Q1. Perceptron learning algorithm AND gate & OR gate

```
import numpy as np
# for AND gate (Input/Output)
x_list = np.array([[0,0],[0,1],[1,0],[1,1]])
y_list = np.array([0,0,0,1])
epochs = 4
w,b = np.zeros(2),0

for _ in range(epochs):
  for x,y in zip(x_list,y_list):
    z = np.dot(x,w) + b
    ### condition area for y_pred
    y_pred = 1 if z >= 0 else 0
    E = y - y_pred
    print("error : ",E,"<- at epoch",_)
    w += E*x
    b += E
    print(w,b)
    print("Avikam Rana, 1/23/SET/BCS/438")
    print("2 February 2026")
    print("+------------------------------+")
```

```
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  -1 <- at epoch 1
[1. 0.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  0 <- at epoch 1
[1. 0.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  1 <- at epoch 1
[2. 1.] -1
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  0 <- at epoch 2
[2. 1.] -1
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  -1 <- at epoch 2
[2. 0.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  -1 <- at epoch 2
[1. 0.] -3
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  1 <- at epoch 2
[2. 1.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  0 <- at epoch 3
[2. 1.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  0 <- at epoch 3
[2. 1.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  -1 <- at epoch 3
[1. 1.] -3
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
error :  1 <- at epoch 3
[2. 2.] -2
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
+------------------------------+
```

```
import numpy as np
# for OR gate (Input/Output)
```

```
x_list = np.array([[0,0],[0,1],[1,0],[1,1]])
y_list = np.array([0,1,1,1])
epochs = 4
w,b = np.zeros(2),0

for _ in range(epochs):
  for x,y in zip(x_list,y_list):
    z = np.dot(x,w) + b
    ### condition area for y_pred
    y_pred = 1 if z >= 0 else 0
    E = y - y_pred
    print("error : ",E,"<- at epoch",_)
    w += E*x
    b += E
    print(w,b)
    print("+------------------------------+")
    print("Avikam Rana, 1/23/SET/BCS/438")
    print("2 February 2026")
```

```
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 1
[0. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 1
[1. 1.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 1
[1. 1.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  -1 <- at epoch 2
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 2
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 2
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 2
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 3
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 3
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 3
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 3
[1. 1.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
```

```
import numpy as np
# for XOR gate (Input/Output)
x_list = np.array([[0,0],[0,1],[1,0],[1,1]])
y_list = np.array([0,1,1,0])
epochs = 9
w,b = np.zeros(2),0

for _ in range(epochs):
  for x,y in zip(x_list,y_list):
```

```
    z = np.dot(x,w) + b
    ### condition area for y_pred
    y_pred = 1 if z >= 0 else 0
    E = y - y_pred
    print("error : ",E,"<- at epoch",_)
    w += E*x
    b += E
    print(w,b)
    print("+------------------------------+")
    print("Avikam Rana, 1/23/SET/BCS/438")
    print("2 February 2026")
```

```
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 6
[-1.  1.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 6
[0. 1.] 1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  -1 <- at epoch 6
[-1.  0.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  -1 <- at epoch 7
[-1.  0.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 7
[-1.  1.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 7
[0. 1.] 1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  -1 <- at epoch 7
[-1.  0.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  -1 <- at epoch 8
[-1.  0.] -1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 8
[-1.  1.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  1 <- at epoch 8
[0. 1.] 1
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  -1 <- at epoch 8
[-1.  0.] 0
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
```

Q3. change the no. of epochs and observe the output

```
import numpy as np
# for AND gate (Input/Output)
x_list = np.array([[0,0],[0,1],[1,0],[1,1]])
y_list = np.array([0,0,0,1])
epochs = 9
w,b = np.zeros(2),0

for _ in range(epochs):
  for x,y in zip(x_list,y_list):
    z = np.dot(x,w) + b
    ### condition area for y_pred
    y_pred = 1 if z >= 0 else 0
    E = y - y_pred
```

```
    print("error : ",E,"<- at epoch",_)
    w += E*x
    b += E
    print(w,b)
    print("+------------------------------+")
    print("Avikam Rana, 1/23/SET/BCS/438")
    print("2 February 2026")
```

```
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 6
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 6
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 6
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 7
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 7
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 7
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 7
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 8
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 8
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 8
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
error :  0 <- at epoch 8
[2. 1.] -3
+------------------------------+
Avikam Rana, 1/23/SET/BCS/438
2 February 2026
```

Q4. chnage the intial random weights and bias to some other integer value and observe the steps before

```
import numpy as np
# for AND gate (Input/Output)
x_list = np.array([[0,0],[0,1],[1,0],[1,1]])
y_list = np.array([0,0,0,1])
epochs = 10
w,b = np.array([2,5]),0
for
_
in range(epochs):
for x,y in zip(x_list,y_list):
z = np.dot(x,w) + b
### condition area for y_pred
y_pred = 1 if z >= 0 else 0
E = y - y_pred
print("error : ",E,"<- at epoch",_)
w += E*x
print("error : ",E,"<- at epoch",_)
b += E
```

```
    w += E*x
    print(w,b)
```