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1. a) True 1. $\varphi(x) = \frac{1}{1+e^{-\alpha x}}$

b) False $\varphi'(x) = \frac{d}{dx} (1+e^{-\alpha x})^{-1}$

$$= -1(e^{-\alpha x})(-\alpha)(1+e^{-\alpha x})^{-2}$$

$$= \frac{\alpha e^{-\alpha x}}{(1+e^{-\alpha x})^2}$$

$$= \alpha \frac{e^{-\alpha x}}{(1+e^{-\alpha x})}$$

$$= \alpha \varphi(x) \left[\frac{1+e^{-\alpha x}}{(1+e^{-\alpha x})} - \frac{1}{(1+e^{-\alpha x})} \right]$$

$$= \alpha \varphi(x) [1 - \varphi(x)]$$

2. $\varphi'(0) = \alpha \varphi(x) [1 - \varphi(x)]$

$$= \alpha 0.5 [1 - 0.5]$$

$$= 0.25 \alpha$$

2. 1. ~~Output_j = $\sum_i w_{ji} x_i$ for hidden layer~~
~~output = $g(\sum_j w_j c \sum_i w_{ji} x_i)$ for output~~
 ~~$= \frac{1}{1+e^{-(\sum_j w_j c \sum_i w_{ji} x_i)}}$~~
~~2. $h(x_1, x_2) = 0$~~

1. For hidden layer, ~~output_j = $\sum_i w_{ji} x_i$~~

$$\text{output}_1 = c [w_1 + w_3 x_1 + w_5 x_2]$$

$$\text{output}_2 = c [w_2 + w_4 x_1 + w_6 x_2]$$

$$\text{output}_3 =$$

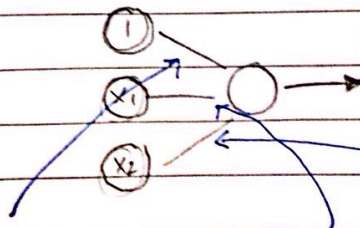
$$\frac{1}{1+e^{-(w_7 + c w_8 [w_1 + w_3 x_1 + w_5 x_2] + c w_9 [w_2 + w_4 x_1 + w_6 x_2])}}$$

2. ~~$g(x) = 0.5$~~ $g(x_1, x_2) = 0.5$

$$\frac{1}{1+e^{-(w_7 + c w_8 [w_1 + w_3 x_1 + w_5 x_2] + c w_9 [w_2 + w_4 x_1 + w_6 x_2])}} = 0.5$$

$$\Rightarrow \frac{1}{1+e^{-(w_7 + c w_8 [w_1 + w_3 x_1 + w_5 x_2] + c w_9 [w_2 + w_4 x_1 + w_6 x_2])}} = 0.5$$

3.



4. $(w_7 + c w_8 w_1 + c w_9 w_2) + c (w_8 w_3 + w_9 w_4) x_1 + c (w_8 w_5 + w_9 w_6) x_2 = 0$

$$3. \quad h, w \text{ after layer 1} = \frac{300 - (7 - 1)}{2}$$

$$= 147$$

$$\text{size} = (147, 147, 30)$$

$$h, w \text{ after layer 2} = \frac{\text{ceil}(147(2-1))}{2}$$

$$= 73$$

$$\text{size} = (73, 73, 1)$$

$$h, w \text{ after layer 3} = \text{ceil}\left(\frac{73 + 6(2-1)}{2}\right)$$

$$= 77$$

$$\text{size} = (77, 77, 50)$$