

## Problem 2 (cont'd)

$$y=0$$

Q.1

$$\max [|\text{Loss}(x, y, w)|]$$

$$\text{occurs when } \nabla_w^2 \text{Loss}(x, y, w) = 0$$

let's maximize w.r.t  $w$

~~which is equivalent to maximizing by  $w$  since~~  
 $\phi(x) = \text{const}$

$$\frac{d}{dw} [\nabla_w \text{Loss}(x, y, w)]$$

$$= \frac{d}{dw} [2\phi(x) ((\sigma(z))^2 - (\sigma(z))^3)]$$

$$= 2\phi(x) (2\sigma(z) - 3(\sigma(z))^2) \frac{d\sigma(z)}{dw}$$

$$\frac{d\sigma(z)}{dw} = \frac{d}{dw} \left[ \frac{1}{1+e^{-z}} \right] = \frac{\phi(x) e^{-z}}{(1+e^{-z})^2} = \frac{\phi(x)(1-\sigma(z))}{\sigma(z)^3} = 0$$

$$\sigma(z) \rightarrow \infty \quad (\text{known to be min})$$

$$\text{or } \phi(x) \rightarrow 0 \quad (\text{null answer})$$

$$\sigma(z) = 0 \quad \leftarrow 2\sigma(z) = 3\sigma(z)^2 \Rightarrow \sigma(z) = \frac{2}{3}$$

$$\frac{1}{1+e^{-z}} = \frac{2}{3} \Rightarrow \frac{3}{2} - 1 = e^{-z} \Rightarrow e^z = 2$$

$$w \cdot \phi(x) = 2 \quad \text{or} \quad \sigma(z) = \frac{2}{3}$$