

DLCV Hw3

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3.

$$\frac{dG(\vec{w})}{d\vec{w}} = \sum_n \frac{dG(\vec{w})}{dx^{(n)}} \frac{dx^{(n)}}{d\vec{w}}$$

$$\begin{aligned} \frac{dG(\vec{w})}{dx^{(n)}} &= - \left[t^{(n)} \cdot \frac{1}{x^{(n)}} + (1-t^{(n)}) \cdot \frac{-1}{1-x^{(n)}} \right] \\ &= - \frac{t^{(n)} - x^{(n)}}{x^{(n)} \times (1-x^{(n)})} \end{aligned}$$

$$\begin{aligned} \frac{dx^{(n)}}{d\vec{w}} &= \frac{d x(\vec{z}^{(n)}; \vec{w})}{d\vec{w}} = \frac{d x(\vec{z}^{(n)}; \vec{w})}{d(\vec{z}^{(n)}; \vec{w})} \cdot \frac{d(\vec{z}^{(n)}; \vec{w})}{d\vec{w}} \\ &= \frac{d x(\vec{z}^{(n)}; \vec{w})}{d(\vec{z}^{(n)}; \vec{w})} \cdot \vec{z}^{(n)} \end{aligned}$$

$$\text{Let } x(p) = \frac{1}{1+e^{-p}}$$

$$\frac{dx(p)}{dp} = \frac{0 - 1 \times (-e^{-p} \times (-1))}{(1+e^{-p})^2} = \frac{-e^{-p}}{(1+e^{-p})^2} = x(p) \times (1-x(p))$$

$$\begin{aligned} \text{So, } \frac{dG(\vec{w})}{d\vec{w}} &= \sum_n \frac{dG(\vec{w})}{dx^{(n)}} \cdot \frac{dx^{(n)}}{d\vec{w}} = \sum_n - \frac{t^{(n)} - x^{(n)}}{x^{(n)} \times (1-x^{(n)})} \times x^{(n)} \times (1-x^{(n)}) \times \vec{z}^{(n)} \\ &= - \sum_n (t^{(n)} - x^{(n)}) \times \vec{z}^{(n)} \quad \# \end{aligned}$$