HW# 5
Application of Neural Network (CPE 520)
Due date: Sept. 28th , 2021

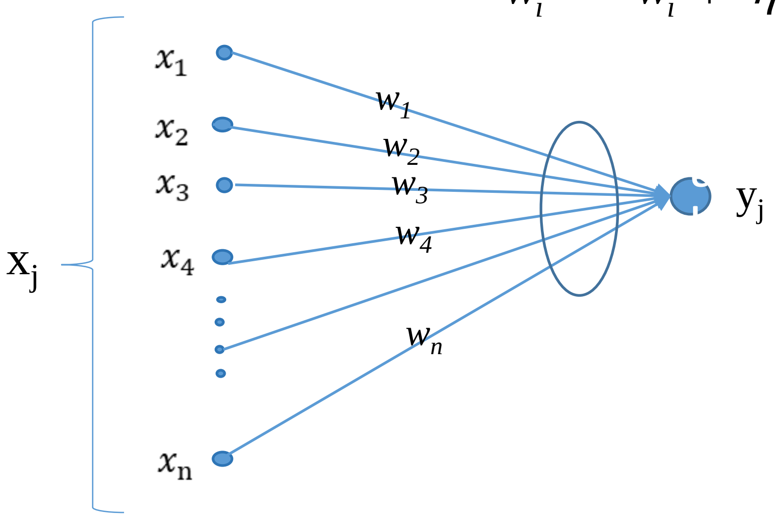
Read the attached PDF file to help you with this HW or search in the internet for solution.

Q.1: Consider the binary (two-class) logistic regression network shown in the figure below. Given N training data $\{\mathbf{x}_j\}_{j=1}^{N}$ with labels $t_j \in [0,1]$ and a loss (squared error) function given by:

$$\min_{\mathbf{w}}(E(\mathbf{w})) = \frac{1}{2}\sum_{j=1}^{N}\left(t_j - y_j(\mathbf{w})\right)^2$$

Show that using the gradient descent method the updating expression for each weight w_i is given by

$$w_i^{t+1} = w_i^t + \eta\sum_{j=1}^{N}(t_j - y_j)y_j(1-y_j)x_i \qquad \text{for } i=1,\ldots,n$$



$$\boxed{y_j(\mathbf{w}) = \frac{1}{1+\exp(-z_j)} \quad , \qquad z_j = \sum_{i=1}^{n} w_i x_i^j}$$

Q2: Repeat question #1 now with a cross entropy cost function which is given by **:**

$$\arg\min_{w}(E(\mathbf{W})) = -\sum_{j}^{N} t_j \log y_j + (1-t_j)\log(1-y_j)$$

which is the same as

$$\arg\max_{w}(E(\mathbf{W})) = +\sum_{j}^{N} t_j \log y_j + (1-t_j)\log(1-y_j)$$

for a two class problem: $t_j \in [0,1]$

$$where \quad y_j = \frac{1}{1+\exp(-z_j)} \text{ , and } z_j = \sum_{i} w_i x_i^j$$

Show that the updating equation for each weight is given by:

$$w_i^{t+1} = w_i^t + \eta \sum_{j}^{N} (t_j - y_j) x_i$$