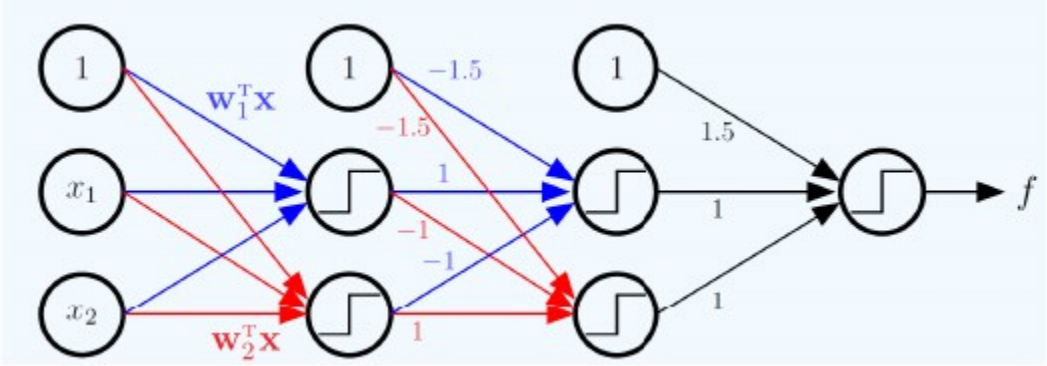
Task 1 – Explicit Formula for f



The given network takes the input vector:

$x = [1, x_1, x_2]^T$

and uses several threshold (step) units defined as:

$H(z) = 1$, if $z \geq 0$; 0, if $z < 0$

Step 1 – First Hidden Layer

Let the first two neurons compute:

$h_1 = H(w_1^T x)$, $h_2 = H(w_2^T x)$

These are the basic activations from the input layer.

Step 2 – Second Hidden Layer

From the diagram, both second-layer units have a bias of –1.5.

• The first one connects with +1 from h_1 and –1 from h_2.

• The second one connects with –1 from h_1 and +1 from h_2.

Therefore:

$g_1 = H(-1.5 + h_1 - h_2)$

$g_2 = H(-1.5 - h_1 + h_2)$

Step 3 – Output Layer

The final node has bias +1.5 and takes inputs from both g_1 and g_2 with weight 1:

$f = H(1.5 + g_1 + g_2)$

Step 4 – Combined Formula

Substituting all the terms, the final formula becomes:

$$f(x) = H(1.5 + H(-1.5 + H(w_1^T x) - H(w_2^T x)) + H(-1.5 - H(w_1^T x) + H(w_2^T x)))$$