

Neural Nets 1 – Solutions

1. Let $x_2 = y$ and $x_1 = x$, Then

$x_2 = -0.3x_1 + 0.7$ which can be re-arranged to: $f(x_1, x_2) = -x_2 - 0.3x_1 + 0.7$ and that gives the neuron shown in fig 1.

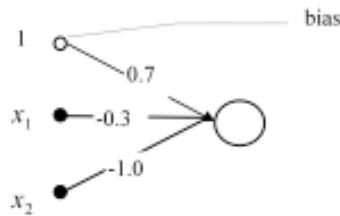


Figure 1:

2. (a) $Sum = (0.1 \times 0.5) + (0.5 \times 0.2) + (0.3 \times 0.1) = 0.05 + 0.1 + 0.03 = 0.18$. This is less than the threshold so the Output is zero.
 (b) The sum is still 0.18, but now the Output $= \frac{1}{1+e^{-0.18}} = 0.545$
3. For the upper image the sum for the neuron is $(1 \times 0) + (0 \times 1) + (0 \times 0) + (1 \times 1) = 0 + 0 + 0 + 1 = 1$. So this image is not recognised.
 For the lower image the sum for the neuron is also 1 and so it is not recognised either.
4. (a) For this image the sum is $(0.2 \times 0) + (0.7 \times 1) + (0.1 \times 0) + (0.9 \times 1) = 0 + 0.7 + 0 + 0.9 = 1.6$. This is greater than the threshold of 0.9 hence the image would be recognised.
 (b) If a sigmoid function were used the Output would be $\frac{1}{1+e^{-1.6}} = 0.83$. This can be viewed as a way of expressing uncertainty about the pattern. Here we could say that we are 83% certain that the output is recognised.
5. (a) The XOR function is not linearly separable using just a single perceptron
 (b) See the lecture notes on perceptrons and the following example:

<https://phiresky.github.io/neural-network-demo/>