ECE 8890/CS 8770 Spring 2019 Example Exam Format

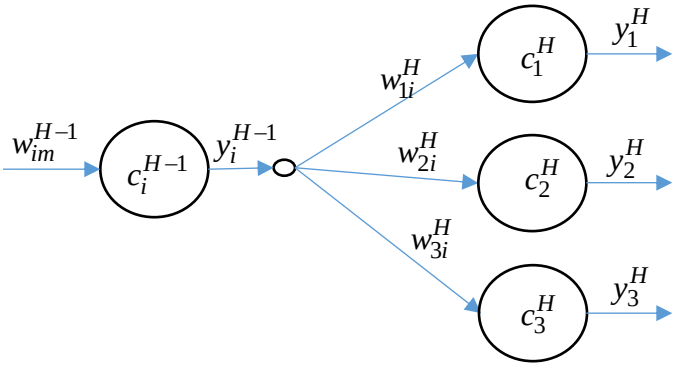
There will be some True/False problems. If False, in a few lines, state **what is False** and **why**.

1. Backpropagation is a form of Gradient Descent.

2. The solution to the equation $ax^2 + bx + c = 0$ is $x = -b \pm \frac{\sqrt{a^2 - 4bc}}{2a}$.

There will be some (2 or 3) "turn the crank" problems.

3. Consider this portion of an MLP:



Note that I have not specifically put "(k)" on these variable names to make the diagram less cluttered.

a. Suppose $\delta_1^H = 0.5$, $\delta_2^H = -0.3$, $\delta_3^H = -0.1$; $w_{1i}^H = 0.2$, $w_{2i}^H = -0.1$, $w_{3i}^H = 0.3$; $y_i^{H-1} = 0.4$ assuming a sigmoid activation function with slope parameter 1, compute δ_i^{H-1}.

b. Suppose δ_i^{H-1} = 0.4, w_{im}^{H-1}(k) = -0.7, y_m^{H-2} = 0.5. With α = 0.9 and β = 0.0, compute the update of the weight w_{im}^{H-1}(k+1). Show the update equation first.

c. Suppose w_{1i}^H = 0.2, y_i^{H-1} = -0.4, y_1^H = 0.1, d_1 = 1.0. Using squared error, ½ e^2, as the error function and assuming a sigmoid activation function with slope parameter 1, compute the update to the weight w_{1i}^H with α = 0.9 and β = 0.0.

There will be some (1 or 2) "derivation" problems.

4. For an MLP with sum of squared error and sigmoid activation functions, derive the backpropagation output for λ_j, the parameter in the sigmoid, for both output neurons and hidden neurons.

5. Consider a pooling operation at hidden layer h that has the following properties:

- no pooling window overlap
- a spatial pooling window size of 3x3
- function

$$f(a_{11},a_{12},a_{13},a_{21},a_{22},\ldots,a_{33}) = (a_{11}+a_{12}+a_{13}+a_{21}+a_{23}+a_{31}+a_{32}+a_{33})/8 + a_{22}$$

for indexing scheme

a_{11}	a_{12}	a_{13}
a_{21}	a_{22}	a_{23}
a_{31}	a_{32}	a_{33}

Derive the weight update formula for backpropagation at layer h-1; aka the network layer that feeds into this pooling layer.

There may be a single "essay type" question to see if you know the "big picture".

Discuss Rosenblatt's algorithm and explain why it is important in the field of neural networks.

EXAM TOPICS include:

1. Multi layer perceptron's and backpropagation
2. Convolutional neural networks
3. Shared weight networks
4. Convolution and correlation
5. Deconvolution (matrix convolutional transpose)
6. Self organizing maps
7. Neural gas
8. Growing neural gas
9. Hopfield nets