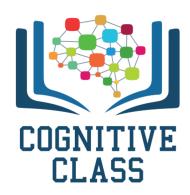


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(http://cocl.us/pytorch_link_top)



Linear Regression 1D: Prediction

Table of Contents

In this lab, we will review how to make a prediction in several different ways by using PyTorch.

- Prediction
- · Class Linear
- Build Custom Modules

Estimated Time Needed: 15 min

Preparation

The following are the libraries we are going to use for this lab.

```
In [1]:
```

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

Prediction

Let us create the following expressions:

```
$b=-1,w=2$
$\hat{y}=-1+2x$
```

First, define the parameters:

In [2]:

```
# Define w = 2 and b = -1 for y = wx + b
w = torch.tensor(2.0, requires_grad = True)
b = torch.tensor(-1.0, requires_grad = True)
```

Then, define the function forward (x, w, b) makes the prediction:

```
In [3]:
```

```
# Function forward(x) for prediction

def forward(x):
    yhat = w * x + b
    return yhat
```

Let's make the following prediction at x = 1

```
$\hat{y}=-1+2x$
$\hat{y}=-1+2(1)$
```

In [4]:

```
# Predict y = 2x - 1 at x = 1

x = torch.tensor([[1.0]])
yhat = forward(x)
print("The prediction: ", yhat)
```

The prediction: tensor([[1.]], grad_fn=<AddBackward0>)

Now, let us try to make the prediction for multiple inputs:

$$\widehat{\mathbf{y}} = -\mathbf{1} + 2\mathbf{x} \qquad \mathbf{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$$\widehat{\mathbf{y}} = \begin{bmatrix} -1 \\ -1 \end{bmatrix} + 2\begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} -1 \\ -1 \end{bmatrix} + \begin{bmatrix} 2x1 \\ 2x2 \end{bmatrix} = \begin{bmatrix} -1+2 \\ -1+4 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$$

Let us construct the x tensor first. Check the shape of x.

In [5]:

```
# Create x Tensor and check the shape of x tensor
x = torch.tensor([[1.0], [2.0]])
print("The shape of x: ", x.shape)
```

The shape of x: torch.Size([2, 1])

Now make the prediction:

In [6]:

```
# Make the prediction of y = 2x - 1 at x = [1, 2]
yhat = forward(x)
print("The prediction: ", yhat)
```

The result is the same as what it is in the image above.

Practice

Make a prediction of the following x tensor using the w and b from above.

```
In [8]:
```

Double-click here for the solution.

Class Linear

The linear class can be used to make a prediction. We can also use the linear class to build more complex models. Let's import the module:

```
In [9]:
```

```
# Import Class Linear
from torch.nn import Linear
```

Set the random seed because the parameters are randomly initialized:

```
In [10]:
```

```
# Set random seed
torch.manual_seed(1)
Out[10]:
```

```
. .
```

```
<torch._C.Generator at 0x7f0ccc0361f0>
```

Let us create the linear object by using the constructor. The parameters are randomly created. Let us print out to see what w and b. The parameters of an torch.nn.Module model are contained in the model's parameters accessed with lr.parameters():

```
In [11]:
```

```
# Create Linear Regression Model, and print out the parameters

lr = Linear(in_features=1, out_features=1, bias=True)
print("Parameters w and b: ", list(lr.parameters()))
```

```
Parameters w and b: [Parameter containing:
tensor([[0.5153]], requires_grad=True), Parameter containing:
tensor([-0.4414], requires_grad=True)]
```

This is equivalent to the following expression:

```
$b=-0.44, w=0.5153$
```

 $hat{y}=-0.44+0.5153x$

A method state_dict() Returns a Python dictionary object corresponding to the layers of each parameter tensor.

In [12]:

```
print("Python dictionary: ",lr.state_dict())
print("keys: ",lr.state_dict().keys())
print("values: ",lr.state_dict().values())

Python dictionary: OrderedDict([('weight', tensor([[0.5153]])), ('bia s', tensor([-0.4414]))])
```

The keys correspond to the name of the attributes and the values correspond to the parameter value.

values: odict values([tensor([[0.5153]]), tensor([-0.4414])])

In [13]:

```
print("weight:",lr.weight)
print("bias:",lr.bias)
```

```
weight: Parameter containing:
tensor([[0.5153]], requires_grad=True)
bias: Parameter containing:
tensor([-0.4414], requires_grad=True)
```

keys: odict_keys(['weight', 'bias'])

Now let us make a single prediction at x = [[1.0]].

```
In [14]:
```

```
# Make the prediction at x = [[1.0]]

x = torch.tensor([[1.0]])
yhat = lr(x)
print("The prediction: ", yhat)
```

The prediction: tensor([[0.0739]], grad_fn=<AddmmBackward>)

Similarly, you can make multiple predictions:

$$\widehat{y} = -0.44 + 0.51x \qquad \mathbf{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$$\widehat{y} = \begin{bmatrix} -0.44 \\ -0.44 \end{bmatrix} + 0.51 \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} -0.44 \\ -0.44 \end{bmatrix} + \begin{bmatrix} 0.51x1 \\ 0.51x2 \end{bmatrix}$$

$$= \begin{bmatrix} -0.44 \\ -0.44 \end{bmatrix} + \begin{bmatrix} 0.51 \\ 1.02 \end{bmatrix} = \begin{bmatrix} 0.07 \\ 0.58 \end{bmatrix}$$

Use model lr(x) to predict the result.

```
In [15]:
```

Practice

Make a prediction of the following x tensor using the linear regression model 1x.

```
In [16]:
```

Double-click here for the solution.

Build Custom Modules

Now, let's build a custom module. We can make more complex models by using this method later on.

First, import the following library.

```
In [17]:
```

```
# Library for this section

from torch import nn
```

Now, let us define the class:

```
In [18]:
```

```
# Customize Linear Regression Class

class LR(nn.Module):

    # Constructor
    def __init__(self, input_size, output_size):

        # Inherit from parent
        super(LR, self).__init__()
        self.linear = nn.Linear(input_size, output_size)

# Prediction function
    def forward(self, x):
        out = self.linear(x)
        return out
```

Create an object by using the constructor. Print out the parameters we get and the model.

```
In [19]:
```

```
# Create the linear regression model. Print out the parameters.
lr = LR(1, 1)
print("The parameters: ", list(lr.parameters()))
print("Linear model: ", lr.linear)
```

```
The parameters: [Parameter containing: tensor([[-0.1939]], requires_grad=True), Parameter containing: tensor([0.4694], requires_grad=True)]
Linear model: Linear(in_features=1, out_features=1, bias=True)
```

Let us try to make a prediction of a single input sample.

In [20]:

```
# Try our customize linear regression model with single input
x = torch.tensor([[1.0]])
yhat = lr(x)
print("The prediction: ", yhat)
```

```
The prediction: tensor([[0.2755]], grad_fn=<AddmmBackward>)
```

Now, let us try another example with multiple samples.

In [21]:

```
# Try our customize linear regression model with multiple input

x = torch.tensor([[1.0], [2.0]])
yhat = lr(x)
print("The prediction: ", yhat)
```

```
The prediction: tensor([[0.2755], [0.0816]], grad_fn=<AddmmBackward>)
```

the parameters are also stored in an ordered dictionary:

In [22]:

```
print("Python dictionary: ", lr.state_dict())
print("keys: ",lr.state_dict().keys())
print("values: ",lr.state_dict().values())
```

```
Python dictionary: OrderedDict([('linear.weight', tensor([[-0.193
9]])), ('linear.bias', tensor([0.4694]))])
keys: odict_keys(['linear.weight', 'linear.bias'])
values: odict_values([tensor([[-0.1939]]), tensor([0.4694])])
```

Practice

Create an object 1r1 from the class we created before and make a prediction by using the following tensor:

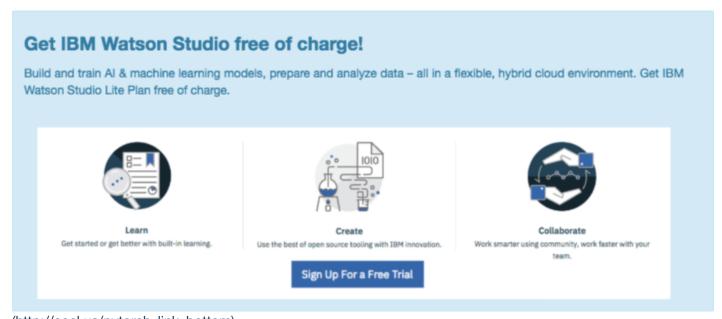
```
In [23]:
```

```
# Practice: Use the LR class to create a model and make a prediction of the followi
ng tensor.

x = torch.tensor([[1.0], [2.0], [3.0]])
lr1 = LR(1,1)
yhat = lr(x)
yhat
```

Out[23]:

Double-click here for the solution.



(http://cocl.us/pytorch_link_bottom)

About the Authors:

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