DLCV Hw3

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3.

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

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

$$= -\frac{t^{(n)} - x^{(n)}}{x^{(n)} \times (1-x^{(n)})}$$

$$\frac{dx^{(n)}}{d\vec{w}} = \frac{d\,x(\vec{z}^{(n)};\vec{w})}{d\vec{w}} = \frac{dx(\vec{z}^{(n)};\vec{w})}{d(\vec{z}^{(n)};\vec{w})} \cdot \frac{d(\vec{z}^{(n)};\vec{w})}{d\vec{w}}$$

$$= \frac{dx(\vec{z}^{(n)};\vec{w})}{d(\vec{z}^{(n)};\vec{w})} \cdot \vec{z}^{(n)}$$

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

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

So, $$\frac{dG(\vec{w})}{d\vec{w}} = \sum_n \frac{dG(\vec{w})}{dx^{(n)}} \cdot \frac{dx^{(n)}}{d\vec{w}} = \sum_n -\frac{t^{(n)}-x^{(n)}}{x^{(n)} \times (1-x^{(n)})} \times x^{(n)} \times (1-x^{(n)}) \times \vec{z}^{(n)}$$

$$= -\sum_n (t^{(n)} - x^{(n)}) \times \vec{z}^{(n)}$$ #