PyTorch Tutorial

08. Dataset and DataLoader

数据降噪 训练　　数据加载 MiniBatch

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()
```

Terminology: Epoch, Batch-Size, Iterations

Mini-Batch：生成数据循环

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

epoch：所有训练样本训练次数

total_batch：Mini-Batch个数

Definition: Epoch

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

所有训练样本

forward

backward

Definition: Batch-Size

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

每批训练样本的数据大小

Mini-Batch

Definition: Iteration

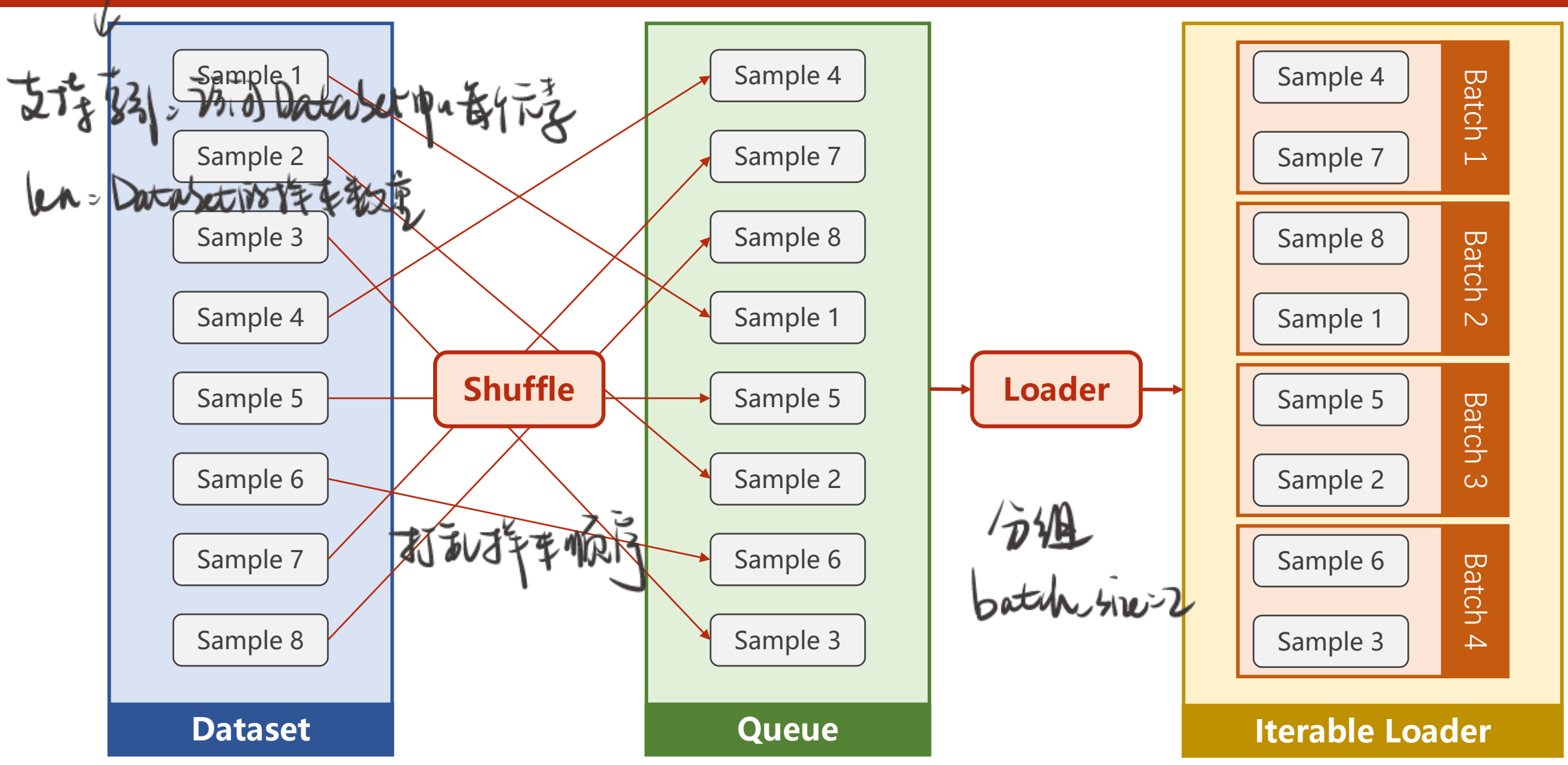
Number of passes, each pass using [**batch size**] number of examples.

每批训练的Mini-Batch个数

eg：总样本数10000个，Mini-Batch大小=1000个

⇒ Iteration = 10000 / 1000 = 10

DataLoader: batch_size=2, shuffle=True



How to define your Dataset

```
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.

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```

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

DataLoader 二加载数据

可读取mini

How to define your Dataset

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                          shuffle=True,
                          num_workers=2)
```
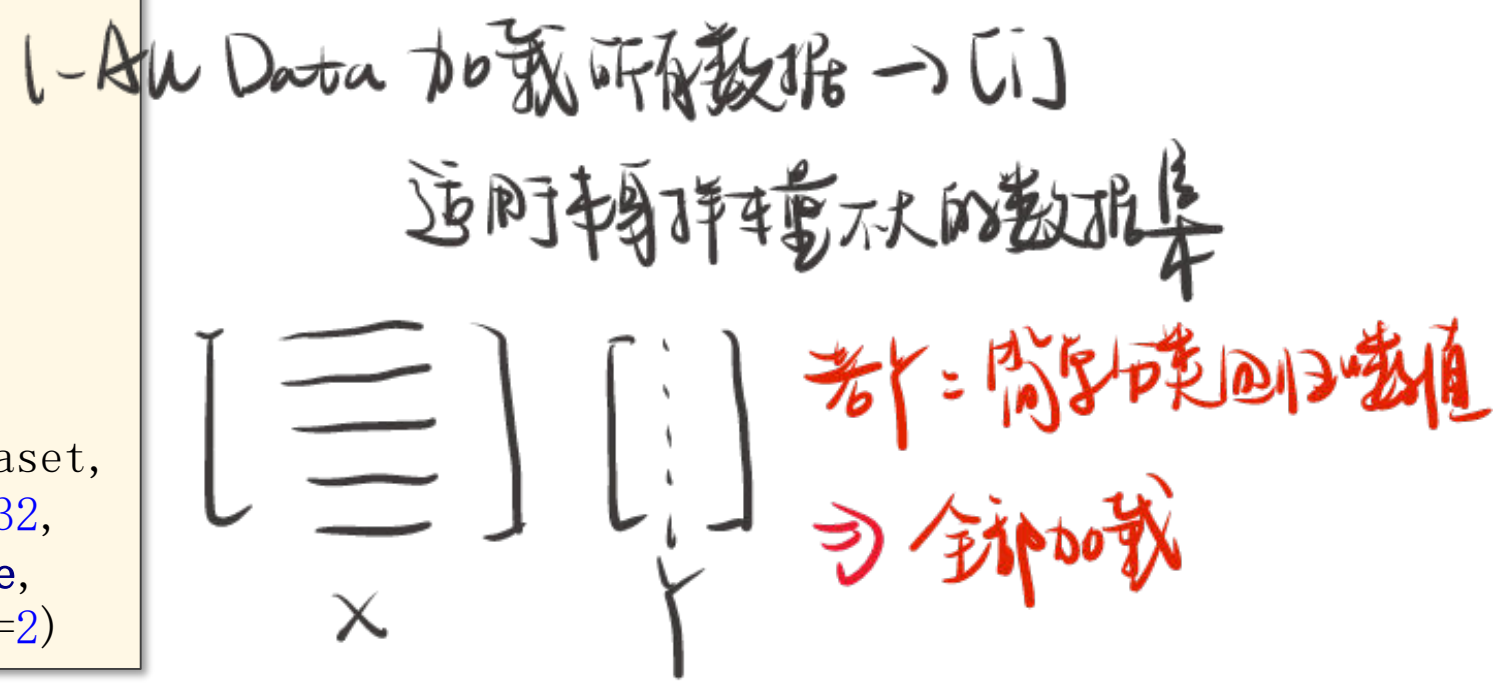
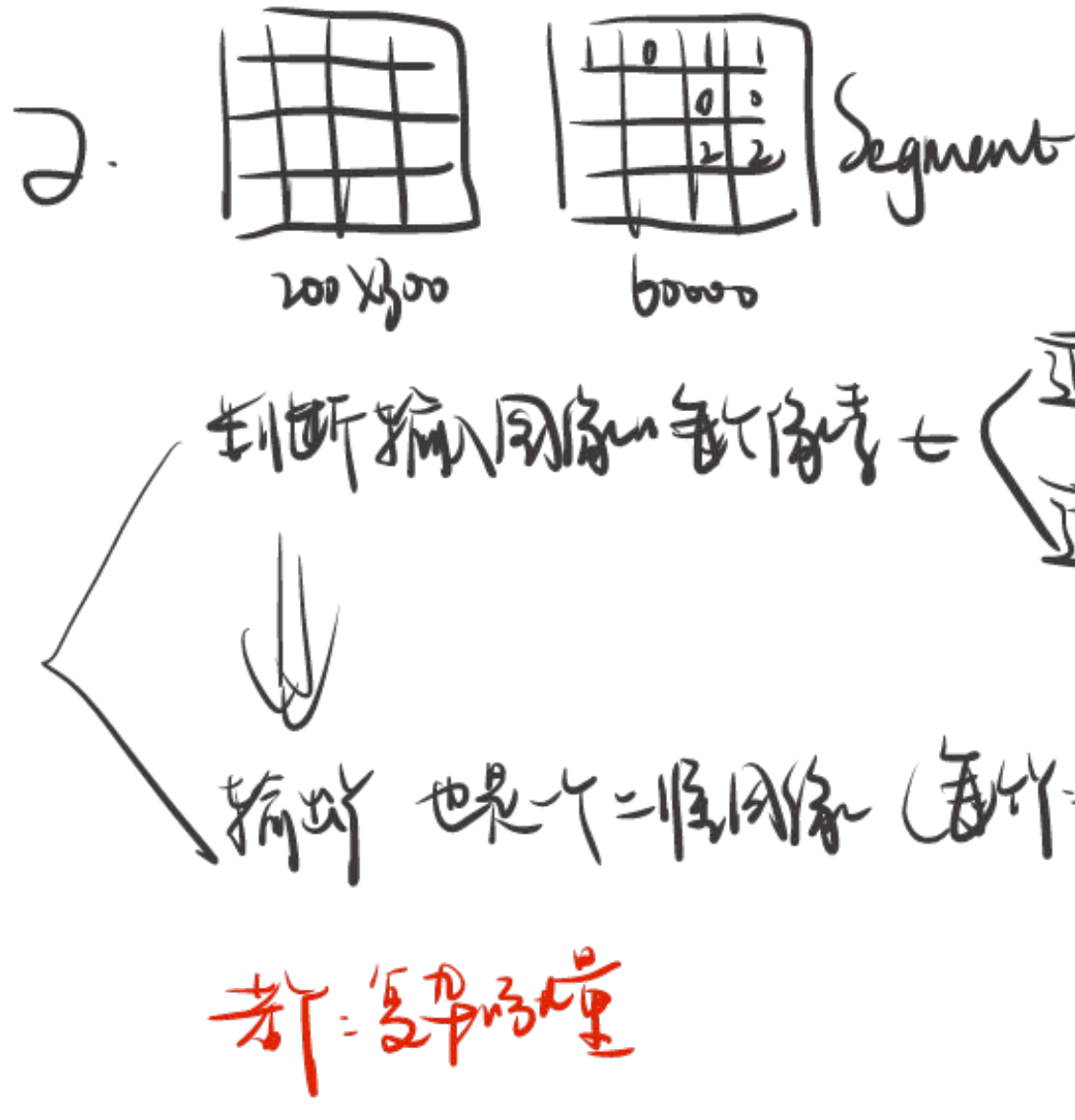
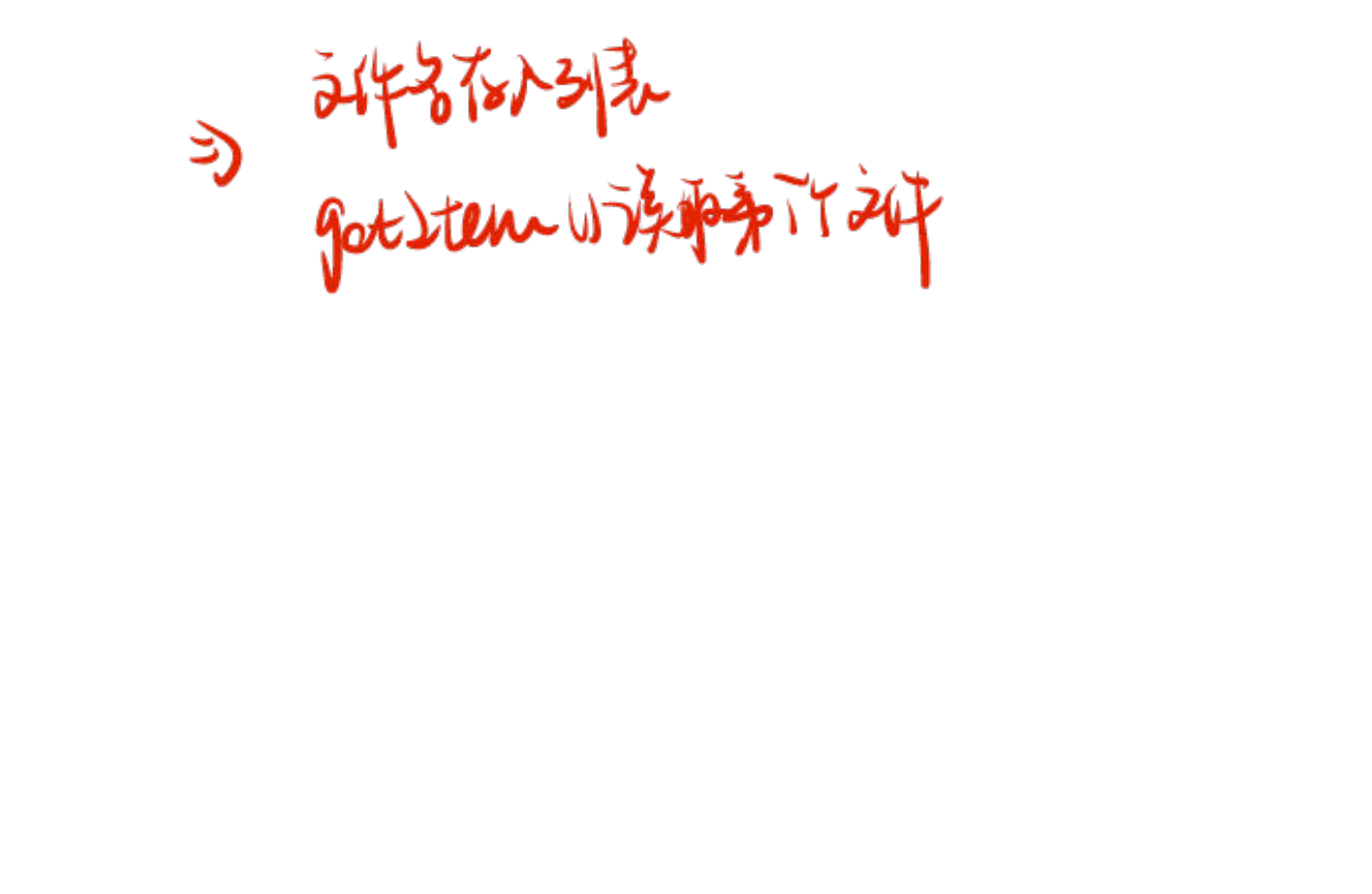

DiabetesDataset is inherited from abstract class **Dataset**.







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)
```

支持下标索引到，取出对应位置的元素

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

How to define your Dataset

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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)
```

返回数据集中的数据条数

This magic function returns length of dataset.

How to define your Dataset

```
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):
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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)
```

实例化数据集

Construct DiabetesDataset object.

How to define your Dataset

```
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)
```

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):
        ......
```

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.

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

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

定义模型

```
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)
```

759/32=23 每批次23个样本数据

Example: Using DataLoader

```
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()
```

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 Mini-Batch

   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

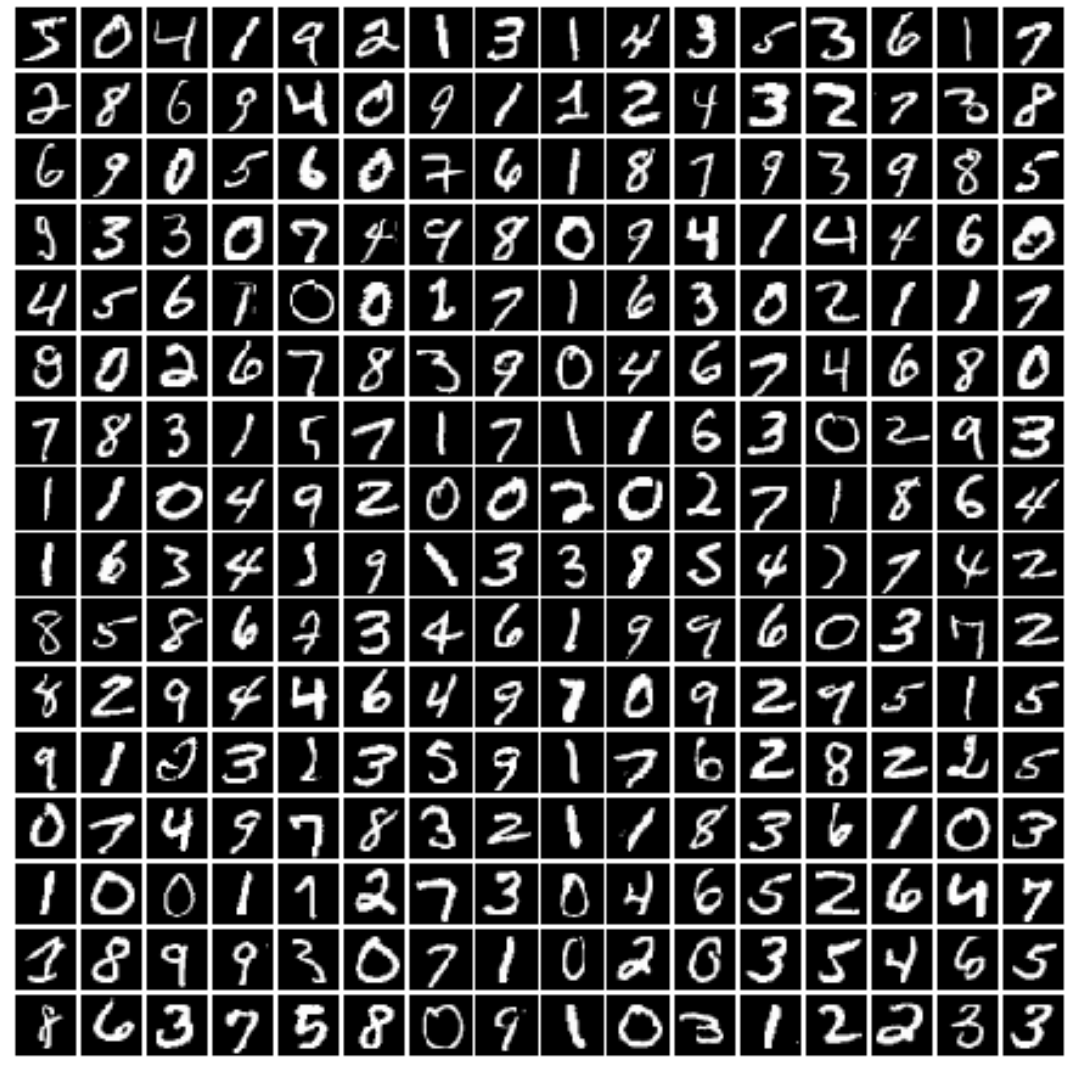
```
import torch
from torch.utils.data import DataLoader
from torchvision import transforms
from torchvision import datasets

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):
    ......
```

PIL

Tensor

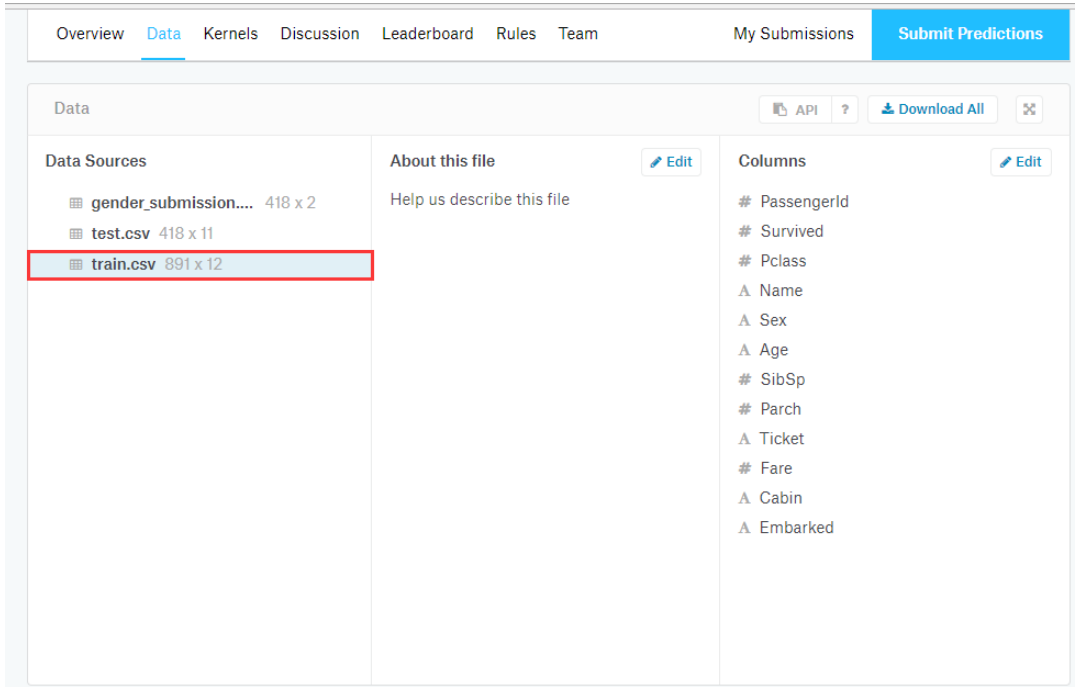
训练 shuffle

测试不shuffle



Exercise 8-1

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



PyTorch Tutorial

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