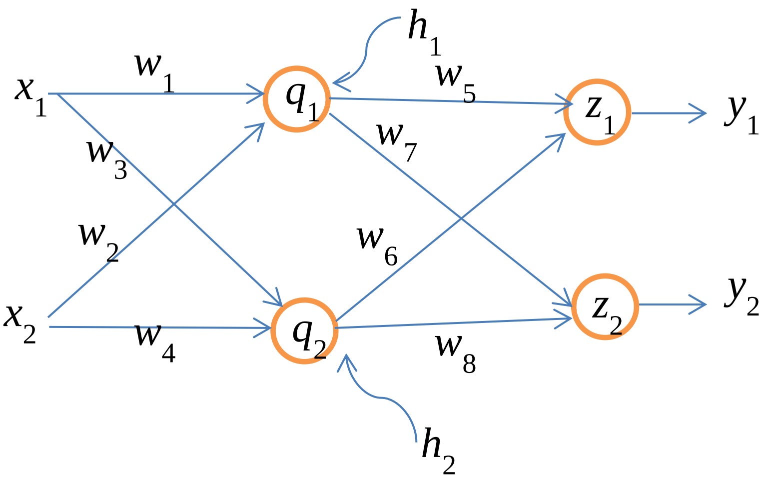
HW #4 Due: 5/8/2018

1. In the SOFM network, the learning rate is a function of time and distance between the current node and the BMU. If $\eta_0 = \sigma_0 = 0.1, \lambda = 10$, find the number of required iteration such that the learning rate of nodes next to BMU is less than 0.001. A node is next to BMU is located at $(x_0 \pm 1, y_0)$ or $(x_0, y_0 \pm 1)$ where (x_0, y_0) as the coordinate of the BMU.
2. We mentioned that the parameter α in GMM was computed based on the Lagrange multipliers. Show that $\alpha_j = \frac{1}{n}\sum_{i=0}^{n} \beta_j(x_i)$ as given in the PPT notes.
3. We have analytically solved the following problem: Maximize $f(x,y) = x + y$ subject to $x^2 + y^2 = 1$. Write a gradient descent program to find the solution numerically. Note that to find the maximum point, you need to follow the gradient (instead of negative gradient). Compare your numerical results with analytical results.
4. Compute the complete update (back propagation) equations for all weights $(w_1 \sim w_8)$ in the following neural networks. The activation function is sigmoid, the loss function is MSE, and the desired outputs are d_1 and d_2.



5. Write a program to implement the neural network with your back propagation equations in problem 4. To test your network, train it to distinguish the classes of versicolor and virginica in the Iris dataset using only the third and fourth features (i.e., petal length and petal width) as the inputs. As usual, use 70% of the data for training and the rest for testing. Repeat the experiments 10 times to find the average accuracy. During training, set the desired output as 0.9 for in class data and 0.1 for out of class data. Don't forget to use random numbers as the initial weights.