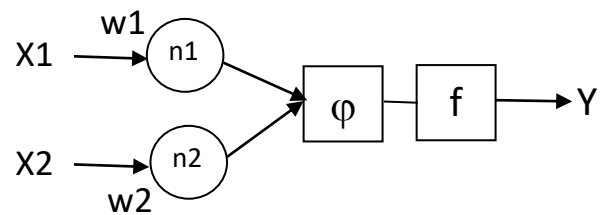


SERIES NO. 03 MODEL ANSWER KEY

Exercise 01

Consider the following diagram representing a simple neural network consisting of two inputs x_1, x_2 , the weights associated with the inputs w_1, w_2 , the weighted summation function ϕ , an activation function f and the output y .



1. The canonical form of $\phi(x_1, x_2)$

$$\phi(X) = WX + b = w_1x_1 + w_2x_2 + b$$

2. The expression of the output y as a function of the activation function f

$$Y = f(\phi(x_1, x_2)) = f(w_1x_1 + w_2x_2 + b)$$

Suppose that the activation function f is a sigmoid function which gives the output value in the interval $[0, 1]$ whatever the values of x_1, x_2 ($\text{sig}(x) = 1/(1+e^{-x})$)

3. The value of the output y in the following two cases:

a) $x_1 = 2, x_2 = 3, w_1 = 0, w_2 = 1, b = 4$

$$\phi(x_1, x_2) = WX + b = w_1x_1 + w_2x_2 + b = 0x_2 + 1x_3 + 4 = 7$$

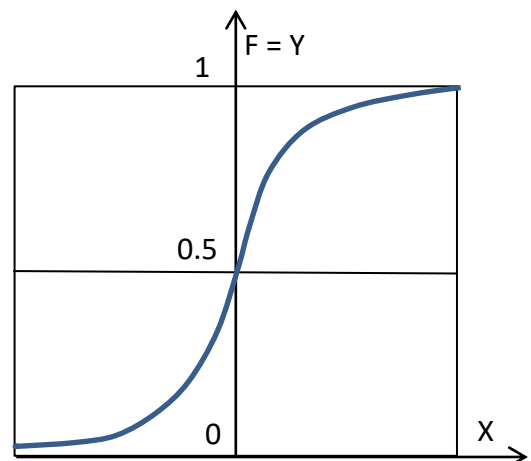
$$Y = f(\phi(x_1, x_2)) = f(7) = \text{sig}(7) = 0.9999$$

b) $x_1 = 2, x_2 = 3, w_1 = -1, w_2 = 0, b = 2$

$$\phi(x_1, x_2) = WX + b = w_1x_1 + w_2x_2 + b = -1x_2 + 0x_3 + 2 = 0$$

$$Y = f(\phi(x_1, x_2)) = f(0) = \text{sig}(0) = 1/2 = 0.5$$

4. Plot the curve of the output function f

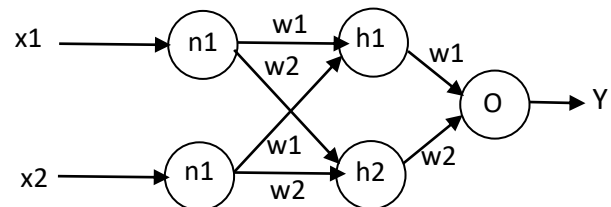


Exercise 02

Let the neural network RN be the one whose characteristics are:

- ✓ 02 entries x_1, x_2
- ✓ An input layer with two neurons n_1, n_2 , a hidden layer with two neurons h_1, h_2
- ✓ 01 output layer O with single neuron

1. Represent this RN network with a diagram



It is assumed that: $x_i \in \{2, 3\}$, all neurons have the same weights $w_i \in \{0, 1\}$, bias $b = 0$, an activation function $f(y) = \text{sigmoid}(y)$

2. Expressions of the outputs h_1 and h_2 as a function of the inputs x_i , the weights w_i and the bias b , then calculation of their values

$$h_1 = h_2 = f(WX + b) = f(w_1x_1 + w_2x_2 + b) = f(0x_2 + 1x_3 + 0) = f(3) = \text{sig}(3) = 0.9526$$

3. Express the output O as a function of h_1, h_2 and then calculate its value

$$\begin{aligned} O &= f(w_1h_1 + w_2h_2 + b) \\ &= f(0 \times 0.9526 + 1 \times 0.9526) \\ &= f(0.9526) = \text{sig}(0.9526) = 0.7216 \end{aligned}$$

Exercise 03

Let $BF = \{B, C\}$,

The BR is composed of the rules:

- | | |
|----------------------------|----------------------|
| 1. If B and D and E then F | 2. If G and D then A |
| 3. If C and F then A | 4. If B then X |
| 5. If D then E | 6. If X and A then H |
| 7. If C then D | 8. If X and C then A |
| 9. If X and B then D | |

1. How to prove the fact H ?

a) Forward Chaining

According to (4) if B then X

B is proven $\implies$ X is also proven

According to (7) if C then D $\implies$ D is proven

According to (5) if D then E $\implies$ E is proven

According to (1) if B and D and E then F $\implies$ F is proven

According to (3) if C and F then A $\implies$ A is proven

According to (6) if X and A then H $\implies$ H is proven

Conclusion: proof before: $(4) \rightarrow (7) \rightarrow (5) \rightarrow (1) \rightarrow (3) \rightarrow (6)$

New $BF = \{B, C, X, D, E, F, A, H\}$

b) Backward Chaining

According to (6) to prove $H \Rightarrow$ Prove X and A

We use (4) to prove $X \Rightarrow$ X is proven, because B is proven

We use (8) to prove $A \Rightarrow$ A is proven, since X and C are proven.

So: X and A are proven $\Rightarrow$ H is proven

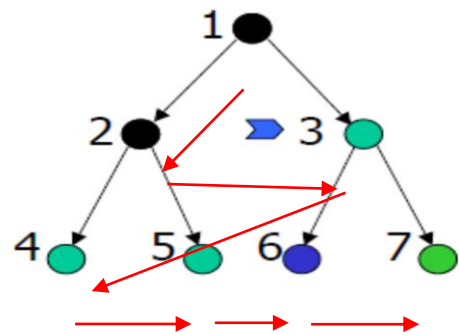
New BF = {B, C, X, A, H}

Exercise 4

1. Build the search tree if the search follows a Breadth-First search strategy and give the contents of the queue for each phase

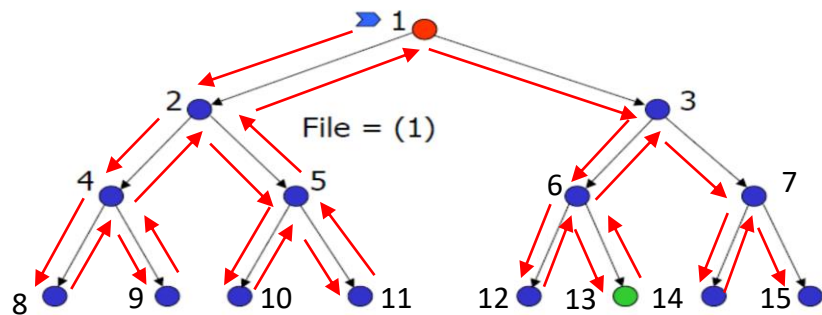
File{} $\rightarrow$ File{1} $\rightarrow$ File{2, 3} $\rightarrow$ file{3, 4,
5} $\rightarrow$ File{4, 5, 6, 7}
 $\rightarrow$ File{5, 6, 7} $\rightarrow$ File{6, 7} $\rightarrow$ File{7} $\rightarrow$ File{}

Route: 1, 2, 3, 4, 5, 6, 7



Exercise 5

Build the search tree if the search follows a depth-first search strategy and give the contents of the queue for each phase



File{} $\rightarrow$ File{1} $\rightarrow$ File{2, 3} $\rightarrow$ file{4, 5, 3} $\rightarrow$ File{8, 9, 5, 3} $\rightarrow$ File{9, 5, 3} $\rightarrow$ File{5, 3} $\rightarrow$

File{10, 11, 3} $\rightarrow$ File{11, 3} $\rightarrow$ File{3} $\rightarrow$ File{6, 7} $\rightarrow$ File{12, 13, 7} $\rightarrow$ File{13, 7} $\rightarrow$ File{13, 7}

$\rightarrow$ File{7} $\rightarrow$ File{14, 15} $\rightarrow$ File{15} $\rightarrow$ File{}

Route: 1, 2, 4, 8, 9, 5, 10, 11, 3, 6, 12, 13, 7, 14, 15