statmlassignment6

September 11, 2024

##Question 1 Imagine you are developing a simple machine learning model to predict whether a student will pass a course based on the following five features:

Study Hours per Week: Number of hours the student studies per week. Class Attendance (%): Percentage of classes attended by the student. Previous Exam Score (%): Score in the previous exam. Participation in Group Study: Whether the student participates in group study sessions (1 for Yes, 0 for No). Submission of Assignments (%): Percentage of assignments submitted by the student.

```
[1]: import numpy as np
     import pandas as pd
     data1 = pd.read_csv('/content/student_data.csv')
     data1.head()
```

```
[1]:    Study Hours per Week  Class Attendance (%)  Previous Exam Score (%)  \
     0                   10                    90                       85
     1                    5                    60                       70
     2                   15                    95                       90
     3                    2                    30                       50
     4                   12                    85                       88

        Participation in Group Study  Submission of Assignments (%)  Pass/Fail
     0                             1                            100          1
     1                             0                             80          0
     2                             1                            100          1
     3                             0                             40          0
     4                             1                             90          1
```

```
[2]: x0 = 1
     x1 = data1['Study Hours per Week']
     x2 = data1['Class Attendance (%)']
     x3 = data1['Previous Exam Score (%)']
     x4 = data1['Participation in Group Study']
     x5 = data1['Submission of Assignments (%)']
     y = data1['Pass/Fail']
```

```
[3]: x = np.array(list(zip(x1, x2, x3, x4, x5)))
     y = np.array(y)
```

```
l_r = 0.001
epochs = 10
```

```
[4]: def activation_function(z):
         if z > 0:
             return 1
         else:
             return 0


     def perceptron(x, y, w, l_r):
         w0, w1, w2, w3, w4, w5 = w

         y_pred = np.zeros(len(y))

         while not np.array_equal(y_pred, y):
                 cp = 0

             for i in range(len(x)):
                     z = (w0 * x0) + (w1 * x[i][0]) + (w2 * x[i][1]) + (w3 * x[i][2])⎵
         ↪+ (w4 * x[i][3]) + (w5 * x[i][4])
                     y_pred[i] = activation_function(z)

                 if y_pred[i] != y[i]:
                   w0 = w0 + l_r * (y[i] - y_pred[i]) * x0
                   w1 = w1 + l_r * (y[i] - y_pred[i]) * x[i][0]
                   w2 = w2 + l_r * (y[i] - y_pred[i]) * x[i][1]
                   w3 = w3 + l_r * (y[i] - y_pred[i]) * x[i][2]
                   w4 = w4 + l_r * (y[i] - y_pred[i]) * x[i][3]
                   w5 = w5 + l_r * (y[i] - y_pred[i]) * x[i][4]
                 else:
                   cp += 1

             accuracy = (cp / len(y)) * 100
             print(f"Accuracy: {accuracy:.2f}%")
             print(f"Actual y: {y}")
             print(f"y_pred:{y_pred}")
             print()

         return np.array([w0, w1, w2, w3, w4, w5])
```

```
[5]: w0 = 1
     w1 = 3
     w2 = 4
     w3 = 2
     w4 = 3
     w5 = 0.2
     w = np.array([w0, w1, w2, w3, w4, w5])
```

2

```
res = perceptron(x, y, w, l_r)

print("\nFinal weights:", res)
```

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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 70.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 1. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 80.00%
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Accuracy: 90.00%
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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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```
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 60.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 1. 1. 0. 1. 1. 1. 0. 0. 0.]

Accuracy: 90.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[1. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 60.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 1. 1. 0. 1. 1. 0. 0. 1. 0.]

Accuracy: 90.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 80.00%
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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 80.00%
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Accuracy: 90.00%
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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[1. 0. 1. 0. 1. 1. 0. 0. 1. 0.]

Accuracy: 70.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[1. 0. 1. 0. 1. 1. 1. 0. 0. 1.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 1. 1. 0. 1. 1. 0. 0. 1. 1.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 1. 1. 0. 1. 1. 0. 0. 1. 1.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
```

```
y_pred:[0. 1. 1. 0. 1. 1. 0. 0. 1. 1.]

Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[0. 0. 1. 0. 1. 1. 1. 0. 1. 0.]

Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 80.00%
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Accuracy: 50.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 80.00%
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Accuracy: 50.00%
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Accuracy: 60.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
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Accuracy: 70.00%
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Accuracy: 70.00%
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Accuracy: 80.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
```

```
y_pred:[0. 1. 1. 0. 1. 0. 1. 0. 1. 0.]


Accuracy: 100.00%
Actual y: [1 0 1 0 1 0 1 0 1 0]
y_pred:[1. 0. 1. 0. 1. 0. 1. 0. 1. 0.]



Final weights: [ 0.659  4.398 -0.15  -0.143  4.02  -0.22 ]
```

0.1 Question 2

https://www.kaggle.com/datasets/ishandutta/early-stage-diabetes-risk-prediction-datasetLinks

Implement a perceptron learning model to train above data, and find the accuracy.

```python
[6]: import numpy as np
     import pandas as pd

     data = pd.read_csv('/content/diabetes_data_upload.csv')
     data.head()
```

```
[6]:    Age Gender Polyuria Polydipsia sudden weight loss weakness Polyphagia  \
     0   40   Male       No        Yes                 No      Yes         No
     1   58   Male       No         No                 No      Yes         No
     2   41   Male      Yes         No                 No      Yes        Yes
     3   45   Male       No         No                Yes      Yes        Yes
     4   60   Male      Yes        Yes                Yes      Yes        Yes

        Genital thrush visual blurring Itching Irritability delayed healing  \
     0             No             No     Yes           No             Yes
     1             No            Yes      No           No              No
     2             No             No     Yes           No             Yes
     3            Yes             No     Yes           No             Yes
     4             No            Yes     Yes          Yes             Yes

        partial paresis muscle stiffness Alopecia Obesity     class
     0             No              Yes      Yes     Yes  Positive
     1            Yes               No      Yes      No  Positive
     2             No              Yes      Yes      No  Positive
     3             No               No       No      No  Positive
     4            Yes              Yes      Yes     Yes  Positive
```

```python
[7]: import numpy as np
     import pandas as pd

     x0 = 1
     x1 = data['Age']
     x2 = data['Gender']
```

```
x3 = data['Polyuria']
x4 = data['Polydipsia']
x5 = data['sudden weight loss']
x6 = data['weakness']
x7 = data['Polyphagia']
x8 = data['Genital thrush']
x9 = data['visual blurring']
x10 = data['Itching']
x11 = data['Irritability']
x12 = data['delayed healing']
x13 = data['partial paresis']
x14 = data['muscle stiffness']
x15 = data['Alopecia']
x16 = data['Obesity']
```

[8]:
```
x2 = x2.map({'Male': 1, 'Female': 0})
x3 = x3.map({'Yes': 1, 'No': 0})
x4 = x4.map({'Yes': 1, 'No': 0})
x5 = x5.map({'Yes': 1, 'No': 0})
x6 = x6.map({'Yes': 1, 'No': 0})
x7 = x7.map({'Yes': 1, 'No': 0})
x8 = x8.map({'Yes': 1, 'No': 0})
x9 = x9.map({'Yes': 1, 'No': 0})
x10 = x10.map({'Yes': 1, 'No': 0})
x11 = x11.map({'Yes': 1, 'No': 0})
x12 = x12.map({'Yes': 1, 'No': 0})
x13 = x13.map({'Yes': 1, 'No': 0})
x14 = x14.map({'Yes': 1, 'No': 0})
x15 = x15.map({'Yes': 1, 'No': 0})
x16 = x16.map({'Yes': 1, 'No': 0})

y = data['class'].map({'Positive': 1, 'Negative': 0})
```

[9]:
```
x = np.array(list(zip(x1, x2, x3, x4, x5, x6, x7, x8, x9, x10, x11, x12, x13,
 ↪x14, x15, x16)))
y = np.array(y)

l_r = 0.01  # Learning rate
target_accuracy = 80  # Stop when accuracy reaches 80%
```

[10]:
```
def activation_function(z):
  if z > 0:
    return 1
  else:
    return 0
```

```
[11]: def perceptron(x, y, w, l_r, target_accuracy):
          w0, w1, w2, w3, w4, w5, w6, w7, w8, w9, w10, w11, w12, w13, w14, w15, w16 =␣
      ↪w

          y_pred = np.zeros(len(y))
          occurances = 0

          while not np.array_equal(y_pred, y):
              correct_predictions = 0

              for i in range(len(x)):
                  z = (w0 * x0) + (w1 * x[i][0]) + (w2 * x[i][1]) + (w3 * x[i][2]) +␣
      ↪(w4 * x[i][3]) + (w5 * x[i][4]) + \
                      (w6 * x[i][5]) + (w7 * x[i][6]) + (w8 * x[i][7]) + (w9 *␣
      ↪x[i][8]) + (w10 * x[i][9]) + \
                      (w11 * x[i][10]) + (w12 * x[i][11]) + (w13 * x[i][12]) + (w14 *␣
      ↪x[i][13]) + \
                      (w15 * x[i][14]) + (w16 * x[i][15])

                  y_pred[i] = activation_function(z)

                  if y_pred[i] != y[i]:
                      w0 = w0 + l_r * (y[i] - y_pred[i]) * x0
                      w1 = w1 + l_r * (y[i] - y_pred[i]) * x[i][0]
                      w2 = w2 + l_r * (y[i] - y_pred[i]) * x[i][1]
                      w3 = w3 + l_r * (y[i] - y_pred[i]) * x[i][2]
                      w4 = w4 + l_r * (y[i] - y_pred[i]) * x[i][3]
                      w5 = w5 + l_r * (y[i] - y_pred[i]) * x[i][4]
                      w6 = w6 + l_r * (y[i] - y_pred[i]) * x[i][5]
                      w7 = w7 + l_r * (y[i] - y_pred[i]) * x[i][6]
                      w8 = w8 + l_r * (y[i] - y_pred[i]) * x[i][7]
                      w9 = w9 + l_r * (y[i] - y_pred[i]) * x[i][8]
                      w10 = w10 + l_r * (y[i] - y_pred[i]) * x[i][9]
                      w11 = w11 + l_r * (y[i] - y_pred[i]) * x[i][10]
                      w12 = w12 + l_r * (y[i] - y_pred[i]) * x[i][11]
                      w13 = w13 + l_r * (y[i] - y_pred[i]) * x[i][12]
                      w14 = w14 + l_r * (y[i] - y_pred[i]) * x[i][13]
                      w15 = w15 + l_r * (y[i] - y_pred[i]) * x[i][14]
                      w16 = w16 + l_r * (y[i] - y_pred[i]) * x[i][15]
                  else:
                      correct_predictions += 1

              occurances += 1
              accuracy = (correct_predictions / len(y)) * 100

              if accuracy >= target_accuracy:
                  print(f"Epoch: {occurances}")
                  print(f"Final Accuracy: {accuracy:.2f}%")
```

```
            break

    return np.array([w0, w1, w2, w3, w4, w5, w6, w7, w8, w9, w10, w11, w12,
    ↪w13, w14, w15, w16])
```

```
[12]: w = np.random.randn(17)

# Run the perceptron
res = perceptron(x, y, w, l_r, target_accuracy)

print("\nFinal weights:", res)
```

```
Epoch: 1
Final Accuracy: 94.81%

Final weights: [ 0.63793697 -0.33998376  0.04633869  1.63329903  0.7602555
-0.585508
 -1.62672148 -0.7126689  -0.49791774 -0.92299915 -0.77601222 -0.14827208
  0.34330483  0.7130885  -0.48559239 -1.3353068   0.48480617]
```