regression-using-gredient-descent

November 10, 2024

[1]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

[3]:
```
df = pd.read_csv('diabetes.csv')
```

[5]:
```
x = df['Glucose'].values
```

[6]:
```
x
```

[6]:
```
array([148,  85, 183,  89, 137, 116,  78, 115, 197, 125, 110, 168, 139,
       189, 166, 100, 118, 107, 103, 115, 126,  99, 196, 119, 143, 125,
       147,  97, 145, 117, 109, 158,  88,  92, 122, 103, 138, 102,  90,
       111, 180, 133, 106, 171, 159, 180, 146,  71, 103, 105, 103, 101,
        88, 176, 150,  73, 187, 100, 146, 105,  84, 133,  44, 141, 114,
        99, 109, 109,  95, 146, 100, 139, 126, 129,  79,   0,  62,  95,
       131, 112, 113,  74,  83, 101, 137, 110, 106, 100, 136, 107,  80,
       123,  81, 134, 142, 144,  92,  71,  93, 122, 163, 151, 125,  81,
        85, 126,  96, 144,  83,  95, 171, 155,  89,  76, 160, 146, 124,
        78,  97,  99, 162, 111, 107, 132, 113,  88, 120, 118, 117, 105,
       173, 122, 170,  84,  96, 125, 100,  93, 129, 105, 128, 106, 108,
       108, 154, 102,  57, 106, 147,  90, 136, 114, 156, 153, 188, 152,
        99, 109,  88, 163, 151, 102, 114, 100, 131, 104, 148, 120, 110,
       111, 102, 134,  87,  79,  75, 179,  85, 129, 143, 130,  87, 119,
         0,  73, 141, 194, 181, 128, 109, 139, 111, 123, 159, 135,  85,
       158, 105, 107, 109, 148, 113, 138, 108,  99, 103, 111, 196, 162,
        96, 184,  81, 147, 179, 140, 112, 151, 109, 125,  85, 112, 177,
       158, 119, 142, 100,  87, 101, 162, 197, 117, 142, 134,  79, 122,
        74, 171, 181, 179, 164, 104,  91,  91, 139, 119, 146, 184, 122,
       165, 124, 111, 106, 129,  90,  86,  92, 113, 111, 114, 193, 155,
       191, 141,  95, 142, 123,  96, 138, 128, 102, 146, 101, 108, 122,
        71, 106, 100, 106, 104, 114, 108, 146, 129, 133, 161, 108, 136,
       155, 119,  96, 108,  78, 107, 128, 128, 161, 151, 146, 126, 100,
       112, 167, 144,  77, 115, 150, 120, 161, 137, 128, 124,  80, 106,
       155, 113, 109, 112,  99, 182, 115, 194, 129, 112, 124, 152, 112,
       157, 122, 179, 102, 105, 118,  87, 180, 106,  95, 165, 117, 115,
       152, 178, 130,  95,   0, 122,  95, 126, 139, 116,  99,   0,  92,
```

```
137,  61,  90,  90, 165, 125, 129,  88, 196, 189, 158, 103, 146,
147,  99, 124, 101,  81, 133, 173, 118,  84, 105, 122, 140,  98,
 87, 156,  93, 107, 105, 109,  90, 125, 119, 116, 105, 144, 100,
100, 166, 131, 116, 158, 127,  96, 131,  82, 193,  95, 137, 136,
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 97, 144,  83, 129, 119,  94, 102, 115, 151, 184,  94, 181, 135,
 95,  99,  89,  80, 139,  90, 141, 140, 147,  97, 107, 189,  83,
117, 108, 117, 180, 100,  95, 104, 120,  82, 134,  91, 119, 100,
175, 135,  86, 148, 134, 120,  71,  74,  88, 115, 124,  74,  97,
120, 154, 144, 137, 119, 136, 114, 137, 105, 114, 126, 132, 158,
123,  85,  84, 145, 135, 139, 173,  99, 194,  83,  89,  99, 125,
 80, 166, 110,  81, 195, 154, 117,  84,   0,  94,  96,  75, 180,
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187, 131, 164, 189, 116,  84, 114,  88,  84, 124,  97, 110, 103,
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 93, 143, 103, 176,  73, 111, 112, 132,  82, 123, 188,  67,  89,
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174, 168, 105, 138, 106, 117,  68, 112, 119, 112,  92, 183,  94,
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145, 115, 112, 145, 111,  98, 154, 165,  99,  68, 123,  91, 195,
156,  93, 121, 101,  56, 162,  95, 125, 136, 129, 130, 107, 140,
144, 107, 158, 121, 129,  90, 142, 169,  99, 127, 118, 122, 125,
168, 129, 110,  80, 115, 127, 164,  93, 158, 126, 129, 134, 102,
187, 173,  94, 108,  97,  83, 114, 149, 117, 111, 112, 116, 141,
175,  92, 130, 120, 174, 106, 105,  95, 126,  65,  99, 102, 120,
102, 109, 140, 153, 100, 147,  81, 187, 162, 136, 121, 108, 181,
154, 128, 137, 123, 106, 190,  88, 170,  89, 101, 122, 121, 126,
 93], dtype=int64)
```

[7]:
```
y = df['Outcome']
```

[8]:
```
y = np.array(y)
y
```

[8]:
```
array([1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0,
       1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1,
       0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0,
       1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0,
       1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1,
       1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 1,
       1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
       1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1,
```

```
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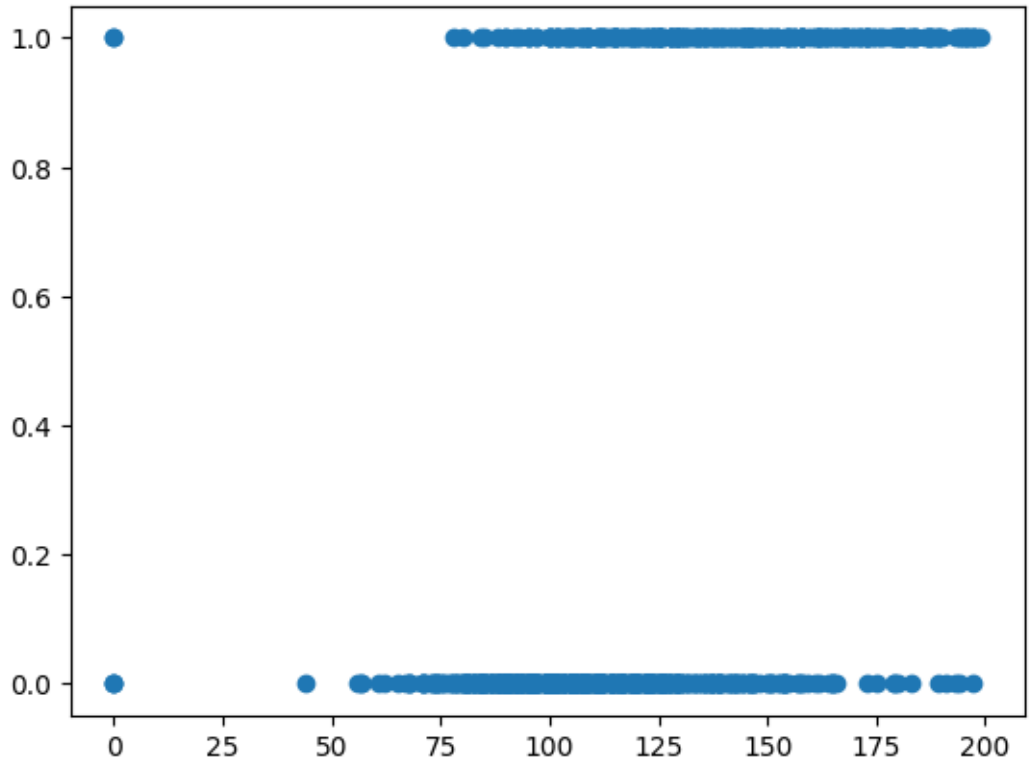
       1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0,
       1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 0,
       1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0,
       0, 1, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0,
       1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0,
       0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0,
       0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0,
       0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 1,
       0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0,
       1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0,
       1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0,
       0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0,
       0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0,
       1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1,
       0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1,
       0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0,
       0, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0,
       0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0,
       1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0],
      dtype=int64)
```

[9]:
```
print(y)
```

```
[1 0 1 0 1 0 1 0 1 1 0 1 0 1 1 1 1 1 0 1 0 0 1 1 1 1 1 0 0 0 0 1 0 0 0 0 0
 1 1 1 0 0 0 1 0 1 0 0 1 0 0 0 0 0 1 0 0 1 0 0 0 0 1 0 0 1 0 1 0 0 0 1 0 1 0
 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 1 1
 1 0 0 1 1 1 0 0 0 1 0 0 0 0 1 1 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0
 0 0 0 0 1 0 1 1 0 0 0 1 0 0 0 0 0 1 1 0 0 0 0 1 1 0 0 0 0 1 0 1 0 1 0 0 0 0 0
 1 1 1 1 1 0 0 1 1 0 1 0 1 1 1 0 0 0 0 0 0 1 1 0 1 0 0 0 1 1 1 1 0 1 1 1 1
 0 0 0 0 0 1 0 0 1 1 0 0 0 1 1 1 1 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 1 1 0 0 0
 1 0 1 0 0 1 0 1 0 0 1 1 0 0 0 0 0 0 1 0 0 0 1 0 0 1 1 0 0 1 0 0 0 1 1 1 0 0
 1 0 1 0 1 1 0 1 0 0 1 0 1 1 0 0 1 0 1 0 0 1 0 1 0 1 1 1 0 0 1 0 1 0 0 0 1
 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 1 1 0 1 1 0 0 1 0 0 1 0 0 1
 1 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 1 0 0 1 0 1 1 0 1 0 1 0 1
 0 1 1 0 0 0 0 1 1 0 1 0 1 0 0 0 0 0 1 1 0 1 0 1 0 0 0 0 0 0 1 0 0 0 0 1 0 0 1
 1 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 1
 0 0 0 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 1 1 0
 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 1 1 1 0 0 1 1 0 0 0 0 0 0 0 0
 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 1 1 0 0 0 1 0 1 0 1 0 1 0
```

```
1 0 0 1 0 0 1 0 0 0 0 1 1 0 1 0 0 0 0 1 1 0 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0
0 1 0 0 0 0 1 0 0 1 0 0 0 1 0 0 0 1 1 1 0 0 0 0 0 0 1 0 0 0 1 0 1 1 1 1 0
1 1 0 0 0 0 0 0 0 0 1 1 0 1 0 0 1 0 1 0 0 0 0 0 1 0 1 0 1 0 1 1 0 0 0 0 1 1
0 0 0 1 0 1 1 0 0 1 0 0 1 1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 1
1 0 0 1 0 0 1 0 1 1 1 0 0 1 1 1 0 1 0 1 0 1 0 0 0 0 0 1 0]
```

[10]:
```
plt.scatter(x,y)
plt.show()
```



[11]:
```
# y = b0 + b1*x
def sigmoid(y):

    return (1 / (1+ np.exp(-y)))
```

[12]:
```
def p(x,b0,b1):
    return ( sigmoid(b0 + b1*x) )
```

[13]:
```
def cost(y,x,b0,b1):
    n = len(x)
    c = 0
    for i in range(n):
```

```
        c += y[i]*np.log(p(x[i],b0,b1) + 0.00001) + (1-y[i]) * np.log(1 -␣
↪p(x[i],b0,b1)+0.0001)
    return -1*(c/n)
```

[14]:
```
def GD(x,y,epoch):
    lemda = 0.001
    b0 = 3.58
    b1 = 2.72
    counter = 1
    c =  cost(y,x,b0,b1)
  #  c = cost(y,x,b0,b1)
    while(True):
        c =  cost(y,x,b0,b1)
        b0_cost = 0
        b1_cost = 0
        for i in range(len(x)):
            b1_cost = b1_cost + (-y[i] + p(x[i],b0,b1)) * x[i]
            b0_cost = b0_cost +  (-y[i] + p(x[i],b0,b1))
        b1 = b1 - (1/len(x)) * lemda * b1_cost
        b0 = b0 - lemda * (1/len(x)) *b0_cost
        c1 = cost(y,x,b0,b1)

        print(cost(y,x,b0,b1))

        if(abs(c1-c) < 0.0000001):
            return (b0,b1)
```

[16]:
```
b0,b1 = GD(x,y,60)
```

```
5.974480542310062
5.9744781239728555
5.9744757057030355
5.9744732875006505
5.974470869365749
5.9744684512983826
5.974466033298596
5.974463615366442
5.974461197501969
5.974458779705223
5.974456361976256
5.974453944315116
5.974451526721854
5.974449109196517
5.9744466917391525
5.974444274349813
5.974441857028547
5.974439439775403
```

5.974437022590429
5.974434605473678
5.974432188425195
5.974429771445032
5.974427354533238
5.974424937689862
5.974422520914953
5.974420104208561
5.974417687570734
5.974415271001515
5.974412854500794
5.9744104380647824
5.97440802160376
5.974405602999884
5.974403131502967
5.974399337168357
5.974358225533185
5.972825439750338
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1.4368930211892446
2.066289748342978
1.1973588916576987
1.6553931581633916
1.4337766334278756

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1.6717623795579526
1.425797842486081
2.0539244307996873
1.2043037504163518
1.6727395423844273
1.4252998724266812
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1.2045837057765671
1.6734902032282648
1.4249120470545777
2.052974508051471
1.2047893290653242
1.6740629602119481
1.4246110309874236
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1.204936171344743
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1.2050363551657708
1.6748161674573456
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2.052266569930523
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1.424066880187892

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1.2051332654583804
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1.2048456740907707
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1.4238223814740516
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1.6751001262338507
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1.6750088957053346
1.4238690402402268
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1.674911478261692
1.4238973275492715

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1.2045505189928618
1.6748091065439488
1.4239280591504107
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1.2044714191750037
1.6747027713652267
1.423960745811222
2.05259300075758
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1.6745932691695729
1.423994994267815
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1.6744812401357425
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1.204227226386518
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1.2041442623592618
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1.6741346518613478
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```

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
Input In [16], in <cell line: 1>()
----> 1 b0,b1 = GD(x,y,1)

Input In [14], in GD(x, y, epoch)
```

```
     15 b1 = b1 - (1/len(x)) * lemda * b1_cost
     16 b0 = b0 - lemda * (1/len(x)) *b0_cost
---> 17 c1 = cost(y,x,b0,b1)
     19 print(cost(y,x,b0,b1))
     21 if(abs(c1-c) < 0.0000001):

Input In [13], in cost(y, x, b0, b1)
      3 c = 0
      4 for i in range(n):
----> 5     c += y[i]*np.log(p(x[i],b0,b1) + 0.00001) + (1-y[i]) * np.log(1 -␣
 ↪p(x[i],b0,b1)+0.0001)
      6 return -1*(c/n)

KeyboardInterrupt:
```

[ ]:
```
b0,b1 = GD(x,y,1)
```

[ ]:
```
def y_pred(b0,b1,x):
    l = []
    for i in range(len(x)):
        if(p(x[i],b0,b1) >= 0.5):
            l.append(1)
        else:
            l.append(0)
    return (np.array(l))
```

[ ]:
```
yPred = y_pred(b0,b1,x)
```

[ ]:
```
yPred
```