$$A \begin{pmatrix} w_{11} & w_{10} & 0 & w_{01} & w_{00} & 0 & 0 & 0 & 0 \\ 0 & w_{12} & w_{11} & 0 & w_{02} & w_{01} & 0 & 0 & 0 \\ w_{21} & w_{20} & 0 & w_{11} & w_{10} & 0 & w_{01} & w_{00} & 0 \\ 0 & w_{22} & w_{21} & 0 & w_{12} & w_{11} & 0 & w_{02} & w_{01} \\ 0 & 0 & 0 & w_{21} & w_{20} & 0 & w_{11} & w_{10} & 0 \\ 0 & 0 & 0 & 0 & w_{22} & w_{21} & 0 & w_{12} & w_{11} \end{pmatrix}$$

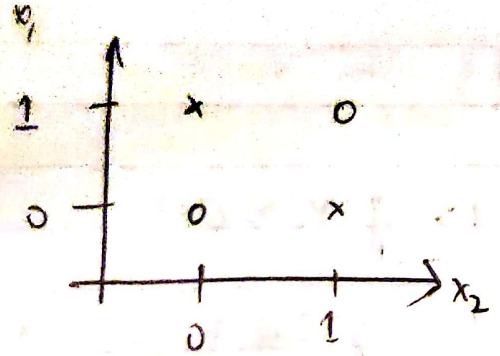
$$
\begin{bmatrix}
W_{00} & 0 & 0 & 0 \\
W_{01} & 0 & 0 & 0 \\
0 & W_{00} & 0 & 0 \\
0 & W_{01} & 0 & 0 \\
W_{10} & 0 & W_{00} & 0 \\
W_{11} & 0 & W_{01} & 0 \\
0 & W_{10} & 0 & W_{00} \\
0 & W_{11} & 0 & W_{01} \\
0 & 0 & W_{10} & 0 \\
0 & 0 & W_{11} & 0 \\
0 & 0 & 0 & W_{10} \\
0 & 0 & 0 & W_{11}
\end{bmatrix}
$$

(2)

1. $W_{AND} = [1 \quad 1]$ $b_{AND} = -1.5$

$W_{OR} = [1 \quad 1]$ $b_{OR} = -0.5$

2. As (4) is a linear seperator, we need to show that a linear seperator cannot seperate the truth and false values. Let us represent as below



We need to seperate the circles from the crosses. Clearly this is not possible using a linear boundary.

$f_1(x) = 1$

(3)

1. $W = \begin{bmatrix} 2 & 0 & \cdots \\ 0 & 2 & \\ \vdots & & \ddots \end{bmatrix}$

$\therefore f_1(x) = |2x - 1|$

As $x \in \mathbb{R}^d$, $f_1(x) \in \mathbb{R}^d$. Let f_i be the i^{th} element of $f_1(x)$ $\forall i \in \{1, 2, \ldots d\}$

~~$f^i = |2x^i - 1|$ where i is a superscript~~

Let $f_2 = f_1$, then $f_i = |2x_i - 1|$

$$= \begin{cases} 2x_i - 1 & \text{if } x_i \geq 0.5 \\ -2x_i + 1 & \cancel{\text{if } x < 0} \text{ otherwise} \end{cases}$$

Therefore in every dimension i, we can split the region into $(0, 0.5]$ and $[0.5, 1)$ for $O = (0,1)^d$. $\therefore$ For every dimension, we have 2 regions and so we can map 2^d regions onto O.

Q. $\therefore$ the input of g can come from n_g ~~ex~~ region & the input of f can come from n_f regions. ~~$\therefore$ the input of $f \circ g$ can come~~ $\therefore$ given the output of $f \circ g$, ~~its input~~ the input to f could have come from n_f. Each of these inputs could have come from n_g regions. $\therefore$ $f \circ g$ can identify $\cancel{n}(n_f \times n_g)$ regions onto $(0,1)^d$.

3. Using the previous part, we can see that $f(x)$ is basically a composition of 'L' functions of the form $(0,1)^d \to (0,1)^d$.

$\therefore$ h_L can map $(2^d)(2^d) \ldots$ L times

$= 2^{Ld}$ regions onto $(0,1)^d$.