HW0partA

September 22, 2022

[1]:
```
"""Edward Pascual-Bautista
   ECGR 4105 HW0
"""
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

[271]:
```
dataset = pd.read_csv('D3.csv')
dataset.head()
```

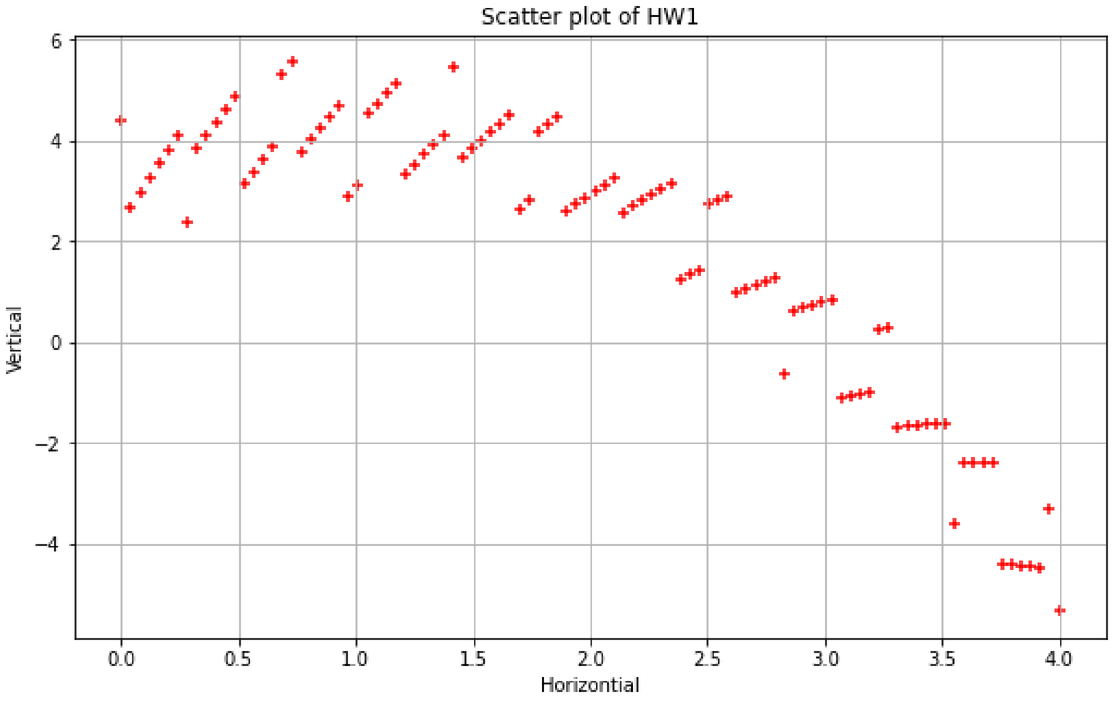
[271]:
```
         X1        X2        X3         Y
0  0.000000  3.440000  0.440000  4.387545
1  0.040404  0.134949  0.888485  2.679650
2  0.080808  0.829899  1.336970  2.968490
3  0.121212  1.524848  1.785455  3.254065
4  0.161616  2.219798  2.233939  3.536375
```

[272]:
```
x1 = dataset.values[:, 0]
x2 = dataset.values[:, 1]
x3 = dataset.values[:, 2]
y = dataset.values[:, 3]
m = len(y)

print('x = ', x1[: 100])
print('m = ', m)
```

```
x =  [0.         0.04040404 0.08080808 0.12121212 0.16161616 0.2020202
 0.24242424 0.28282828 0.32323232 0.36363636 0.4040404  0.44444444
 0.48484848 0.52525252 0.56565657 0.60606061 0.64646465 0.68686869
 0.72727273 0.76767677 0.80808081 0.84848485 0.88888889 0.92929293
 0.96969697 1.01010101 1.05050505 1.09090909 1.13131313 1.17171717
 1.21212121 1.25252525 1.29292929 1.33333333 1.37373737 1.41414141
 1.45454546 1.49494949 1.53535354 1.57575758 1.61616162 1.65656566
 1.6969697  1.73737374 1.77777778 1.81818182 1.85858586 1.8989899
 1.93939394 1.97979798 2.02020202 2.06060606 2.1010101  2.14141414
 2.18181818 2.22222222 2.26262626 2.3030303  2.34343434 2.38383838
 2.42424242 2.46464646 2.5050505  2.54545455 2.58585859 2.62626263
 2.66666667 2.70707071 2.74747475 2.78787879 2.82828283 2.86868687
 2.90909091 2.94949495 2.98989899 3.03030303 3.07070707 3.11111111
 3.15151515 3.19191919 3.23232323 3.27272727 3.31313131 3.35353535
 3.39393939 3.43434343 3.47474748 3.51515151 3.55555556 3.5959596
 3.63636364 3.67676768 3.71717172 3.75757576 3.7979798  3.83838384
 3.87878788 3.91919192 3.95959596 4.        ]
m =  100
```

[273]:
```
plt.scatter(x1,y, color='red' , marker= '+')
plt.grid()
plt.rcParams["figure.figsize"] = (10,6)
plt.xlabel('Horizontial')
plt.ylabel('Vertical')
plt.title('Scatter plot of HW1')
```

[273]:
```
Text(0.5, 1.0, 'Scatter plot of HW1')
```



[274]:
```
x_0 = np.ones((m, 1))
x_0[:5]
```

[274]:
```
array([[1.],
       [1.],
       [1.],
       [1.],
       [1.]])
```

```
[275]: x_1 = x1.reshape(m, 1)
       x_1[:5]
```

```
[275]: array([[0.        ],
              [0.04040404],
              [0.08080808],
              [0.12121212],
              [0.16161616]])
```

```
[276]: x_2 = x2.reshape(m, 1)
       x_2[:5]
```

```
[276]: array([[3.44      ],
              [0.1349495 ],
              [0.82989899],
              [1.52484848],
              [2.21979798]])
```

```
[277]: x_3 = x3.reshape(m, 1)
       x_3[:5]
```

```
[277]: array([[0.44      ],
              [0.88848485],
              [1.3369697 ],
              [1.78545454],
              [2.23393939]])
```

```
[278]: X1 = np.hstack((x_0, x_1))
       X1[:5]
```

```
[278]: array([[1.        , 0.        ],
              [1.        , 0.04040404],
              [1.        , 0.08080808],
              [1.        , 0.12121212],
              [1.        , 0.16161616]])
```

```
[279]: X2 = np.hstack((x_0, x_2))
       X2[:5]
```

```
[279]: array([[1.        , 3.44      ],
              [1.        , 0.1349495 ],
              [1.        , 0.82989899],
              [1.        , 1.52484848],
              [1.        , 2.21979798]])
```

```
[280]: X3 = np.hstack((x_0, x_3))
       X3[:5]
```

[280]:
```
array([[1.        , 0.44      ],
       [1.        , 0.88848485],
       [1.        , 1.3369697 ],
       [1.        , 1.78545454],
       [1.        , 2.23393939]])
```

[281]:
```
theta = np.zeros(2)
theta
```

[281]:
```
array([0., 0.])
```

[321]:
```
def get_loss_1(X1, y, theta):
    """
    x is inpute data (m x n)
    y (m x 1)
    theta (n x 1)
    """
    h1 = X1.dot(theta)
    error = np.subtract(h1, y)
    sqrError = np.square(error)
    J1 = 1 / (2 * m) * np.sum(sqrError)

    return J1
```

[322]:
```
loss_x1 = get_loss_1(X1, y, theta)

print(loss_x1)
```

```
0.9849930825405946
```

[323]:
```
def gradient_descent_x1(X1, y, theta, alpha, iterations):

    cost_history_1 = np.zeros(iterations)

    for i in range(iterations):
        h1 = X1.dot(theta)
        error = np.subtract(h1, y)
        sum_delta = (alpha / m) * X1.transpose().dot(error);
        theta = theta - sum_delta;
        cost_history_1[i] = get_loss_1(X1, y, theta)

    return theta, cost_history_1
```

[324]:
```
theta = [0., 0.]
iterations = 1500;
alpha = 0.1;
```

[325]:

```
theta, cost_history_1 = gradient_descent_x1(X1, y, theta, alpha, iterations)
print('Value of Theta: ', theta)
print('Cost History: ', cost_history_1)
```

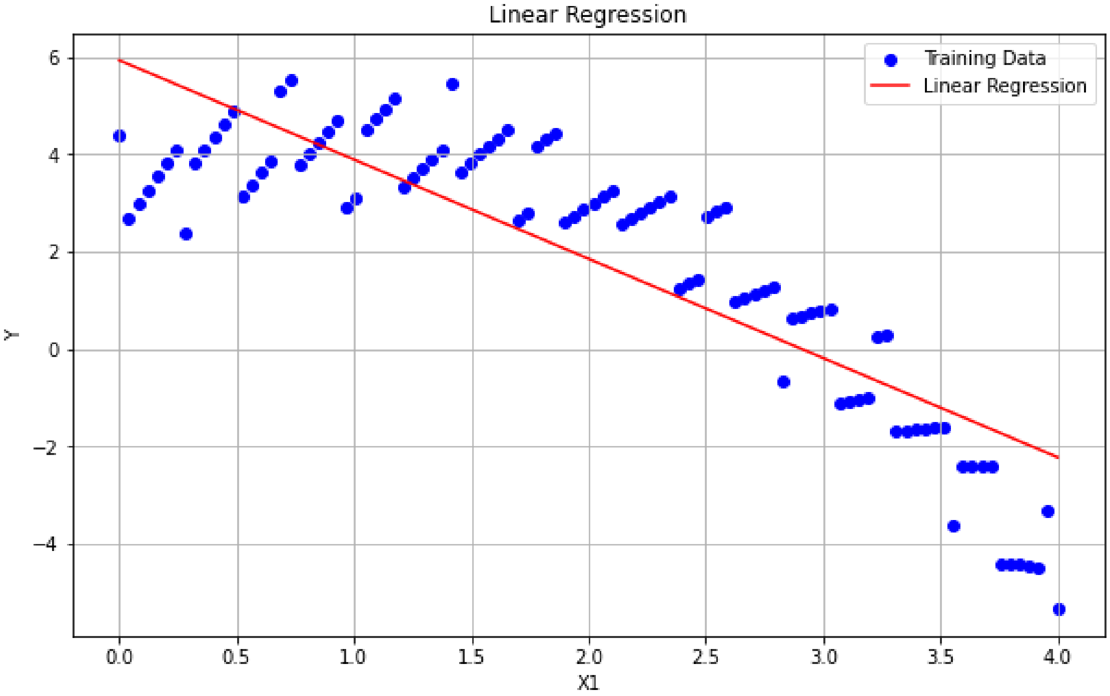
```
Value of Theta:  [ 5.92794892 -2.03833663]
Cost History:  [5.16999006 4.96338989 4.7855721  … 0.98499308 0.98499308
0.98499308]
```

[326]:

```
plt.scatter(X1[:,1], y, color = 'blue', label = 'Training Data')
plt.plot(X1[:,1], X1.dot(theta), color = 'red', label = 'Linear Regression')


plt.rcParams["figure.figsize"] = (10, 6)
plt.grid()
plt.xlabel('X1')
plt.ylabel('Y')
plt.title('Linear Regression')

plt.legend()
```

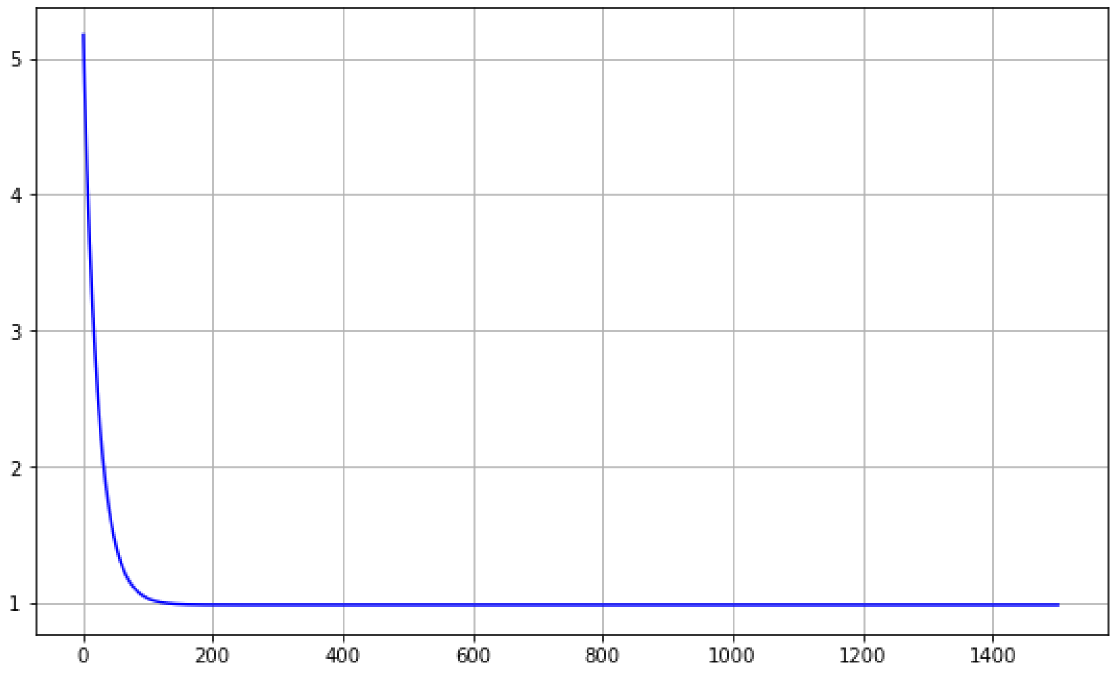
[326]:

```
<matplotlib.legend.Legend at 0x260971bf760>
```



[327]:

```
plt.plot(range(1, iterations + 1), cost_history_1, color = 'blue')
plt.rcParams["figure.figsize"] = (10, 6)
plt.grid()
```



[328]:
```
def get_loss_2(X2, y, theta):
    """
    x is inpute data (m x n)
    y (m x 1)
    theta (n x 1)
    """
    h2 = X2.dot(theta)
    error = np.subtract(h2, y)
    sqrError = np.square(error)
    J2 = 1 / (2 * m) * np.sum(sqrError)

    return J2
```

[329]:
```
loss_x2 = get_loss_2(X2, y, theta)

print(loss_x2)
```

```
8.182525826043467
```

[330]:
```
def gradient_descent_x2(X2, y, theta, alpha, iterations):

    cost_history_2 = np.zeros(iterations)

    for i in range(iterations):
        h2 = X2.dot(theta)
        error = np.subtract(h2, y)
        sum_delta = (alpha / m) * X2.transpose().dot(error);
        theta = theta - sum_delta;
        cost_history_2[i] = get_loss_2(X2, y, theta)

    return theta, cost_history_2
```

[331]:

```
theta = [0., 0.]
iterations = 1500;
alpha = 0.01;
```

[332]:

```
theta, cost_history_2 = gradient_descent_x2(X2, y, theta, alpha, iterations)
print('Value of Theta: ', theta)
print('Cost History: ', cost_history_2)
```

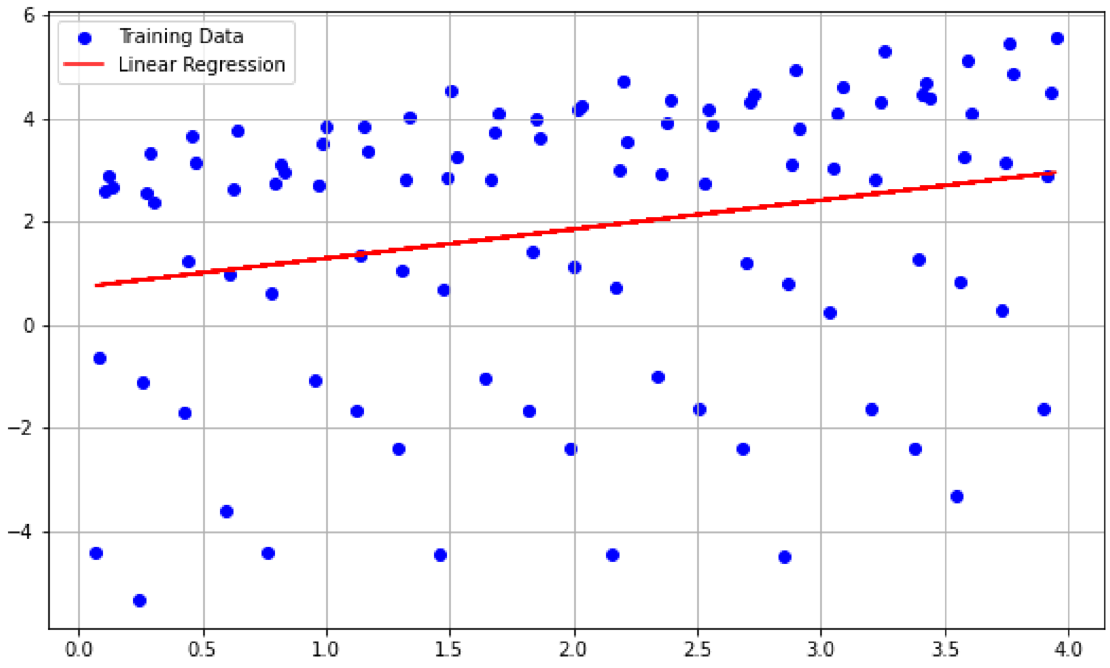
```
Value of Theta:  [0.71988473 0.56390334]
Cost History:  [5.29831663 5.09909109 4.92356115 … 3.5993997  3.59939955
3.5993994 ]
```

[333]:

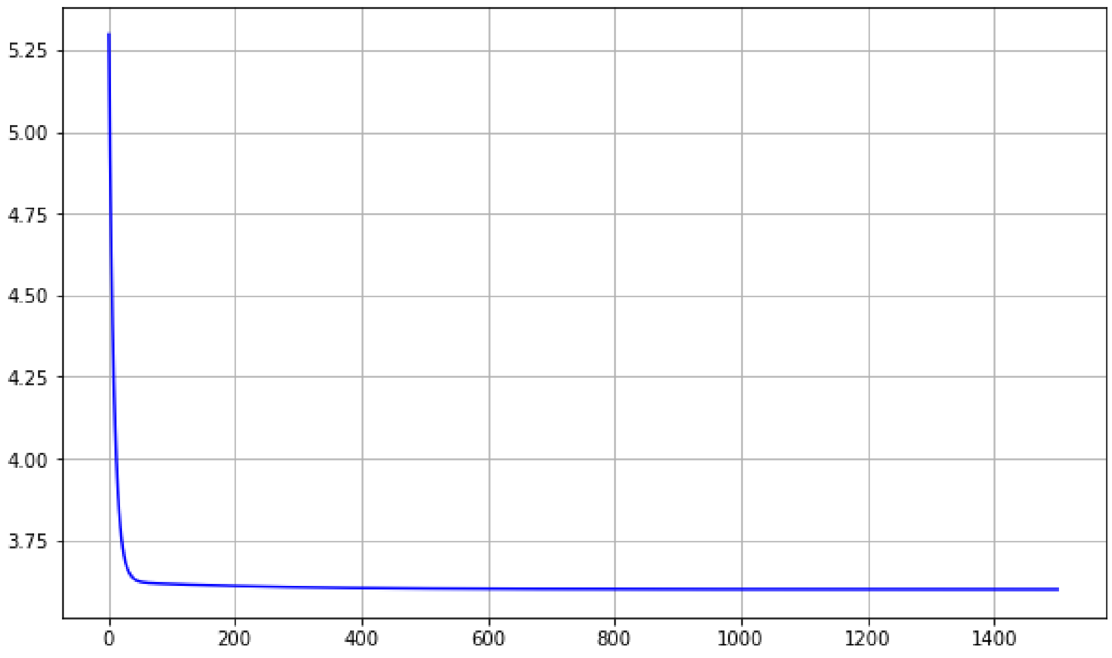
```
plt.scatter(X2[:,1], y, color = 'blue', label = 'Training Data')
plt.plot(X2[:,1], X2.dot(theta), color = 'red', label = 'Linear Regression')


plt.rcParams["figure.figsize"] = (10, 6)
plt.grid()


plt.legend()
```

[333]:

```
<matplotlib.legend.Legend at 0x2609bd02820>
```



[334]:
```
plt.plot(range(1, iterations + 1), cost_history_2, color = 'blue')
plt.rcParams["figure.figsize"] = (10, 6)
plt.grid()
```



[335]:

```
def get_loss_3(X3, y, theta):
    """
    x is inpute data (m x n)
    y (m x 1)
    theta (n x 1)
    """
    h3 = X3.dot(theta)
    error = np.subtract(h3, y)
    sqrError = np.square(error)
    J3 = 1 / (2 * m) * np.sum(sqrError)

    return J3
```

[336]:

```
loss_x3 = get_loss_3(X3, y, theta)

print(loss_x3)
```

```
4.417085543820646
```

[337]:

```
def gradient_descent_x3(X3, y, theta, alpha, iterations):

    cost_history_3 = np.zeros(iterations)

    for i in range(iterations):
        h3 = X3.dot(theta)
        error = np.subtract(h3, y)
        sum_delta = (alpha / m) * X3.transpose().dot(error);
        theta = theta - sum_delta;
        cost_history_3[i] = get_loss_3(X3, y, theta)

    return theta, cost_history_3
```

[342]:

```
theta = [0., 0.]
iterations = 2000;
alpha = 0.1;
```

[343]:

```
theta, cost_history_3 = gradient_descent_x3(X3, y, theta, alpha, iterations)
print('Value of Theta: ', theta)
print('Cost History: ', cost_history_3)
```

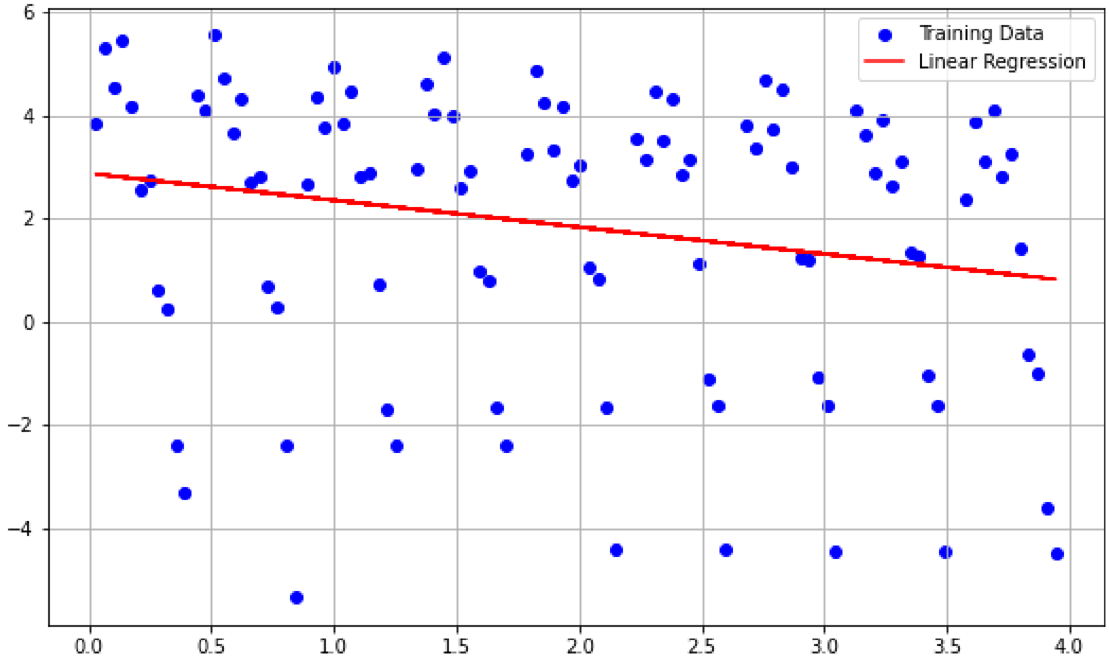
```
Value of Theta:  [ 2.8714221  -0.52048288]
Cost History:  [4.66843939 4.49602325 4.43685075 … 3.62945112 3.62945112
3.62945112]
```

[344]:

```
plt.scatter(X3[:,1], y, color = 'blue', label = 'Training Data')
plt.plot(X3[:,1], X3.dot(theta), color = 'red', label = 'Linear Regression')
plt.rcParams["figure.figsize"] = (10, 6)
plt.grid()


plt.legend()
```

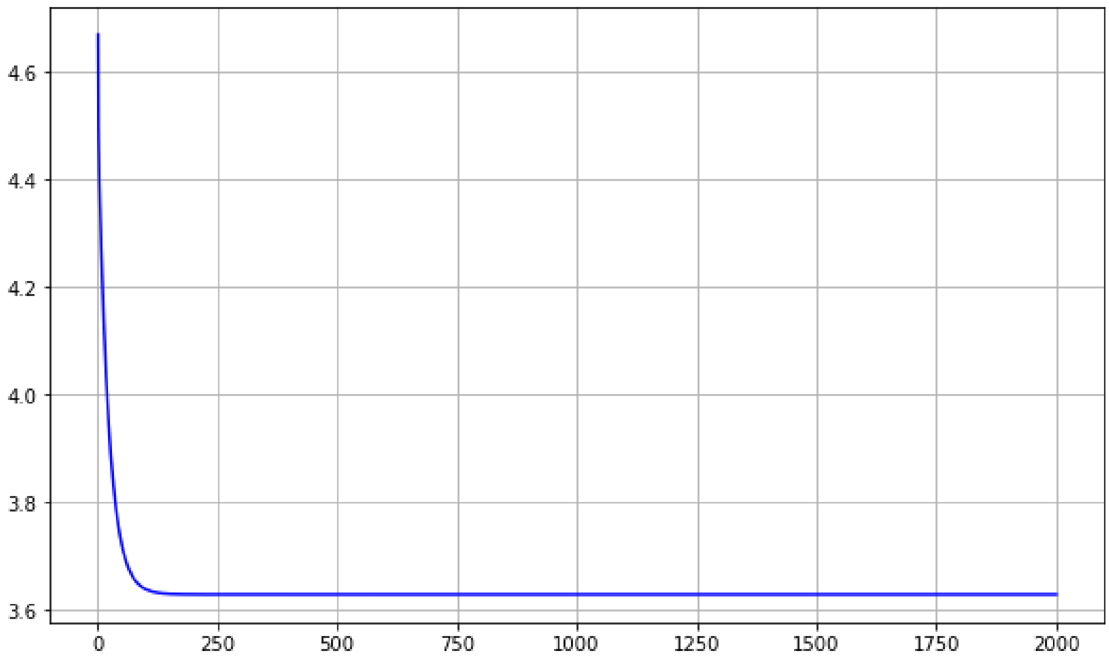
[344]:

```
<matplotlib.legend.Legend at 0x2609bf22cd0>
```



[345]:

```
plt.plot(range(1, iterations + 1), cost_history_3, color = 'blue')
plt.rcParams["figure.figsize"] = (10, 6)
plt.grid()
```


4.6
4.4
4.2
4.0
3.8
3.6
0
250
500
750
1000
1250
1500
1750
2000

[ ]:

[ ]: