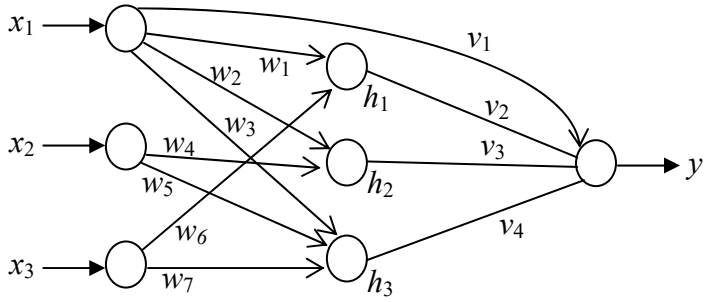
ENGG*6570 Advanced Soft Computing
Assignment #1

Due Time: Tuesday, June 8, 2021

Question 1: The following diagram shows the relationship among the inputs, output and some other variables and parameters of a specific system. The activation functions of h_1, h_2 and h_3 are nonlinear sigmoid functions, i.e., $f(a) = \tanh(a)$. The output y has a linear activation function, i.e., $g(a)=a$.

(1) Write the feedforward equations of h_1, h_2, h_3 and y, as a function of the input variables x_1, x_2 and x_3. Note that the thresholds must be included.

(2) Derive a learning algorithm for v_2 and w_5, using LMS (Least Mean Square) method, i.e., by minimizing the output error $e = t - y$, where t is the target output.



Question 2: Consider the classification problem defined below:

$$\left\{x_1=\begin{bmatrix}-1\\1\end{bmatrix},t_1=1\right\};\left\{x_2=\begin{bmatrix}-1\\-1\end{bmatrix},t_2=1\right\};\left\{x_3=\begin{bmatrix}0\\0\end{bmatrix},t_3=0\right\};\left\{x_4=\begin{bmatrix}1\\0\end{bmatrix},t_4=0\right\}$$

(1) Design a single-neuron perceptron to solve this problem. Hint: design the network graphically, by first finding a decision boundary manually, and then choosing the weight vector that is orthogonal to the decision boundary.

(2) Test your solution with all four input vectors.

(3) Classify the following input vectors with your solution. You can either perform the calculations manually or with Matlab.

$$x_5=\begin{bmatrix}-2\\0\end{bmatrix};x_6=\begin{bmatrix}1\\1\end{bmatrix};x_7=\begin{bmatrix}0\\1\end{bmatrix};x_8=\begin{bmatrix}-1\\-2\end{bmatrix}$$

(4) Which of the input vectors in Part (3) is always classified the same way, regardless of the solution values of the weigh $\boldsymbol{W}$ and the threshold θ? Which may vary depending on the solution? Why?