A.Y. 2022-2023

ARTIFICIAL INTELLIGENCE AYUSH JAIN COMPUTER ENGINEERING | TE - B2 | 60004200132 EXPERIMENT - 9

Aim: Neural Network Perceptron Learning

Theory:

Perceptrons are a type of artificial neuron that predates the sigmoid neuron. It appears that they were invented in 1957 by Frank Rosenblatt at the Cornell Aeronautical Laboratory.

A perceptron can have any number of inputs, and produces a binary output, which is called its activation.

First, we assign each input a weight, loosely meaning the amount of influence the input has over the output.

To determine the perceptron's activation, we take the weighted sum of each of the inputs and then determine if it is above or below a certain threshold, or *bias, *represented by b.

The formula for perceptron neurons can can be expressed like this:

Algorithm:

```
def perceptron(inputs, bias)
weighted_sum = sum {
for each input in inputs
  input.value * input.weight
}

if weighted_sum <= bias
  return 0
  if weighted_sum > bias
  return 1
end
```



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Code:

```
def sgn(net_input):
 if net_input <= 0:
   return -1
 return 1
def pattern_classifier(n_iterations, input, weight, desired_output, learning_rate):
  for iteration in range(n_iterations):
   print(f'Iteration {iteration+1}')
   output = []
   for i,X in enumerate(input):
     net_input = 0
     for j in range(len(X)):
       net_input+=weight[i]*X[i]
     generated_output = sgn(net_input)
     output.append(generated_output)
     if generated_output != desired_output[i]:
       difference = desired_output[i] - generated_output
       for position in range(len(weight)):
         weight[position] = float("{:.2f}".format(weight[position] +
learning_rate*difference*X[position]))
   print(f'Generated Output vector for Iteration {iteration+1} : {output}')
   print(f'Weight vector after Iteration {iteration+1} : {weight}')
   print("----"*25)
   if output == desired_output:
     break
 return output, weight
def main():
 input = [
   [1,0,0,0,0,1,0,0,0,0,1,0,1,0,0,1,1,0,1,1],
   [0,1,0,0,0,0,1,0,0,0,0,1,1,0,0,1,1,0,1,1],
   [1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1,1,0,1,1],
```



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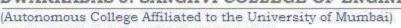
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```
[0,1,0,1,0,1,1,0,1,1,1,0,1,0,1,1,0,0,0,1], #M starts here
    [1,0,0,0,1,1,1,0,1,1,1,0,1,0,1,1,0,0,0,1],
    [1,1,0,1,1,1,0,1,0,1,1,0,1,0,1,1,0,0,0,1],
    [1,1,0,1,1,1,0,1,0,1,1,0,0,0,1,1,0,0,0,1],
    [1,0,0,0,1,1,1,0,1,1,1,0,0,0,1,1,0,0,0,1],
    [1,0,0,0,1,1,1,0,1,1,1,0,1,1,1,0,1,0,1]
    [1,0,0,0,1,1,1,1,1,1,1,0,1,0,1,1,0,0,0,1],
 1
  initial_weight = [1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1,0,1,1]
  learning_rate = 0.05
  n_{iterations} = 3
  classification_output, weight_vector = pattern_classifier(n_iterations, input,
initial_weight, desired_output, learning_rate)
  count = 0
 for i, output in enumerate(classification_output):
    if output == desired_output[i]:
      count+=1
  accuracy = (count / len(input))*100
  print(f'Accuracy of Classifier : {accuracy} %')
  print('Classifying an Unknown Sample of L (Output = 1)')
  unknown_sample = [1,1,0,0,0,1,0,0,0,1,0,0,0,0,1,1,1,1,1,0]
  print('Unknown Sample: ',unknown_sample)
  net_input=0
 for i in range(len(unknown_sample)):
    net_input+=weight_vector[i]*unknown_sample[i]
  predicted_output = sgn(net_input)
  print('Predicted Output : ', predicted_output)
  print("\n")
main()
```



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Output:

Iteration 1

Weight vector after Iteration 1: [0.2, 0.6, 0.0, 0.6, 0.2, -0.9, 0.4, 0.6, -0.6, 0.1, 0.1, -0.1, 0.4, 0.9, -0.9, 0.1, 1.0, -0.3, 1.0, 0.1]

Iteration 2

-1]

Weight vector after Iteration 2: [0.1, 0.5, 0.0, 0.5, 0.1, -1.0, 0.4, 0.5, -0.6, 0.0, 0.0, -0.1, 0.3, 0.9, -1.0, 0.0, 1.0, -0.3, 1.0, 0.0

Iteration 3

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Weight vector after Iteration 3: [0.1, 0.4, 0.0, 0.4, 0.0, -1.0, 0.4, 0.4, -0.6, -0.1, 0.0, -0.1, 0.2, 0.9. -1.0. 0.0. 1.1. -0.2. 1.1. 0.0

Accuracy of Classifier: 90.0 %

Classifying an Unknown Sample of L (Output = 1)

Unknown Sample: [1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0]

Predicted Output: 1

Conclusion:

Neural Network Perceptron Learning implementation.