problem1:- The proof

$\because Z = w_0 + w^T x$, $p(C_1/X) = \sigma(w_0 + w^T x)$, $p(C_2/X) = 1 - p(C_1/X)$

$$\therefore p(C_2/X) = \frac{e^{(-w_0 - w^T x)}}{1 + e^{(-w_0 - w^T x)}}$$

$$L(\omega) = p(t^{(1)} \ldots t^{(n)} / x^{(1)} \ldots x^{(n)}, w) = \prod_{<i>} p(t^{(i)} / x^{(i)}, w)$$

$$\max_{w} L(w)^2 = \max\left(\prod_{<i>} p(t^{(i)} / x^{(i)}, w)\right)$$

$$\therefore p(t^{(i)} / x^{(i)}, w) = \left(p(c=1 / x^{(i)}, w)\right)^{t^{(i)}} \left(p(c=0 / x^{(i)}, w)\right)^{(1-t^{(i)})}$$

by taking log for both sides

$$\therefore \operatorname{Log}(L(\omega)) = -\sum_{<i>}\left(t^{(i)} \log(1 - p(c=0 / x^{(i)}, w) + (1-t^{(i)}) \operatorname{Log}(p(c=0 / X, w)\right)$$

$$\therefore \operatorname{Log}(L(\omega)) = -\sum_{<i>}\left(t^{(i)} \operatorname{Log}\left(\frac{e^{-z}}{1+e^{-z}}\right) + (1-t^{(i)}) \operatorname{Log}\left(\frac{1}{1-e^{-z}}\right)\right)$$

$$\therefore \log(w) = \sum_{<i>} t^{(i)} \log(1+e^{-z^{(i)}}) + t^{(i)} z^{(i)} + (1-t^{(i)}) \log(1+e^{-z^{(i)}})$$

$$= \sum_{i=1}^{N} t^{(i)} z^{(i)} + \log(1+e^{-z^{(i)}})$$

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$$\therefore \frac{\partial l_{wg}}{\partial w_j} = \sum_{<i>} t^{(i)} x_j^{(i)} - x_j^{(i)} * \frac{e^{(-z^{(i)})}}{1+e^{-z^{(i)}}}$$

$$= \sum x_j^{(i)} \left(t^{(i)} - p(c=1 / x^{(i)}, w)\right)$$

in MAP rule:-

we want to maximize $p(w) \prod_{<i>} p(t^{(i)} | x^{(i)}, w)$

$$\therefore p(w) = \frac{1}{\sqrt{2\pi}} e^{\left(-\frac{w_i^2}{2}\right)}$$

$$\therefore \frac{\partial \log(p(w))}{\partial w} = -w_j$$

$\therefore$ for GA:-

$$\boxed{w_j = w_j + \alpha[-w_j + \sum x_j^{(i)} [t^{(i)} - p(c=1 | x_j^{(i)}, w)]]}$$