HW1

September 29, 2022

[376]:
```
"""
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ECGR 4105 HW1
"""

import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import train_test_split
```

[377]:
```
housing = pd.DataFrame(pd.read_csv("Housing.csv"))
housing.head()
```

[377]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea	furnishingstatus
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	yes	furnished
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	no	furnished
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	yes	semi-furnished
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	yes	furnished
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	no	furnished

[378]:
```
m = len(housing)
m
```

[378]: 545

[379]:
```
housing.shape
```

[379]: (545, 13)

[380]:
```
np.random.seed(0)
```

```
df_Train, df_Test = train_test_split(housing, train_size = 0.8, test_size = 0.2)

df_Train.shape
```

[380]: (436, 13)

[381]:
```
df_test.shape
```

[381]: (109, 13)

[382]:
```
m1 = len(df_Train)
m1
```

[382]: 436

[383]:
```
m2 = len(df_Test)
m2
```

[383]: 109

[384]:
```
x_Train = df_Train[['area','bedrooms','bathrooms','stories','parking']]
x_Test = df_Test[['area','bedrooms','bathrooms','stories','parking']]

y_Train = df_Train[['price']]
y_Test = df_Test[['price']]

y_Train[:5]
```

[384]:

	price
542	1750000
496	2695000
484	2870000
507	2590000
252	4515000

[385]:
```
x0 = np.ones((m1,1))
x_0 = np.ones((m2,1))
x0[:3]
```

[385]:
```
array([[1.],
       [1.],
       [1.]])
```

[386]:
```
xTr = x_Train.values
xTe = x_Test.values
```

[387]:
```
x1 = np.hstack((x0,xTr))
x2 = np.hstack((x_0,xTe))
```

```
x1[:4]
```

[387]:
```
array([[1.00e+00, 3.62e+03, 2.00e+00, 1.00e+00, 1.00e+00, 0.00e+00],
       [1.00e+00, 4.00e+03, 2.00e+00, 1.00e+00, 1.00e+00, 0.00e+00],
       [1.00e+00, 3.04e+03, 2.00e+00, 1.00e+00, 1.00e+00, 0.00e+00],
       [1.00e+00, 3.60e+03, 2.00e+00, 1.00e+00, 1.00e+00, 0.00e+00]])
```

[388]:
```
yTr = y_Train.values
yTe = y_Test.values
yTr.shape
```

[388]:
```
(436, 1)
```

[389]:
```
theta = np.zeros(6)

theta
```

[389]:
```
array([0., 0., 0., 0., 0., 0.])
```

[390]:
```
def get_cost(x1, yTr, theta):
    H = x1.dot(theta)
    error = np.subtract(H, yTr)
    sqrError = np.square(error)
    J = 1 / (2*m) * np.sum(sqrError)

    return J
```

[391]:
```
def grad_descent(x1, yTr, theta, alpha, iterations, x2, yTe):

    cost_history = np.zeros(iterations)
    vali_cost_history = np.zeros(iterations)

    for i in range(iterations):
        H = x1.dot(theta)
        error = np.subtract(H, yTr)
        delta_sum = (alpha / m) * x1.transpose().dot(error);
        theta = theta - delta_sum
        cost_history[i] = get_cost(x1, yTr, theta)
        vali_cost_history[i] = get_cost(x2, yTe, theta)

        return theta, cost_history, vali_cost_history
```

[395]:
```
theta = np.zeros(6)
theta = theta.reshape(6,1)
iterations = 25;
alpha = 0.01;
```

[396]:
```
theta, cost_history, vali_cost_history = grad_descent(x1, yTr, theta, alpha,␣
 ↪iterations, x2, yTe)

print(theta)
print(cost_history)
print(vali_cost_history)
```

```
[[3.82210815e+04]
 [2.14260071e+08]
 [1.17564070e+05]
 [5.26780620e+04]
 [7.48306653e+04]
 [3.23576400e+04]]
[5.71174101e+23 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00]
[1.45640384e+23 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
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 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00 0.00000000e+00 0.00000000e+00 0.00000000e+00
 0.00000000e+00]
```
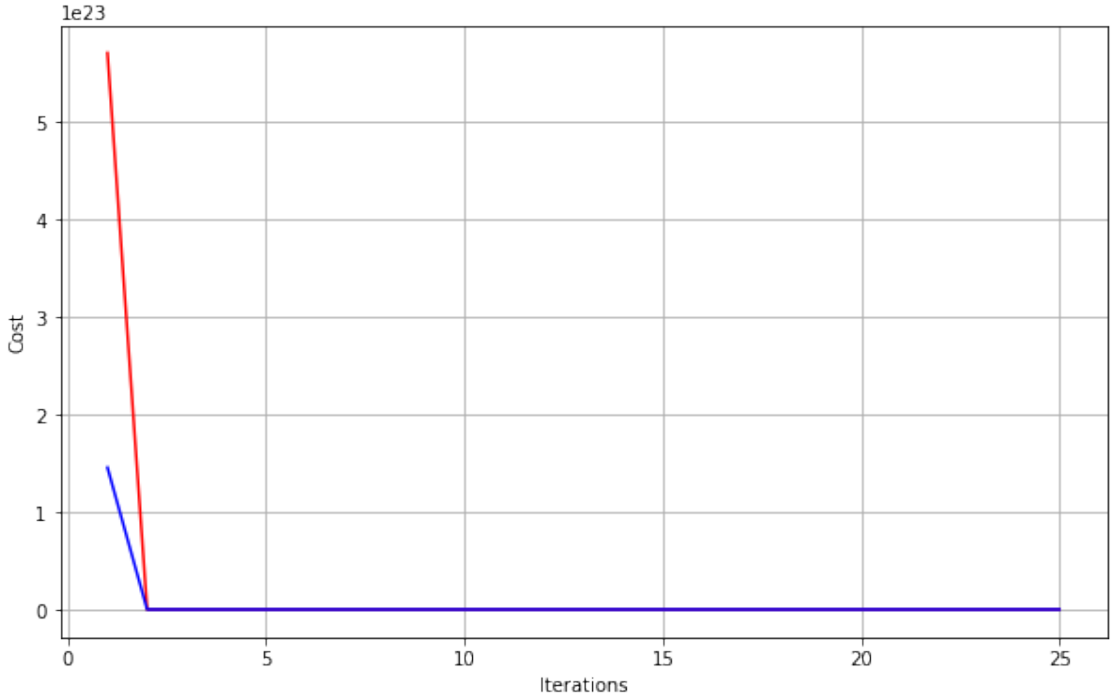

[397]:
```
plt.plot(range(1, iterations + 1), cost_history, color = 'red')
plt.plot(range(1, iterations + 1), vali_cost_history, color = 'blue')

plt.rcParams["figure.figsize"] = (10,6)
plt.grid()
plt.xlabel('Iterations')
plt.ylabel('Cost')
plt.show()
```



[ ]:

[ ]:

[373]:
```
df_train_b, df_test_b = train_test_split(housing, train_size = 0.7, test_size =␣
↪0.3)
```

[374]:
```
x_Train_b =␣
↪df_train_b[['area','bedrooms','bathrooms','stories','mainroad','guestroom','basement','hotw
x_Test_b =␣
↪df_test_b[['area','bedrooms','bathrooms','stories','mainroad','guestroom','basement','hotwa

y_Train_b = df_train_b[['price']].values
y_Test_b = df_test_b[['price']].values

x_Train_b[:4]
```

[374]:

	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	\
223	6321	3	1	2	yes	no	yes	
117	3700	4	1	2	yes	yes	no	
176	8520	3	1	1	yes	no	no	
166	7800	3	1	1	yes	no	yes	

	hotwaterheating	airconditioning	parking	prefarea

```
223              no             yes        1       no
117              no             yes        0       no
176              no             yes        2       no
166              no             yes        2      yes
```

[375]:
```
x_Train_b.shape
```

[375]:
```
(381, 11)
```

[ ]:
```

```

[320]:
```
m3 = len(y_Train_b)
m4 = len(y_Test_b)
```

[320]:
```
381
```

[328]:
```
x0_b = np.ones((m3,1))
x_0_b = np.ones((m4,1))

x1_b = np.hstack((x0_b, x_Train_b))
x2_b = np.hstack((x_0_b, x_Test_b))
```

[323]:
```
theta_b = np.zeros(12)
theta_b = theta_b.reshape(12,1)
theta_b.shape
```

[323]:
```
(12, 1)
```

[325]:
```
def get_cost(x1_b, y_Train_b, theta_b):
    H = x1_b.dot(theta_b)
    error = np.subtract(H, y_Train_b)
    sqrError = np.square(error)
    J = 1 / (2*m) * np.sum(sqrError)

    return J
```

[329]:
```
def grad_descent(x1_b, y_Train_b, theta_b, alpha, iterations, x2_b, y_Test_b):

    cost_history_b = np.zeros(iterations)
    vali_cost_history_b = np.zeros(iterations)

    for i in range(iterations):
        H = x1_b.dot(theta_b)
        error = np.subtract(H, y_Train_b)
        delta_sum = (alpha / m) * x1_b.transpose().dot(error);
        theta_b = theta_b - delta_sum
        cost_history_b[i] = get_cost(x1_b, y_Train_b, theta_b)
        vali_cost_history_b[i] = get_cost(x2_b, y_Test_b, theta_b)
```

```
        return theta_b, cost_history_b, vali_cost_history_b
```

[301]:
```
theta = np.zeros(6)
theta = theta.reshape(6,1)
iterations = 25;
alpha = 0.00001;
```

[330]:
```
theta_b, cost_history_b, vali_cost_history_b = grad_descent(x1_b, y_Train_b,␣
 ↪theta_b, alpha, iterations, x2_b, y_Test_b)

print(theta_b)
print(cost_history_b)
print(vali_cost_history_b)
```

```
[[nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]
 [nan]]
[nan  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.
  0.  0.  0.  0.  0.  0.  0.]
[nan  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.  0.
  0.  0.  0.  0.  0.  0.  0.]
```

[ ]:
```
```