Continuum

Simple Management of Complex Continual Learning Scenarios

```
$ pip3 install continuum
```

https://github.com/Continvvm/continuum

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Data Loading for Continual Learning

Continual data loading is **complex**

Each paper requires **many different settings**

Reinventing the wheel

```
dataset = MNIST("my/data/path", download=True, train=True)
scenario = ClassIncremental(dataset, increment=2)

for task_id, taskset in enumerate(scenario):
    train_taskset, val_taskset = split_train_val(taskset, val_split=0.1)
    train_loader = DataLoader(train_taskset, batch_size=32, shuffle=True)
    val_loader = DataLoader(val_taskset, batch_size=32, shuffle=True)

    for x, y, t in train_loader:
        # Do your cool stuff here
```

UNIX Philosophy:

Minimal

One Single Goal

Modular

1. Choose a dataset,
2. Choose a scenario,
3. and use *torchvision* loaders!

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    loader = DataLoader(taskset, batch_size=32, shuffle=True)

    for x, y, t in train_loader:
        # Do your cool stuff here
```

But wait there is already many libraries...

Sequoia FACIL Avalanche

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Continuum

Released to public and used by several researchers since **April 2020**

Light-weight with only goal in mind: data loading, no models!

Easiest to **plug in** existing codebase

Also **good synergy** with large codebase such as Sequoia!

But wait there is already many libraries...

Sequoia FACIL Avalanche

Different goal than existing libraries

Continuum

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Easiest to **plug in** existing codebase

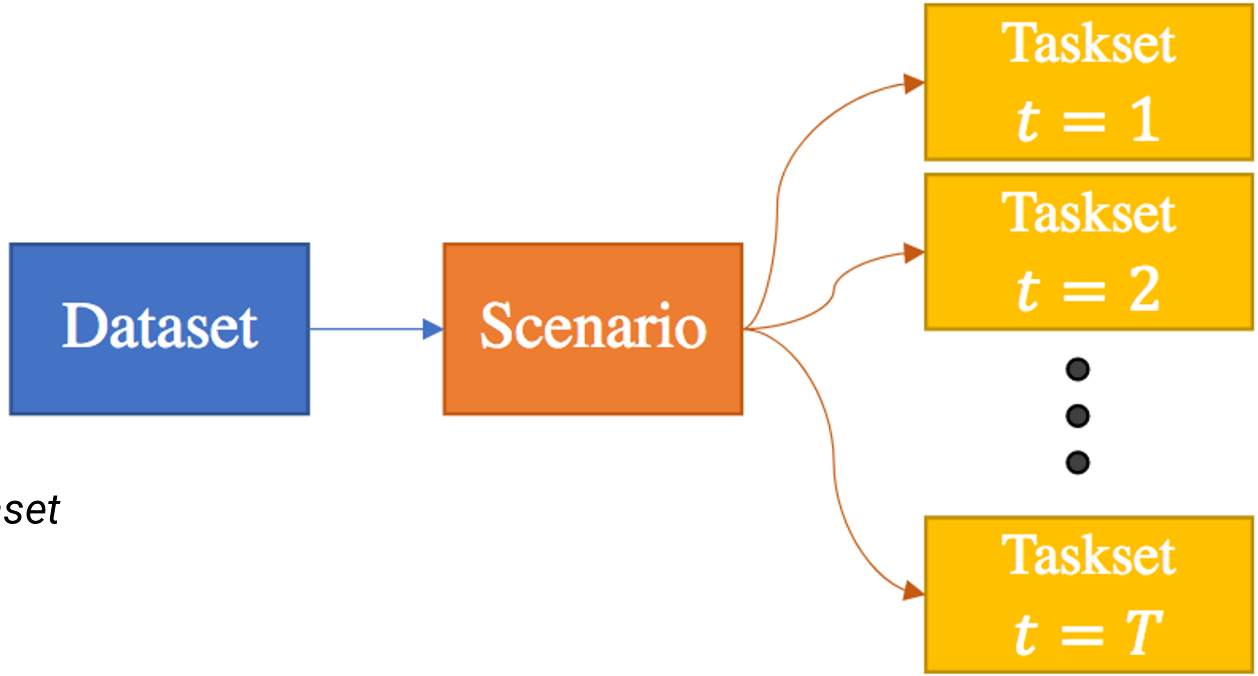
Also **good synergy** with large codebase such as Sequoia!

No big diagram

More than 20 datasets

5 different scenarios

Tasksets are *torchvision.Dataset*



Smooth integration in Pytorch

```python
from torch.utils.data import DataLoader
from continuum import ClassIncremental
from continuum.datasets import MNIST

dataset = MNIST("/data", train=True)
scenario = ClassIncremental(dataset, increment=2)

for task_id, train_taskset in enumerate(scenario):
    train_loader = DataLoader(train_taskset, batch_size=32, shuffle=True)

    for x, y, t in train_loader:
        # x --> data
        # y --> labels
        # t --> task ids
```

Class-Incremental vs Task-Incremental

Use task ids, or not.

Your choice!

```
from torch.utils.data import DataLoader
from continuum import ClassIncremental
from continuum.datasets import MNIST

dataset = MNIST("/data", train=False)
scenario = ClassIncremental(dataset, increment=2)

for task_id, test_taskset in enumerate(scenario):
    test_loader = DataLoader(test_taskset, batch_size=32)

    for x, y, t in test_loader:
        # x --> data
        # y --> labels
        # t --> task ids
```

Tasks Flexibility

```python
dataset = MNIST("/data", train=False)
scenario = ClassIncremental(dataset, increment=2)

third_taskset = scenario[2]
all_seen_tasksets = scenario[:3]
```

All usual python fancy indexing for scenario

Split MNIST

```python
from continuum import ClassIncremental
from continuum.datasets import MNIST

dataset = MNIST("/path", train=True)
scenario = ClassIncremental(dataset, increment=2)
```





Split MNIST

```python
from continuum import ClassIncremental
from continuum.datasets import MNIST

dataset = MNIST("/path", train=True)
scenario = ClassIncremental(dataset, increment=[4, 4, 2])
```

New Instances

```python
from continuum import InstanceIncremental
from continuum.datasets import Core50v2_79

dataset = Core50v2_79("/path", train=True, download=True)
scenario = InstanceIncremental(dataset)
```

...

Segmentation

```python
dataset = PascalVOC2012("/path", train=True, download=True)
scenario = SegmentationClassIncremental(
    dataset,
    increment=[19, 1],  # Learning 19 classes then 1
    nb_classes=20,
    mode="overlap",
    transformations=[Resize((512, 512)), ToTensor()]
)

for taskset in scenario:
    loader = DataLoader(taskset, batch_size=12)
    for x, y, t in loaders:
        # Same interface, your model goes here
```

Incremental Learning Techniques for Semantic Segmentation, Michielli and Zanuttight, ICCV-W 2019
Modeling the Background for Incremental Learning in Semantic Segmentation, Cermelli et al., CVPR 2020

Transformations Scenario

```python
from torchvision.transforms import RandomAffine

dataset = MNIST("/path", train=True)
scenario = TransformationIncremental(
    dataset,
    [
        [RandomAffine(degrees=0)],
        [RandomAffine(degrees=45)],
        [RandomAffine(degrees=90)]
    ]
)
```

Task 0: 0° degree

Task 1: 45° degree

Task 2: 90° degree

Rehearsal Learning

Handle rehearsal memory as you want

Use memory in the taskset you want

Oversample with **native** pytorch samplers

```
from torch.utils.data import DataLoader
from continuum import ClassIncremental
from continuum.datasets import MNIST

dataset = MNIST("/path", train=True)
scenario = ClassIncremental(dataset, increment=2)

taskset = scenario[2]
# Add rehearsal memory to current task
taskset.add_samples(memory_x, memory_y)

loader = DataLoader(
    taskset,
    sampler=my_pytorch_sampler
)
```

🚀 Future

🚫 We don’t want to increase complexity:

- No addition of tons of options, attributes, etc.
- No models, no losses, etc.

✅ We want to offer a large choice of simple interfaces:

- More datasets (more segmentation, more NLP, etc.)
- More scenarios

Don’t use Continuum

- if you wants a whole ecosystem,
- many models,
- and a strict way to do continual learning

Do use Continuum

- if you wants a **light-weight** library,
- easily **pluggable** in any codebase, no matter how small or large it is
- with the most **pytorch*nic*** interface

Want more?

📖 Documentation: continuum.readthedocs.io

💻 Github: github.com/Continvvm/continuum

⚙️ Colab tutorial: colab.research.google.com

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