mini-batch

PyTorch Tutorial

08. Dataset and DataLoader

Revision: Manual data feed

```
xy = np.loadtxt( ‘diabetes.csv.gz’ , delimiter= ‘,’ , dtype=np.float32)
x_data = torch.from_numpy(xy[:,:-1])
y_data = torch.from_numpy(xy[:, [-1]])

……

for epoch in range(100):
    # 1. Forward
    y_pred = model(x_data)
    loss = criterion(y_pred, y_data)
    print(epoch, loss.item())
    # 2. Backward
    optimizer.zero_grad()
    loss.backward()
    # 3. Update
    optimizer.step()
```

Use all of the data

mini-batch

鞍点

Terminology: Epoch, Batch-Size, Iterations

```python
# Training cycle
for epoch in range(training_epochs):
    # Loop over all batches
    for i in range(total_batch):
```

10000
1000.
→ 10

Definition: Epoch

One forward pass and one backward pass of **all the training examples**.

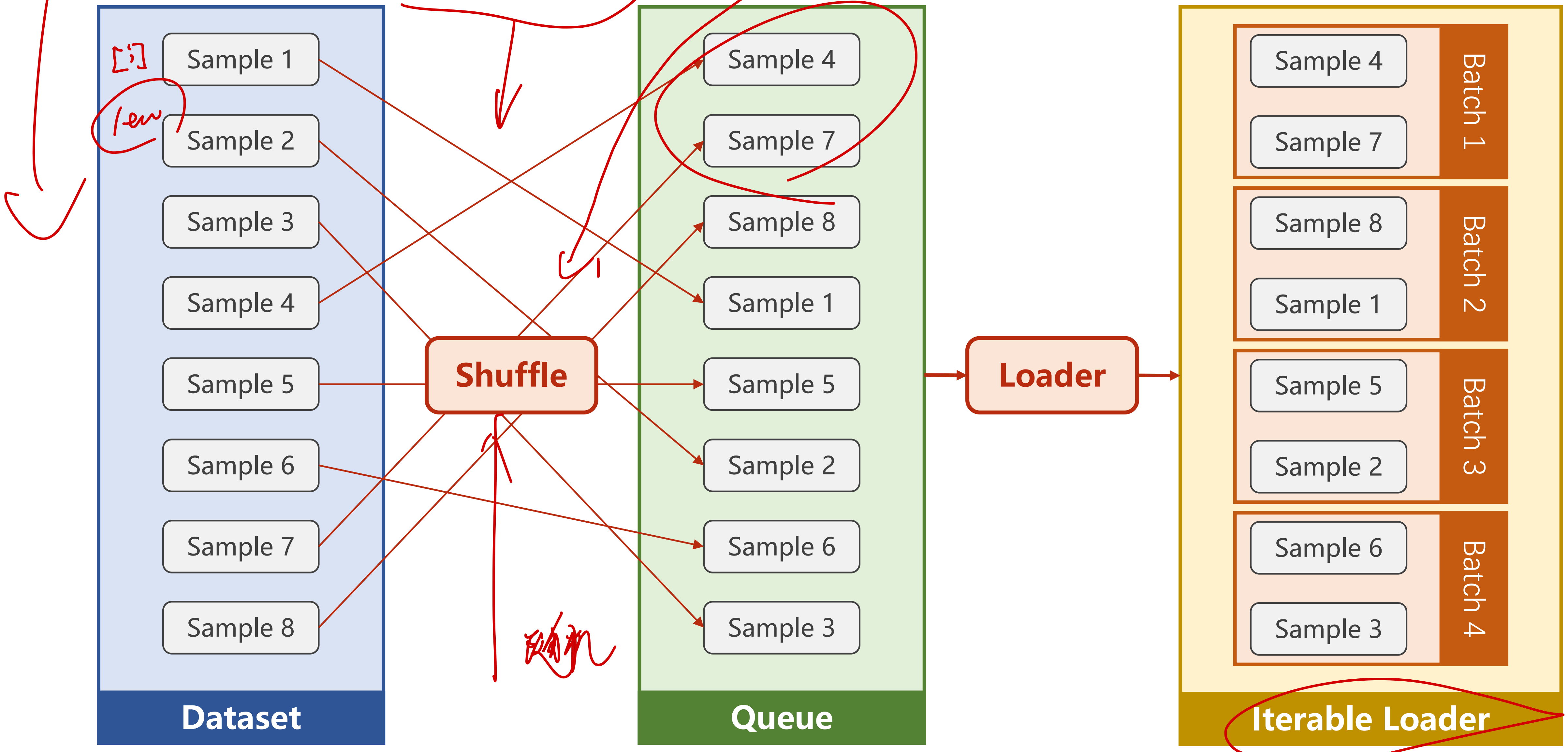
Definition: Batch-Size

The **number of training examples** in one forward backward pass.

Definition: Iteration

Number of passes, each pass using [**batch size**] number of examples.

DataLoader: batch_size=2, shuffle=True



How to define your Dataset

```python
import torch
from torch.utils.data import Dataset
from torch.utils.data import DataLoader

class DiabetesDataset(Dataset):
    def __init__(self):
        pass

    def __getitem__(self, index):
        pass

    def __len__(self):
        pass

dataset = DiabetesDataset()
train_loader = DataLoader(dataset=dataset,
                          batch_size=32,
                          shuffle=True,
                          num_workers=2)
```

Dataset is an **abstract** class. We can define our class inherited from this class.

只能被继承

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DataLoader is a class to help us loading data in PyTorch.

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                          shuffle=True,
                          num_workers=2)
```

DiabetesDataset is inherited from abstract class **Dataset**.

下标操作

len( )

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                          batch_size=32,
                          shuffle=True,
                          num_workers=2)
```

The expression, **dataset[index]**, will call this magic function.

init

1. All data / [i] (小数据)

2.

x

文件名

3、 [illegible] -> 读取 getitem 处理

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```

This magic function returns length of dataset.

多线程：

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                          num_workers=2)
```

Construct DiabetesDataset object.

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from torch.utils.data import DataLoader

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    def __len__(self):
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dataset = DiabetesDataset()
train_loader = DataLoader(dataset=dataset,
                          batch_size=32,
                          shuffle=True,
                          num_workers=2)
```

Initialize loader with batch-size, shuffle, process number.

Extra: *num_workers* in Windows

```
train_loader = DataLoader(dataset=dataset,
                          batch_size=32,
                          shuffle=True,
                          num_workers=2)
……
for epoch in range(100):
    for i, data in enumerate(train_loader, 0):
        ……
```

So we have to **wrap** the code with an if-clause to protect the code from executing multiple times.

The implementation of multiprocessing is different on Windows, which uses **spawn** instead of **fork**.

So left code will cause:

```
RuntimeError:
        An attempt has been made to start a new process before the
        current process has finished its bootstrapping phase.

        This probably means that you are not using fork to start your
        child processes and you have forgotten to use the proper idiom
        in the main module:

            if __name__ == '__main__':
                freeze_support()
                ...

        The "freeze_support()" line can be omitted if the program
        is not going to be frozen to produce an executable.
```

Extra: *num_workers* in Windows

```
train_loader = DataLoader(dataset=dataset,
                          batch_size=32,
                          shuffle=True,
                          num_workers=2)
……
if __name__ == '__main__':
    for epoch in range(100):
        for i, data in enumerate(train_loader, 0):
            # 1. Prepare data
```

So we have to **wrap** the code with an if-clause to protect the code from executing multiple times.

Example: Diabetes Dataset

```python
class DiabetesDataset(Dataset):
    def __init__(self, filepath):
        xy = np.loadtxt(filepath, delimiter=',', dtype=np.float32)
        self.len = xy.shape[0]
        self.x_data = torch.from_numpy(xy[:, :-1])
        self.y_data = torch.from_numpy(xy[:, [-1]])

    def __getitem__(self, index):
        return self.x_data[index], self.y_data[index]

    def __len__(self):
        return self.len

dataset = DiabetesDataset('diabetes.csv.gz')
train_loader = DataLoader(dataset=dataset, batch_size=32, shuffle=True, num_workers=2)
```

(N, 9)

元组

(x, y)

Example: Using DataLoader

```python
for epoch in range(100):
    for i, data in enumerate(train_loader, 0):
        # 1. Prepare data
        inputs, labels = data
        # 2. Forward
        y_pred = model(inputs)
        loss = criterion(y_pred, labels)
        print(epoch, i, loss.item())
        # 3. Backward
        optimizer.zero_grad()
        loss.backward()
        # 4. Update
        optimizer.step()
```

x y

Classifying Diabetes

```python
import numpy as np
import torch
from torch.utils.data import Dataset, DataLoader

class DiabetesDataset(Dataset):
    def __init__(self, filepath):
        xy = np.loadtxt(filepath, delimiter=',', dtype=np.float32)
        self.len = xy.shape[0]
        self.x_data = torch.from_numpy(xy[:, :-1])
        self.y_data = torch.from_numpy(xy[:, [-1]])

    def __getitem__(self, index):
        return self.x_data[index], self.y_data[index]

    def __len__(self):
        return self.len

dataset = DiabetesDataset('diabetes.csv.gz')
train_loader = DataLoader(dataset=dataset,
                          batch_size=32,
                          shuffle=True,
                          num_workers=2)

class Model(torch.nn.Module):
    def __init__(self):
        super(Model, self).__init__()
        self.linear1 = torch.nn.Linear(8, 6)
        self.linear2 = torch.nn.Linear(6, 4)
        self.linear3 = torch.nn.Linear(4, 1)
        self.sigmoid = torch.nn.Sigmoid()

    def forward(self, x):
        x = self.sigmoid(self.linear1(x))
        x = self.sigmoid(self.linear2(x))
        x = self.sigmoid(self.linear3(x))
        return x

model = Model()

criterion = torch.nn.BCELoss(size_average=True)
optimizer = torch.optim.SGD(model.parameters(), lr=0.01)

for epoch in range(100):
    for i, data in enumerate(train_loader, 0):
        # 1. Prepare data
        inputs, labels = data
        # 2. Forward
        y_pred = model(inputs)
        loss = criterion(y_pred, labels)
        print(epoch, i, loss.item())
        # 3. Backward
        optimizer.zero_grad()
        loss.backward()
        # 4. Update
        optimizer.step()
```

1 Prepare dataset

Dataset and Dataloader

2 Design model using Class

inherit from nn.Module

3 Construct loss and optimizer

using PyTorch API

4 Training cycle

forward, backward, update

The following dataset loaders are available

- MNIST
- Fashion-MNIST
- EMNIST
- COCO
- LSUN
- ImageFolder
- DatasetFolder
- Imagenet-12
- CIFAR
- STL10
- PhotoTour

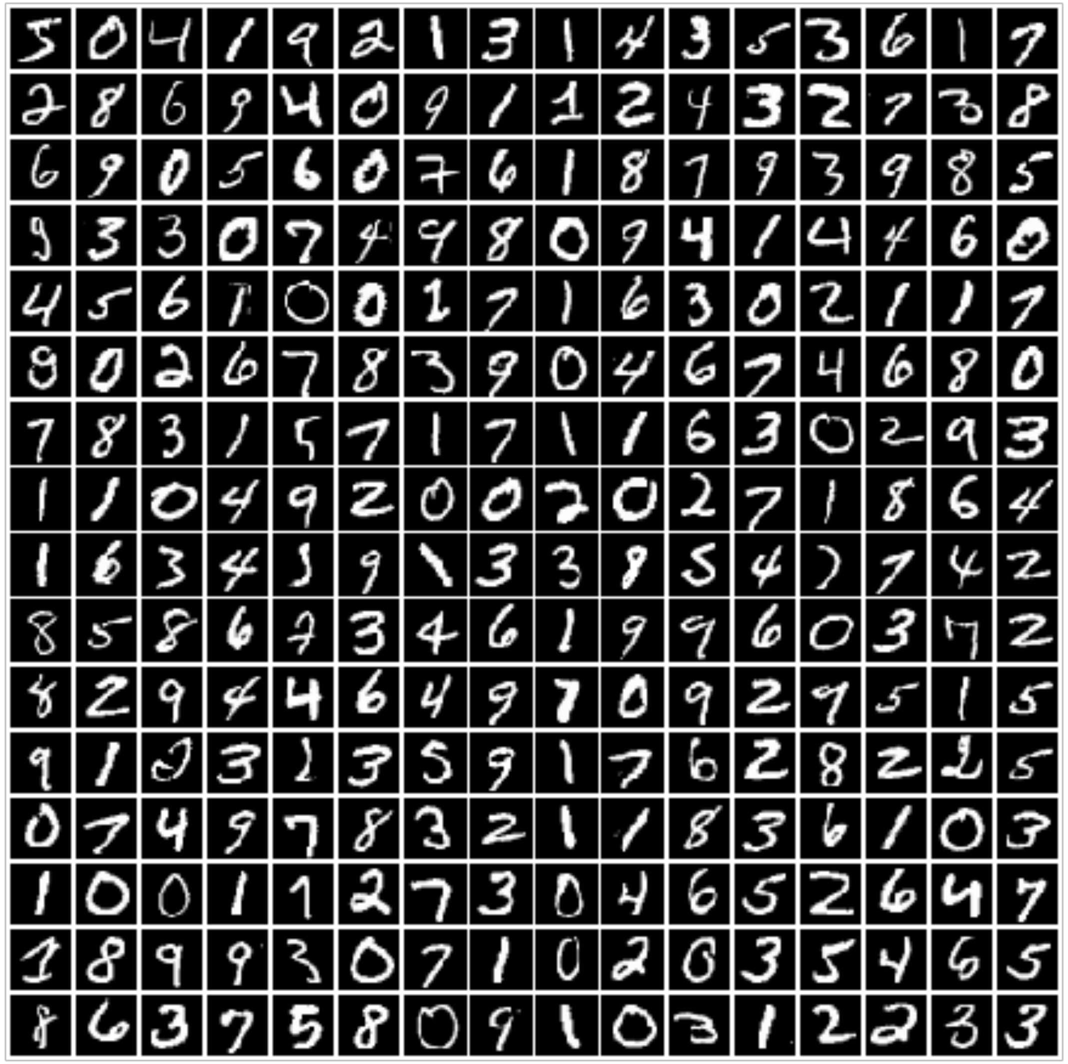
torchvision.datasets

All datasets are subclasses of `torch.utils.data.Dataset` i.e, they have `__getitem__` and `__len__` methods implemented. Hence, they can all be passed to a `torch.utils.data.DataLoader` which can load multiple samples parallelly using `torch.multiprocessing` workers. For example:

```
imagenet_data = torchvision.datasets.ImageFolder('path/to/imagenet_root/')
data_loader = torch.utils.data.DataLoader(imagenet_data,
                                          batch_size=4,
                                          shuffle=True,
                                          num_workers=args.nThreads)
```

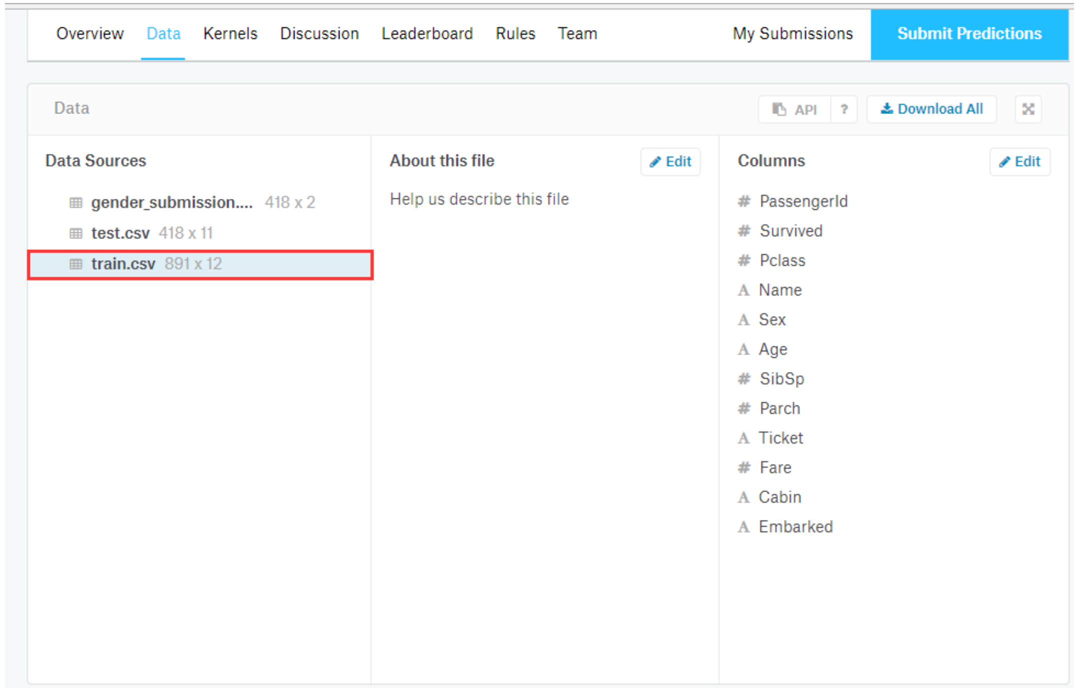
Example: MINST Dataset

```python
import torch
from torch.utils.data import DataLoader
from torchvision import transforms
from torchvision import datasets

train_dataset = datasets.MNIST(root='../dataset/mnist',
                               train=True,
                               transform= transforms.ToTensor(),
                               download=True)
test_dataset = datasets.MNIST(root='../dataset/mnist',
                              train=False,
                              transform= transforms.ToTensor(),
                              download=True)

train_loader = DataLoader(dataset=train_dataset,
                          batch_size=32,
                          shuffle=True)
test_loader = DataLoader(dataset=test_dataset,
                         batch_size=32,
                         shuffle=False)

for batch_idx, (inputs, target) in enumerate(train_loader):
    ......
```



Exercise 8-1

- Build DataLoader for
  - Titanic dataset: https://www.kaggle.com/c/titanic/data
- Build a classifier using the DataLoader



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