In [1]:
```
# importing libraries
import pandas as pd #analysis and manipulation
import numpy as np #numerical &computational package
import matplotlib.pyplot as plt # visualisation
```

In [2]:
```
plt.rcParams['figure.figsize'] = (20.0, 10.0)
from mpl_toolkits.mplot3d import Axes3D
```

In [3]:
```
my_data = pd.read_csv(r'C:\Users\HP\Desktop\multivariate.txt',names=["size","bedroom
print(my_data); print(my_data.shape)
my_data.head()
```

```
    size  bedroom   price
0   2104        3  399900
1   1600        3  329900
2   2400        3  369000
3   1416        2  232000
4   3000        4  539900
5   1985        4  299900
6   1534        3  314900
7   1427        3  198999
8   1380        3  212000
9   1494        3  242500
10  1940        4  239999
11  2000        3  347000
12  1890        3  329999
13  4478        5  699900
14  1268        3  259900
15  2300        4  449900
16  1320        2  299900
17  1236        3  199900
18  2609        4  499998
19  3031        4  599000
20  1767        3  252900
21  1888        2  255000
22  1604        3  242900
23  1962        4  259900
24  3890        3  573900
25  1100        3  249900
26  1458        3  464500
27  2526        3  469000
28  2200        3  475000
29  2637        3  299900
30  1839        2  349900
31  1000        1  169900
32  2040        4  314900
33  3137        3  579900
34  1811        4  285900
35  1437        3  249900
36  1239        3  229900
37  2132        4  345000
38  4215        4  549000
39  2162        4  287000
40  1664        2  368500
41  2238        3  329900
42  2567        4  314000
43  1200        3  299000
44   852        2  179900
45  1852        4  299900
46  1203        3  239500
(47, 3)
```

Out[3]:

	size	bedroom	price

	size	bedroom	price
0	2104	3	399900
1	1600	3	329900
2	2400	3	369000
3	1416	2	232000
4	3000	4	539900

In [4]:

```
my_data = (my_data - my_data.mean())/my_data.std()
newhead=my_data.head(47);
print(newhead)
```

```
        size   bedroom     price
0   0.130010 -0.223675  0.475747
1  -0.504190 -0.223675 -0.084074
2   0.502476 -0.223675  0.228626
3  -0.735723 -1.537767 -0.867025
4   1.257476  1.090417  1.595389
5  -0.019732  1.090417 -0.323998
6  -0.587240 -0.223675 -0.204036
7  -0.721881 -0.223675 -1.130948
8  -0.781023 -0.223675 -1.026973
9  -0.637573 -0.223675 -0.783051
10 -0.076357  1.090417 -0.803053
11 -0.000857 -0.223675  0.052682
12 -0.139273 -0.223675 -0.083283
13  3.117292  2.404508  2.874981
14 -0.921956 -0.223675 -0.643896
15  0.376643  1.090417  0.875619
16 -0.856523 -1.537767 -0.323998
17 -0.962223 -0.223675 -1.123743
18  0.765468  1.090417  1.276275
19  1.296484  1.090417  2.068039
20 -0.294048 -0.223675 -0.699878
21 -0.141790 -1.537767 -0.683083
22 -0.499157 -0.223675 -0.779852
23 -0.048673  1.090417 -0.643896
24  2.377392 -0.223675  1.867303
25 -1.133356 -0.223675 -0.723870
26 -0.682873 -0.223675  0.992382
27  0.661026 -0.223675  1.028370
28  0.250810 -0.223675  1.076355
29  0.800701 -0.223675 -0.323998
30 -0.203448 -1.537767  0.075875
31 -1.259189 -2.851859 -1.363666
32  0.049477  1.090417 -0.204036
33  1.429868 -0.223675  1.915287
34 -0.238682  1.090417 -0.435962
35 -0.709298 -0.223675 -0.723870
36 -0.958448 -0.223675 -0.883819
37  0.165243  1.090417  0.036687
38  2.786350  1.090417  1.668166
39  0.202993  1.090417 -0.427165
40 -0.423657 -1.537767  0.224627
41  0.298626 -0.223675 -0.084074
42  0.712618  1.090417 -0.211234
43 -1.007523 -0.223675 -0.331196
44 -1.445423 -1.537767 -1.283692
45 -0.187090  1.090417 -0.323998
46 -1.003748 -0.223675 -0.807044
```

In [5]:

```
S=newhead['size'].values
```

```
print(S)
```

```
[ 1.30009869e-01 -5.04189838e-01  5.02476364e-01 -7.35723065e-01
  1.25747602e+00 -1.97317285e-02 -5.87239800e-01 -7.21881404e-01
 -7.81023044e-01 -6.37573110e-01 -7.63567023e-02 -8.56737193e-04
 -1.39273340e-01  3.11729182e+00 -9.21956312e-01  3.76643089e-01
 -8.56523009e-01 -9.62222960e-01  7.65467909e-01  1.29648433e+00
 -2.94048269e-01 -1.41790005e-01 -4.99156507e-01 -4.86733818e-02
  2.37739217e+00 -1.13335621e+00 -6.82873089e-01  6.61026291e-01
  2.50809813e-01  8.00701226e-01 -2.03448310e-01 -1.25918949e+00
  4.94765729e-02  1.42986760e+00 -2.38681627e-01 -7.09298077e-01
 -9.58447962e-01  1.65243186e-01  2.78635031e+00  2.02993169e-01
 -4.23656542e-01  2.98626458e-01  7.12617934e-01 -1.00752294e+00
 -1.44542274e+00 -1.87089985e-01 -1.00374794e+00]
```

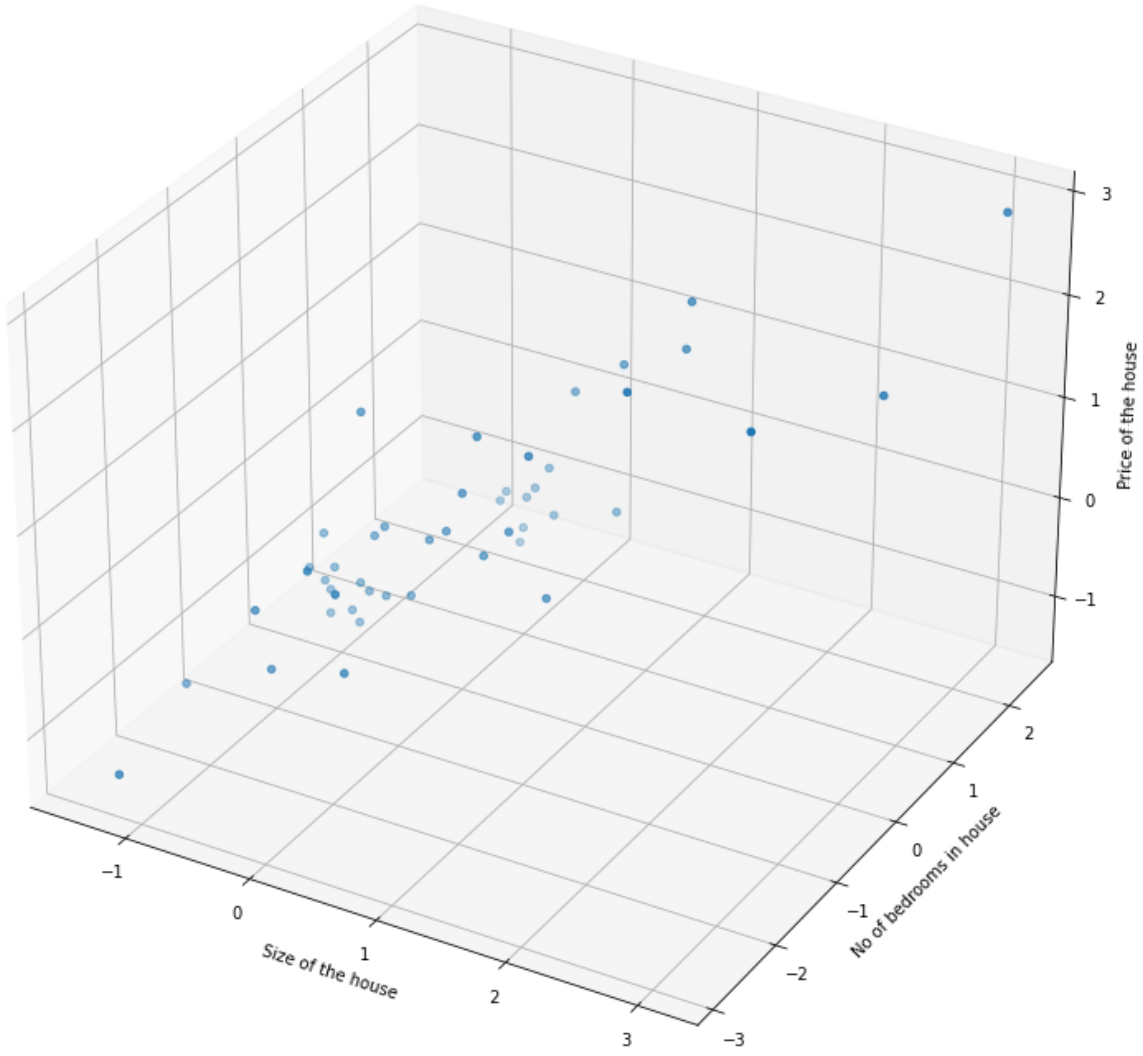
In [6]:

```
B=newhead['bedroom'].values; print(B)
Old_Y=newhead['price'].values
print(Old_Y)
```

```
[-0.22367519 -0.22367519 -0.22367519 -1.53776691  1.09041654  1.09041654
 -0.22367519 -0.22367519 -0.22367519 -0.22367519  1.09041654 -0.22367519
 -0.22367519  2.40450826 -0.22367519  1.09041654 -1.53776691 -0.22367519
  1.09041654  1.09041654 -0.22367519 -1.53776691 -0.22367519  1.09041654
 -0.22367519 -0.22367519 -0.22367519 -0.22367519 -0.22367519 -0.22367519
 -1.53776691 -2.85185864  1.09041654 -0.22367519  1.09041654 -0.22367519
 -0.22367519  1.09041654  1.09041654  1.09041654 -1.53776691 -0.22367519
  1.09041654 -0.22367519 -1.53776691  1.09041654 -0.22367519]
[ 0.47574687 -0.08407444  0.22862575 -0.86702453  1.59538948 -0.32399786
 -0.20403615 -1.13094828 -1.02697347 -0.78305133 -0.80305294  0.05268191
 -0.08328269  2.87498104 -0.64389575  0.87561923 -0.32399786 -1.12374258
  1.27627534  2.06803861 -0.69987788 -0.68308324 -0.77985235 -0.64389575
  1.86730269 -0.72387022  0.99238196  1.02837047  1.07635515 -0.32399786
  0.0758745  -1.363666   -0.20403615  1.91528737 -0.43596212 -0.72387022
 -0.88381916  0.03668701  1.66816625 -0.42716493  0.22462702 -0.08407444
 -0.21123385 -0.33119556 -1.28369153 -0.32399786 -0.80704367]
```

In [7]:

```
fig = plt.figure()
ax = Axes3D(fig)
ax.scatter(S, B, Old_Y)
ax.set_xlabel('Size of the house')
ax.set_ylabel('No of bedrooms in house')
ax.set_zlabel('Price of the house')
plt.show()
```



In [8]:
```
m = len(S); print(m)
```

```
47
```

In [9]:
```
x0 = np.ones(m);print(x0)
```

```
[1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.
 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]
```

In [10]:
```
X=np.array([x0, S, B]).T
print(X); print(X.shape)
```

```
[[ 1.00000000e+00  1.30009869e-01 -2.23675187e-01]
 [ 1.00000000e+00 -5.04189838e-01 -2.23675187e-01]
 [ 1.00000000e+00  5.02476364e-01 -2.23675187e-01]
 [ 1.00000000e+00 -7.35723065e-01 -1.53776691e+00]
 [ 1.00000000e+00  1.25747602e+00  1.09041654e+00]
 [ 1.00000000e+00 -1.97317285e-02  1.09041654e+00]
 [ 1.00000000e+00 -5.87239800e-01 -2.23675187e-01]
 [ 1.00000000e+00 -7.21881404e-01 -2.23675187e-01]
 [ 1.00000000e+00 -7.81023044e-01 -2.23675187e-01]
 [ 1.00000000e+00 -6.37573110e-01 -2.23675187e-01]
 [ 1.00000000e+00 -7.63567023e-02  1.09041654e+00]
 [ 1.00000000e+00 -8.56737193e-04 -2.23675187e-01]
 [ 1.00000000e+00 -1.39273340e-01 -2.23675187e-01]
```

```
 [ 1.00000000e+00  3.11729182e+00  2.40450826e+00]
 [ 1.00000000e+00 -9.21956312e-01 -2.23675187e-01]
 [ 1.00000000e+00  3.76643089e-01  1.09041654e+00]
 [ 1.00000000e+00 -8.56523009e-01 -1.53776691e+00]
 [ 1.00000000e+00 -9.62222960e-01 -2.23675187e-01]
 [ 1.00000000e+00  7.65467909e-01  1.09041654e+00]
 [ 1.00000000e+00  1.29648433e+00  1.09041654e+00]
 [ 1.00000000e+00 -2.94048269e-01 -2.23675187e-01]
 [ 1.00000000e+00 -1.41790005e-01 -1.53776691e+00]
 [ 1.00000000e+00 -4.99156507e-01 -2.23675187e-01]
 [ 1.00000000e+00 -4.86733818e-02  1.09041654e+00]
 [ 1.00000000e+00  2.37739217e+00 -2.23675187e-01]
 [ 1.00000000e+00 -1.13335621e+00 -2.23675187e-01]
 [ 1.00000000e+00 -6.82873089e-01 -2.23675187e-01]
 [ 1.00000000e+00  6.61026291e-01 -2.23675187e-01]
 [ 1.00000000e+00  2.50809813e-01 -2.23675187e-01]
 [ 1.00000000e+00  8.00701226e-01 -2.23675187e-01]
 [ 1.00000000e+00 -2.03448310e-01 -1.53776691e+00]
 [ 1.00000000e+00 -1.25918949e+00 -2.85185864e+00]
 [ 1.00000000e+00  4.94765729e-02  1.09041654e+00]
 [ 1.00000000e+00  1.42986760e+00 -2.23675187e-01]
 [ 1.00000000e+00 -2.38681627e-01  1.09041654e+00]
 [ 1.00000000e+00 -7.09298077e-01 -2.23675187e-01]
 [ 1.00000000e+00 -9.58447962e-01 -2.23675187e-01]
 [ 1.00000000e+00  1.65243186e-01  1.09041654e+00]
 [ 1.00000000e+00  2.78635031e+00  1.09041654e+00]
 [ 1.00000000e+00  2.02993169e-01  1.09041654e+00]
 [ 1.00000000e+00 -4.23656542e-01 -1.53776691e+00]
 [ 1.00000000e+00  2.98626458e-01 -2.23675187e-01]
 [ 1.00000000e+00  7.12617934e-01  1.09041654e+00]
 [ 1.00000000e+00 -1.00752294e+00 -2.23675187e-01]
 [ 1.00000000e+00 -1.44542274e+00 -1.53776691e+00]
 [ 1.00000000e+00 -1.87089985e-01  1.09041654e+00]
 [ 1.00000000e+00 -1.00374794e+00 -2.23675187e-01]]
(47, 3)
```

In [11]:

```
theta=np.array([0,0,0]); print(theta.shape)
New_theta=theta.reshape(-1,1)
print(New_theta.shape)
```

```
(3,)
(3, 1)
```

In [12]:

```
Y=np.array(Old_Y); print(Y);print(len(Y)); print(Y.shape)
```

```
[ 0.47574687 -0.08407444  0.22862575 -0.86702453  1.59538948 -0.32399786
 -0.20403615 -1.13094828 -1.02697347 -0.78305133 -0.80305294  0.05268191
 -0.08328269  2.87498104 -0.64389575  0.87561923 -0.32399786 -1.12374258
  1.27627534  2.06803861 -0.69987788 -0.68308324 -0.77985235 -0.64389575
  1.86730269 -0.72387022  0.99238196  1.02837047  1.07635515 -0.32399786
  0.0758745  -1.363666   -0.20403615  1.91528737 -0.43596212 -0.72387022
 -0.88381916  0.03668701  1.66816625 -0.42716493  0.22462702 -0.08407444
 -0.21123385 -0.33119556 -1.28369153 -0.32399786 -0.80704367]
47
(47,)
```

In [13]:

```
newY=Y.reshape(-1,1)
print(newY);print(newY.shape)
```

```
[[ 0.47574687]
 [-0.08407444]
 [ 0.22862575]
 [-0.86702453]
 [ 1.59538948]
 [-0.32399786]
 [-0.20403615]
```

```
[-1.13094828]
[-1.02697347]
[-0.78305133]
[-0.80305294]
[ 0.05268191]
[-0.08328269]
[ 2.87498104]
[-0.64389575]
[ 0.87561923]
[-0.32399786]
[-1.12374258]
[ 1.27627534]
[ 2.06803861]
[-0.69987788]
[-0.68308324]
[-0.77985235]
[-0.64389575]
[ 1.86730269]
[-0.72387022]
[ 0.99238196]
[ 1.02837047]
[ 1.07635515]
[-0.32399786]
[ 0.0758745 ]
[-1.363666  ]
[-0.20403615]
[ 1.91528737]
[-0.43596212]
[-0.72387022]
[-0.88381916]
[ 0.03668701]
[ 1.66816625]
[-0.42716493]
[ 0.22462702]
[-0.08407444]
[-0.21123385]
[-0.33119556]
[-1.28369153]
[-0.32399786]
[-0.80704367]]
(47, 1)
```

In [14]:

```
# taking the parameters and hyperparameters
alpha = 0.001;
iterations=2000
```

In [15]:

```
# finding the cost function
def cost_function(X, newY, New_theta):
        m = len(newY)
        J = np.sum((X.dot(New_theta) - newY) ** 2)/(2 * m)
        return J

cost_function(X, newY, New_theta)
```

Out[15]: 0.48936170212765967

In [18]:

```
# finding the cost function
def gradient_descent(X, newY, New_theta, alpha, iterations):
    cost_history = [0] * iterations
    m = len(newY)

    for i in range(iterations):
        h = X.dot(New_theta)
        loss = h - newY
```

```
        gradient = X.T.dot(loss) / m
        New_theta = New_theta- alpha * gradient
        cost = cost_function(X, newY, New_theta)
        cost_history[i] = cost

    return New_theta, cost_history

new_theta, cost_new = gradient_descent(X, newY, New_theta, alpha, iterations)
print(new_theta);print(cost_new)
print("the new cost function:\n")
print(cost_new[-1])
```

```
[[-1.20877303e-16]
 [ 6.67041350e-01]
 [ 1.25393882e-01]]
[0.48847474657503553, 0.48759031868064795, 0.4867084108858881, 0.48582901565507675,
0.4849521254753967, 0.4840777328568201, 0.4832058303320421, 0.4823364104564095, 0.48
146946580785277, 0.48060498898681664, 0.47974297261619225, 0.4788834093412483, 0.478
02629182956263, 0.47717161277095477, 0.4763193648774181, 0.4754695408830524, 0.47462
213354399574, 0.47377713563835844, 0.47293453996615525, 0.47209433934923906, 0.47125
6526631235, 0.4704210946774725, 0.4695880363749207, 0.4687573446321217, 0.4679290123
791252, 0.46710303256742314, 0.46627939816988345, 0.46545810218068656, 0.46463913761
52591, 0.46382249751020926, 0.46300817492326307, 0.46219616293319987, 0.461386454639
78745, 0.4605790431637191, 0.4597739216465491, 0.4589710832506297, 0.458170521159047
3, 0.45737222857556, 0.4565761987245336, 0.45578242485087994, 0.45499090021999383,
0.45420161811769, 0.4534145718501424, 0.4526297547438207, 0.4518471601454295, 0.4510
6678142184614, 0.4502886119600592, 0.4495126451671082, 0.44873887447002075, 0.447967
293315754, 0.44719789517113123, 0.4464306735227839, 0.44566562187709, 0.444902733760
11347, 0.44414200271754567, 0.4433834223146444, 0.44262698613617496, 0.4418726877863
5, 0.44112052088877146, 0.4403704790863702, 0.43962255604134853, 0.4388767454351201,
0.4381330409682523, 0.43739143636040745, 0.43665192535028563, 0.43591450169556506,
0.4351791591728456, 0.43444589157759067, 0.4337146927240699, 0.43298555644530146, 0.
43225847659299615, 0.4315334470374986, 0.4308104616677322, 0.4300895143911416, 0.429
37059913363657, 0.4286537098395362, 0.4279388404715115, 0.4272259850105313, 0.426515
1374558052, 0.4258062918247286, 0.42509944215282713, 0.42439458249370143, 0.42369170
691897234, 0.4229908095182257, 0.4222918843989578, 0.42159492568652074, 0.4208999275
240686, 0.42020688407250195, 0.41951578951041524, 0.41882663803404235, 0.41813942385
72024, 0.41745414121124685, 0.41677078434500603, 0.41608934752473564, 0.415409825034
06365, 0.41473221117393777, 0.4140565002625724, 0.41338268663539657, 0.4127107646450
0017, 0.41204072866108377, 0.41137257307040437, 0.4107062922767252, 0.41004188070076
286, 0.4093793327801359, 0.408718642969314, 0.40805980573956546, 0.4074028155789077,
0.40674766699205395, 0.40609435450036496, 0.40544287264179685, 0.4047932159708502,
0.4041453790585214, 0.40349935649225, 0.402855142875871, 0.40221273282956377, 0.4015
721209898017, 0.4009333020093041, 0.4002962705569857, 0.39966102131790754, 0.3990275
4899322784, 0.3983958483001529, 0.39776591397188826, 0.3971377407575904, 0.396511323
42231754, 0.3958866567469814, 0.3952637355282995, 0.3946425545787459, 0.394023108726
5047, 0.39340539281542086, 0.392789401704953, 0.39217513027012635, 0.391562573401484
26, 0.3909517260050427, 0.3903425830022409, 0.38973513932989634, 0.3891293899401568
3, 0.3885253298004543, 0.38792295389345793, 0.3873222572170282, 0.3867232347841703,
0.38612588162298817, 0.38553019277663814, 0.3849361633032841, 0.38434378827605065,
0.38375306278297805, 0.383163981926977, 0.3825765408257833, 0.38199073461191196, 0.3
8140655843261395, 0.38082400744982936, 0.38024307684014363, 0.3796637617947432, 0.37
90860575193708, 0.3785099592342803, 0.37793546217419455, 0.3773625615882592, 0.37679
125273999986, 0.37622153090727856, 0.3756533913822488, 0.3750868294713145, 0.3745218
404950831, 0.3739584197883259, 0.37339656269993243, 0.37283626459286895, 0.372277520
84413435, 0.37172032684471895, 0.3711646779995602, 0.37061056972750184, 0.3700579974
612499, 0.36950695664733235, 0.3689574427460559, 0.3684094512314634, 0.3678629775912
942, 0.36731801732694025, 0.3667745659534053, 0.36623261899926407, 0.365692172006620
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