Implementation of Batch Gradient Descent& Stochastic Gradient Descent

In [2]:

```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
%matplotlib inline
```

In [7]:

```
df=pd.read_csv('Downloads/houseprices_bangalore.csv')
df.sample(5)
```

Out[7]:

	area	bedrooms	price
14	2250	3	101.0
15	1175	2	42.0
17	1540	3	60.0
4	1200	2	51.0
8	1310	3	50.0

Scaling

In [9]:

```
from sklearn import preprocessing

sx=preprocessing.MinMaxScaler()
sy=preprocessing.MinMaxScaler()
```

```
scaled_X=sx.fit_transform(df.drop('price',axis='columns'))
scaled_X
```

Out[9]:

```
array([[0.08827586, 0.25      ],
       [0.62068966, 0.75      ],
       [0.22068966, 0.5       ],
       [0.24862069, 0.5       ],
       [0.13793103, 0.25      ],
       [0.12758621, 0.25      ],
       [0.6662069 , 0.75      ],
       [0.86206897, 0.75      ],
       [0.17586207, 0.5       ],
       [1.        , 1.        ],
       [0.34482759, 0.5       ],
       [0.68448276, 0.75      ],
       [0.06896552, 0.25      ],
       [0.10344828, 0.25      ],
       [0.5       , 0.5       ],
       [0.12931034, 0.25      ],
       [0.13103448, 0.5       ],
       [0.25517241, 0.5       ],
       [0.67931034, 0.5       ],
       [0.        , 0.        ]])
```

In [10]:

```
scaled_y=sy.fit_transform(df['price'].values.reshape(df.shape[0],1))
scaled_y
```

Out[10]:

```
array([[0.05237037],
       [0.65185185],
       [0.22222222],
       [0.31851852],
       [0.14074074],
       [0.04444444],
       [0.76296296],
       [0.91111111],
       [0.13333333],
       [1.        ],
       [0.37037037],
       [0.8       ],
       [0.04444444],
       [0.05925926],
       [0.51111111],
       [0.07407407],
       [0.11851852],
       [0.20740741],
       [0.51851852],
       [0.        ]])
```

In [ ]:

In [ ]:

In [17]:

```
w=np.ones(shape=(2))
```

In [ ]:

```
a=np.array([1,2,3])
b=np.
```

In [29]:

```
def batch_gradient_descent(X,y_true,epochs,learning_rate=0.01):

    number_of_features=X.shape[1]
    w=np.ones(shape=(number_of_features))
    b=0
    total_samples=X.shape[0]
    cost_list=[]
    epoch_list=[]

    for i in range(epochs):
        y_predicted = np.dot(w,scaled_X.T) +b  # w1 *area +w2 *bedrooms

        w_grad=-(2/total_samples)*(X.T.dot(y_true-y_predicted))
        b_grad=-(2/total_samples)*np.sum(y_true-y_predicted)

        w=w-learning_rate * w_grad
        b=b-learning_rate * b_grad

        cost=np.mean(np.square(y_true-y_predicted))

        if i%10==0:
            cost_list.append(cost)
            epoch_list.append(i)
    return w,b,cost,cost_list,epoch_list

w,b,cost,cost_list,epoch_list=batch_gradient_descent(scaled_X,scaled_y.reshape(scaled_y.shape[0],),500)

w,b,cost
```

Out[29]:

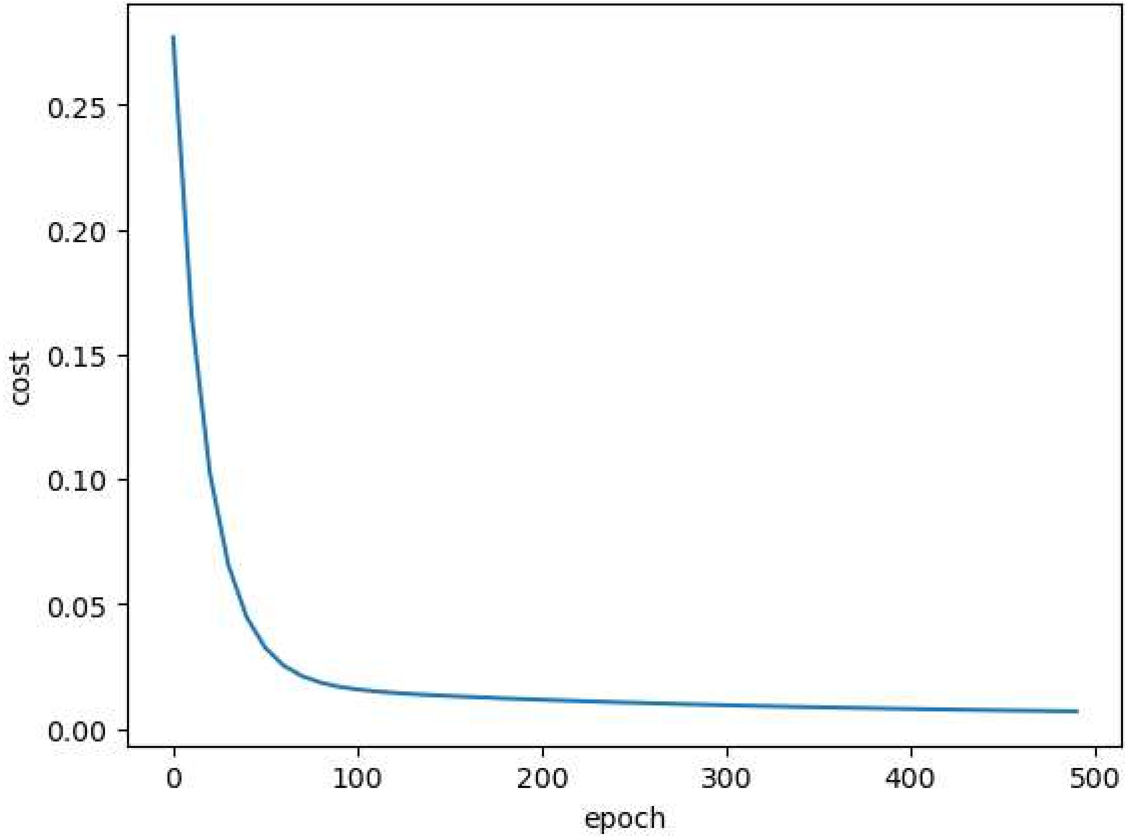
```
(array([0.70712464, 0.67456527]), -0.23034857438407422, 0.0068641890429808105)
```

In [30]:

```
plt.xlabel('epoch')
plt.ylabel('cost')
plt.plot(epoch_list,cost_list)
```

Out[30]:

```
[<matplotlib.lines.Line2D at 0x1b9725f5910>]
```



Prediction Function

```
In [ ]:
```

```
In [31]: sx.transform([[2600,4]])
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[31]:

```
array([[0.62068966, 0.75      ]])
```

In [32]:

```
sy.inverse_transform([[1,0.5,0]])
```

Out[32]:

```
array([[167. ,  99.5,  32. ]])
```

In [35]:

```
def predict(area,bedrooms,w,b):
    scaled_X=sx.transform([[area,bedrooms]])[0]

    scaled_price=w[0]*scaled_X[0]+w[1]*scaled_X[1]+b

    return sy.inverse_transform([[scaled_price]])[0][0]


predict(2600,4,w,b)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[35]:

```
128.45484403267596
```

In [36]:

```
predict(1000,2,w,b)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[36]:

```
30.253094462442363
```

In [37]:

```
predict(1500,3,w,b)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[37]:

```
69.47860785714694
```

In [39]:

```python
predict(1500,3,w,b)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[39]:

```
69.47860785714694
```

In [40]:

```python
predict(1500,4,w,b)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[40]:

```
92.24518560116454
```

STOCHASTIC GRADIENT DESCENT

In [45]:

```python
import random
random.randint(0,6)
```

Out[45]:

```
3
```

In [62]:

```python
def stochastic_gradient_descent(X,y_true,epochs,learning_rate=0.01):

    number_of_features=X.shape[1]
    w=np.ones(shape=(number_of_features))
    b=0
    total_samples=X.shape[0]
    cost_list=[]
    epoch_list=[]

    for i in range(epochs):
        random_index=random.randint(0,total_samples-1)
        sample_x=X[random_index]
        sample_y=y_true[random_index]
        y_predicted=np.dot(w,sample_x.T)+b
        w_grad=-(2/total_samples)*(sample_x.T.dot(sample_y-y_predicted))
        b_grad=-(2/total_samples)*np.sum(sample_y-y_predicted)

        w=w-learning_rate * w_grad
        b=b-learning_rate * b_grad

        cost=np.mean(np.square(sample_y-y_predicted))

        if i%10==0:
            cost_list.append(cost)
            epoch_list.append(i)
    return w,b,cost,cost_list,epoch_list

w_sgd,b_sgd,cost_sgd,cost_list_sgd,epoch_list_sgd=stochastic_gradient_descent(scaled_X,scaled_y.reshape(scaled_y

w_sgd,b_sgd,cost_sgd
```

Out[62]:

```
(array([0.82291706, 0.79038561]), -0.3019889280829538, 0.017363327024298467)
```

In [63]:

```
w,b,cost
```

Out[63]:

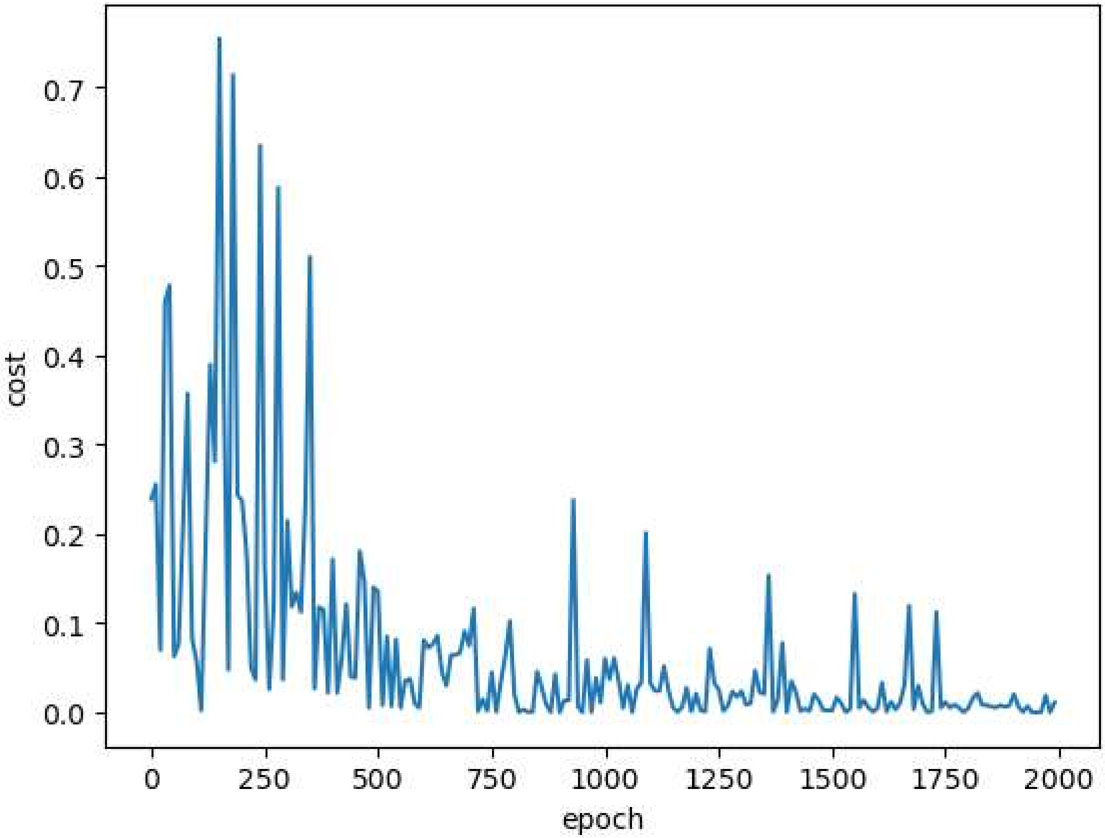
```
(array([0.70712464, 0.67456527]), -0.23034857438407422, 0.0068641890429808105)
```

In [64]:

```
plt.xlabel('epoch')
plt.ylabel('cost')
plt.plot(epoch_list_sgd,cost_list_sgd)
```

Out[64]:

```
[<matplotlib.lines.Line2D at 0x1b974880910>]
```



In [53]:

```
predict(2600,4,w_sgd,b_sgd)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[53]:

```
128.57418053345236
```

In [54]:

```
predict(1500,3,w_sgd,b_sgd)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

Out[54]:

```
69.66570568090523
```

Exercise: Implement mini batch gradient descent in python and plot cost vs epoch graph. Mini batch is intermediate version of batch GD and stochastic GD. In stochastic we used one randomly picked training sample, in mini gradient descent you will use a batch of samples in each iterations. For example if you have total 50 training samples, you can take a batch of 10 samples, calculate cumulative error for those 10 samples and then adjust weights. In SGD we adjust weights after every one sample. In Batch we adjust weights after going through all samples but in mini batch we do after every m samples(where m is batch size and it is 0<m<n, where n is total number of samples)

Mini Batch Gradient Descent

In [73]:

```
def mini_batch_gradient_descent(X,y_true,epochs,batch_size,learning_rate=0.01):

    number_of_features=X.shape[1]
    w=np.ones(shape=(number_of_features))
    b=0
    total_samples=X.shape[0]

    cost_list=[]
    epoch_list=[]

    for i in range(epochs):
        random_index=random.sample(range(total_samples),batch_size)
        batch_x=X[random_index]
        batch_y=y_true[random_index]
        y_predicted=np.dot(w,sample_x.T)+b
        w_grad=-(2/total_samples)*(batch_x.T.dot(batch_y-y_predicted))
        b_grad=-(2/total_samples)*np.sum(batch_y-y_predicted)

        w=w-learning_rate * w_grad
        b=b-learning_rate * b_grad

        cost=np.mean(np.square(batch_y-y_predicted))

        if i%10==0:
            cost_list.append(cost)
            epoch_list.append(i)
    return w,b,cost,cost_list,epoch_list

w_mbgd,b_mbgd,cost_mbgd,cost_list_mbgd,epoch_list_mbgd=stochastic_gradient_descent(scaled_X,scaled_y.reshape(scal

w_mbgd,b_mbgd,cost_mbgd
```

Out[73]:

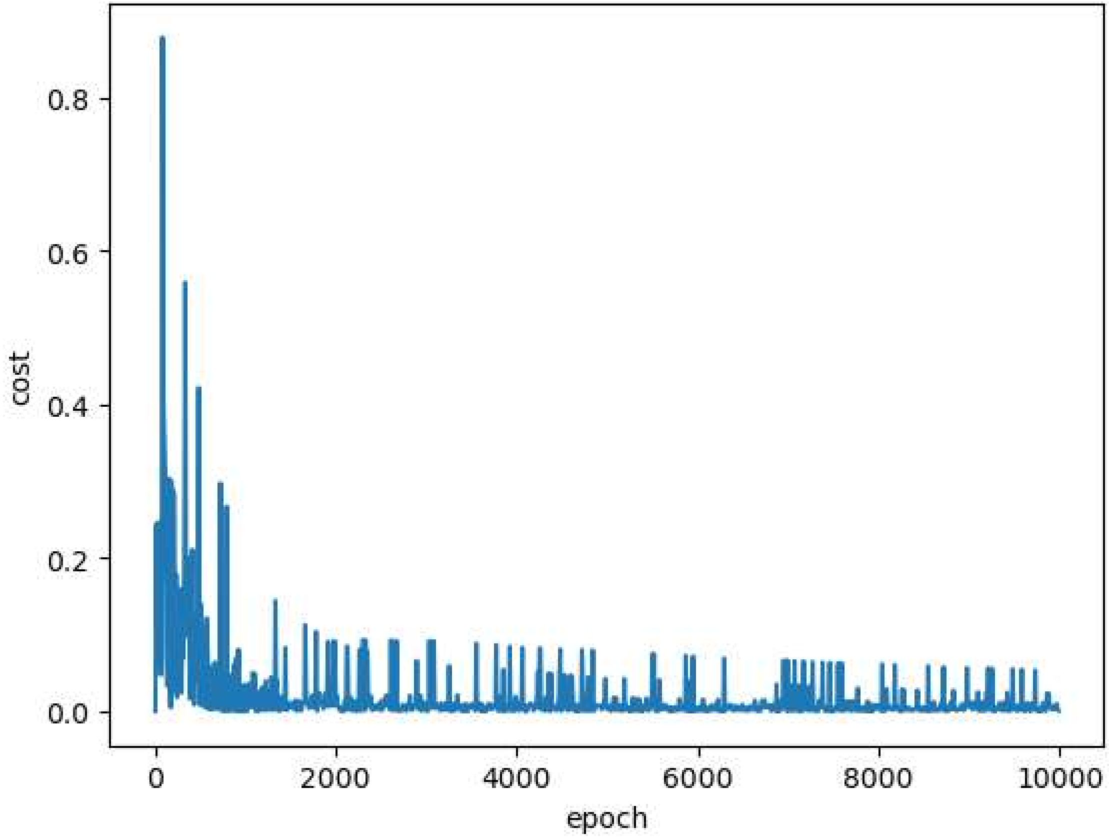
```
(array([0.70539484, 0.6756928 ]), -0.2298151660444562, 0.052920799221685126)
```

In [74]:

```
plt.xlabel('epoch')
plt.ylabel('cost')
plt.plot(epoch_list_mbgd,cost_list_mbgd)
```

Out[74]:

```
[<matplotlib.lines.Line2D at 0x1b975b4ef40>]
```



```
In [75]: predict(2600,4,w_mbgd,b_mbgd)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

```
Out[75]: 128.49607183039188
```

```
In [78]: predict(1310,3,w_sgd,b_sgd)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

```
Out[78]: 64.11970933615656
```

```
In [79]: predict(1100,2,w_sgd,b_sgd)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

```
Out[79]: 29.39947138798771
```

```
In [80]: predict(2250,3,w_sgd,b_sgd)
```

```
C:\Users\KIRAN\anaconda3\lib\site-packages\sklearn\base.py:439: UserWarning: X does not have valid feature name
s, but MinMaxScaler was fitted with feature names
  warnings.warn(
```

```
Out[80]: 100.12942497122951
```

```
In [ ]:
```