LAB 2| 29/01/26

```
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)
```

```
error :  -1 <- at epoch 0
[0. 0.] -1
error :  0 <- at epoch 0
[0. 0.] -1
error :  0 <- at epoch 0
[0. 0.] -1
error :  1 <- at epoch 0
[1. 1.] 0
error :  -1 <- at epoch 1
[1. 1.] -1
error :  -1 <- at epoch 1
[1. 0.] -2
error :  0 <- at epoch 1
[1. 0.] -2
error :  1 <- at epoch 1
[2. 1.] -1
error :  0 <- at epoch 2
[2. 1.] -1
error :  -1 <- at epoch 2
[2. 0.] -2
error :  -1 <- at epoch 2
[1. 0.] -3
error :  1 <- at epoch 2
[2. 1.] -2
error :  0 <- at epoch 3
[2. 1.] -2
error :  0 <- at epoch 3
[2. 1.] -2
error :  -1 <- at epoch 3
error :  -1 <- at epoch 3
[1. 1.] -3
error :  1 <- at epoch 3
[2. 2.] -2
```

```
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 = 6
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)
```

```
error :  -1 <- at epoch 0
[0. 0.] -1
error :  0 <- at epoch 0
[0. 0.] -1
error :  0 <- at epoch 0
[0. 0.] -1
error :  1 <- at epoch 0
[1. 1.] 0
error :  -1 <- at epoch 1
[1. 1.] -1
error :  -1 <- at epoch 1
[1. 0.] -2
error :  0 <- at epoch 1
[1. 0.] -2
error :  1 <- at epoch 1
[2. 1.] -1
error :  0 <- at epoch 2
[2. 1.] -1
error :  -1 <- at epoch 2
[2. 0.] -2
error :  -1 <- at epoch 2
[1. 0.] -3
error :  1 <- at epoch 2
[2. 1.] -2
error :  0 <- at epoch 3
[2. 1.] -2
error :  0 <- at epoch 3
[2. 1.] -2
error :  -1 <- at epoch 3
[1. 1.] -3
```

```
[1. 1.] -3
error :  1 <- at epoch 3
[2. 2.] -2
error :  0 <- at epoch 4
[2. 2.] -2
error :  -1 <- at epoch 4
[2. 1.] -3
error :  0 <- at epoch 4
[2. 1.] -3
error :  0 <- at epoch 4
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
```

```python
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 = 6
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)
```

```
error :  -1 <- at epoch 0
[0. 0.] -1
error :  0 <- at epoch 0
[0. 0.] -1
error :  0 <- at epoch 0
[0. 0.] -1
error :  1 <- at epoch 0
[1. 1.] 0
error :  -1 <- at epoch 1
[1. 1.] -1
error :  -1 <- at epoch 1
[1. 0.] -2
error :  0 <- at epoch 1
[1. 0.] -2
```

```
error :  1 <- at epoch 1
[2. 1.] -1
error :  0 <- at epoch 2
[2. 1.] -1
error :  -1 <- at epoch 2
[2. 0.] -2
error :  -1 <- at epoch 2
[1. 0.] -3
error :  1 <- at epoch 2
[2. 1.] -2
error :  0 <- at epoch 3
[2. 1.] -2
error :  0 <- at epoch 3
[2. 1.] -2
error :  -1 <- at epoch 3
[1. 1.] -3
error :  1 <- at epoch 3
[2. 2.] -2
error :  0 <- at epoch 4
[2. 2.] -2
error :  -1 <- at epoch 4
[2. 1.] -3
error :  0 <- at epoch 4
[2. 1.] -3
error :  0 <- at epoch 4
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
error :  0 <- at epoch 5
[2. 1.] -3
```

```
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,-1,-1,2])
epochs = 5
w,b = np.random.rand(2),np.random.rand ()

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)
```

```
error :  -1 <- at epoch 0
[0.60119623 0.02782633] -0.8680020674906832
error :  -1 <- at epoch 0
[ 0.60119623 -0.97217367] -1.8680020674906832
error :  -1 <- at epoch 0
[-0.39880377 -0.97217367] -2.868002067490683
error :  2 <- at epoch 0
[1.60119623 1.02782633] -0.868002067490683
error :  0 <- at epoch 1
[1.60119623 1.02782633] -0.868002067490683
error :  -2 <- at epoch 1
[ 1.60119623 -0.97217367] -2.868002067490683
error :  -1 <- at epoch 1
[ 0.60119623 -0.97217367] -3.868002067490683
error :  2 <- at epoch 1
[2.60119623 1.02782633] -1.868002067490683
error :  0 <- at epoch 2
[2.60119623 1.02782633] -1.868002067490683
error :  -1 <- at epoch 2
[2.60119623 0.02782633] -2.868002067490683
error :  -1 <- at epoch 2
[1.60119623 0.02782633] -3.868002067490683
error :  2 <- at epoch 2
[3.60119623 2.02782633] -1.868002067490683
error :  0 <- at epoch 3
[3.60119623 2.02782633] -1.868002067490683
error :  -2 <- at epoch 3
[3.60119623 0.02782633] -3.868002067490683
error :  -1 <- at epoch 3
[2.60119623 0.02782633] -4.868002067490683
error :  2 <- at epoch 3
[4.60119623 2.02782633] -2.868002067490683
error :  0 <- at epoch 4
[4.60119623 2.02782633] -2.868002067490683
error :  -1 <- at epoch 4
[4.60119623 1.02782633] -3.868002067490683
error :  -2 <- at epoch 4
[2.60119623 1.02782633] -5.868002067490683
error :  2 <- at epoch 4
[4.60119623 3.02782633] -3.868002067490683
```

```
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([0,1,1,0])
epochs = 5
w,b = np.random.rand(2),np.random.rand ()

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
    E = y - y_pred
    print("error : ",E,"<- at epoch",_)
    w += E*x
    b += E
    print(w,b)
```

```
error :  -1 <- at epoch 0
[0.47377972 0.84772052] -0.9622188296899636
error :  1 <- at epoch 0
[0.47377972 1.84772052] 0.03778117031003636
error :  0 <- at epoch 0
[0.47377972 1.84772052] 0.03778117031003636
error :  -1 <- at epoch 0
[-0.52622028  0.84772052] -0.9622188296899636
error :  0 <- at epoch 1
[-0.52622028  0.84772052] -0.9622188296899636
error :  1 <- at epoch 1
[-0.52622028  1.84772052] 0.03778117031003636
error :  1 <- at epoch 1
[0.47377972 1.84772052] 1.0377811703100364
error :  -1 <- at epoch 1
[-0.52622028  0.84772052] 0.03778117031003636
error :  -1 <- at epoch 2
[-0.52622028  0.84772052] -0.9622188296899636
error :  1 <- at epoch 2
[-0.52622028  1.84772052] 0.03778117031003636
error :  1 <- at epoch 2
[0.47377972 1.84772052] 1.0377811703100364
error :  -1 <- at epoch 2
[-0.52622028  0.84772052] 0.03778117031003636
error :  -1 <- at epoch 3
[-0.52622028  0.84772052] -0.9622188296899636
error :  1 <- at epoch 3
[-0.52622028  1.84772052] 0.03778117031003636
error :  1 <- at epoch 3
[0.47377972 1.84772052] 1.0377811703100364
error :  -1 <- at epoch 3
[-0.52622028  0.84772052] 0.03778117031003636
error :  -1 <- at epoch 4
[-0.52622028  0.84772052] -0.9622188296899636
error :  1 <- at epoch 4
[-0.52622028  1.84772052] 0.03778117031003636
error :  1 <- at epoch 4
[0.47377972 1.84772052] 1.0377811703100364
error :  -1 <- at epoch 4
[-0.52622028  0.84772052] 0.03778117031003636
```

```
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([0,1,1,1])
epochs = 5
w,b = np.random.rand(2),np.random.rand ()
```

```
    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)
```