COMS 4030A

Adaptive Computation and Machine Learning

EXERCISES

(1) Consider a 3-input perceptron with weights $w_1 = 2.5$, $w_2 = -3$, $w_3 = 1.5$ and threshold $\theta = 2$.

Find the output of the perceptron for the following input vectors:

(a) $\boldsymbol{x} = (-1, 2, 4)$

(b) $\boldsymbol{x} = (2, -1, -2)$

Solution:

(a) $(-1)(2.5) + 2(-3) + 4(1.5) = -2.5$ and $-2.5 < 2$ so output is 0.

(b) $2(2.5) + (-1)(-3) + (-2)(1.5) = 6$ and $6 > 2$ so output is 1.

(2) Using the perceptron in exercise (1), do one update of the weights w_1, w_2, w_3 and threshold θ as follows: Suppose the input vector $\boldsymbol{x} = (1, 1, 2)$ from your dataset has target $t = 0$. When $\boldsymbol{x}$ is fed into the perceptron the output we get is $y = 1$, which differs from the target t. Update all the weights and threshold using the rules in the Perceptron Training Algorithm. Use $\eta = 0.1$.

Solution:

$1(2.5) + 1(-3) + 2(1.5) = 2.5$ and $2.5 > 2$ so output is $y = 1$.

update w_1 as follows: $w_1 \leftarrow w_1 + \eta(t - y)x_1 = 2.5 + (0.1)(0 - 1)1 = 2.4$

update w_2 as follows: $w_2 \leftarrow w_2 + \eta(t - y)x_2 = -3 + (0.1)(0 - 1)1 = -3.1$

update w_3 as follows: $w_3 \leftarrow w_3 + \eta(t - y)x_3 = 1.5 + (0.1)(0 - 1)2 = 1.3$

update θ as follows: $\theta \leftarrow \theta - \eta(t - y) = 2 - (0.1)(0 - 1) = 1.9$