2.1Prediction1Dregression_v3

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Linear Regression 1D: Prediction

Objective

How to make the prediction for multiple inputs.

How to use linear class to build more complex models.

How to build a custom module.

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.

[ ]:
```
# 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:

[ ]:
```
# 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:

[ ]:
```
# Function forward(x) for prediction

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

Let's make the following prediction at x = 1

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

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

[ ]:
```
# Predict y = 2x - 1 at x = 1

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

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

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

[ ]:
```
# Create x Tensor and check the shape of x tensor

x = torch.tensor([[1.0], [2.0]])
print("The shape of x: ", x.shape)
```

Now make the prediction:

[ ]:
```
# 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.

[ ]:
```
# Practice: Make a prediction of y = 2x - 1 at x = [[1.0], [2.0], [3.0]]

x = torch.tensor([[1.0], [2.0], [3.0]])
```

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:

[ ]:
```
# Import Class Linear

from torch.nn import Linear
```

Set the random seed because the parameters are randomly initialized:

[ ]:
```
# Set random seed

torch.manual_seed(1)
```

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():

[ ]:
```
# 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()))
```

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.

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

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

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

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

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

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

Similarly, you can make multiple predictions:

Use model lr(x) to predict the result.

[ ]:
```
# Create the prediction using linear model

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

Practice

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

[ ]:
```
# Practice: Use the linear regression model object lr to make the prediction.

x = torch.tensor([[1.0],[2.0],[3.0]])
```

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.

[ ]:
```
# Library for this section

from torch import nn
```

Now, let us define the class:

[ ]:
```
# 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.

[ ]:
```
# Create the linear regression model. Print out the parameters.

lr = LR(1, 1)
```

```
print("The parameters: ", list(lr.parameters()))
print("Linear model: ", lr.linear)
```

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

[ ]:
```
# Try our customize linear regression model with single input

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

Now, let us try another example with multiple samples.

[ ]:
```
# Try our customize linear regression model with multiple input

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

the parameters are also stored in an ordered dictionary :

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

Practice

Create an object lr1 from the class we created before and make a prediction by using the following tensor:

[ ]:
```
# Practice: Use the LR class to create a model and make a prediction of the␣
↪following tensor.

x = torch.tensor([[1.0], [2.0], [3.0]])
```

Double-click here for the solution.

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0.1 Change Log

Date (YYYY-MM-DD)	Version	Changed By	Change Description
2020-09-21	2.0	Shubham	Migrated Lab to Markdown and added to course repo in GitLab

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