Artificial Intelligence

Exercises week 2 - Artificial neural networks

COMP9414

Question 1: McCulloch-Pitts' model

Consider the logic function AND with 4 inputs. Implement a McCulloch-Pitts' model that produces this result in its output. Assume $w_i = 1$.

Question 2: Forward propagation

Consider a single-layer perceptron with 2 inputs and 4 neurons with an activation function sgn or threshold logic function. Moreover, take into account inputs, weight matrix, and thresholds shown next. What would be the network output for these inputs?

$$W_{ij} = \begin{bmatrix} 0.5 & 1.0 & 0.6 \\ -0.5 & -0.7 & 0.1 \\ 0.25 & 0.1 & 0.0 \\ 0.55 & -1.1 & -0.2 \end{bmatrix} \quad X = \begin{bmatrix} 12 & -6 \end{bmatrix} \quad \theta = \begin{bmatrix} 0.5 & 0 & 1.2 & 0.2 \end{bmatrix}$$

Question 3: Perceptron learning

Consider the training data shown in Table 1 to divide the space as shown in Fig. 1. Demonstrate the single-layer perceptron learning rule using a learning rate $\alpha = 1.0$ and initial weights $w_1 = 0$, $w_2 = -1$, and $b = -2.5$.

Table 1: Training examples and classes.

Training example	x_1	x_2	Class
a	0.0	1.0	-1
b	2.0	0.0	-1
c	1.0	1.0	1

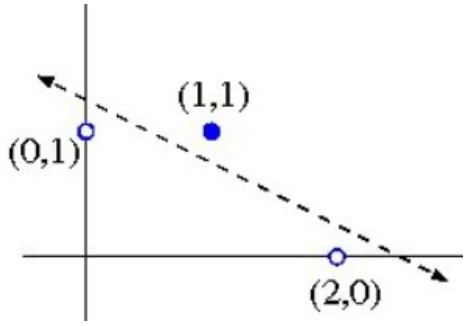

Figure 1: Space division of the training examples.

Question 4: Neural desing

- What would be the MLP architecture to approximate a non-linear function of 3 inputs and 2 outputs if you have available 3,000 samples? Consider 70% data for training and 30% for validation.
- What would be the MLP architecture to approximate a non-linear function of 6 inputs and 3 outputs if you have available 100 samples? Consider 80% data for training and 20% for validation.