another.
- **null\_score\_diff\_threshold** (float) – The threshold used to select the null answer: if the best answer has a score that is less than the score of the null answer minus this threshold, the null answer is selected for this example. Only useful when *version\_2\_with\_negative=True*.
- **use\_stemmer** (bool) – Whether Porter stemmer should be used to strip word suffixes to improve matching.
- **rouge\_newline\_sep** (bool) – Add a new line at the beginning of each sentence in Rouge Metric calculation.

**property task:** Optional[str]

Override to define AutoConfig task specific parameters stored within the model.

**Return type** Optional[str]

## 50.2.2 QuestionAnsweringData

```
class flash.text.question_answering.data.QuestionAnsweringData(
    train_dataset=None,
    val_dataset=None,
    test_dataset=None,
    predict_dataset=None,
    data_source=None,
    preprocess=None,
    postprocess=None,
    data_fetcher=None,
    val_split=None, batch_size=4,
    num_workers=0, sampler=None)
```

Data module for QuestionAnswering task.

```
classmethod from_csv(
    train_file=None, val_file=None, test_file=None, predict_file=None,
    train_transform=None, val_transform=None, test_transform=None,
    predict_transform=None, data_fetcher=None, preprocess=None, val_split=None,
    batch_size=4, num_workers=0, sampler=None, **preprocess_kwargs)
```

Creates a [DataModule](#) object from the given CSV files using the [DataSource](#) of name CSV from the passed or constructed [Preprocess](#).

### Parameters

- **input\_fields** – The field or fields (columns) in the CSV file to use for the input.
- **target\_fields** – The field or fields (columns) in the CSV file to use for the target.
- **train\_file** (Optional[str]) – The CSV file containing the training data.
- **val\_file** (Optional[str]) – The CSV file containing the validation data.
- **test\_file** (Optional[str]) – The CSV file containing the testing data.
- **predict\_file** (Optional[str]) – The CSV file containing the data to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps [Preprocess](#) hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps [Preprocess](#) hook names to callable transforms.

- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps *Preprocess* hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps *Preprocess* hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The *BaseDataFetcher* to pass to the *DataModule*.
- **preprocess** (Optional[Preprocess]) – The *Preprocess* to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **sampler** (Optional[Sampler]) – The `sampler` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the *preprocess*. Will only be used if `preprocess = None`.

---

**Note:** The following keyword arguments can be passed through to the `preprocess_kwargs`

- `backbone`: The HF model to be used for the task.
  - `max_source_length`: Max length of the sequence to be considered during tokenization.
  - `max_target_length`: Max length of each answer to be produced.
  - `padding`: Padding type during tokenization. Defaults to 'max\_length'.
  - `question_column_name`: The key in the JSON file to recognize the question field. Defaults to "question".
  - `context_column_name`: The key in the JSON file to recognize the context field. Defaults to "context".
  - `answer_column_name`: The key in the JSON file to recognize the answer field. Defaults to "answer".
  - `doc_stride`: The stride amount to be taken when splitting up a long document into chunks.
- 

**Return type** *DataModule*

**Returns** The constructed data module.

Examples:

```
data_module = QuestionAnsweringData.from_csv(
    "input",
    "target",
    train_file="train_data.csv",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
    backbone="distilbert-base-uncased",
    max_source_length=384,
    max_target_length=30,
    padding='max_length',
```

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```

question_column_name="question",
context_column_name="context",
answer_column_name="answer",
doc_stride=128
)

```

```

classmethod from_json(train_file=None, val_file=None, test_file=None, predict_file=None,
                      train_transform=None, val_transform=None, test_transform=None,
                      predict_transform=None, data_fetcher=None, preprocess=None, val_split=None,
                      batch_size=4, num_workers=0, sampler=None, field=None,
                      **preprocess_kwargs)

```

Creates a `QuestionAnsweringData` object from the given JSON files using the JSON from the passed or constructed `QuestionAnsweringPreprocess`.

#### Parameters

- **train\_file** (Optional[str]) – The JSON file containing the training data.
- **val\_file** (Optional[str]) – The JSON file containing the validation data.
- **test\_file** (Optional[str]) – The JSON file containing the testing data.
- **predict\_file** (Optional[str]) – The JSON file containing the data to use when predicting.
- **train\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps `Preprocess` hook names to callable transforms.
- **val\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps `Preprocess` hook names to callable transforms.
- **test\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps `Preprocess` hook names to callable transforms.
- **predict\_transform** (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during predicting which maps `Preprocess` hook names to callable transforms.
- **data\_fetcher** (Optional[BaseDataFetcher]) – The `BaseDataFetcher` to pass to the `DataModule`.
- **preprocess** (Optional[Preprocess]) – The `Preprocess` to pass to the `DataModule`. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the `DataModule`.
- **batch\_size** (int) – The `batch_size` argument to pass to the `DataModule`.
- **num\_workers** (int) – The `num_workers` argument to pass to the `DataModule`.
- **sampler** (Optional[Sampler]) – The `sampler` argument to pass to the `DataModule`.
- **field** (Optional[str]) – To specify the field that holds the data in the JSON file.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Note:** The following keyword arguments can be passed through to the `preprocess_kwargs`

- **backbone**: The HF model to be used for the task.
- **max\_source\_length**: Max length of the sequence to be considered during tokenization.

- `max_target_length`: Max length of each answer to be produced.
- `padding`: Padding type during tokenization. Defaults to 'max\_length'.
- `question_column_name`: The key in the JSON file to recognize the question field. Defaults to "question".
- `context_column_name`: The key in the JSON file to recognize the context field. Defaults to "context".
- `answer_column_name`: The key in the JSON file to recognize the answer field. Defaults to "answer".
- `doc_stride`: The stride amount to be taken when splitting up a long document into chunks.

**Return type** `DataModule`

**Returns** The constructed data module.

Examples:

```
data_module = QuestionAnsweringData.from_json(
    train_file="train_data.json",
    train_transform={
        "to_tensor_transform": torch.as_tensor,
    },
    backbone="distilbert-base-uncased",
    max_source_length=384,
    max_target_length=30,
    padding='max_length',
    question_column_name="question",
    context_column_name="context",
    answer_column_name="answer",
    doc_stride=128
)
```

**classmethod** `from_squad_v2`(*train\_file=None, val\_file=None, test\_file=None, train\_transform=None, val\_transform=None, test\_transform=None, data\_fetcher=None, preprocess=None, val\_split=None, batch\_size=4, num\_workers=0, \*\*preprocess\_kwargs*)

Creates a `QuestionAnsweringData` object from the given data JSON files in the SQuAD2.0 format.

**Parameters**

- `train_file` (Optional[str]) – The JSON file containing the training data.
- `val_file` (Optional[str]) – The JSON file containing the validation data.
- `test_file` (Optional[str]) – The JSON file containing the testing data.
- `train_transform` (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during training which maps `Preprocess` hook names to callable transforms.
- `val_transform` (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during validation which maps `Preprocess` hook names to callable transforms.
- `test_transform` (Optional[Dict[str, Callable]]) – The dictionary of transforms to use during testing which maps `Preprocess` hook names to callable transforms.
- `data_fetcher` (Optional[BaseDataFetcher]) – The `BaseDataFetcher` to pass to the `DataModule`.

- **preprocess** (Optional[Preprocess]) – The Preprocess to pass to the *DataModule*. If None, `cls.preprocess_cls` will be constructed and used.
- **val\_split** (Optional[float]) – The `val_split` argument to pass to the *DataModule*.
- **batch\_size** (int) – The `batch_size` argument to pass to the *DataModule*.
- **num\_workers** (int) – The `num_workers` argument to pass to the *DataModule*.
- **preprocess\_kwargs** (Any) – Additional keyword arguments to use when constructing the preprocess. Will only be used if `preprocess = None`.

**Returns** The constructed data module.

Examples:

```
data_module = QuestionAnsweringData.from_squad_v2(
    train_file="train.json",
    doc_stride=128,
)
```

### 50.2.3 QuestionAnsweringBackboneState

**class** `flash.text.question_answering.data.QuestionAnsweringBackboneState(backbone)`

The `QuestionAnsweringBackboneState` stores the backbone in use by the *QuestionAnsweringPreprocess*

### 50.2.4 QuestionAnsweringCSVDataSource

**class** `flash.text.question_answering.data.QuestionAnsweringCSVDataSource(backbone,`  
`max_source_length=384,`  
`max_target_length=30,`  
`padding='max_length',`  
`ques-`  
`tion_column_name='question',`  
`con-`  
`text_column_name='context',`  
`an-`  
`swer_column_name='answer',`  
`doc_stride=128)`

### 50.2.5 QuestionAnsweringDataSource

**class** `flash.text.question_answering.data.QuestionAnsweringDataSource(backbone,`  
`max_source_length=384,`  
`max_target_length=30,`  
`padding='max_length',`  
`ques-`  
`tion_column_name='question',`  
`con-`  
`text_column_name='context',`  
`an-`  
`swer_column_name='answer',`  
`doc_stride=128)`

### 50.2.6 QuestionAnsweringDictionaryDataSource

```
class flash.text.question_answering.data.QuestionAnsweringDictionaryDataSource(backbone,
                                                                              max_source_length=384,
                                                                              max_target_length=30,
                                                                              padding='max_length',
                                                                              ques-
tion_column_name='question',
con-
text_column_name='context',
an-
swer_column_name='answer',
doc_stride=128)
```

### 50.2.7 QuestionAnsweringFileDataSource

```
class flash.text.question_answering.data.QuestionAnsweringFileDataSource(filetype, backbone,
                                                                           max_source_length=384,
                                                                           max_target_length=30,
                                                                           padding='max_length',
                                                                           ques-
tion_column_name='question',
con-
text_column_name='context',
an-
swer_column_name='answer',
doc_stride=128)
```

### 50.2.8 QuestionAnsweringJSONDataSource

```
class flash.text.question_answering.data.QuestionAnsweringJSONDataSource(backbone,
                                                                           max_source_length=384,
                                                                           max_target_length=30,
                                                                           padding='max_length',
                                                                           ques-
tion_column_name='question',
con-
text_column_name='context',
an-
swer_column_name='answer',
doc_stride=128)
```

### 50.2.9 QuestionAnsweringPostprocess

```
class flash.text.question_answering.data.QuestionAnsweringPostprocess
```

```
    static per_sample_transform(sample)
```

Transforms to apply to a single sample after splitting up the batch.

Can involve both CPU and Device transforms as this is not applied in separate workers.

Return type `Any`

### 50.2.10 QuestionAnsweringPreprocess

```
class flash.text.question_answering.data.QuestionAnsweringPreprocess(train_transform=None,  
                                                                    val_transform=None,  
                                                                    test_transform=None,  
                                                                    predict_transform=None,  
                                                                    backbone='distilbert-  
                                                                    base-uncased',  
                                                                    max_source_length=384,  
                                                                    max_target_length=30,  
                                                                    padding='max_length',  
                                                                    ques-  
                                                                    tion_column_name='question',  
                                                                    con-  
                                                                    text_column_name='context',  
                                                                    an-  
                                                                    swer_column_name='answer',  
                                                                    doc_stride=128)
```

```
    collate(samples)
```

Override to convert a set of samples to a batch.

Return type `Tensor`

### 50.2.11 SQuADDataSource

```
class flash.text.question_answering.data.SQuADDataSource(backbone, max_source_length=384,  
                                                         max_target_length=30,  
                                                         padding='max_length',  
                                                         question_column_name='question',  
                                                         context_column_name='context',  
                                                         answer_column_name='answer',  
                                                         doc_stride=128)
```



## 50.3 Summarization

<i>SummarizationTask</i>	The SummarizationTask is a Task for Seq2Seq text summarization.
<i>SummarizationData</i>	
<i>seq2seq.summarization.data. SummarizationPreprocess</i>	

### 50.3.1 SummarizationTask

```
class flash.text.seq2seq.summarization.model.SummarizationTask(backbone='sshleifer/distilbart-xsum-1-1', loss_fn=None,
                                                                optimizer='Adam',
                                                                lr_scheduler=None,
                                                                metrics=None,
                                                                learning_rate=1e-05,
                                                                val_target_max_length=None,
                                                                num_beams=4,
                                                                use_stemmer=True,
                                                                rouge_newline_sep=True,
                                                                enable_ort=False)
```

The SummarizationTask is a Task for Seq2Seq text summarization. For more details, see [Summarization](#).

You can change the backbone to any summarization model from [HuggingFace/transformers](#) using the backbone argument.

**Note:** When changing the backbone, make sure you pass in the same backbone to the Task and the [DataModule](#) object! Since this is a Seq2Seq task, make sure you use a Seq2Seq model.

#### Parameters

- **backbone** (str) – backbone model to use for the task.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Defaults to calculating the ROUGE metric. Changing this argument currently has no effect.
- **learning\_rate** (float) – Learning rate to use for training, defaults to  $3e-4$
- **val\_target\_max\_length** (Optional[int]) – Maximum length of targets in validation. Defaults to 128
- **num\_beams** (Optional[int]) – Number of beams to use in validation when generating predictions. Defaults to 4

- **use\_stemmer** (bool) – Whether Porter stemmer should be used to strip word suffixes to improve matching.
- **rouge\_newline\_sep** (bool) – Add a new line at the beginning of each sentence in Rouge Metric calculation.
- **enable\_ort** (bool) – Enable Torch ONNX Runtime Optimization: <https://onnxruntime.ai/docs/#onnx-runtime-for-training>

### 50.3.2 SummarizationData

```
class flash.text.seq2seq.summarization.data.SummarizationData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None,
                                                             postprocess=None,
                                                             data_fetcher=None,
                                                             val_split=None, batch_size=4,
                                                             num_workers=0, sampler=None)
```

### 50.3.3 SummarizationPreprocess

```
class flash.text.seq2seq.summarization.data.SummarizationPreprocess(train_transform=None,
                                                                    val_transform=None,
                                                                    test_transform=None,
                                                                    predict_transform=None,
                                                                    backbone='sshleifer/distilbart-
                                                                    xsum-1-1',
                                                                    max_source_length=128,
                                                                    max_target_length=128,
                                                                    padding='max_length',
                                                                    **kwargs)
```

## 50.4 Translation

<i>TranslationTask</i>	The TranslationTask is a Task for Seq2Seq text translation.
<i>TranslationData</i> <i>seq2seq.translation.data.</i> <i>TranslationPreprocess</i>	Data module for Translation tasks.

### 50.4.1 TranslationTask

```
class flash.text.seq2seq.translation.model.TranslationTask(backbone='t5-small', loss_fn=None,
                                                         optimizer='Adam', lr_scheduler=None,
                                                         metrics=None, learning_rate=1e-05,
                                                         val_target_max_length=128,
                                                         num_beams=4, n_gram=4,
                                                         smooth=True, enable_ort=False)
```

The TranslationTask is a Task for Seq2Seq text translation. For more details, see [Translation](#).

You can change the backbone to any translation model from [HuggingFace/transformers](#) using the backbone argument.

---

**Note:** When changing the backbone, make sure you pass in the same backbone to the Task and the [DataModule](#) object! Since this is a Seq2Seq task, make sure you use a Seq2Seq model.

---

#### Parameters

- **backbone** (str) – backbone model to use for the task.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Defaults to calculating the BLEU metric. Changing this argument currently has no effect.
- **learning\_rate** (float) – Learning rate to use for training, defaults to 1e-5
- **val\_target\_max\_length** (Optional[int]) – Maximum length of targets in validation. Defaults to 128
- **num\_beams** (Optional[int]) – Number of beams to use in validation when generating predictions. Defaults to 4
- **n\_gram** (bool) – Maximum n\_grams to use in metric calculation. Defaults to 4
- **smooth** (bool) – Apply smoothing in BLEU calculation. Defaults to True
- **enable\_ort** (bool) – Enable Torch ONNX Runtime Optimization: <https://onnxruntime.ai/docs/#onnx-runtime-for-training>

### 50.4.2 TranslationData

```
class flash.text.seq2seq.translation.data.TranslationData(train_dataset=None, val_dataset=None,
                                                         test_dataset=None,
                                                         predict_dataset=None,
                                                         data_source=None, preprocess=None,
                                                         postprocess=None, data_fetcher=None,
                                                         val_split=None, batch_size=4,
                                                         num_workers=0, sampler=None)
```

Data module for Translation tasks.

### 50.4.3 TranslationPreprocess

```
class flash.text.seq2seq.translation.data.TranslationPreprocess(
    train_transform=None,
    val_transform=None,
    test_transform=None,
    predict_transform=None,
    backbone='t5-small',
    max_source_length=128,
    max_target_length=128,
    padding='max_length',
    **kwargs)
```

## 50.5 General Seq2Seq

<a href="#"><i>Seq2SeqTask</i></a>	General Task for Sequence2Sequence.
<a href="#"><i>Seq2SeqData</i></a>	Data module for Seq2Seq tasks.
<a href="#"><i>Seq2SeqFreezeEmbeddings</i></a>	Freezes the embedding layers during Seq2Seq training.
<a href="#"><i>seq2seq.core.data.Seq2SeqBackboneState</i></a>	The <a href="#"><i>Seq2SeqBackboneState</i></a> stores the backbone in use by the <a href="#"><i>Seq2SeqPreprocess</i></a>
<a href="#"><i>seq2seq.core.data.Seq2SeqCSVDataSource</i></a>	
<a href="#"><i>seq2seq.core.data.Seq2SeqDataSource</i></a>	
<a href="#"><i>seq2seq.core.data.Seq2SeqFileDataSource</i></a>	
<a href="#"><i>seq2seq.core.data.Seq2SeqJSONDataSource</i></a>	
<a href="#"><i>seq2seq.core.data.Seq2SeqPostprocess</i></a>	
<a href="#"><i>seq2seq.core.data.Seq2SeqPreprocess</i></a>	
<a href="#"><i>seq2seq.core.data.Seq2SeqSentencesDataSource</i></a>	
<a href="#"><i>seq2seq.core.metrics.BLEUScore</i></a>	Calculate BLEU score of machine translated text with one or more references.
<a href="#"><i>seq2seq.core.metrics.RougeBatchAggregator</i></a>	Aggregates rouge scores and provides confidence intervals.
<a href="#"><i>seq2seq.core.metrics.RougeMetric</i></a>	Metric used for automatic summarization.

### 50.5.1 Seq2SeqTask

```
class flash.text.seq2seq.core.model.Seq2SeqTask(
    backbone='t5-small', loss_fn=None,
    optimizer='Adam', lr_scheduler=None,
    metrics=None, learning_rate=5e-05,
    val_target_max_length=None, num_beams=None,
    enable_ort=False)
```

General Task for Sequence2Sequence.

#### Parameters

- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training

- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Changing this argument currently has no effect
- **learning\_rate** (float) – Learning rate to use for training, defaults to  $3e-4$
- **val\_target\_max\_length** (Optional[int]) – Maximum length of targets in validation. Defaults to 128
- **num\_beams** (Optional[int]) – Number of beams to use in validation when generating predictions. Defaults to 4
- **enable\_ort** (bool) – Enable Torch ONNX Runtime Optimization: <https://onnxruntime.ai/docs/#onnx-runtime-for-training>

**property task:** Optional[str]

Override to define AutoConfig task specific parameters stored within the model.

**Return type** Optional[str]

## 50.5.2 Seq2SeqData

```
class flash.text.seq2seq.core.data.Seq2SeqData(train_dataset=None, val_dataset=None,
                                              test_dataset=None, predict_dataset=None,
                                              data_source=None, preprocess=None,
                                              postprocess=None, data_fetcher=None,
                                              val_split=None, batch_size=4, num_workers=0,
                                              sampler=None)
```

Data module for Seq2Seq tasks.

## 50.5.3 Seq2SeqFreezeEmbeddings

```
class flash.text.seq2seq.core.finetuning.Seq2SeqFreezeEmbeddings(model_type, train_bn=True)
```

Freezes the embedding layers during Seq2Seq training.

## 50.5.4 Seq2SeqBackboneState

```
class flash.text.seq2seq.core.data.Seq2SeqBackboneState(backbone, backbone_kwargs=<factory>)
```

The Seq2SeqBackboneState stores the backbone in use by the [Seq2SeqPreprocess](#)

### 50.5.5 Seq2SeqCSVDataSource

```
class flash.text.seq2seq.core.data.Seq2SeqCSVDataSource(backbone, max_source_length=128,
                                                         max_target_length=128,
                                                         padding='max_length',
                                                         **backbone_kwargs)
```

### 50.5.6 Seq2SeqDataSource

```
class flash.text.seq2seq.core.data.Seq2SeqDataSource(backbone, max_source_length=128,
                                                         max_target_length=128,
                                                         padding='max_length', **backbone_kwargs)
```

### 50.5.7 Seq2SeqFileDataSource

```
class flash.text.seq2seq.core.data.Seq2SeqFileDataSource(filetype, backbone,
                                                         max_source_length=128,
                                                         max_target_length=128,
                                                         padding='max_length',
                                                         **backbone_kwargs)
```

### 50.5.8 Seq2SeqJSONDataSource

```
class flash.text.seq2seq.core.data.Seq2SeqJSONDataSource(backbone, max_source_length=128,
                                                         max_target_length=128,
                                                         padding='max_length',
                                                         **backbone_kwargs)
```

### 50.5.9 Seq2SeqPostprocess

```
class flash.text.seq2seq.core.data.Seq2SeqPostprocess
```

### 50.5.10 Seq2SeqPreprocess

```
class flash.text.seq2seq.core.data.Seq2SeqPreprocess(train_transform=None, val_transform=None,
                                                         test_transform=None,
                                                         predict_transform=None,
                                                         backbone='sshleifer/tiny-mbart',
                                                         max_source_length=128,
                                                         max_target_length=128,
                                                         padding='max_length', **backbone_kwargs)
```

**collate**(*samples*)

Override to convert a set of samples to a batch.

**Return type** `Tensor`

### 50.5.11 Seq2SeqSentencesDataSource

```
class flash.text.seq2seq.core.data.Seq2SeqSentencesDataSource(backbone,
                                                             max_source_length=128,
                                                             max_target_length=128,
                                                             padding='max_length',
                                                             **backbone_kwargs)
```

### 50.5.12 BLEUScore

```
class flash.text.seq2seq.core.metrics.BLEUScore(n_gram=4, smooth=False)
    Calculate BLEU score of machine translated text with one or more references.
```

#### Example

```
>>> translate_corpus = ['the cat is on the mat'.split()]
>>> reference_corpus = [['there is a cat on the mat'.split(), 'a cat is on the mat'.
    ↪split()]]
>>> metric = BLEUScore()
>>> metric(translate_corpus, reference_corpus)
tensor(0.7598)
```

**update**(*translate\_corpus*, *reference\_corpus*)

Actual metric computation :param\_sphinx\_paramlinks\_flash.text.seq2seq.core.metrics.BLEUScore.update.translate\_corpus:

An iterable of machine translated corpus :param\_sphinx\_paramlinks\_flash.text.seq2seq.core.metrics.BLEUScore.update.refe

An iterable of iterables of reference corpus

**Return type** `None`

### 50.5.13 RougeBatchAggregator

```
class flash.text.seq2seq.core.metrics.RougeBatchAggregator
    Aggregates rouge scores and provides confidence intervals.
```

**aggregate**()

Override function to wrap the final results in *Score* objects.

This is due to the scores being replaced with a list of torch tensors.

### 50.5.14 RougeMetric

```
class flash.text.seq2seq.core.metrics.RougeMetric(rouge_newline_sep=False, use_stemmer=False,
                                                  rouge_keys=('rouge1', 'rouge2', 'rougeL',
                                                  'rougeLsum'))
```

Metric used for automatic summarization. <https://www.aclweb.org/anthology/W04-1013/>

**Example**

```
>>> target = "Is your name John".split()
>>> preds = "My name is John".split()
>>> rouge = RougeMetric()
>>> from pprint import pprint
>>> pprint(rouge(preds, target))
{'rouge1_fmeasure': 0.25,
 'rouge1_precision': 0.25,
 'rouge1_recall': 0.25,
 'rouge2_fmeasure': 0.0,
 'rouge2_precision': 0.0,
 'rouge2_recall': 0.0,
 'rougeL_fmeasure': 0.25,
 'rougeL_precision': 0.25,
 'rougeL_recall': 0.25,
 'rougeLsum_fmeasure': 0.25,
 'rougeLsum_precision': 0.25,
 'rougeLsum_recall': 0.25}
```



- *Classification*

## 51.1 Classification

<i>VideoClassifier</i>	Task that classifies videos.
<i>VideoClassificationData</i>	Data module for Video classification tasks.
<i>classification.data.</i>	
<i>BaseVideoClassification</i>	
<i>classification.data.</i>	
<i>VideoClassificationFiftyOneDataSource</i>	
<i>classification.data.</i>	
<i>VideoClassificationPathsDataSource</i>	
<i>classification.data.</i>	
<i>VideoClassificationPreprocess</i>	
<i>classification.model.</i>	
<i>VideoClassifierFinetuning</i>	

### 51.1.1 VideoClassifier

```
class flash.video.classification.model.VideoClassifier(num_classes, backbone='x3d_xs',  
                                                       backbone_kwargs=None, pretrained=True,  
                                                       loss_fn=torch.nn.functional.cross_entropy,  
                                                       optimizer='SGD', lr_scheduler=None,  
                                                       metrics=torchmetrics.Accuracy,  
                                                       learning_rate=0.001, head=None,  
                                                       serializer=None)
```

Task that classifies videos.

#### Parameters

- **num\_classes** (int) – Number of classes to classify.
- **backbone** (Union[str, Module]) – A string mapped to pytorch\_video backbones or nn.Module, defaults to "slowfast\_r50".
- **backbone\_kwargs** (Optional[Dict]) – Arguments to customize the backbone from PyTorchVideo.

- **pretrained** (bool) – Use a pretrained backbone, defaults to True.
- **loss\_fn** (Union[Callable, Mapping, Sequence, None]) – Loss function for training, defaults to `torch.nn.functional.cross_entropy()`.
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training, defaults to `torch.optim.SGD`.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any]], None) – The scheduler or scheduler class to use.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation. Can either be an metric from the *torchmetrics* package, a custom metric inheriting from *torchmetrics.Metric*, a callable function or a list/dict containing a combination of the aforementioned. In all cases, each metric needs to have the signature *metric(preds, target)* and return a single scalar tensor. Defaults to `torchmetrics.Accuracy`.
- **learning\_rate** (float) – Learning rate to use for training, defaults to 1e-3.
- **head** (Union[function, Module, None]) – either a *nn.Module* or a callable function that converts the features extrated from the backbone into class log probabilities (assuming default loss function). If *None*, will default to using a single linear layer.
- **serializer** (Union[Serializer, Mapping[str, Serializer], None]) – A instance of *Serializer* that determines how the output should be serialized e.g. convert the model output into the desired output format when predicting.

### 51.1.2 VideoClassificationData

```
class flash.video.classification.data.VideoClassificationData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None,
                                                             postprocess=None,
                                                             data_fetcher=None,
                                                             val_split=None, batch_size=4,
                                                             num_workers=0, sampler=None)
```

Data module for Video classification tasks.

### 51.1.3 BaseVideoClassification

```
class flash.video.classification.data.BaseVideoClassification(clip_sampler,
                                                             video_sampler=torch.utils.data.RandomSampler,
                                                             decode_audio=True,
                                                             decoder='pyav')
```

#### 51.1.4 VideoClassificationFiftyOneDataSource

```
class flash.video.classification.data.VideoClassificationFiftyOneDataSource(clip_sampler,
                                                                           video_sampler=torch.utils.data.Ran
                                                                           de-
                                                                           code_audio=True,
                                                                           decoder='pyav',
                                                                           la-
                                                                           bel_field='ground_truth')
```

#### 51.1.5 VideoClassificationPathsDataSource

```
class flash.video.classification.data.VideoClassificationPathsDataSource(clip_sampler,
                                                                           video_sampler=torch.utils.data.Random
                                                                           decode_audio=True,
                                                                           decoder='pyav')
```

#### 51.1.6 VideoClassificationPreprocess

```
class flash.video.classification.data.VideoClassificationPreprocess(train_transform=None,
                                                                      val_transform=None,
                                                                      test_transform=None,
                                                                      predict_transform=None,
                                                                      clip_sampler='random',
                                                                      clip_duration=2,
                                                                      clip_sampler_kwargs=None,
                                                                      video_sampler=torch.utils.data.RandomSamp
                                                                      decode_audio=True,
                                                                      decoder='pyav',
                                                                      **data_source_kwargs)
```

#### 51.1.7 VideoClassifierFinetuning

```
class flash.video.classification.model.VideoClassifierFinetuning(num_layers=5, train_bn=True,
                                                                unfreeze_epoch=1)
```



## FLASH.GRAPH

- *Classification*
- *flash.graph.data*

### 52.1 Classification

<i>GraphClassifier</i>	The <code>GraphClassifier</code> is a Task for classifying graphs.
<i>GraphClassificationData</i> <i>classification.data</i> <i>GraphClassificationPreprocess</i>	Data module for graph classification tasks.

#### 52.1.1 GraphClassifier

```
class flash.graph.classification.model.GraphClassifier(num_features, num_classes,
                                                       hidden_channels=512, model=None,
                                                       loss_fn=torch.nn.functional.cross_entropy,
                                                       learning_rate=0.001, optimizer='Adam',
                                                       lr_scheduler=None, metrics=None,
                                                       conv_cls=None, **conv_kwargs)
```

The `GraphClassifier` is a Task for classifying graphs. For more details, see [Graph Classification](#).

##### Parameters

- **num\_features** (int) – Number of columns in table (not including target column).
- **num\_classes** (int) – Number of classes to classify.
- **hidden\_channels** (Union[List[int], int]) – Hidden dimension sizes.
- **learning\_rate** (float) – Learning rate to use for training, defaults to  $1e-3$
- **optimizer** (Union[str, Callable, Tuple[str, Dict[str, Any]]]) – Optimizer to use for training.
- **lr\_scheduler** (Union[str, Callable, Tuple[str, Dict[str, Any]], Tuple[str, Dict[str, Any], Dict[str, Any], None]) – The LR scheduler to use during training.
- **metrics** (Union[Metric, Mapping, Sequence, None]) – Metrics to compute for training and evaluation.

- **model** *(Optional[Module])* – GraphNN used, defaults to BaseGraphModel.
- **conv\_cls** *(Optional[Type[None]])* – kind of convolution used in model, defaults to GCNConv

### 52.1.2 GraphClassificationData

```
class flash.graph.classification.data.GraphClassificationData(train_dataset=None,
                                                             val_dataset=None,
                                                             test_dataset=None,
                                                             predict_dataset=None,
                                                             data_source=None,
                                                             preprocess=None,
                                                             postprocess=None,
                                                             data_fetcher=None,
                                                             val_split=None, batch_size=4,
                                                             num_workers=0, sampler=None)
```

Data module for graph classification tasks.

### 52.1.3 GraphClassificationPreprocess

```
class flash.graph.classification.data.GraphClassificationPreprocess(train_transform=None,
                                                                    val_transform=None,
                                                                    test_transform=None,
                                                                    predict_transform=None)
```

## 52.2 flash.graph.data

---

*GraphDatasetDataSource*

---

### 52.2.1 GraphDatasetDataSource

```
class flash.graph.data.GraphDatasetDataSource
```

## INTRODUCTION / SET-UP

### 53.1 Welcome

Before you begin, we'd like to express our gratitude to you for wanting to add a task to Flash. With Flash our aim is to create a great user experience, enabling awesome advanced applications with just a few lines of code. We're really pleased with what we've achieved with Flash and we hope you will be too. Now let's dive in!

### 53.2 Set-up

The Task template is designed to guide you through contributing a task to Flash. It contains the code, tests, and examples for a task that performs classification with a multi-layer perceptron, intended for use with the classic data sets from scikit-learn. The Flash tasks are organized in folders by data-type (image, text, video, etc.), with sub-folders for different task types (classification, regression, etc.).

Copy the files in `flash/template/classification` to a new sub-directory under the relevant data-type. If a data-type folder already exists for your task, then a task type sub-folder should be added containing the template files. If a data-type folder doesn't exist, then you will need to add that too. You should also copy the files from `tests/template/classification` to the corresponding data-type, task type folder in `tests`. For example, if you were adding an image classification task, you would do:

```
mkdir flash/image/classification
cp flash/template/classification/* flash/image/classification/
mkdir tests/image/classification
cp tests/template/classification/* tests/image/classification/
```

### 53.3 Tutorials

The tutorials in this section will walk you through all of the components you need to implement (or adapt from the template) for your custom task.

- *The Data*: our first tutorial goes over the best practices for implementing everything you need to connect data to your task
- *The Backbones*: the second tutorial shows you how to create an extensible backbone registry for your task
- *The Task*: now that we have the data and the models, in this tutorial we create our custom task
- *Optional Extras*: this tutorial covers some optional extras you can add if needed for your particular task
- *The Example*: this tutorial guides you through creating some simple examples showing your task in action

- *The Tests*: in this tutorial, we cover best practices for writing some tests for your new task
- *The Docs*: in our final tutorial, we provide a template for you to create the docs page for your task



## THE DATA

The first step to contributing a task is to implement the classes we need to load some data. Inside `data.py` you should implement:

1. some *DataSource* classes (*optional*)
2. a *Preprocess*
3. a *DataModule*
4. a *BaseVisualization* (*optional*)
5. a *Postprocess* (*optional*)

### 54.1 DataSource

The *DataSource* class contains the logic for data loading from different sources such as folders, files, tensors, etc. Every Flash *DataModule* can be instantiated with `from_datasets()`. For each additional way you want the user to be able to instantiate your *DataModule*, you'll need to create a *DataSource*. Each *DataSource* has 2 methods:

- `load_data()` takes some dataset metadata (e.g. a folder name) as input and produces a sequence or iterable of samples or sample metadata.
- `load_sample()` then takes as input a single element from the output of `load_data` and returns a sample.

By default these methods just return their input, so you don't need both a `load_data()` and a `load_sample()` to create a *DataSource*. Where possible, you should override one of our existing *DataSource* classes.

Let's start by implementing a *TemplateNumpyDataSource*, which overrides *NumpyDataSource*. The main *DataSource* method that we have to implement is `load_data()`. As we're extending the *NumpyDataSource*, we expect the same data argument (in this case, a tuple containing data and corresponding target arrays).

We can also take the dataset argument. Any attributes we set on `dataset` will be available on the *Dataset* generated by our *DataSource*. In this data source, we'll set the `num_features` attribute.

Here's the code for our *TemplateNumpyDataSource.load\_data* method:

```
def load_data(self, data: Tuple[np.ndarray, Sequence[Any]], dataset: Any) -> Sequence[Mapping[str, Any]]:
    """Sets the ``num_features`` attribute and calls ``super().load_data``.

    Args:
        data: The tuple of ``np.ndarray`` (num_examples x num_features) and associated targets.
        dataset: The object that we can set attributes (such as ``num_features``) on.
```

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```

Returns:
    A sequence of samples / sample metadata.
"""
dataset.num_features = data[0].shape[1]
return super().load_data(data, dataset)

```

**Note:** Later, when we add *our DataModule implementation*, we'll make `num_features` available to the user.

Sometimes you need to something a bit more custom. When creating a custom `DataSource`, the type of the data argument is up to you. For our template Task, it would be cool if the user could provide a scikit-learn Bunch as the data source. To achieve this, we'll add a `TemplateSKLearnDataSource` whose `load_data` expects a Bunch as input. We override our `TemplateNumpyDataSource` so that we can call `super` with the data and targets extracted from the Bunch. We perform two additional steps here to improve the user experience:

1. We set the `num_classes` attribute on the dataset. If `num_classes` is set, it is automatically made available as a property of the `DataModule`.
2. We create and set a `LabelsState`. The labels provided here will be shared with the `Labels` serializer, so the user doesn't need to provide them.

Here's the code for the `TemplateSKLearnDataSource.load_data` method:

```

def load_data(self, data: Bunch, dataset: Any) -> Sequence[Mapping[str, Any]]:
    """Gets the ``data`` and ``target`` attributes from the ``Bunch`` and passes them to
    ↪ ``super().load_data``.

    Args:
        data: The scikit-learn data ``Bunch``.
        dataset: The object that we can set attributes (such as ``num_classes``) on.

    Returns:
        A sequence of samples / sample metadata.
    """
    dataset.num_classes = len(data.target_names)
    self.set_state(LabelsState(data.target_names))
    return super().load_data((data.data, data.target), dataset=dataset)

```

We can customize the behaviour of our `load_data()` for different stages, by prepending *train*, *val*, *test*, or *predict*. For our `TemplateSKLearnDataSource`, we don't want to provide any targets to the model when predicting. We can implement `predict_load_data` like this:

```

def predict_load_data(self, data: Bunch) -> Sequence[Mapping[str, Any]]:
    """Avoid including targets when predicting.

    Args:
        data: The scikit-learn data ``Bunch``.

    Returns:
        A sequence of samples / sample metadata.
    """
    return super().predict_load_data(data.data)

```

### 54.1.1 DataSource vs Dataset

A *DataSource* is not the same as a `torch.utils.data.Dataset`. When a `from_*` method is called on your *DataModule*, it gets the *DataSource* to use from the *Preprocess*. A *Dataset* is then created from the *DataSource* for each stage (*train*, *val*, *test*, *predict*) using the provided metadata (e.g. folder name, numpy array etc.).

The output of the `load_data()` can just be a `torch.utils.data.Dataset` instance. If the library that your Task is based on provides a custom dataset, you don't need to re-write it as a *DataSource*. For example, the `load_data()` of the `VideoClassificationPathsDataSource` just creates an `EncodedVideoDataset` from the given folder. Here's how it looks (from `video/classification.data.py`):

```
def load_data(self, data: str, dataset: Optional[Any] = None) -> "LabeledVideoDataset":
    ds = self._make_encoded_video_dataset(data)
    if self.training:
        label_to_class_mapping = {p[1]: p[0].split("/")[2] for p in ds._labeled_videos._
    ↪ paths_and_labels}
        self.set_state(LabelsState(label_to_class_mapping))
        dataset.num_classes = len(np.unique([s[1]["label"] for s in ds._labeled_videos]))
    return ds
```

## 54.2 Preprocess

The *Preprocess* object contains all the data transforms. Internally we inject the *Preprocess* transforms at several points along the pipeline.

Defining the standard transforms (typically at least a `to_tensor_transform` should be defined) for your *Preprocess* is as simple as implementing the `default_transforms` method. The *Preprocess* must take `train_transform`, `val_transform`, `test_transform`, and `predict_transform` arguments in the `__init__`. These arguments can be provided by the user (when creating the *DataModule*) to override the default transforms. Any additional arguments are up to you.

Inside the `__init__`, we make a call to `super`. This is where we register our data sources. Data sources should be given as a dictionary which maps data source name to data source object. The name can be anything, but if you want to take advantage of our built-in `from_*` classmethods, you should use *DefaultDataSources* as the names. In our case, we have both a `NUMPY` and a custom scikit-learn data source (which we'll call "*sklearn*").

You should also provide a `default_data_source`. This is the name of the data source to use by default when predicting. It'd be cool if we could get predictions just from a numpy array, so we'll use `NUMPY` as the default.

Here's our `TemplatePreprocess.__init__`:

```
def __init__(
    self,
    train_transform: Optional[Dict[str, Callable]] = None,
    val_transform: Optional[Dict[str, Callable]] = None,
    test_transform: Optional[Dict[str, Callable]] = None,
    predict_transform: Optional[Dict[str, Callable]] = None,
):
    super().__init__(
        train_transform=train_transform,
        val_transform=val_transform,
        test_transform=test_transform,
        predict_transform=predict_transform,
        data_sources={
```

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```

        DefaultDataSources.NUMPY: TemplateNumpyDataSource(),
        "sklearn": TemplateSKLearnDataSource(),
    },
    default_data_source=DefaultDataSources.NUMPY,
)

```

For our `TemplatePreprocess`, we'll just configure a default `to_tensor_transform`. Let's first define the transform as a staticmethod:

```

@staticmethod
def input_to_tensor(input: np.ndarray):
    """Transform which creates a tensor from the given numpy ``ndarray`` and converts it_
    ↪ to ``float``"""
    return torch.from_numpy(input).float()

```

Our inputs samples will be dictionaries whose keys are in the `DefaultDataKeys`. You can map each key to different transforms using `ApplyToKeys`. Here's our `default_transforms` method:

```

def default_transforms(self) -> Optional[Dict[str, Callable]]:
    """Configures the default ``to_tensor_transform``.

    Returns:
        Our dictionary of transforms.
    """
    return {
        "to_tensor_transform": nn.Sequential(
            ApplyToKeys(DefaultDataKeys.INPUT, self.input_to_tensor),
            ApplyToKeys(DefaultDataKeys.TARGET, torch.as_tensor),
        ),
    }

```

## 54.3 DataModule

The `DataModule` is responsible for creating the `DataLoader` and injecting the transforms for each stage. When the user calls a `from_*` method (such as `from_numpy()`), the following steps take place:

1. The `from_data_source()` method is called with the name of the `DataSource` to use and the inputs to provide to `load_data()` for each stage.
2. The `Preprocess` is created from `cls.preprocess_cls` (if it wasn't provided by the user) with any provided transforms.
3. The `DataSource` of the provided name is retrieved from the `Preprocess`.
4. A `BaseAutoDataset` is created from the `DataSource` for each stage.
5. The `DataModule` is instantiated with the data sets.

To create our `TemplateData DataModule`, we first need to attach our preprocess class like this:

```
preprocess_cls = TemplatePreprocess
```

Since we provided a NUMPY *DataSource* in the *TemplatePreprocess*, *from\_numpy()* will now work with our *TemplateData*.

If you've defined a fully custom *DataSource* (like our *TemplateSKLearnDataSource*), then you will need to write a *from\_\** method for each. Here's the *from\_sklearn* method for our *TemplateData*:

```
@classmethod
def from_sklearn(
    cls,
    train_bunch: Optional[Bunch] = None,
    val_bunch: Optional[Bunch] = None,
    test_bunch: Optional[Bunch] = None,
    predict_bunch: Optional[Bunch] = None,
    train_transform: Optional[Dict[str, Callable]] = None,
    val_transform: Optional[Dict[str, Callable]] = None,
    test_transform: Optional[Dict[str, Callable]] = None,
    predict_transform: Optional[Dict[str, Callable]] = None,
    data_fetcher: Optional[BaseDataFetcher] = None,
    preprocess: Optional[Preprocess] = None,
    val_split: Optional[float] = None,
    batch_size: int = 4,
    num_workers: int = 0,
    **preprocess_kwargs: Any,
):
    """This is our custom ``from_`` method. It expects scikit-learn ``Bunch`` objects as
    ↪ input and passes them
    ↪ through to the :meth:`~flash.core.data.data_module.DataModule.from_data_source`
    ↪ method underneath.

    Args:
        train_bunch: The scikit-learn ``Bunch`` containing the train data.
        val_bunch: The scikit-learn ``Bunch`` containing the validation data.
        test_bunch: The scikit-learn ``Bunch`` containing the test data.
        predict_bunch: The scikit-learn ``Bunch`` containing the predict data.
        train_transform: The dictionary of transforms to use during training which maps
            ↪ :class:`~flash.core.data.process.Preprocess` hook names to callable
            ↪ transforms.
        val_transform: The dictionary of transforms to use during validation which maps
            ↪ :class:`~flash.core.data.process.Preprocess` hook names to callable
            ↪ transforms.
        test_transform: The dictionary of transforms to use during testing which maps
            ↪ :class:`~flash.core.data.process.Preprocess` hook names to callable
            ↪ transforms.
        predict_transform: The dictionary of transforms to use during predicting which
            ↪ maps
            ↪ :class:`~flash.core.data.process.Preprocess` hook names to callable
            ↪ transforms.
        data_fetcher: The :class:`~flash.core.data.callback.BaseDataFetcher` to pass to
            ↪ the
            ↪ :class:`~flash.core.data.data_module.DataModule`.
        preprocess: The :class:`~flash.core.data.data.Preprocess` to pass to the
```

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```

        :class:`~flash.core.data.data_module.DataModule`. If ``None``, ``cls.preprocess_
↪cls`` will be
        constructed and used.
        val_split: The ``val_split`` argument to pass to the :class:`~flash.core.data.data_
↪module.DataModule`.
        batch_size: The ``batch_size`` argument to pass to the :class:`~flash.core.data.
↪data_module.DataModule`.
        num_workers: The ``num_workers`` argument to pass to the :class:`~flash.core.data.
↪data_module.DataModule`.
        preprocess_kwargs: Additional keyword arguments to use when constructing the_
↪preprocess. Will only be used
        if ``preprocess = None``.

Returns:
    The constructed data module.
    """
    return super().from_data_source(
        "sklearn",
        train_bunch,
        val_bunch,
        test_bunch,
        predict_bunch,
        train_transform=train_transform,
        val_transform=val_transform,
        test_transform=test_transform,
        predict_transform=predict_transform,
        data_fetcher=data_fetcher,
        preprocess=preprocess,
        val_split=val_split,
        batch_size=batch_size,
        num_workers=num_workers,
        **preprocess_kwargs,
    )

```

The final step is to implement the `num_features` property for our `TemplateData`. This is just a convenience for the user that finds the `num_features` attribute on any of the data sets and returns it. Here's the code:

```

@property
def num_features(self) -> Optional[int]:
    """Tries to get the ``num_features`` from each dataset in turn and returns the output.
    ↪"""
    n_fts_train = getattr(self.train_dataset, "num_features", None)
    n_fts_val = getattr(self.val_dataset, "num_features", None)
    n_fts_test = getattr(self.test_dataset, "num_features", None)
    return n_fts_train or n_fts_val or n_fts_test

```

## 54.4 BaseVisualization

An optional step is to implement a *BaseVisualization*. The *BaseVisualization* lets you control how data at various points in the pipeline can be visualized. This is extremely useful for debugging purposes, allowing users to view their data and understand the impact of their transforms.

**Note:** Don't worry about implementing it right away, you can always come back and add it later!

Here's the code for our *TemplateVisualization* which just prints the data:

```
class TemplateVisualization(BaseVisualization):
    """The ``TemplateVisualization`` class is a :class:`~flash.core.data.callbacks.
↳BaseVisualization` that just
    prints the data.

    If you want to provide a visualization with your task, you can override these hooks.
    """

    def show_load_sample(self, samples: List[Any], running_stage: RunningStage):
        print(samples)

    def show_pre_tensor_transform(self, samples: List[Any], running_stage: RunningStage):
        print(samples)

    def show_to_tensor_transform(self, samples: List[Any], running_stage: RunningStage):
        print(samples)

    def show_post_tensor_transform(self, samples: List[Any], running_stage: ↳
↳RunningStage):
        print(samples)

    def show_per_batch_transform(self, batch: List[Any], running_stage):
        print(batch)
```

We can configure our custom visualization in the *TemplateData* using *configure\_data\_fetcher()* like this:

```
@staticmethod
def configure_data_fetcher(*args, **kwargs) -> BaseDataFetcher:
    """We can, *optionally*, provide a data visualization callback using the ``configure_
↳data_fetcher``
    method."""
    return TemplateVisualization(*args, **kwargs)
```

## 54.5 Postprocess

*Postprocess* contains any transforms that need to be applied *after* the model. You may want to use it for: converting tokens back into text, applying an inverse normalization to an output image, resizing a generated image back to the size of the input, etc. As an example, here's the `TextClassificationPostprocess` which gets the logits from a `SequenceClassifierOutput`:

```
class TextClassificationPostprocess(Postprocess):
    def per_batch_transform(self, batch: Any) -> Any:
        if isinstance(batch, SequenceClassifierOutput):
            batch = batch.logits
        return super().per_batch_transform(batch)
```

In your *DataSource* or *Preprocess*, you can add metadata to the batch using the `METADATA` key. Your *Postprocess* can then use this metadata in its transforms. You should use this approach if your postprocessing depends on the state of the input before the *Preprocess* transforms. For example, if you want to resize the predictions to the original size of the inputs you should add the original image size in the `METADATA`. Here's an example from the `SemanticSegmentationNumpyDataSource`:

```
def load_sample(self, sample: Dict[str, Any], dataset: Optional[Any] = None) -> Dict[str,
→ Any]:
    img = torch.from_numpy(sample[DefaultDataKeys.INPUT]).float()
    sample[DefaultDataKeys.INPUT] = img
    sample[DefaultDataKeys.METADATA] = {"size": img.shape}
    return sample
```

The `METADATA` can now be referenced in your *Postprocess*. For example, here's the code for the `per_sample_transform` method of the `SemanticSegmentationPostprocess`:

```
def per_sample_transform(self, sample: Any) -> Any:
    resize = K.geometry.Resize(sample[DefaultDataKeys.METADATA]["size"][-2:],
→ interpolation="bilinear")
    sample[DefaultDataKeys.PREDS] = resize(sample[DefaultDataKeys.PREDS])
    sample[DefaultDataKeys.INPUT] = resize(sample[DefaultDataKeys.INPUT])
    return super().per_sample_transform(sample)
```

Now that you've got some data, it's time to *add some backbones for your task!*



## THE BACKBONES

Now that you've got a way of loading data, you should implement some backbones to use with your *Task*. Create a *FlashRegistry* to use with your *Task* in *backbones.py*.

The registry allows you to register backbones for your task that can be selected by the user. The backbones can come from anywhere as long as you can register a function that loads the backbone. Furthermore, the user can add their own models to the existing backbones, without having to write their own *Task*!

You can create a registry like this:

```
TEMPLATE_BACKBONES = FlashRegistry("backbones")
```

Let's add a simple MLP backbone to our registry. We need a function that creates the backbone and returns it along with the output size (so that we can create the model head in our *Task*). You can use any name for the function, although we use `load_{model name}` by convention. You also need to provide name and namespace of the backbone. The standard for *namespace* is `data_type/task_type`, so for an image classification task the namespace will be `image/classification`. Here's the code:

```
@TEMPLATE_BACKBONES(name="mlp-128", namespace="template/classification")
def load_mlp_128(num_features, **_):
    """A simple MLP backbone with 128 hidden units."""
    return (
        nn.Sequential(
            nn.Linear(num_features, 128),
            nn.ReLU(True),
            nn.BatchNorm1d(128),
        ),
        128,
    )
```

Here's another example with a slightly more complex model:

```
@TEMPLATE_BACKBONES(name="mlp-128-256", namespace="template/classification")
def load_mlp_128_256(num_features, **_):
    """An two layer MLP backbone with 128 and 256 hidden units respectively."""
    return (
        nn.Sequential(
            nn.Linear(num_features, 128),
            nn.ReLU(True),
            nn.BatchNorm1d(128),
            nn.Linear(128, 256),
            nn.ReLU(True),
            nn.BatchNorm1d(256),
        ),
        256,
    )
```

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```
    ),  
    256,  
)
```

Here's a another example, which adds DINO pretrained model from PyTorch Hub to the `IMAGE_CLASSIFIER_BACKBONES`, from [flash/image/classification/backbones/transformers.py](#):

```
def dino_vitb16(*_, **__):  
    backbone = torch.hub.load("facebookresearch/dino:main", "dino_vitb16")  
    return backbone, 768
```

---

Once you've got some data and some backbones, *implement your task!*

## THE TASK

Once you've implemented a Flash *DataModule* and some backbones, you should implement your *Task* in `model.py`. The *Task* is responsible for: setting up the backbone, performing the forward pass of the model, and calculating the loss and any metrics. Remember that, under the hood, the Flash *Task* is simply a *LightningModule* with some helpful defaults.

To build your task, you can start by overriding the base *Task* or any of the existing *Task* implementations. For example, in our scikit-learn example, we can just override *ClassificationTask* which provides good defaults for classification.

You should attach your backbones registry as a class attribute like this:

```
class TemplateSKLearnClassifier(ClassificationTask):  
  
    backbones: FlashRegistry = TEMPLATE_BACKBONES
```

### 56.1 Model architecture and hyper-parameters

In the `__init__()`, you will need to configure defaults for the:

- loss function
- optimizer
- metrics
- backbone / model

You will also need to create the backbone from the registry and create the model head. Here's the code:

```
def __init__(  
    self,  
    num_features: int,  
    num_classes: int,  
    backbone: Union[str, Tuple[nn.Module, int]] = "mlp-128",  
    backbone_kwargs: Optional[Dict] = None,  
    loss_fn: LOSS_FN_TYPE = None,  
    optimizer: OPTIMIZER_TYPE = "Adam",  
    lr_scheduler: LR_SCHEDULER_TYPE = None,  
    metrics: METRICS_TYPE = None,  
    learning_rate: float = 1e-2,  
    multi_label: bool = False,  
    serializer: SERIALIZER_TYPE = None,
```

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```

):
    super().__init__(
        model=None,
        loss_fn=loss_fn,
        optimizer=optimizer,
        lr_scheduler=lr_scheduler,
        metrics=metrics,
        learning_rate=learning_rate,
        multi_label=multi_label,
        serializer=serializer or Labels(),
    )

    self.save_hyperparameters()

    if not backbone_kwargs:
        backbone_kwargs = {}

    if isinstance(backbone, tuple):
        self.backbone, out_features = backbone
    else:
        self.backbone, out_features = self.backbones.get(backbone)(num_features=num_
↪ features, **backbone_kwargs)

    self.head = nn.Linear(out_features, num_classes)

```

**Note:** We call `save_hyperparameters()` to log the arguments to the `__init__` as hyperparameters. Read more [here](#).

## 56.2 Adding the model routines

You should override the `{train,val,test,predict}_step` methods. The default `{train,val,test,predict}_step` implementations in `Task` expect a tuple containing the input (to be passed to the model) and target (to be used when computing the loss), and should be suitable for most applications. In our template example, we just extract the input and target from the input mapping and forward them to the super methods. Here's the code for the `training_step`:

```

def training_step(self, batch: Any, batch_idx: int) -> Any:
    """For the training step, we just extract the :attr:`~flash.core.data.data_source.
↪ DefaultDataKeys.INPUT` and
    :attr:`~flash.core.data.data_source.DefaultDataKeys.TARGET` keys from the input and
↪ forward them to the
    :meth:`~flash.core.model.Task.training_step`. """
    batch = (batch[DefaultDataKeys.INPUT], batch[DefaultDataKeys.TARGET])
    return super().training_step(batch, batch_idx)

```

We use the same code for the `validation_step` and `test_step`. For `predict_step` we don't need the targets, so our code looks like this:

```
def predict_step(self, batch: Any, batch_idx: int, dataloader_idx: int = 0) -> Any:
    """For the predict step, we just extract the :attr:`~flash.core.data.data_source.
    ↳DefaultDataKeys.INPUT` key
    from the input and forward it to the :meth:`~flash.core.model.Task.predict_step`."""
    batch = batch[DefaultDataKeys.INPUT]
    return super().predict_step(batch, batch_idx, dataloader_idx=dataloader_idx)
```

**Note:** You can completely replace the {train, val, test, predict}\_step methods (that is, without a call to super) if you need more custom behaviour for your *Task* at a particular stage.

Finally, we use our backbone and head in a custom forward pass:

```
def forward(self, x) -> torch.Tensor:
    """First call the backbone, then the model head."""
    x = self.backbone(x)
    return self.head(x)
```

Now that you've got your task, take a look at some *optional advanced features you can add* or go ahead and *create some examples showing your task in action!*



## OPTIONAL EXTRAS

### 57.1 Organize your transforms in transforms.py

If you have a lot of default transforms, it can be useful to put them all in a `transforms.py` file, to be referenced in your *Preprocess*. Here's an example from `image/classification/transforms.py` which creates some default transforms given the desired image size:

```
def default_transforms(image_size: Tuple[int, int]) -> Dict[str, Callable]:
    """The default transforms for image classification: resize the image, convert the
    ↪ image and target to a tensor,
    collate the batch, and apply normalization."""
    if _KORNIA_AVAILABLE and os.getenv("FLASH_TESTING", "0") != "1":
        # Better approach as all transforms are applied on tensor directly
        return {
            "to_tensor_transform": nn.Sequential(
                ApplyToKeys(DefaultDataKeys.INPUT, torchvision.transforms.ToTensor()),
                ApplyToKeys(DefaultDataKeys.TARGET, torch.as_tensor),
            ),
            "post_tensor_transform": ApplyToKeys(
                DefaultDataKeys.INPUT,
                K.geometry.Resize(image_size),
            ),
            "collate": kornia_collate,
            "per_batch_transform_on_device": ApplyToKeys(
                DefaultDataKeys.INPUT,
                K.augmentation.Normalize(torch.tensor([0.485, 0.456, 0.406]), torch.
    ↪ tensor([0.229, 0.224, 0.225])),
            ),
        }
    return {
        "pre_tensor_transform": ApplyToKeys(DefaultDataKeys.INPUT, T.Resize(image_size)),
        "to_tensor_transform": nn.Sequential(
            ApplyToKeys(DefaultDataKeys.INPUT, torchvision.transforms.ToTensor()),
            ApplyToKeys(DefaultDataKeys.TARGET, torch.as_tensor),
        ),
        "post_tensor_transform": ApplyToKeys(
            DefaultDataKeys.INPUT,
            T.Normalize([0.485, 0.456, 0.406], [0.229, 0.224, 0.225]),
        ),
        "collate": kornia_collate,
    }
```

Here's how we create our transforms in the *ImageClassificationPreprocess*:

```
def default_transforms(self) -> Optional[Dict[str, Callable]]:
    return default_transforms(self.image_size)
```

## 57.2 Add output serializers to your Task

We recommend that you do most of the heavy lifting in the *Postprocess*. Specifically, it should include any formatting and transforms that should always be applied to the predictions. If you want to support different use cases that require different prediction formats, you should add some *Serializer* implementations in a *serialization.py* file.

Some good examples are in *flash/core/classification.py*. Here's the *Classes Serializer*:

```
class Classes(PredsClassificationSerializer):
    """A :class:`.Serializer` which applies an argmax to the model outputs (either logits,
    ↪or probabilities) and
    converts to a list.

    Args:
        multi_label: If true, treats outputs as multi label logits.
        threshold: The threshold to use for multi_label classification.
    """

    def __init__(self, multi_label: bool = False, threshold: float = 0.5):
        super().__init__(multi_label)

        self.threshold = threshold

    def serialize(self, sample: Any) -> Union[int, List[int]]:
        sample = super().serialize(sample)
        if self.multi_label:
            one_hot = (sample.sigmoid() > self.threshold).int().tolist()
            result = []
            for index, value in enumerate(one_hot):
                if value == 1:
                    result.append(index)
            return result
        return torch.argmax(sample, -1).tolist()
```

Alternatively, here's the *Logits Serializer*:

```
class Logits(PredsClassificationSerializer):
    """A :class:`.Serializer` which simply converts the model outputs (assumed to be,
    ↪logits) to a list."""

    def serialize(self, sample: Any) -> Any:
        return super().serialize(sample).tolist()
```

Take a look at *Predictions (inference)* to learn more.

---

Once you've added any optional extras, it's time to *create some examples showing your task in action!*



## THE EXAMPLE

Now you've implemented your task, it's time to add an example showing how cool it is! We usually provide one example in `flash_examples/`. You can base these off of our `template.py` examples.

The example should:

1. download the data (we'll add the example to our CI later on, so choose a dataset small enough that it runs in reasonable time)
2. load the data into a *DataModule*
3. create an instance of the *Task*
4. create a *Trainer*
5. call `finetune()` or `fit()` to train your model
6. generate predictions for a few examples
7. save the checkpoint

For our template example we don't have a pretrained backbone, so we can just call `fit()` rather than `finetune()`. Here's the full example (`flash_examples/template.py`):

```
import numpy as np
import torch
from sklearn import datasets

import flash
from flash.template import TemplateData, TemplateSKLearnClassifier

# 1. Create the DataModule
datamodule = TemplateData.from_sklearn(
    train_bunch=datasets.load_iris(),
    val_split=0.1,
)

# 2. Build the task
model = TemplateSKLearnClassifier(num_features=datamodule.num_features, num_
    ↪ classes=datamodule.num_classes)

# 3. Create the trainer and train the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.fit(model, datamodule=datamodule)

# 4. Classify a few examples
```

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```
predictions = model.predict(  
    [  
        np.array([4.9, 3.0, 1.4, 0.2]),  
        np.array([6.9, 3.2, 5.7, 2.3]),  
        np.array([7.2, 3.0, 5.8, 1.6]),  
    ]  
)  
print(predictions)  
  
# 5. Save the model!  
trainer.save_checkpoint("template_model.pt")
```

We get this output:

```
['setosa', 'virginica', 'versicolor']
```

---

Now that you've got an example showing your awesome task in action, it's time to *write some tests!*

## THE TESTS

Our next step is to create some tests for our *Task*. For the `TemplateSKLearnClassifier`, we will just create some basic tests. You should expand on these to include tests for any specific functionality you have in your *Task*.

### 59.1 Smoke tests

We use smoke tests, usually called `test_smoke`, throughout. These just instantiate the class we are testing, to see that they can be created without raising any errors.

### 59.2 tests/examples/test\_scripts.py

Before we write our custom tests, we should add out examples to the CI. To do this, add a line for each example (`finetuning` and `predict`) to the annotation of `test_example` in `tests/examples/test_scripts.py`. Here's how those lines look for our `template.py` examples:

```
pytest.param(
    "finetuning", "template.py", marks=pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason=
↳ "sklearn isn't installed")
),
...
pytest.param(
    "predict", "template.py", marks=pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason=
↳ "sklearn isn't installed")
),
```

### 59.3 test\_data.py

The most important tests in `test_data.py` check that the `from_*` methods work correctly. In the class `TestTemplateData`, we have two of these: `test_from_numpy` and `test_from_sklearn`. In general, there should be one `test_from_*` method for each `data_source` you have configured.

Here's the code for `test_from_numpy`:

```
def test_from_numpy(self):
    """Tests that ``TemplateData`` is properly created when using the ``from_numpy``
↳ method."""
    data = np.random.rand(10, self.num_features)
```

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```

targets = np.random.randint(0, self.num_classes, (10,))

# instantiate the data module
dm = TemplateData.from_numpy(
    train_data=data,
    train_targets=targets,
    val_data=data,
    val_targets=targets,
    test_data=data,
    test_targets=targets,
    batch_size=2,
    num_workers=0,
)
assert dm is not None
assert dm.train_dataloader() is not None
assert dm.val_dataloader() is not None
assert dm.test_dataloader() is not None

# check training data
data = next(iter(dm.train_dataloader()))
rows, targets = data[DefaultDataKeys.INPUT], data[DefaultDataKeys.TARGET]
assert rows.shape == (2, self.num_features)
assert targets.shape == (2,)

# check val data
data = next(iter(dm.val_dataloader()))
rows, targets = data[DefaultDataKeys.INPUT], data[DefaultDataKeys.TARGET]
assert rows.shape == (2, self.num_features)
assert targets.shape == (2,)

# check test data
data = next(iter(dm.test_dataloader()))
rows, targets = data[DefaultDataKeys.INPUT], data[DefaultDataKeys.TARGET]
assert rows.shape == (2, self.num_features)
assert targets.shape == (2,)

```

## 59.4 test\_model.py

In `test_model.py`, we first have `test_forward` and `test_train`. These test that tensors can be passed to the forward and that the `Task` can be trained. Here's the code for `test_forward` and `test_train`:

```

@pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason="sklearn isn't installed")
@pytest.mark.parametrize("num_classes", [4, 256])
@pytest.mark.parametrize("shape", [(1, 3), (2, 128)])
def test_forward(num_classes, shape):
    """Tests that a tensor can be given to the model forward and gives the correct_
    ↪ output size."""
    model = TemplateSKLearnClassifier(
        num_features=shape[1],
        num_classes=num_classes,

```

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```

)
model.eval()

row = torch.rand(*shape)

out = model(row)
assert out.shape == (shape[0], num_classes)

```

```

@pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason="sklearn isn't installed")
def test_train(tmpdir):
    """Tests that the model can be trained on our `DummyDataset`."""
    model = TemplateSKLearnClassifier(num_features=DummyDataset.num_features, num_
    ↪classes=DummyDataset.num_classes)
    train_dl = torch.utils.data.DataLoader(DummyDataset(), batch_size=4)
    trainer = Trainer(default_root_dir=tmpdir, fast_dev_run=True)
    trainer.fit(model, train_dl)

```

We also include tests for validating and testing: `test_val`, and `test_test`. These tests are very similar to `test_train`, but here they are for completeness:

```

@pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason="sklearn isn't installed")
def test_val(tmpdir):
    """Tests that the model can be validated on our `DummyDataset`."""
    model = TemplateSKLearnClassifier(num_features=DummyDataset.num_features, num_
    ↪classes=DummyDataset.num_classes)
    val_dl = torch.utils.data.DataLoader(DummyDataset(), batch_size=4)
    trainer = Trainer(default_root_dir=tmpdir, fast_dev_run=True)
    trainer.validate(model, val_dl)

```

```

@pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason="sklearn isn't installed")
def test_test(tmpdir):
    """Tests that the model can be tested on our `DummyDataset`."""
    model = TemplateSKLearnClassifier(num_features=DummyDataset.num_features, num_
    ↪classes=DummyDataset.num_classes)
    test_dl = torch.utils.data.DataLoader(DummyDataset(), batch_size=4)
    trainer = Trainer(default_root_dir=tmpdir, fast_dev_run=True)
    trainer.test(model, test_dl)

```

We also include tests for prediction named `test_predict_*` for each of our data sources. In our case, we have `test_predict_numpy` and `test_predict_sklearn`. These tests should use the `data_source` argument to `predict()` to select the required `DataSource`. Here's `test_predict_sklearn` as an example:

```
@pytest.mark.skipif(not _SKLEARN_AVAILABLE, reason="sklearn isn't installed")
def test_predict_sklearn():
    """Tests that we can generate predictions from a scikit-learn ``Bunch``."""
    bunch = datasets.load_iris()
    model = TemplateSKLearnClassifier(num_features=DummyDataset.num_features, num_
↪classes=DummyDataset.num_classes)
    data_pipe = DataPipeline(preprocess=TemplatePreprocess())
    out = model.predict(bunch, data_source="sklearn", data_pipeline=data_pipe)
    assert isinstance(out[0], int)
```

---

Now that you've written the tests, it's time to *add some docs!*

## THE DOCS

The final step is to add some docs. For each *Task* in Flash, we have a docs page in [docs/source/reference](#). You should create a `.rst` file there with the following:

- a brief description of the task
- the predict example
- the finetuning example
- any relevant API reference

Here are the contents of [docs/source/reference/template.rst](#) which breaks down each of these steps:

```
.. _template:

#####
Template
#####

*****
The Task
*****

Here you should add a description of your task. For example:
Classification is the task of assigning one of a number of classes to each data point.

-----

*****
Example
*****

.. note::

    Here you should add a short intro to your example, and then use ``literalinclude``
    ↪ to add it.
    To make it simple, you can fill in this template.

Let's look at the task of <describe the task> using the <data set used in the example>.
The dataset contains <describe the data>.
Here's an outline:
```

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```
.. code-block::
```

```
<present the folder structure of the data or some data samples here>
```

Once we've downloaded the data using `:func:`~flash.core.data.download_data``, we create

↳ the <link to the DataModule with ```:class:```>.

We select a pre-trained backbone to use for our <link to the Task with ```:class:```> and

↳ finetune on the <name of the data set> data.

We then use the trained <link to the Task with ```:class:```> for inference.

Finally, we save the model.

Here's the full example:

```
<include the example with ``literalinclude``>
```

```
.. literalinclude:: ../../../../flash_examples/template.py
   :language: python
   :lines: 14-
```

*Here's the rendered doc page!*

---

Once the docs are done, it's finally time to open a PR and wait for some reviews!

Congratulations on adding your first [Task](#) to Flash, we hope to see you again soon!



## FLASH GOVERNANCE | PERSONS OF INTEREST

### 61.1 Leads

- William Falcon ([williamFalcon](#))
- Thomas Chaton ([tchaton](#))
- Ethan Harris ([ethanwharris](#))

### 61.2 Core Maintainers

- Jirka Borovec ([Borda](#))
- Kaushik Bokka ([kaushikb11](#))
- Justus Schock ([justusschock](#))
- Carlos Mocholí ([carmocca](#))
- Sean Narenthiran ([SeanNaren](#))
- Akihiro Nitta ([akihironitta](#))
- Aniket Maurya ([aniketmaurya](#))
- Ananya Harsh Jha ([ananyahjha93](#))
- Sivaraman Karthik Rangasai ([karthikrangasai](#))
- Pietro Lesci ([pietrolesci](#))



## CONTRIBUTING

Welcome to the PyTorch Lightning community! We're building the most advanced research platform on the planet to implement the latest, best practices that the amazing PyTorch team rolls out!

### 62.1 Flash Design Principles

We encourage all sorts of contributions you're interested in adding! When coding for Flash, please follow these principles.

#### 62.1.1 Simple Internal Code

It's useful for users to look at the code and understand very quickly what's happening. Many users won't be engineers. Thus we need to value clear, simple code over condensed ninja moves. While that's super cool, this isn't the project for that :)

#### 62.1.2 Force User Decisions To Best Practices

There are 1,000 ways to do something. However, eventually one popular solution becomes standard practice, and everyone follows. We try to find the best way to solve a particular problem, and then force our users to use it for readability and simplicity.

When something becomes a best practice, we add it to the framework. This is usually something like bits of code in utils or in the model file that everyone keeps adding over and over again across projects. When this happens, bring that code inside the trainer and add a flag for it.

#### 62.1.3 Backward-compatible API

We all hate updating our deep learning packages because we don't want to refactor a bunch of stuff. In Flash, we make sure every change we make which could break an API is backward compatible with good deprecation warnings.

### 62.1.4 Gain User Trust

As a researcher, you can't have any part of your code going wrong. So, make thorough tests to ensure that every implementation of a new trick or subtle change is correct.

### 62.1.5 Interoperability

PyTorch Lightning Flash is highly interoperable with PyTorch Lightning and PyTorch.

---

## 62.2 Contribution Types

We are always looking for help implementing new features or fixing bugs.

A lot of good work has already been done in project mechanics (requirements.txt, setup.py, pep8, badges, ci, etc...) so we're in a good state there thanks to all the early contributors (even pre-beta release)!

### 62.2.1 Bug Fixes:

1. If you find a bug please submit a GitHub issue.
  - Make sure the title explains the issue.
  - Describe your setup, what you are trying to do, expected vs. actual behaviour. Please add configs and code samples.
  - Add details on how to reproduce the issue - a minimal test case is always best, colab is also great. Note, that the sample code shall be minimal and if needed with publicly available data.
2. Try to fix it or recommend a solution. We highly recommend to use test-driven approach:
  - Convert your minimal code example to a unit/integration test with assert on expected results.
  - Start by debugging the issue... You can run just this particular test in your IDE and draft a fix.
  - Verify that your test case fails on the master branch and only passes with the fix applied.
3. Submit a PR!

***Note**, even if you do not find the solution, sending a PR with a test covering the issue is a valid contribution and we can help you or finish it with you :]*

### 62.2.2 New Features:

1. Submit a GitHub issue - describe what is the motivation of such feature (adding the use case or an example is helpful).
2. Let's discuss to determine the feature scope.
3. Submit a PR! We recommend test driven approach to adding new features as well:
  - Write a test for the functionality you want to add.
  - Write the functional code until the test passes.
4. Add/update the relevant tests!
  - [This PR](#) is a good example for adding a new metric, and [this one](#) for a new logger.

### 62.2.3 New Tasks:

Flash is a framework of tasks for fast prototyping, baselining, finetuning and solving business and scientific problems with deep learning. Following are general guidelines for adding new tasks.

1. Models which are standard baselines
2. Whose results are reproduced properly either by us or by authors.
3. Top models which are not SOTA but highly cited for production usage / for other uses. (E.g. Mobile BERT, MobileNets, FBNet).
4. Do not reinvent the wheel, natively support torchvision, torchtext, torchaudio models.
5. Use open source licensed models.

Please raise an issue before adding a new task. Please let us know why the particular task is important for Flash.

### 62.2.4 Test cases:

Want to keep Lightning Flash healthy? Love seeing those green tests? So do we! How to we keep it that way? We write tests! We value tests contribution even more than new features.

Tests are written using [pytest](#).

Have a look at sample tests [here](#).

After you have added the respective tests, you can run the tests locally with make script:

```
make test
```

Want to add a new test case and not sure how? [Talk to us!](#)

## 62.3 Guidelines

For this section, we refer to read the [parent PL guidelines](#)

### Reminder

All added or edited code shall be the own original work of the particular contributor. If you use some third-party implementation, all such blocks/functions/modules shall be properly referred and if possible also agreed by code's author. For example - This code is inspired from <http://...> In case you adding new dependencies, make sure that they are compatible with the actual PyTorch Lightning license (ie. dependencies should be *at least* as permissive as the PyTorch Lightning license).

### 62.3.1 How to rebase my PR?

We recommend creating a PR in a separate branch other than `master`, especially if you plan to submit several changes and do not want to wait until the first one is resolved (we can work on them in parallel).

First, make sure you have set [upstream](#) by running:

```
git remote add upstream https://github.com/PyTorchLightning/lightning-flash.git
```

You'll know its set up right if you run `git remote -v` and see something similar to this:

```
origin https://github.com/{YOUR_USERNAME}/lightning-flash.git (fetch)
origin https://github.com/{YOUR_USERNAME}/lightning-flash.git (push)
upstream https://github.com/PyTorchLightning/lightning-flash.git (fetch)
upstream https://github.com/PyTorchLightning/lightning-flash.git (push)
```

Checkout your feature branch and rebase it with upstream's master before pushing up your feature branch:

```
git fetch --all --prune
git rebase upstream/master
# follow git instructions to resolve conflicts
git push -f
```

## 62.3.2 Question & Answer

### 1. How can I help/contribute?

All help is extremely welcome - reporting bugs, fixing documentation, adding test cases, solving issues and preparing bug fixes. To solve some issues you can start with label [good first issue](#) or chose something close to your domain with label [help wanted](#). Before you start to implement anything check that the issue description that it is clear and self-assign the task to you (if it is not possible, just comment that you take it and we assign it to you...).

### 2. Is there a recommendation for branch names?

We do not rely on the name convention so far you are working with your own fork. Anyway it would be nice to follow this convention `<type>/<issue-id>_<short-name>` where the types are: `bugfix`, `feature`, `docs`, `tests`, ...

### 3. I have a model in other framework than PyTorch, how do I add it here?

Since PyTorch Lightning is written on top of PyTorch. We need models in PyTorch only. Also, we would need same or equivalent results with PyTorch Lightning after converting the models from other frameworks.

## CHANGELOG

All notable changes to this project will be documented in this file.

The format is based on [Keep a Changelog](#).

### 63.1 [0.5.2] - 2021-11-05

#### 63.1.1 [0.5.2] - Added

- Added a `TabularForecaster` task based on PyTorch Forecasting (#647)
- Added a `TabularRegressor` task (#892)

#### 63.1.2 [0.5.2] - Fixed

- Fixed a bug where test metrics were not logged correctly with active learning (#879)
- Fixed a bug where validation metrics could be aggregated together with test metrics in some cases (#900)
- Fixed a bug where the latest versions of torchmetrics and Lightning Flash could not be installed together (#902)
- Fixed compatibility with PyTorch-Lightning 1.5 (#933)

### 63.2 [0.5.1] - 2021-10-26

#### 63.2.1 [0.5.1] - Added

- Added `LabelStudio` integration (#554)
- Added support `learn2learn` training\_strategy for `ImageClassifier` (#737)
- Added `vissl` training\_strategies for `ImageEmbedder` (#682)
- Added support for `from_data_frame` to `TextClassificationData` (#785)
- Added `FastFace` integration (#606)
- Added support for `from_lists` to `TextClassificationData` (#805)

### 63.2.2 [0.5.1] - Changed

- Changed the default `num_workers` on linux to 0 (matching the default for other OS) (#759)
- Optimizer and LR Scheduler registry are used to get the respective inputs to the Task using a string (or a callable). (#777)

### 63.2.3 [0.5.1] - Fixed

- Fixed a bug where additional kwargs (e.g. `sampler`) passed to tabular data would be ignored (#792)
- Fixed a bug where loading text data with additional non-numeric columns (not input or target) would give an error (#888)

## 63.3 [0.5.0] - 2021-09-07

### 63.3.1 [0.5.0] - Added

- Added support for (input, target) style datasets (e.g. `torchvision`) to the `from_datasets` method (#552)
- Added support for `from_csv` and `from_data_frame` to `ImageClassificationData` (#556)
- Added SimCLR, SwAV, Barlow-twins pretrained weights for resnet50 backbone in `ImageClassifier` task (#560)
- Added support for Semantic Segmentation backbones and heads from `segmentation-models.pytorch` (#562)
- Added support for nesting of Task objects (#575)
- Added `PointCloudSegmentation` Task (#566)
- Added `PointCloudObjectDetection` Task (#600)
- Added a `GraphClassifier` task (#73)
- Added the option to pass `pretrained` as a string to `SemanticSegmentation` to change pretrained weights to load from `segmentation-models.pytorch` (#587)
- Added support for `field` parameter for loading JSON based datasets in text tasks. (#585)
- Added `AudioClassificationData` and an example for classifying audio spectrograms (#594)
- Added a `SpeechRecognition` task for speech to text using `Wav2Vec` (#586)
- Added `Flash Zero`, a zero code command line ML platform built with flash (#611)
- Added support for `.npy` and `.npz` files to `ImageClassificationData` and `AudioClassificationData` (#651)
- Added support for `from_csv` to the `AudioClassificationData` (#651)
- Added option to pass a `resolver` to the `from_csv` and `from_pandas` methods of `ImageClassificationData`, which is used to resolve filenames given IDs (#651)
- Added integration with `IceVision` for the `ObjectDetector` (#608)
- Added keypoint detection task (#608)
- Added instance segmentation task (#608)
- Added Torch ORT support to Transformer based tasks (#667)
- Added support for flash zero with the `InstanceSegmentation` and `KeypointDetector` tasks (#672)



- Added support for `in_chans` argument to the flash ResNet to control the expected number of input channels (#673)
- Added a `QuestionAnswering` task for extractive question answering (#607)
- Added automatic unwrapping of IceVision prediction objects (#727)
- Added support for the `ObjectDetector` with `FiftyOne` (#727)
- Added support for MP3 files to the `SpeechRecognition` task with `librosa` (#726)
- Added support for `from_numpy` and `from_tensors` to `AudioClassificationData` (#745)

### 63.3.2 [0.5.0] - Changed

- Changed how pretrained flag works for loading weights for `ImageClassifier` task (#560)
- Removed bolts pretrained weights for SSL from `ImageClassifier` task (#560)
- Changed the behaviour of the `sampler` argument of the `DataModule` to take a `Sampler` type rather than instantiated object (#651)
- Changed arguments to `ObjectDetector`, use `head` instead of `model` and append `_fpn` to the backbone name instead of the `fpn` argument (#608)

### 63.3.3 [0.5.0] - Fixed

- Fixed a bug where serve sanity checking would not be triggered using the latest PyTorchLightning version (#493)
- Fixed a bug where train and validation metrics weren't being correctly computed (#559)
- Fixed a bug where an uncaught `ValueError` could be raised when checking if a module is available (#615)
- Fixed a bug where some tasks were not compatible with PyTorch 1.7 due to use of `torch.jit.isinstance` (#611)
- Fixed a bug where custom samplers would not be properly forwarded to the data loader (#651)
- Fixed a bug where it was not possible to pass no metrics to the `ImageClassifier` or `TestClassifier` (#660)
- Fixed a bug where `drop_last` would be set to `True` during prediction and testing (#671)
- Fixed a bug where flash was not compatible with `pytorch-lightning`  $\geq 1.4.3$  (#690)

## 63.4 [0.4.0] - 2021-06-22

### 63.4.1 [0.4.0] - Added

- Added integration with `FiftyOne` (#360)
- Added `flash.serve` (#399)
- Added support for `torch.jit` to tasks where possible and documented task JIT compatibility (#389)
- Added option to provide a `Sampler` to the `DataModule` to use when creating a `DataLoader` (#390)
- Added support for multi-label text classification and toxic comments example (#401)
- Added a sanity checking feature to `flash.serve` (#423)

### 63.4.2 [0.4.0] - Changed

- Split backbone argument to `SemanticSegmentation` into backbone and head arguments (#412)

### 63.4.3 [0.4.0] - Fixed

- Fixed a bug where the `DefaultDataKeys.METADATA` couldn't be a dict (#393)
- Fixed a bug where the `SemanticSegmentation` task would not work as expected with finetuning callbacks (#412)
- Fixed a bug where predict batches could not be visualized with `ImageClassificationData` (#438)

## 63.5 [0.3.2] - 2021-06-08

### 63.5.1 [0.3.2] - Fixed

- Fixed a bug where `flash.Trainer.from_argparse_args + finetune` would not work (#382)

## 63.6 [0.3.1] - 2021-06-08

### 63.6.1 [0.3.1] - Added

- Added `deeplabv3`, `lraspp`, and `unet` backbones for the `SemanticSegmentation` task (#370)

### 63.6.2 [0.3.1] - Changed

- Changed the installation command for extra features (#346)
- Change resize interpolation default mode to nearest (#352)

### 63.6.3 [0.3.1] - Deprecated

- Deprecated `SemanticSegmentation` backbone names `torchvision/fcn_resnet50` and `torchvision/fcn_resnet101`, use `fc_resnet50` and `fcn_resnet101` instead (#370)

### 63.6.4 [0.3.1] - Fixed

- Fixed `flash.Trainer.add_argparse_args` not adding any arguments (#343)
- Fixed a bug where the translation task wasn't decoding tokens properly (#332)
- Fixed a bug where huggingface tokenizers were sometimes being pickled (#332)
- Fixed issue with `KorniaParallelTransforms` to assure to share the random state between transforms (#351)
- Fixed a bug where using `val_split` with `overfit_batches` would give an infinite recursion (#375)
- Fixed a bug where some timm models were mistakenly given a `global_pool` argument (#377)
- Fixed `flash.Trainer.from_argparse_args` not passing arguments correctly (#380)

## 63.7 [0.3.0] - 2021-05-20

### 63.7.1 [0.3.0] - Added

- Added DataPipeline API (#188 #141 #207)
- Added timm integration (#196)
- Added BaseViz Callback (#201)
- Added backbone API (#204)
- Added support for Iterable auto dataset (#227)
- Added multi label support (#230)
- Added support for schedulers (#232)
- Added visualisation callback for image classification (#228)
- Added Video Classification task (#216)
- Added Dino backbone for image classification (#259)
- Added Data Sources API (#256 #264 #272)
- Refactor preprocess\_cls to preprocess, add Serializer, add DataPipelineState (#229)
- Added Semantic Segmentation task (#239 #287 #290)
- Added Object detection prediction example (#283)
- Added Style Transfer task and accompanying finetuning and prediction examples (#262)
- Added a Template task and tutorials showing how to contribute a task to flash (#306)

### 63.7.2 [0.3.0] - Changed

- Rename valid\_ to val\_ (#197)
- Refactor preprocess\_cls to preprocess, add Serializer, add DataPipelineState (#229)

### 63.7.3 [0.3.0] - Fixed

- Fix DataPipeline resolution in Task (#212)
- Fixed a bug where the backbone used in summarization was not correctly passed to the postprocess (#296)

## 63.8 [0.2.3] - 2021-04-17

### 63.8.1 [0.2.3] - Added

- Added TIMM integration as backbones (#196)

### 63.8.2 [0.2.3] - Fixed

- Fixed nltk.download (#210)

## 63.9 [0.2.2] - 2021-04-05

### 63.9.1 [0.2.2] - Changed

- Switch to use torchmetrics (#169)
- Better support for optimizer and schedulers (#232)
- Update lightning version to v1.2 (#133)

### 63.9.2 [0.2.2] - Fixed

- Fixed classification softmax (#169)
- Fixed a bug where loading from a local checkpoint that had pretrained=True without an internet connection would sometimes raise an error (#237)
- Don't download data if exists (#157)

## 63.10 [0.2.1] - 2021-3-06

### 63.10.1 [0.2.1] - Added

- Added RetinaNet & backbones to ObjectDetector Task (#121)
- Added .csv image loading utils (#116, #117, #118)

### 63.10.2 [0.2.1] - Changed

- Set inputs as optional (#109)

### 63.10.3 [0.2.1] - Fixed

- Set minimal requirements (#62)
- Fixed VGG backbone num\_features (#154)

## 63.11 [0.2.0] - 2021-02-12

### 63.11.1 [0.2.0] - Added

- Added ObjectDetector Task (#56)
- Added TabNet for tabular classification (#101)
- Added support for more backbones(mobilnet, vgg, densenet, resnext) (#45)
- Added backbones for image embedding model (#63)
- Added SWAV and SimCLR models to imageclassifier + backbone reorg (#68)

### 63.11.2 [0.2.0] - Changed

- Applied transform in FilePathDataset (#97)
- Moved classification integration from vision root to folder (#86)

### 63.11.3 [0.2.0] - Fixed

- Unfreeze default number of workers in datamodule (#57)
- Fixed wrong label in FilePathDataset (#94)

### 63.11.4 [0.2.0] - Removed

- Removed densenet161 duplicate in DENSENET\_MODELS (#76)
- Removed redundant num\_features arg from Classification model (#88)

## 63.12 [0.1.0] - 2021-02-02

### 63.12.1 [0.1.0] - Added

- Added flash\_notebook examples (#9)
- Added strategy to trainer.finetune with NoFreeze, Freeze, FreezeUnfreeze, UnfreezeMilestones Callbacks(#39)
- Added SummarizationData, SummarizationTask and TranslationData, TranslationTask (#37)
- Added ImageEmbedder (#36)



## TEMPLATE

### 64.1 The Task

Here you should add a description of your task. For example: Classification is the task of assigning one of a number of classes to each data point.

---

### 64.2 Example

**Note:** Here you should add a short intro to your example, and then use `literalinclude` to add it. To make it simple, you can fill in this template.

---

Let's look at the task of <describe the task> using the <data set used in the example>. The dataset contains <describe the data>. Here's an outline:

<present the folder structure of the data **or** some data samples here>

Once we've downloaded the data using `download_data()`, we create the <link to the DataModule with :class:>. We select a pre-trained backbone to use for our <link to the Task with :class:> and finetune on the <name of the data set> data. We then use the trained <link to the Task with :class:> for inference. Finally, we save the model. Here's the full example:

<include the example with `literalinclude`>

```
import numpy as np
import torch
from sklearn import datasets

import flash
from flash.template import TemplateData, TemplateSKLearnClassifier

# 1. Create the DataModule
datamodule = TemplateData.from_sklearn(
    train_bunch=datasets.load_iris(),
    val_split=0.1,
)
```

(continues on next page)

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```
# 2. Build the task
model = TemplateSKLearnClassifier(num_features=datamodule.num_features, num_
    ↪classes=datamodule.num_classes)

# 3. Create the trainer and train the model
trainer = flash.Trainer(max_epochs=3, gpus=torch.cuda.device_count())
trainer.fit(model, datamodule=datamodule)

# 4. Classify a few examples
predictions = model.predict(
    [
        np.array([4.9, 3.0, 1.4, 0.2]),
        np.array([6.9, 3.2, 5.7, 2.3]),
        np.array([7.2, 3.0, 5.8, 1.6]),
    ]
)
print(predictions)

# 5. Save the model!
trainer.save_checkpoint("template_model.pt")
```



## INDICES AND TABLES

- `genindex`
- `search`



## Symbols

`__init__()` (*flash.core.integrations.icevision.transforms.IceVisionTransformAdapter* method), 178

## A

*Adapter* (class in *flash.core.adapter*), 173  
*AdapterTask* (class in *flash.core.adapter*), 174  
*add\_argparse\_args()* (*flash.core.trainer.Trainer* class method), 171  
*aggregate()* (*flash.text.seq2seq.core.metrics.RougeBatchAggregator* method), 273  
*apply\_filtering()* (*flash.core.model.Task* static method), 169  
*ApplyToKeys* (class in *flash.core.data.transforms*), 200  
*AudioClassificationData* (class in *flash.audio.classification.data*), 231  
*AudioClassificationPreprocess* (class in *flash.audio.classification.data*), 231  
*AutoDataset* (class in *flash.core.data.auto\_dataset*), 188  
*available\_data\_sources()* (*flash.core.data.data\_module.DataModule* method), 149  
*available\_data\_sources()* (*flash.core.data.process.Preprocess* method), 166  
*available\_keys()* (*flash.core.registry.ExternalRegistry* method), 181

## B

*BaseAutoDataset* (class in *flash.core.data.auto\_dataset*), 188  
*BaseDataFetcher* (class in *flash.core.data.callback*), 191  
*BasePreprocess* (class in *flash.core.data.process*), 198  
*BaseSpeechRecognition* (class in *flash.audio.speech\_recognition.data*), 234  
*BaseVideoClassification* (class in *flash.video.classification.data*), 276  
*BaseVisualization* (class in *flash.core.data.base\_viz*), 188

*BenchmarkConvergenceCI* (class in *flash.core.model*), 179  
*BLEUScore* (class in *flash.text.seq2seq.core.metrics*), 273  
*build\_data\_pipeline()* (*flash.core.model.Task* method), 169

## C

*CheckDependenciesMeta* (class in *flash.core.model*), 180  
*Classes* (class in *flash.core.classification*), 174  
*ClassificationSerializer* (class in *flash.core.classification*), 175  
*ClassificationTask* (class in *flash.core.classification*), 175  
*collate()* (*flash.core.data.process.Preprocess* method), 166  
*collate()* (*flash.text.classification.data.TextClassificationPreprocess* method), 257  
*collate()* (*flash.text.question\_answering.data.QuestionAnsweringPreprocess* method), 266  
*collate()* (*flash.text.seq2seq.core.data.Seq2SeqPreprocess* method), 272  
*Composition* (class in *flash.core.serve.composition*), 203  
*ConcatRegistry* (class in *flash.core.registry*), 181  
*configure\_data\_fetcher()* (*flash.core.data.data\_module.DataModule* static method), 150  
*configure\_optimizers()* (*flash.core.model.Task* method), 170  
*ControlFlow* (class in *flash.core.data.callback*), 193  
*convert\_predictions()* (in *flash.core.integrations.pytorch\_forecasting.transforms*), 179  
*convert\_to\_modules()* (in *flash.core.data.utils*), 202  
*CurrentFuncContext* (class in *flash.core.data.utils*), 202  
*CurrentRunningStageContext* (class in *flash.core.data.utils*), 202  
*CurrentRunningStageFuncContext* (class in *flash.core.data.utils*), 202

## D

`data_fetcher` (*flash.core.data.data\_module.DataModule* property), 150

`data_pipeline` (*flash.core.data.data\_module.DataModule* property), 150

`data_source` (*flash.core.data.data\_module.DataModule* property), 150

`data_source_of_name()` (*flash.core.data.process.Preprocess* method), 166

`DataModule` (class in *flash.core.data.data\_module*), 149

`DataPipeline` (class in *flash.core.data.data\_pipeline*), 193

`DataPipelineState` (class in *flash.core.data.data\_pipeline*), 194

`DatasetDataSource` (class in *flash.core.data.data\_source*), 195

`DatasetProcessor` (class in *flash.core.model*), 180

`DataSource` (class in *flash.core.data.data\_source*), 147

`default_transforms()` (*flash.core.data.process.Preprocess* static method), 166

`default_transforms()` (in module *flash.core.integrations.icevision.transforms*), 178

`default_transforms()` (in module *flash.image.classification.transforms*), 210

`default_transforms()` (in module *flash.image.segmentation.transforms*), 227

`default_uncollate()` (in module *flash.core.data.batch*), 191

`DefaultDataKeys` (class in *flash.core.data.data\_source*), 195

`DefaultDataSources` (class in *flash.core.data.data\_source*), 195

`DefaultPreprocess` (class in *flash.core.data.process*), 199

`Deserializer` (class in *flash.core.data.process*), 199

`DeserializerMapping` (class in *flash.core.data.process*), 199

`disable()` (*flash.core.data.process.Serializer* method), 168

`download_data()` (in module *flash.core.data.utils*), 202

## E

`embedding_sizes` (*flash.tabular.data.TabularData* property), 246

`enable()` (*flash.core.data.callback.BaseDataFetcher* method), 193

`enable()` (*flash.core.data.process.Serializer* method), 168

`Endpoint` (class in *flash.core.serve.core*), 204

`expose()` (in module *flash.core.serve.decorators*), 204

`ExternalRegistry` (class in *flash.core.registry*), 181

## F

`FiftyOneDataSource` (class in *flash.core.data.data\_source*), 195

`FiftyOneDetectionLabels` (class in *flash.image.detection.serialization*), 215

`FiftyOneLabels` (class in *flash.core.classification*), 175

`FiftyOneParser` (class in *flash.image.detection.data*), 215

`FiftyOneSegmentationLabels` (class in *flash.image.segmentation.serialization*), 226

`find_classes()` (*flash.core.data.data\_source.PathsDataSource* static method), 196

`finetune()` (*flash.core.trainer.Trainer* method), 171

`fit()` (*flash.core.trainer.Trainer* method), 171

`FlashBaseFinetuning` (class in *flash.core.finetuning*), 176

`FlashCallback` (class in *flash.core.data.callback*), 163

`FlashRegistry` (class in *flash.core.registry*), 180

`forward()` (*flash.pointcloud.detection.model.PointCloudObjectDetector* method), 238

`forward()` (*flash.pointcloud.segmentation.model.PointCloudSegmentation* method), 236

`FreezeUnfreeze` (class in *flash.core.finetuning*), 177

`from_argparse_args()` (*flash.core.trainer.Trainer* class method), 171

`from_argparse_args()` (in module *flash.core.trainer*), 185

`from_coco()` (*flash.image.detection.data.ObjectDetectionData* class method), 212

`from_coco()` (*flash.image.instance\_segmentation.data.InstanceSegmentationData* class method), 219

`from_coco()` (*flash.image.keypoint\_detection.data.KeypointDetectionData* class method), 217

`from_csv()` (*flash.core.data.data\_module.DataModule* class method), 150

`from_csv()` (*flash.image.classification.data.ImageClassificationData* class method), 207

`from_csv()` (*flash.tabular.data.TabularData* class method), 246

`from_csv()` (*flash.text.question\_answering.data.QuestionAnsweringData* class method), 260

`from_data_frame()` (*flash.image.classification.data.ImageClassificationData* class method), 208

`from_data_frame()` (*flash.tabular.data.TabularData* class method), 248

`from_data_frame()` (*flash.tabular.forecasting.data.TabularForecastingData* class method), 244

`from_data_frame()` (*flash.text.classification.data.TextClassificationData* class method), 252

`from_data_source()` (*flash.core.data.data\_module.DataModule* class method), 151

`from_datasets()` (*flash.core.data.data\_module.DataModule* class method), 152

`from_fiftyone()` (*flash.core.data.data\_module.DataModule* class method), 152

class method), 153  
 from\_files() (flash.core.data.data\_module.DataModule class method), 154  
 from\_folders() (flash.core.data.data\_module.DataModule class method), 155  
 from\_folders() (flash.image.segmentation.data.SemanticSegmentationData class method), 224  
 from\_folders() (flash.pointcloud.detection.data.PointCloudObjectDetectionData class method), 238  
 from\_hf\_datasets() (flash.text.classification.data.TextClassificationData class method), 253  
 from\_json() (flash.core.data.data\_module.DataModule class method), 156  
 from\_json() (flash.text.question\_answering.data.QuestionAnsweringData class method), 262  
 from\_labelstudio() (flash.core.data.data\_module.DataModule class method), 158  
 from\_lists() (flash.text.classification.data.TextClassificationData class method), 254  
 from\_numpy() (flash.core.data.data\_module.DataModule class method), 159  
 from\_parquet() (flash.text.classification.data.TextClassificationData class method), 256  
 from\_squad\_v2() (flash.text.question\_answering.data.QuestionAnsweringData class method), 263  
 from\_task() (flash.core.adapter.Adapter class method), 173  
 from\_tensors() (flash.core.data.data\_module.DataModule class method), 160  
 from\_via() (flash.image.detection.data.ObjectDetectionData class method), 213  
 from\_voc() (flash.image.detection.data.ObjectDetectionData class method), 214  
 from\_voc() (flash.image.instance\_segmentation.data.InstanceSegmentationData class method), 220  
 FuncModule (class in flash.core.data.utils), 202

## G

generate\_dataset() (flash.core.data.data\_source.DataSource method), 147  
 get() (flash.core.registry.ExternalRegistry method), 181  
 get() (flash.core.registry.FlashRegistry method), 180  
 get\_callable\_dict() (in module flash.core.utilities.apply\_func), 185  
 get\_callable\_name() (in module flash.core.utilities.apply\_func), 185  
 get\_lr() (flash.core.optimizers.LinearWarmupCosineAnnealing method), 184  
 get\_num\_training\_steps() (flash.core.model.Task method), 170  
 get\_state() (flash.core.data.data\_pipeline.DataPipelineStep method), 194  
 get\_state\_dict() (flash.core.data.process.BasePreprocessor method), 198

## H

GraphClassificationData (class in flash.graph.classification.data), 280  
 GraphClassificationPreprocess (class in flash.graph.classification.data), 280  
 GraphClassifier (class in flash.graph.classification.model), 279  
 GraphDatasetDataSource (class in flash.graph.data), 280  
 ImageClassificationData (class in flash.image.classification.data), 207  
 ImageClassificationPreprocess (class in flash.image.classification.data), 210  
 ImageClassifier (class in flash.image.classification.model), 205  
 ImageDeserializer (class in flash.image.data), 230  
 ImageEmbedder (class in flash.image.embedding.model), 222  
 ImageFiftyOneDataSource (class in flash.image.data), 230  
 ImageLabelsMap (class in flash.core.data.data\_source), 195  
 ImageNumpyDataSource (class in flash.image.data), 230  
 ImagePathsDataSource (class in flash.image.data), 230  
 ImageTensorDataSource (class in flash.image.data), 230  
 initialize() (flash.core.data.data\_pipeline.DataPipeline method), 193

## I

InstanceSegmentation (class in flash.image.instance\_segmentation.model), 218  
 InstanceSegmentationData (class in flash.image.instance\_segmentation.data), 219  
 InstanceSegmentationPreprocess (class in flash.image.instance\_segmentation.data), 221  
 IterableAutoDataset (class in flash.core.data.auto\_dataset), 188

## K

KeypointDetectionData (class in flash.image.keypoint\_detection.data), 217  
 KeypointDetectionPreprocess (class in flash.image.keypoint\_detection.data), 218

- KeypointDetector (class in *flash.image.keypoint\_detection.model*), 216
- kornia\_collate() (in module *flash.core.data.transforms*), 201
- KorniaParallelTransforms (class in *flash.core.data.transforms*), 201
- ## L
- Labels (class in *flash.core.classification*), 175
- labels\_to\_image() (*flash.image.segmentation.serialization.serialization\_utils* static method), 227
- LabelsState (class in *flash.core.data.data\_source*), 196
- LAMB (class in *flash.core.optimizers*), 182
- LARS (class in *flash.core.optimizers*), 181
- LinearWarmupCosineAnnealingLR (class in *flash.core.optimizers*), 183
- load\_data() (*flash.core.data.data\_source.DataSource* static method), 147
- load\_data() (*flash.text.classification.data.TextDataSource* method), 257
- load\_sample() (*flash.core.data.data\_source.DataSource* static method), 148
- load\_state\_dict() (*flash.core.data.process.BasePreprocess* class method), 198
- Logits (class in *flash.core.classification*), 176
- ## M
- make\_dataset() (in module *flash.core.data.data\_source*), 197
- MatplotlibVisualization (class in *flash.image.classification.data*), 210
- merge\_transforms() (in module *flash.core.data.transforms*), 201
- MockDataset (class in *flash.core.data.data\_source*), 196
- ModelComponent (in module *flash.core.serve.component*), 203
- ModuleWrapperBase (class in *flash.core.model*), 180
- multi\_label (*flash.core.data.data\_module.DataModule* property), 161
- ## N
- NoFreeze (class in *flash.core.finetuning*), 177
- num\_classes (*flash.core.data.data\_module.DataModule* property), 162
- NumpyDataSource (class in *flash.core.data.data\_source*), 196
- ## O
- ObjectDetectionData (class in *flash.image.detection.data*), 212
- ObjectDetectionFiftyOneDataSource (class in *flash.image.detection.data*), 215
- ObjectDetectionPreprocess (class in *flash.image.detection.data*), 215
- ObjectDetector (class in *flash.image.detection.model*), 211
- on\_collate() (*flash.core.data.callback.FlashCallback* method), 163
- on\_load\_sample() (*flash.core.data.callback.FlashCallback* method), 163
- on\_per\_batch\_transform() (*flash.core.data.callback.FlashCallback* method), 163
- on\_per\_batch\_transform\_on\_device() (*flash.core.data.callback.FlashCallback* method), 163
- on\_per\_sample\_transform\_on\_device() (*flash.core.data.callback.FlashCallback* method), 163
- on\_post\_tensor\_transform() (*flash.core.data.callback.FlashCallback* method), 163
- on\_pre\_tensor\_transform() (*flash.core.data.callback.FlashCallback* method), 163
- on\_to\_tensor\_transform() (*flash.core.data.callback.FlashCallback* method), 163
- ## P
- parameters (*flash.tabular.forecasting.data.TabularForecastingData* property), 245
- PathsDataSource (class in *flash.core.data.data\_source*), 196
- per\_batch\_transform() (*flash.core.data.process.Postprocess* static method), 168
- per\_batch\_transform() (*flash.core.data.process.Preprocess* method), 166
- per\_batch\_transform\_on\_device() (*flash.core.data.process.Preprocess* method), 167
- per\_sample\_transform() (*flash.core.data.process.Postprocess* static method), 168
- per\_sample\_transform() (*flash.text.question\_answering.data.QuestionAnsweringPostprocess* static method), 266
- per\_sample\_transform\_on\_device() (*flash.core.data.process.Preprocess* method), 167
- PointCloudObjectDetector (class in *flash.pointcloud.detection.model*), 237
- PointCloudObjectDetectorData (class in *flash.pointcloud.detection.data*), 238
- PointCloudObjectDetectorDatasetDataSource (class in *flash.pointcloud.detection.data*), 240



- PointCloudObjectDetectorFoldersDataSource (class in *flash.pointcloud.detection.data*), 240
- PointCloudObjectDetectorPreprocess (class in *flash.pointcloud.detection.data*), 240
- PointCloudSegmentation (class in *flash.pointcloud.segmentation.model*), 235
- PointCloudSegmentationData (class in *flash.pointcloud.segmentation.data*), 236
- PointCloudSegmentationDatasetDataSource (class in *flash.pointcloud.segmentation.data*), 237
- PointCloudSegmentationFoldersDataSource (class in *flash.pointcloud.segmentation.data*), 237
- PointCloudSegmentationPreprocess (class in *flash.pointcloud.segmentation.data*), 237
- post\_tensor\_transform() (*flash.core.data.process.Preprocess* method), 167
- Postprocess (class in *flash.core.data.process*), 168
- postprocess (*flash.core.data.data\_module.DataModule* property), 162
- postprocess\_cls (*flash.core.data.data\_module.DataModule* attribute), 162
- pre\_tensor\_transform() (*flash.core.data.process.Preprocess* method), 167
- predict() (*flash.core.model.Task* method), 170
- predict\_context() (in module *flash.core.model*), 185
- predict\_dataset (*flash.core.data.data\_module.DataModule* property), 162
- PredsClassificationSerializer (class in *flash.core.classification*), 176
- prepare\_target() (in module *flash.image.segmentation.transforms*), 227
- Preprocess (class in *flash.core.data.process*), 164
- preprocess (*flash.core.data.data\_module.DataModule* property), 162
- preprocess\_cls (*flash.image.classification.data.ImageClassificationData* attribute), 210
- Probabilities (class in *flash.core.classification*), 176
- ProcessState (class in *flash.core.data.properties*), 199
- Properties (class in *flash.core.data.properties*), 200
- pytorch\_forecasting\_model (*flash.tabular.forecasting.model.TabularForecaster* property), 244
- QuestionAnsweringDictionaryDataSource (class in *flash.text.question\_answering.data*), 265
- QuestionAnsweringFileDataSource (class in *flash.text.question\_answering.data*), 265
- QuestionAnsweringJSONDataSource (class in *flash.text.question\_answering.data*), 265
- QuestionAnsweringPostprocess (class in *flash.text.question\_answering.data*), 266
- QuestionAnsweringPreprocess (class in *flash.text.question\_answering.data*), 266
- QuestionAnsweringTask (class in *flash.text.question\_answering.model*), 259
- ## R
- raise\_not\_supported() (in module *flash.image.style\_transfer.utils*), 229
- request\_dataloader() (*flash.core.trainer.Trainer* method), 171
- RougeBatchAggregator (class in *flash.text.seq2seq.core.metrics*), 273
- RougeMetric (class in *flash.text.seq2seq.core.metrics*), 273
- ## S
- save\_data() (*flash.core.data.process.Postprocess* static method), 168
- save\_sample() (*flash.core.data.process.Postprocess* static method), 168
- SegmentationLabels (class in *flash.image.segmentation.serialization*), 227
- SegmentationMatplotlibVisualization (class in *flash.image.segmentation.data*), 226
- SemanticSegmentation (class in *flash.image.segmentation.model*), 223
- SemanticSegmentationData (class in *flash.image.segmentation.data*), 224
- SemanticSegmentationDeserializer (class in *flash.image.segmentation.data*), 226
- SemanticSegmentationFiftyOneDataSource (class in *flash.image.segmentation.data*), 226
- SemanticSegmentationNumpyDataSource (class in *flash.image.segmentation.data*), 226
- SemanticSegmentationPathsDataSource (class in *flash.image.segmentation.data*), 226
- SemanticSegmentationPostprocess (class in *flash.image.segmentation.model*), 226
- SemanticSegmentationPreprocess (class in *flash.image.segmentation.data*), 225
- SemanticSegmentationTensorDataSource (class in *flash.image.segmentation.data*), 226
- Seq2SeqBackboneState (class in *flash.text.seq2seq.core.data*), 271
- Seq2SeqCSVDDataSource (class in *flash.text.seq2seq.core.data*), 272
- ## Q
- QuestionAnsweringBackboneState (class in *flash.text.question\_answering.data*), 264
- QuestionAnsweringCSVDDataSource (class in *flash.text.question\_answering.data*), 264
- QuestionAnsweringData (class in *flash.text.question\_answering.data*), 260
- QuestionAnsweringDataSource (class in *flash.text.question\_answering.data*), 264

Seq2SeqData (class in flash.text.seq2seq.core.data), 271	show_predict_batch() (flash.core.data.data_module.DataModule method), 162
Seq2SeqDataSource (class in flash.text.seq2seq.core.data), 272	show_test_batch() (flash.core.data.data_module.DataModule method), 162
Seq2SeqFileDataSource (class in flash.text.seq2seq.core.data), 272	show_to_tensor_transform() (flash.core.data.base_viz.BaseVisualization method), 190
Seq2SeqFreezeEmbeddings (class in flash.text.seq2seq.core.finetuning), 271	show_train_batch() (flash.core.data.data_module.DataModule method), 162
Seq2SeqJSONDataSource (class in flash.text.seq2seq.core.data), 272	show_val_batch() (flash.core.data.data_module.DataModule method), 162
Seq2SeqPostprocess (class in flash.text.seq2seq.core.data), 272	SpeechRecognition (class in flash.audio.speech_recognition.model), 233
Seq2SeqPreprocess (class in flash.text.seq2seq.core.data), 272	SpeechRecognitionBackboneState (class in flash.audio.speech_recognition.data), 233
Seq2SeqSentencesDataSource (class in flash.text.seq2seq.core.data), 273	SpeechRecognitionCSVDDataSource (class in flash.audio.speech_recognition.data), 233
Seq2SeqTask (class in flash.text.seq2seq.core.model), 270	SpeechRecognitionData (class in flash.audio.speech_recognition.data), 232
SequenceDataSource (class in flash.core.data.data_source), 196	SpeechRecognitionDatasetDataSource (class in flash.audio.speech_recognition.data), 234
serialize() (flash.core.data.process.Serializer static method), 168	SpeechRecognitionDeserializer (class in flash.audio.speech_recognition.data), 234
Serializer (class in flash.core.data.process), 168	SpeechRecognitionFileDataSource (class in flash.audio.speech_recognition.data), 234
SerializerMapping (class in flash.core.data.process), 199	SpeechRecognitionJSONDataSource (class in flash.audio.speech_recognition.data), 234
Servable (class in flash.core.serve.core), 204	SpeechRecognitionPathsDataSource (class in flash.audio.speech_recognition.data), 234
set_block_viz_window() (flash.image.classification.data.ImageClassificationData method), 210	SpeechRecognitionPostprocess (class in flash.audio.speech_recognition.data), 233
set_block_viz_window() (flash.image.segmentation.data.SemanticSegmentationData method), 225	SpeechRecognitionPreprocess (class in flash.audio.speech_recognition.data), 233
set_state() (flash.core.data.data_pipeline.DataPipelineState method), 194	SplitDataset (class in flash.core.data.splits), 200
show() (flash.core.data.base_viz.BaseVisualization method), 190	SQUADDataSource (class in flash.text.question_answering.data), 266
show_collate() (flash.core.data.base_viz.BaseVisualization method), 190	step() (flash.core.model.Task method), 170
show_load_sample() (flash.core.data.base_viz.BaseVisualization method), 190	step() (flash.core.optimizers.LAMB method), 183
show_per_batch_transform() (flash.core.data.base_viz.BaseVisualization method), 190	step() (flash.core.optimizers.LARS method), 182
show_per_batch_transform_on_device() (flash.core.data.base_viz.BaseVisualization method), 190	StyleTransfer (class in flash.image.style_transfer.model), 228
show_per_sample_transform_on_device() (flash.core.data.base_viz.BaseVisualization method), 190	StyleTransferData (class in flash.image.style_transfer.data), 229
show_post_tensor_transform() (flash.core.data.base_viz.BaseVisualization method), 190	StyleTransferPreprocess (class in flash.image.style_transfer.data), 229
show_pre_tensor_transform() (flash.core.data.base_viz.BaseVisualization method), 190	SummarizationData (class in flash.text.seq2seq.summarization.data), 268
	SummarizationPreprocess (class in flash.text.seq2seq.summarization.data), 268
	SummarizationTask (class in flash.text.seq2seq.summarization.model), 267



T

<b>T</b>			
TabularClassificationData	(class in flash.tabular.classification.data), 242	in	
TabularClassifier	(class in flash.tabular.classification.model), 241	in	
TabularCSVDataSource	(class in flash.tabular.data), 249		
TabularData	(class in flash.tabular.data), 246		
TabularDataFrameDataSource	(class in flash.tabular.data), 249	in	
TabularDeserializer	(class in flash.tabular.data), 249		
TabularForecaster	(class in flash.tabular.forecasting.model), 244	in	
TabularForecastingData	(class in flash.tabular.forecasting.data), 244	in	
TabularForecastingDataFrameDataSource	(class in flash.tabular.forecasting.data), 246		
TabularForecastingPreprocess	(class in flash.tabular.forecasting.data), 246	in	
TabularPostprocess	(class in flash.tabular.data), 250		
TabularPreprocess	(class in flash.tabular.data), 249		
TabularRegressionData	(class in flash.tabular.regression.data), 243	in	
TabularRegressor	(class in flash.tabular.regression.model), 242	in	
Task	(class in flash.core.model), 169		
task	(flash.text.question_answering.model.QuestionAnsweringTask property), 260		
task	(flash.text.seq2seq.core.model.Seq2SeqTask property), 271		
TensorDataSource	(class in flash.core.data.data_source), 197	in	
test_dataset	(flash.core.data.data_module.DataModule property), 162		
TextClassificationData	(class in flash.text.classification.data), 252	in	
TextClassificationPostprocess	(class in flash.text.classification.data), 257	in	
TextClassificationPreprocess	(class in flash.text.classification.data), 257	in	
TextClassifier	(class in flash.text.classification.model), 252	in	
TextCSVDataSource	(class in flash.text.classification.data), 258	in	
TextDataFrameDataSource	(class in flash.text.classification.data), 258	in	
TextDataSource	(class in flash.text.classification.data), 257		
TextDeserializer	(class in flash.text.classification.data), 257	in	
TextHuggingFaceDatasetDataSource	(class in flash.text.classification.data), 258	in	
TextJSONDataSource	(class in flash.text.classification.data), 258	in	
TextListDataSource	(class in flash.text.classification.data), 258	in	
TextParquetDataSource	(class in flash.text.classification.data), 258	in	
TimeSeriesDataSetParametersState	(class in flash.tabular.forecasting.data), 246	in	
to_datasets()	(flash.core.data.data_source.DataSource method), 148		
to_tensor_transform()	(flash.core.data.process.Preprocess method), 167		
train_dataset	(flash.core.data.data_module.DataModule property), 162		
train_default_transforms()	(in module flash.core.integrations.icevision.transforms), 178		
train_default_transforms()	(in module flash.image.classification.transforms), 211		
train_default_transforms()	(in module flash.image.segmentation.transforms), 227		
Trainer	(class in flash.core.trainer), 171		
transforms	(flash.core.data.process.Preprocess property), 167		
TranslationData	(class in flash.text.seq2seq.translation.data), 269	in	
TranslationPreprocess	(class in flash.text.seq2seq.translation.data), 270	in	
TranslationTask	(class in flash.text.seq2seq.translation.model), 269	in	
<b>U</b>			
uncollate()	(flash.core.data.process.Postprocess static method), 168		
UnfreezeMilestones	(class in flash.core.finetuning), 177		
update()	(flash.text.seq2seq.core.metrics.BLEUScore method), 273		
<b>V</b>			
val_dataset	(flash.core.data.data_module.DataModule property), 162		
VideoClassificationData	(class in flash.video.classification.data), 276	in	
VideoClassificationFiftyOneDataSource	(class in flash.video.classification.data), 277		
VideoClassificationPathsDataSource	(class in flash.video.classification.data), 277		
VideoClassificationPreprocess	(class in flash.video.classification.data), 277	in	
VideoClassifier	(class in flash.video.classification.model), 275	in	
VideoClassifierFinetuning	(class in flash.video.classification.model), 277	in	

`visualize()` (in *module*  
*flash.core.integrations.fiftyone.utils*), 177