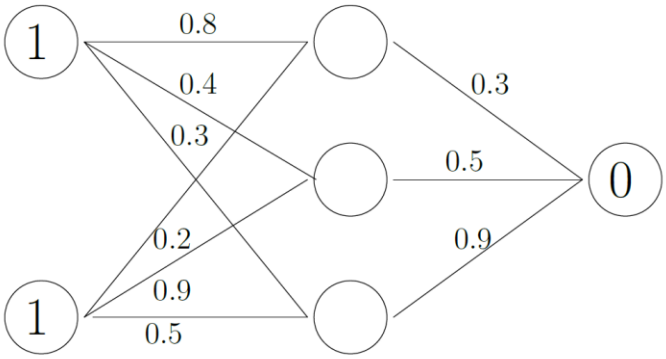
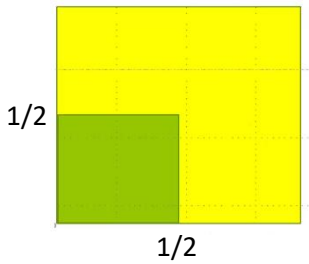
Assignment 1

Follow the instructions below very carefully, please submit your source code named as **FirstName_LastName_problem_n where n is the problem number,** and also a PDF file described at the end of this document.

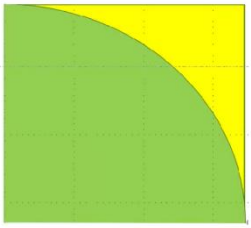
1. Show that the *tanh* function is a re-scaled sigmoid function with both horizontal and vertical streching, as well as vertical translation:
$$\tanh(v) = 2sigmoid(2v) - 1$$
2. Show the following properties of the sigmoid and tanh activation functions:
   a. Sigmoid: $\Phi(-v) = 1 - \Phi(v)$
   b. Tanh activation: $\Phi(-v) = -\Phi(v)$
   c. Hard tanh activation: $\Phi(-v) = -\Phi(v)$
3. Consider the neural network:



All the activation functions from the neurons in the hidden layer are sigmoids and the error is calculated by using squared error function:
   a. Describe all the essential parts from the neural network.
   b. Given the input {1,1} compute the predicted output of the network step by step and calculate the error if the target output is 0.
   c. Compute step by step 2 training epochs using Back-Propagation algorithm.
4. Program your own MLP in Python for a basic neural network with one or to hidden layers and binary output (select the proper activation function)
   a. Generate a random data set for binary classification where each class correspond to the 2D region depicted in the figure. The random data should have normal distribution with variance $\sigma^2 = 0.08$. Use 200 points (100 in each region) to train your neural network and report the results in terms of the loss function and the training epochs.



   b. Repeat 4.a. for the following ıs:



I expect your reports to be well formed and conform to the following rules:

1. First and above all, I will not accept any late assignments and I will not accept any assignments by email. All submissions must be via Blackboard and on time.

2. All reports have to be submitted as a PDF report that contains:

2.1. Title page with your name, assignment number and the day you are actually submitting this report (Not the assignment due date)

2.2. A comprehensive set of snapshots showing the inputs submitted and outputs obtained in the case of a successful output or a failure.

3. A source code file for each programming problem and each must be named FirstName_LastName_problem_n.* where n is the problem number.

4. Make sure that you include as a comment at the top of your file your name and section

As an example:

```
#**************************#
 #* John Q. Public *                  #
#* CECS 590-01 *                      #
 #* Assignment 35 *                  #
#**************************  #
```

Failure to do this will cost you points.

5. Please zip both the PDF document with the source code files in one zip files that must be named as **lastName_firstName_n.zip** where n is the assignment number, e.g. my zip file for assignment 3 should be called “Sierra_Daniel_03.zip”.