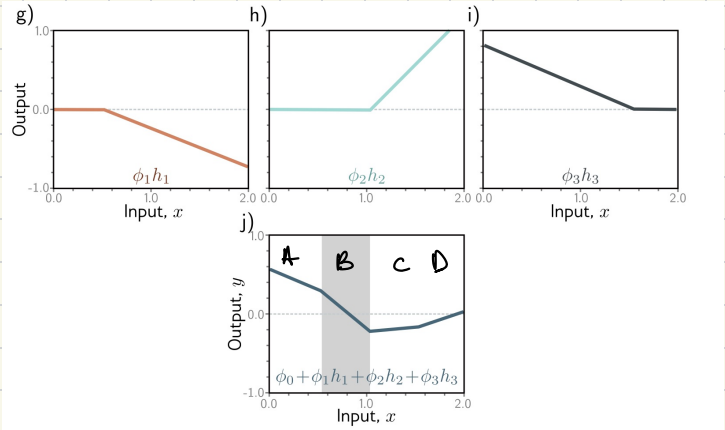
2.



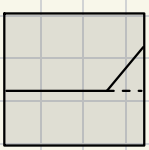
A: h_1 inactive, h_2 inactive, h_3 active

B: h_1 active, h_2 inactive, h_3 active

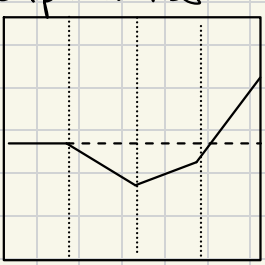
C: h_1 active, h_2 active, h_3 active

D: h_1 active, h_2 active, h_3 inactive

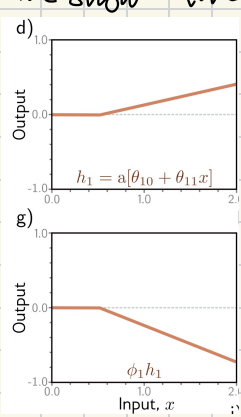
4. Now hidden unit 3 looks like



The output will be



6. We show that $\text{ReLU}[\alpha \cdot z] = \alpha\,\text{ReLU}[z]$



We have here

$\phi_1 \text{ReLU}[\theta_{10} + \theta_{11} x]$

If we do

$$\frac{\phi_1}{\alpha} \text{ReLU}[\alpha(\theta_{10}+\theta_{11}x)] = \frac{\phi_1}{\alpha}\,\alpha\,\text{ReLU}[\theta_{10}+\theta_{11}x]$$

$$= \phi_1 \text{ReLU}[\theta_{10}+\theta_{11}x]$$

No change.

If α is negative then

Where the nodes is active/inactive flips.

10. If the joints are in the same places then there will be less than 4 regions.

12.

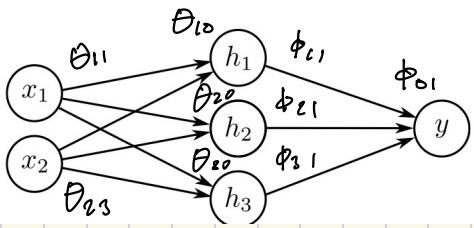


Figure 3.7 Visualization of neural network with 2D multivariate input $\mathbf{x} = [x_1, x_2]^T$ and scalar output y.

2x3 weights + 3 biases = 9
Total: 13 parameters.

3 weights + 1 bias = 4 parameters.

14.

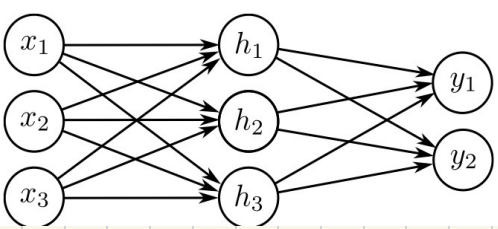
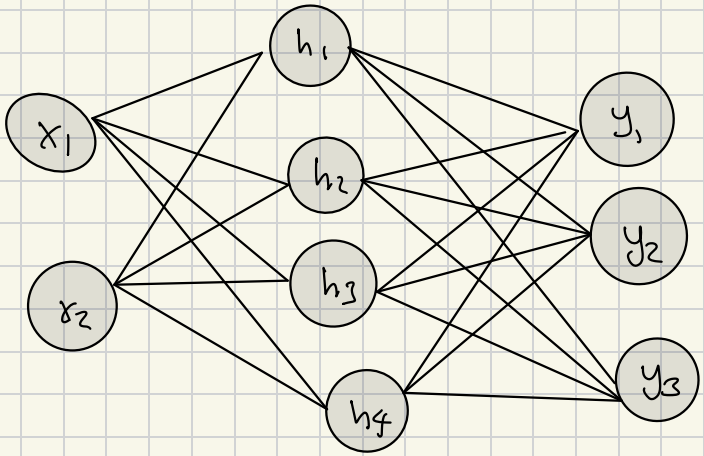


Figure 3.11 Visualization of neural network with three inputs and two outputs. This network has twenty parameters. There are fifteen slopes (indicated by arrows) and five offsets (not shown).

$$h_1 = a[\theta_{10} + \theta_{11}x_1 + \theta_{12}x_2 + \theta_{13}x_3]$$
$$h_2 = a[\theta_{20} + \theta_{21}x_1 + \theta_{22}x_2 + \theta_{23}x_3]$$
$$h_3 = a[\theta_{30} + \theta_{31}x_1 + \theta_{32}x_2 + \theta_{33}x_3]$$

$$y_1 = a[\phi_{10} + \phi_{11}h_1 + \phi_{12}h_2 + \phi_{13}h_3]$$
$$y_2 = a[\phi_{20} + \phi_{21}h_1 + \phi_{22}h_2 + \phi_{23}h_3]$$

16.



$$h_i = g[\theta_{i0} + \theta_{i1} x_1 + \theta_{i2} x_2]$$
$$y_i = g[\phi_{i0} + \sum_{j=1}^{4} \phi_{ij} h_j]$$

18. $D_i = 2$
$D = 3$

Max no hidden regions

$$\sum_{j=0}^{D_i=2} \binom{D}{j} = \binom{3}{0} + \binom{3}{1} + \binom{3}{2}$$
$$= 1 + 3 + 3 = 7$$

If $D = 5$.

$$\sum_{j=0}^{D_i=2} \binom{5}{j} = \binom{5}{0} + \binom{5}{1} + \binom{5}{2}$$
$$= 1 + 5 + 10$$
$$= 16 \text{ regions.}$$

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1