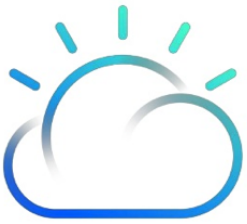

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(http://cocl.us/pytorch_link_top)

Simple Dataset

Table of Contents

In this lab, you will construct a basic dataset by using PyTorch and learn how to apply basic transformations to it.

Estimated Time Needed: **30 min**

Preparation

The following are the libraries we are going to use for this lab. The `torch.manual_seed()` is for forcing the random function to give the same number every time we try to recompile it.

In [1]:

```
# These are the libraries will be used for this lab.

import torch
from torch.utils.data import Dataset
torch.manual_seed(1)
```

Out[1]:

```
<torch._C.Generator at 0x7f1a840b1310>
```

Simple dataset

Let us try to create our own dataset class.

In [2]:

```
# Define class for dataset

class toy_set(Dataset):

    # Constructor with defult values
    def __init__(self, length = 100, transform = None):
        self.len = length
        self.x = 2 * torch.ones(length, 2)
        self.y = torch.ones(length, 1)
        self.transform = transform

    # Getter
    def __getitem__(self, index):
        sample = self.x[index], self.y[index]
        if self.transform:
            sample = self.transform(sample)
        return sample

    # Get Length
    def __len__(self):
        return self.len
```

Now, let us create our `toy_set` object, and find out the value on index 1 and the length of the inital dataset

In [3]:

```
# Create Dataset Object. Find out the value on index 1. Find out the length of Data set Object.

our_dataset = toy_set()
print("Our toy_set object: ", our_dataset)
print("Value on index 0 of our toy_set object: ", our_dataset[0])
print("Our toy_set length: ", len(our_dataset))
```

```
Our toy_set object:  <__main__.toy_set object at 0x7f1a112b92e8>
Value on index 0 of our toy_set object:  (tensor([2., 2.]), tensor
([1.]))
Our toy_set length:  100
```

As a result, we can apply the same indexing convention as a `list` , and apply the fuction `len` on the `toy_set` object. We are able to customize the indexing and length method by `def __getitem__(self, index)` and `def __len__(self)` .

Now, let us print out the first 3 elements and assign them to x and y:

In [4]:

```
# Use loop to print out first 3 elements in dataset

for i in range(3):
    x, y=our_dataset[i]
    print("index: ", i, '; x:', x, '; y:', y)
```

```
index:  0 ; x: tensor([2., 2.]) ; y: tensor([1.])
index:  1 ; x: tensor([2., 2.]) ; y: tensor([1.])
index:  2 ; x: tensor([2., 2.]) ; y: tensor([1.])
```

The dataset object is an Iterable; as a result, we apply the loop directly on the dataset object

In [5]:

```
for x,y in our_dataset:
    print(' x:', x, 'y:', y)
```

```
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
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x: tensor([2., 2.]) y: tensor([1.])
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x: tensor([2., 2.]) y: tensor([1.])
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x: tensor([2., 2.]) y: tensor([1.])
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x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
```

```
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
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x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
x: tensor([2., 2.]) y: tensor([1.])
```

Practice

Try to create an `toy_set` object with length **50**. Print out the length of your object.

In [6]:

```
# Practice: Create a new object with length 50, and print the length of object out.
my_dataset = toy_set(length = 50)
print("My toy_set length: ", len(my_dataset))
```

```
My toy_set length:  50
```

Double-click **here** for the solution.

Transforms

You can also create a class for transforming the data. In this case, we will try to add 1 to x and multiply y by 2:

In [7]:

```
# Create tranform class add_mult

class add_mult(object):

    # Constructor
    def __init__(self, addx = 1, muly = 2):
        self.addx = addx
        self.muly = muly

    # Executor
    def __call__(self, sample):
        x = sample[0]
        y = sample[1]
        x = x + self.addx
        y = y * self.muly
        sample = x, y
        return sample
```

Now, create a transform object:.

In [8]:

```
# Create an add_mult transform object, and an toy_set object

a_m = add_mult()
data_set = toy_set()
```

Assign the outputs of the original dataset to `x` and `y`. Then, apply the transform `add_mult` to the dataset and output the values as `x_` and `y_`, respectively:

In [9]:

```
# Use loop to print out first 10 elements in dataset

for i in range(10):
    x, y = data_set[i]
    print('Index: ', i, 'Original x: ', x, 'Original y: ', y)
    x_, y_ = a_m(data_set[i])
    print('Index: ', i, 'Transformed x_:', x_, 'Transformed y_:', y_)
```

```
Index:  0 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  0 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  1 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  1 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  2 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  2 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  3 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  3 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  4 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  4 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  5 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  5 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  6 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  6 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  7 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  7 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  8 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  8 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  9 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  9 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
```

As the result, `x` has been added by 1 and y has been multiplied by 2, as *[2, 2] + 1 = [3, 3]* and *[1] x 2 = [2]*

We can apply the transform object every time we create a new `toy_set object` ? Remember, we have the constructor in toy_set class with the parameter `transform = None` . When we create a new object using the constructor, we can assign the transform object to the parameter transform, as the following code demonstrates.

In [10]:

```
# Create a new data_set object with add_mult object as transform

cust_data_set = toy_set(transform = a_m)
```

This applied `a_m` object (a transform method) to every element in `cust_data_set` as initialized. Let us print out the first 10 elements in `cust_data_set` in order to see whether the `a_m` applied on `cust_data_set`

In [11]:

```
# Use loop to print out first 10 elements in dataset

for i in range(10):
    x, y = data_set[i]
    print('Index: ', i, 'Original x: ', x, 'Original y: ', y)
    x_, y_ = cust_data_set[i]
    print('Index: ', i, 'Transformed x_:', x_, 'Transformed y_:', y_)
```

```
Index:  0 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  0 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  1 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  1 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  2 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  2 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  3 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  3 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  4 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  4 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  5 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  5 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  6 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  6 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  7 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  7 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  8 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  8 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  9 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  9 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
```

The result is the same as the previous method.

In [12]:

```
# Practice: Construct your own my_add_mult transform. Apply my_add_mult on a new to
y_set object. Print out the first three elements from the transformed dataset.
my_add_mult = toy_set(transform = a_m)
for i in range (4):
    x, y = data_set[i]
    print('Index: ', i, 'Original x: ', x, 'Original y: ', y)
    x_, y_ = my_add_mult[i]
    print('Index: ', i, 'Transformed x_: ', x_, 'Transformed y_: ', y_)
```

```
Index:  0 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  0 Transformed x_:  tensor([3., 3.]) Transformed y_:  tensor
([2.])
Index:  1 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  1 Transformed x_:  tensor([3., 3.]) Transformed y_:  tensor
([2.])
Index:  2 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  2 Transformed x_:  tensor([3., 3.]) Transformed y_:  tensor
([2.])
Index:  3 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  3 Transformed x_:  tensor([3., 3.]) Transformed y_:  tensor
([2.])
```

In [13]:

```
class my_add_mult(object):
    def __init__(self, add = 2, mul = 10):
        self.add=add
        self.mul=mul

    def __call__(self, sample):
        x = sample[0]
        y = sample[1]
        x = x + self.add
        y = y + self.add
        x = x * self.mul
        y = y * self.mul
        sample = x, y
        return sample


my_dataset = toy_set(transform = my_add_mult())
for i in range(3):
    x_, y_ = my_dataset[i]
    print('Index: ', i, 'Transformed x_:', x_, 'Transformed y_:', y_)
```

```
Index:  0 Transformed x_: tensor([40., 40.]) Transformed y_: tensor([3
0.])
Index:  1 Transformed x_: tensor([40., 40.]) Transformed y_: tensor([3
0.])
Index:  2 Transformed x_: tensor([40., 40.]) Transformed y_: tensor([3
0.])
```

Double-click **here** for the solution. <!-- class my_add_mult(object):
def **init**(self, add = 2, mul = 10): self.add=add self.mul=mul

```
    def __call__(self, sample):
        x = sample[0]
        y = sample[1]
        x = x + self.add
        y = y + self.add
        x = x * self.mul
        y = y * self.mul
        sample = x, y
        return sample
```

my_dataset = toy_set(transform = my_add*mult()) for i in range(3): x*, y_ = my*dataset[i] print('Index: ', i,* '*Transformed x*:', x, '*Transformed y*:', y_)

-->

Compose

You can compose multiple transforms on the dataset object. First, import `transforms` from `torchvision` :

In [14]:

```
# Run the command below when you do not have torchvision installed
# !conda install -y torchvision

from torchvision import transforms
```

Then, create a new transform class that multiplies each of the elements by 100:

In [15]:

```
# Create tranform class mult

class mult(object):

    # Constructor
    def __init__(self, mult = 100):
        self.mult = mult

    # Executor
    def __call__(self, sample):
        x = sample[0]
        y = sample[1]
        x = x * self.mult
        y = y * self.mult
        sample = x, y
        return sample
```

Now let us try to combine the transforms `add_mult` and `mult`

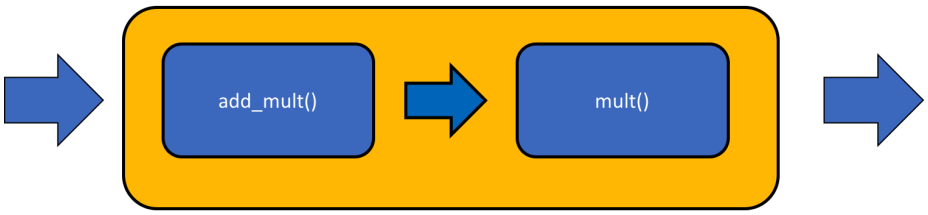
In [16]:

```
# Combine the add_mult() and mult()

data_transform = transforms.Compose([add_mult(), mult()])
print("The combination of transforms (Compose): ", data_transform)
```

```
The combination of transforms (Compose):  Compose(
    <__main__.add_mult object at 0x7f1a10379a20>
    <__main__.mult object at 0x7f1a10379a58>
)
```

The new `Compose` object will perform each transform concurrently as shown in this figure:



In [17]:

```
data_transform(data_set[0])
```

Out[17]:

```
(tensor([300., 300.]), tensor([200.]))
```

In [18]:

```
x,y=data_set[0]
x_,y_=data_transform(data_set[0])
print( 'Original x: ', x, 'Original y: ', y)

print( 'Transformed x_:', x_, 'Transformed y_:', y_)
```

```
Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Transformed x_: tensor([300., 300.]) Transformed y_: tensor([200.])
```

Now we can pass the new `Compose` object (The combination of methods `add_mult()` and `mult`) to the constructor for creating `toy_set` object.

In [19]:

```
# Create a new toy_set object with compose object as transform

compose_data_set = toy_set(transform = data_transform)
```

Let us print out the first 3 elements in different `toy_set` datasets in order to compare the output after different transforms have been applied:

In [20]:

```
# Use loop to print out first 3 elements in dataset

for i in range(3):
    x, y = data_set[i]
    print('Index: ', i, 'Original x: ', x, 'Original y: ', y)
    x_, y_ = cust_data_set[i]
    print('Index: ', i, 'Transformed x_:', x_, 'Transformed y_:', y_)
    x_co, y_co = compose_data_set[i]
    print('Index: ', i, 'Compose Transformed x_co: ', x_co ,'Compose Transformed y_
co: ',y_co)
```

```
Index:  0 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  0 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  0 Compose Transformed x_co:  tensor([300., 300.]) Compose Trans
formed y_co:  tensor([200.])
Index:  1 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  1 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  1 Compose Transformed x_co:  tensor([300., 300.]) Compose Trans
formed y_co:  tensor([200.])
Index:  2 Original x:  tensor([2., 2.]) Original y:  tensor([1.])
Index:  2 Transformed x_: tensor([3., 3.]) Transformed y_: tensor([2.])
Index:  2 Compose Transformed x_co:  tensor([300., 300.]) Compose Trans
formed y_co:  tensor([200.])
```

Let us see what happened on index 0. The original value of `x` is *[2, 2]*, and the original value of `y` is [1]. If we only applied `add_mult()` on the original dataset, then the `x` became *[3, 3]* and y became *[2]*. Now let us see what is the value after applied both `add_mult()` and `mult()`. The result of x is *[300, 300]* and y is *[200]*. The calculation which is equavalent to the compose is *x = ([2, 2] + 1) x 100 = [300, 300], y = ([1] x 2) x 100 = 200*

Practice

Try to combine the `mult()` and `add_mult()` as `mult()` to be executed first. And apply this on a new `toy_set` dataset. Print out the first 3 elements in the transformed dataset.

In [23]:

```
# Practice: Make a compose as mult() execute first and then add_mult(). Apply the c
ompose on toy_set dataset. Print out the first 3 elements in the transformed datase
t.
my_compose = transforms.Compose([mult(), add_mult()])
my_transformed_dataset = toy_set(transform = my_compose)
for i in range(3):
    x_, y_ = my_transformed_dataset[i]
    print('Index: ', i, 'Transformed x_: ', x_, 'Transformed y_: ', y_)
```

```
Index:  0 Transformed x_:  tensor([201., 201.]) Transformed y_:  tensor
([200.])
Index:  1 Transformed x_:  tensor([201., 201.]) Transformed y_:  tensor
([200.])
Index:  2 Transformed x_:  tensor([201., 201.]) Transformed y_:  tensor
([200.])
```

Double-click **here** for the solution.

About the Authors:

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