# Introduction To Machine Learning
# Open Book Examination - C3

### Dr. K. P. Singh

### May 9, 2020

Max Marks: 20                                Duration: $9:00$AM to
$9:00$PM

**Note:**Submit in Google doc or in PDF with source code. No group work like project. Don't share your solution with others.

**Question 01**

Suggest a learning and/or inference machine with its architecture, an objective function, and an optimization routine, along with how input and output will be pre-processed or prepared for each of the following goals. Briefly, justify your choices.

1. Stock trading data for a company comes in as a 4-d vector of prices (high, low, open, close) for every second, along with volume (number of shares traded) for that second. The goal is to generate a buy or a sell signal for a company's stock. One would like to buy a stock if it goes up by 5% in the near future, and sell if it goes down by 5%. The model should work for many different companies of a similar type (e.g. highly traded internet technology companies), but their individual average stock price and trade volume can be very different from each other.

**Question 02**

Consider the following feature matrix:

$$\mathbf{X} = \begin{bmatrix} 7 & 6 & 3 \\ 4 & 1 & 8 \\ 6 & 6 & 5 \\ 8 & 6 & 1 \\ 9 & 5 & 7 \\ 7 & 5 & 9 \\ 5 & 3 & 3 \\ 9 & 5 & 9 \\ 7 & 4 & 4 \\ 8 & 2 & 8 \end{bmatrix}$$

1. Compute the correlation matrix $\Sigma$ and its roots

2. Using the answer obtained in (a), find out the corresponding eigen vector matrix

3. Use the eigen vector matrix obtained in the above step to reduce the dimensionality of the feature matrix to $\Re^2$

4. Describe the physical significance of *explained variance ratio* and compute this for each of the selected components

**Question 03**

Consider the initialized graph shown below: The inputs to the network are
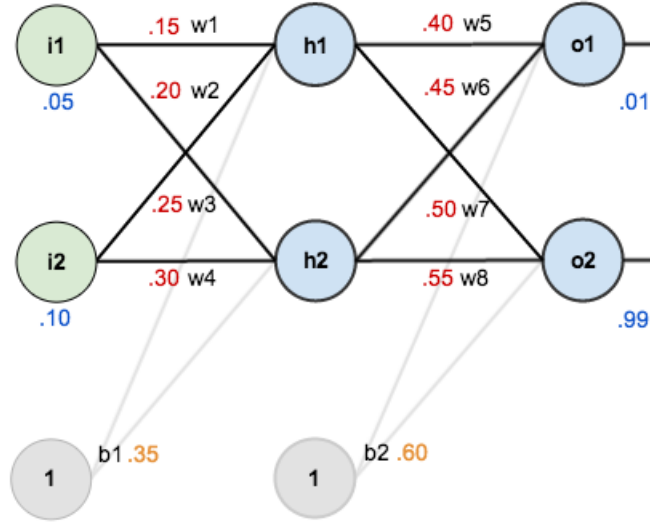


Figure 1: Question 03

$i_1 = 0.05$ and $i_2 = 0.10$ while the target values are $o_1 = 0.01$ and $o_2 = 0.99$ respectively. Use LeakyReLU activation function for the hidden units (choose your own leak value) and Sigmoid activation for the output units.

1. Compute the output at the hidden and output nodes marked $h_1, h_2$ and $o_1, o_2$ in the forward pass and total error for the neural network given by $E_{total} = E_{o_1} + E_{o_2}$.

2. Use the values computed in the above step to perform back-propagation and show clearly the weight updates (for all the weights) taking place for one iteration.