Perceptron

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Apprentissage de la fonction AND

In [ ]:

```
import numpy as np
import random
import matplotlib.pyplot as plt

random.seed(1)
```

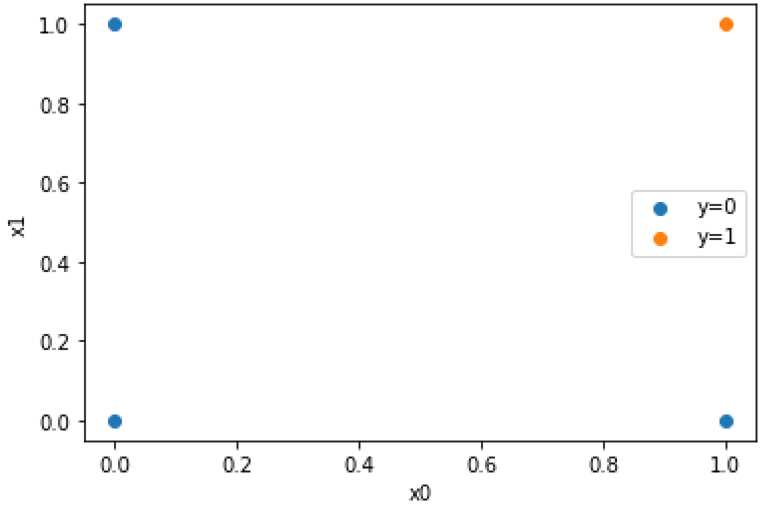
In [ ]:

```
# Dataset: AND function
X = np.array([[0, 0],[0, 1],[1, 0],[1, 1]])
y = [0, 0, 0, 1]
```

In [ ]:

```
def plot_dataset(X, y):
    X0 = np.array([x for x, y in zip(X, y) if y==0])
    X1 =  np.array([x for x, y in zip(X, y) if y==1])
    if len(X0)>0: plt.scatter(X0[:,0], X0[:,1], label="y=0")
    if len(X1)>0: plt.scatter(X1[:,0], X1[:,1], label="y=1")
    plt.xlabel("x0")
    plt.ylabel("x1")
    plt.legend()

plot_dataset(X, y)
plt.show()
```



In [ ]:

```
n = 0.1              # Learning rate
A = [0.1, 0.2, 0.05] # Initial weigth
```

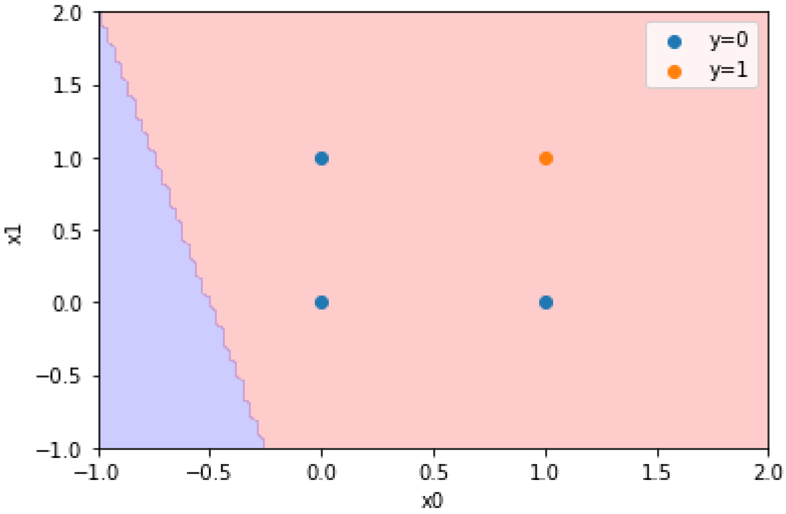
In [ ]:

```
def predict(X, A):
    y_hat = np.dot(A, X)
    if y_hat > 0:
        y_hat = 1
    else:
        y_hat = 0
    return y_hat
```

In [ ]:

```
def plot_space(A, threshold=0.5):
    xx, yy = np.meshgrid(np.linspace(-1, 2, 100), np.linspace(-1, 2, 100))
    Z = np.array([predict([1,x0,x1], A) for x0, x1 in zip(xx.ravel(), yy.ravel())])
    Z = Z.reshape(xx.shape)
    plt.contourf(xx, yy, Z, levels=[threshold, Z.max()],
                     colors='red', alpha=0.2)
    plt.contourf(xx, yy, Z, levels=[Z.min(), threshold],
                     colors='blue', alpha=0.2)
    #a = plt.contour(xx, yy, Z, levels=[threshold],
    #                     linewidths=2, colors='red', alpha=0.2)
    plot_dataset(X, y)
```

```
plot_space(A)
```



In [ ]:

```
def one_observation(X, y, A):
    # Accept one observation X and y and a weigth matrix A
    X = np.array([1]+list(X))
    y_hat = predict(X, A)
    error = (y-y_hat)
    # Return the new weigth matrix
    return [a + n*error*x for x, a in zip(X,A)]
```

In [ ]:

```
one_observation(X[0], y[0], A)
```

Out[ ]:

```
[0.0, 0.2, 0.05]
```

In [ ]:

```
one_observation(X[2], y[2], A)
```

Out[ ]:

```
[0.0, 0.1, 0.05]
```

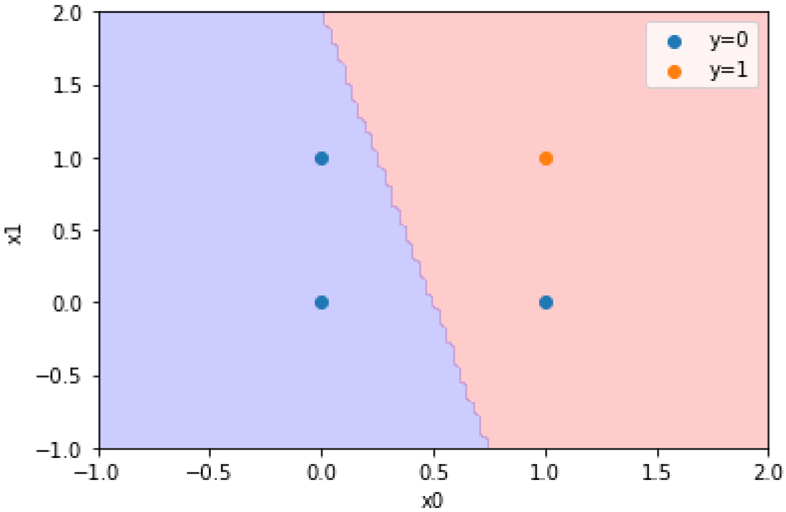
In [ ]:

```
def one_epoch(X, y, A):
    # Update weigth for all observation
```

```
    # Plot the new space
    # And return the new weigth
    for X_, y_ in zip(X, y):
        A = one_observation(X_, y_, A)
    plot_space(A)
    return A
```

In [ ]:

```
A = one_epoch(X, y, A)
```



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A = one_epoch(X, y, A)
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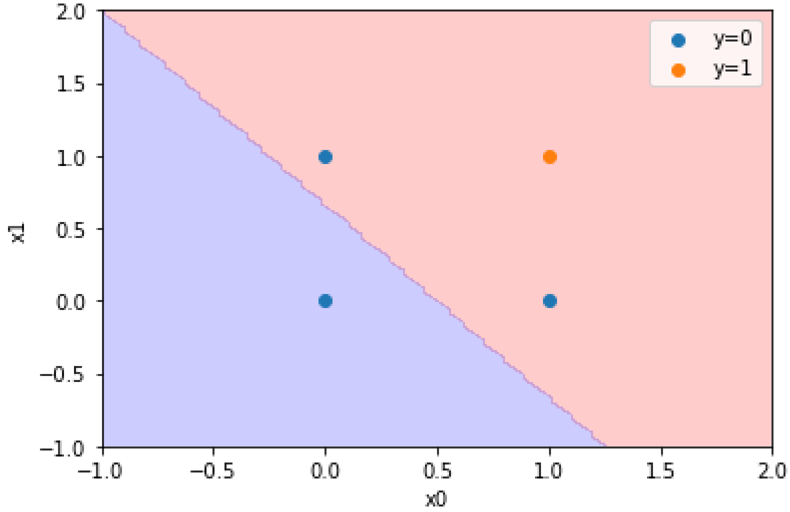

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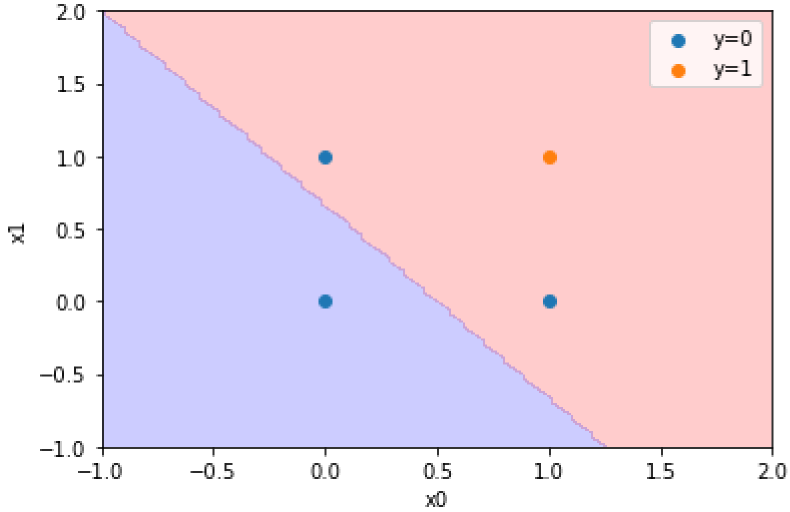
A = one_epoch(X, y, A)
```



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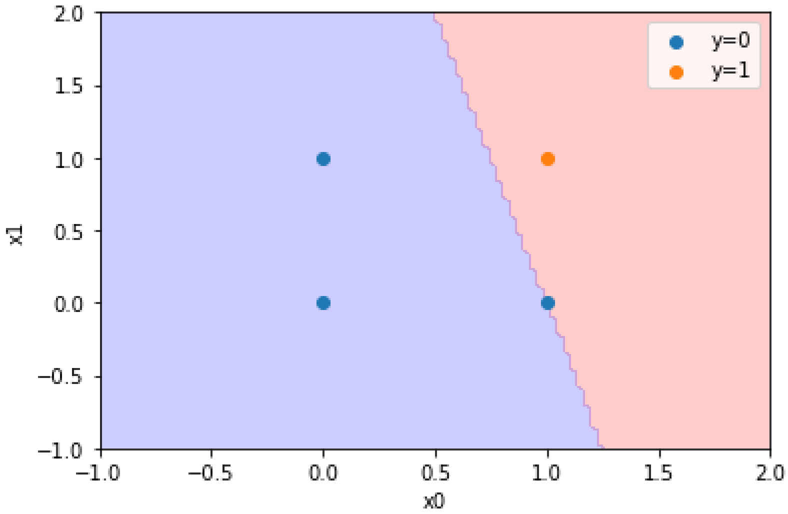
A = one_epoch(X, y, A)
```



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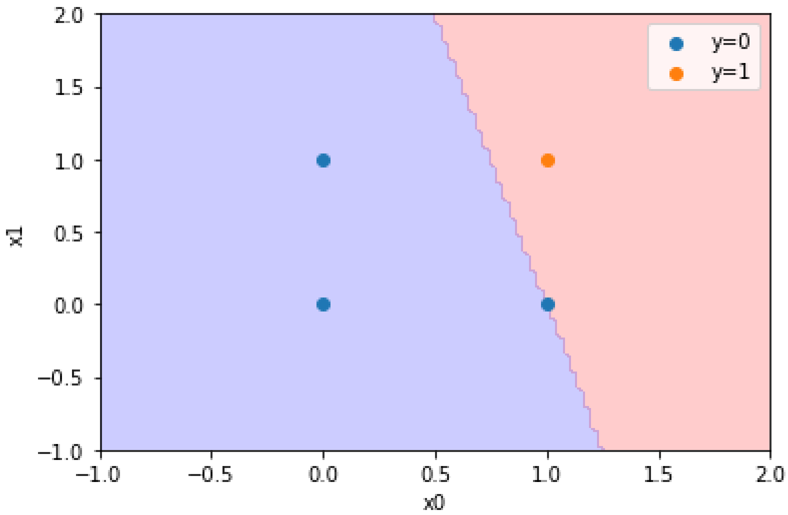
A = one_epoch(X, y, A)
```



On revient au cours

In [ ]:

In [ ]:

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In [ ]:

Remplacement de la fonction à seuil par sigmoid

$g(v) = \frac{1}{1+e^{-v}}$, $g(v)$ est une estimation de P(y|X)]

La règle de décision devient : si g(v)>0.5 alors y=1 sinon y=0

La fonction de transfert (g(v)) est dérivable : $g'(v) = g(v)(1 - g(v)))$

La règle de mise à jour devient : $a_j = a_j - n(y - \hat{y})g'(v)x_j$

In [ ]:

```
# Dataset: AND function
X = np.array([[0, 0],[0, 1],[1, 0],[1, 1]])
y = [0, 0, 0, 1]
```

In [ ]:

```
def sigmoid(X):
    return 1/(1+np.exp(-X))

def sigmoid_derivative(X):
    return sigmoid(X)*(1-sigmoid(X))

def one_observation(X, y, A):
    X = np.array([1]+list(X))
    g = sigmoid(np.dot(A, X))
    if g > 0.5:
        y_hat = 1
    else:
        y_hat = 0
    error = (y-y_hat)
    print("error", error)
    return [a + n*error*sigmoid_derivative(g)*x for x, a in zip(X,A)]
```

In [ ]:
```
n = 0.15
A = [0.1, 0.2, 0.05]
```

In [ ]:
```
one_observation(X[0], y[0], A)
```

In [ ]:
```
one_observation(X[2], y[2], A)
```

In [ ]:
```
plot_space(A)
```

In [ ]:
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A = one_epoch(X, y, A)
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