$x_1 \rightarrow (w_1)$

$x_2 \rightarrow (w_2)$

$x_3 \rightarrow (w_3)$

bias b

Σ z

$\varphi(z)$

Output y

$\varphi(z):$

1 if $z \geq 0$,
else 0

$\varphi(1.13) = \underline{1}$

Perception ①

• x_1, x_2, x_3 : real-valued

• Binary output

• Threshold activation function

②

$x_1 = 0.2$ $w_1 = 0.2$

$x_2 = -0.7$ $w_2 = 0.3$

$\cancel{x_3 = 0.5}$ $w_3 = -0.4$

$x_3 = -0.5$

$b = 1.1 = w_0$

$(x_0 = 1)$ "Dummy" Feature

③

$z = 0.2 \times 0.2$
$+ -0.7 \times 0.3$
$+ -0.5 \times -0.4$
$+ 1.1$
$= 0.04$
$+ -0.21$
$+ 0.20$
$+ 1.1$
$= 1.13.$

Our perceptron output $y = 1$.

If we are <u>training</u>, then we know either 🖐 $d = 0$ or $d = 1$

• If $d = 1$, our perceptron is <u>correct</u> : don't change anything!

• If $d = 0$, our perceptron is wrong : update the weights.

    ↳ Our output is too <u>HIGH</u>.

$$W_i \leftarrow W_i + \eta \, (d - y) \, x_i \quad \text{for } i = 0, 1, 2, \ldots, m$$

<u>Do for all Features</u>

new weight i current weight i "eta": learning rate   correct output (label)   predicted output   Feature value i

$w_0 = 1.1$ (bias) $z_0 = 1$

$w_1 = 0.2$

$w_2 = 0.3$

$w_3 = -0.4$

$x_1 = 0.2$

$x_2 = -0.7$

$x_3 = -0.5$

$\eta = 1$

$d = 0$

$y = 1$

$w_0 = 1.1 + 1(0-1) \times 1 = 1.1 + -1 \times 1 = 1.1 - 1 = 0.1$

$w_1 = 0.2 - 1 \times 0.2 = 0$

$w_2 = 0.3 - 1 \times -0.7 = 1.0$

$w_3 = -0.4 - 1 \times -0.5 = 0.1$

What is our new output?

$z = 0.1 \times 1 + 0 \times 0.2 + 1 \times -0.7 + 0.1 \times -0.5$

$= 0.1 + 0 - 0.7 - 0.5$

$= -1.1$

$y = \varphi(z) = \varphi(-1.1) = 0$

Now, $y=0$ and $d=0$

$\Rightarrow$ Correct classification!