

ML2018fall HW4 report

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ML2018fall @ NCTU HW4 code

developed on MacOS/Windows10

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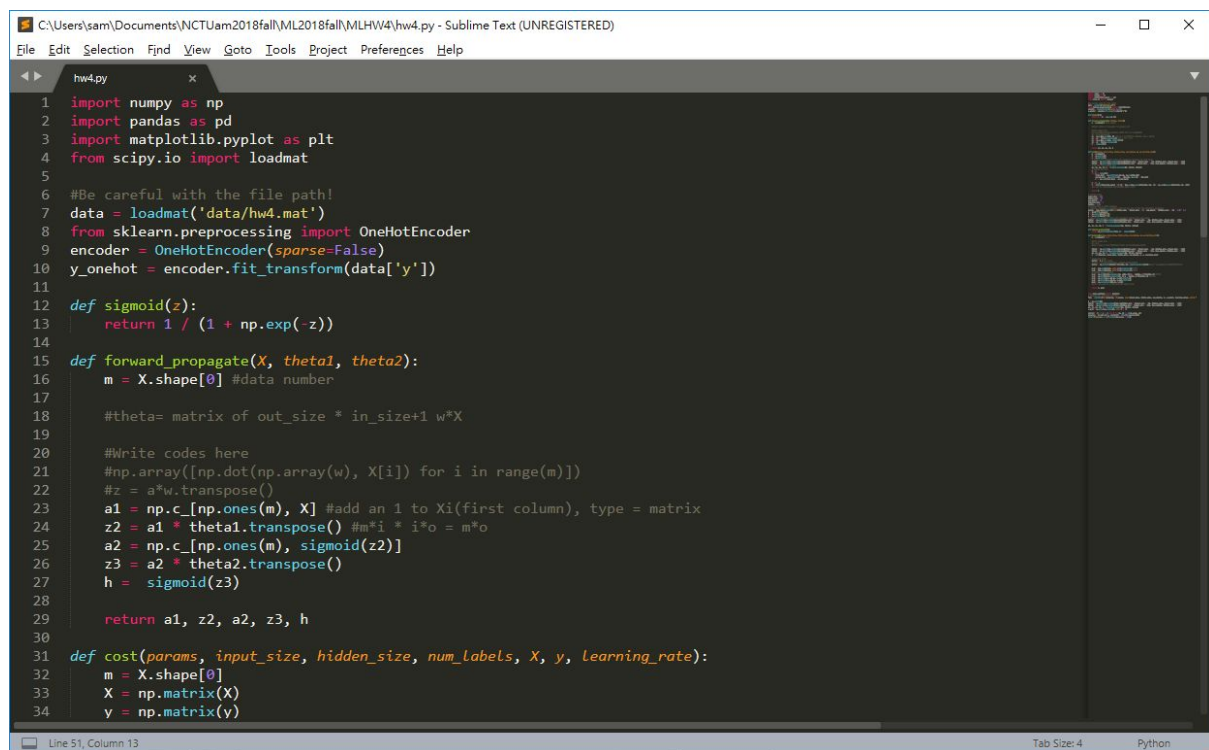
version control with git/github

tool used : jupyter notebook

programming language : python3.7

<https://github.com/EazyReal/ML2018fall/blob/master/MLHW4/hw4.py>

1.implementation of forward propagation:



```
1 import numpy as np
2 import pandas as pd
3 import matplotlib.pyplot as plt
4 from scipy.io import loadmat
5
6 #Be careful with the file path!
7 data = loadmat('data/hw4.mat')
8 from sklearn.preprocessing import OneHotEncoder
9 encoder = OneHotEncoder(sparse=False)
10 y_onehot = encoder.fit_transform(data['y'])
11
12 def sigmoid(z):
13     return 1 / (1 + np.exp(-z))
14
15 def forward_propagate(X, theta1, theta2):
16     m = X.shape[0] #data number
17
18     #theta= matrix of out_size * in_size+1 w*X
19
20     #Write codes here
21     #np.array([np.dot(np.array(w), X[i]) for i in range(m)])
22     #z = a*w.transpose()
23     a1 = np.c_[np.ones(m), X] #add an 1 to Xi(first column), type = matrix
24     z2 = a1 * theta1.transpose() #m*i * i*o = m*o
25     a2 = np.c_[np.ones(m), sigmoid(z2)]
26     z3 = a2 * theta2.transpose()
27     h = sigmoid(z3)
28
29     return a1, z2, a2, z3, h
30
31 def cost(params, input_size, hidden_size, num_labels, X, y, Learning_rate):
32     m = X.shape[0]
33     X = np.matrix(X)
34     y = np.matrix(y)
```

2.implementation of back propagation:

```
C:\Users\sam\Documents\NCTUam2018fall\ML2018fall\MLHW4\hw4.py - Sublime Text (UNREGISTERED)
File Edit Selection Find View Goto Tools Project Preferences Help

hw4.py
70
71 def sigmoid_gradient(z):
72     return np.multiply(sigmoid(z), (1 - sigmoid(z)))
73
74 def backprop(params, input_size, hidden_size, num_labels, X, y, learning_rate):
75     m = X.shape[0] #size
76
77     #Write codes here
78     #J = 0.0
79     #grad = grad of each theta(i,j) init= np.zeros(params.shape)
80
81     theta1 = np.matrix(np.reshape(params[:hidden_size * (input_size + 1)], (hidden_size, (input_size + 1))))
82     theta2 = np.matrix(np.reshape(params[hidden_size * (input_size + 1):], (num_labels, (hidden_size + 1))))
83     a1, z2, a2, z3, h = forward_propagate(X, theta1, theta2)
84     J = cost(params, input_size, hidden_size, num_labels, X, y, learning_rate)
85
86     #calculate delta
87     delta3 = h - y #(m, nlab)
88     #delta3 = np.multiply(delta3, sigmoid_gradient(z3))
89     delta2 = np.multiply(delta3*theta2[:,1:], sigmoid_gradient(z2))#(m,n) * (n,hidden+1) (5000*10**10*11)
90
91     d_b2 = (np.sum(delta3, axis=0)/m).transpose() #10*1
92     d_b1 = (np.sum(delta2, axis=0)/m).transpose() #10*1
93     #print(a2.shape) 5000*11
94     d_w2 = np.dot(delta3.transpose(), a2[:,1:])/m + lambda_/m*theta2[:,1:] #10*10
95     d_w1 = np.dot(delta2.transpose(), X)/m + lambda_/m*theta1[:,1:] #10*400
96     d_t1 = np.array(np.c_[d_b1, d_w1]).flatten()
97     d_t2 = np.array(np.c_[d_b2, d_w2]).flatten()
98     grad = np.concatenate((d_t1, d_t2))
99     #grad = np.c_[d_t1, d_t2].flatten() lead to bug
100
101     return J, grad
102
103
```

3.accuracy:

```
PS C:\Users\sam\Documents\NCTUam2018fall\ML2018fall\MLHW4> python hw4.py
C:\Program Files (x86)\Python\Python37\lib\site-packages\sklearn\externals\joblib\externals\cloudpickle\cloudpickle.py:47: DeprecationWarning: the imp module is deprecated in favour of importlib; see the module's documentation for alternative uses
  import imp
C:\Program Files (x86)\Python\Python37\lib\site-packages\sklearn\preprocessing\_encoders.py:363: FutureWarning: The handling of integer data will change in version 0.22. Currently, the categories are determined based on the range [0, max(values)], while in the future they will be determined based on the unique values.
If you want the future behaviour and silence this warning, you can specify "categories='auto'".
In case you used a LabelEncoder before this OneHotEncoder to convert the categories to integers, then you can now use the OneHotEncoder directly.
  warnings.warn(msg, FutureWarning)
accuracy = 97.06%
PS C:\Users\sam\Documents\NCTUam2018fall\ML2018fall\MLHW4>
```