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```
clc; clear all; close all;
```

Delivery report Pt 2

This report contains the awnsers to questions posed in the Deliverable

Deliverable 3ci

```
% The number of neurons that worked better for step 3  was 400 for a
 sample
% size of 9000. This number of neurons worked better because
 increasing the
% number of neurons showed a decrese in accuracy and favorable
 readings
% from the ROC (Receiver Operating Characteristic). This is most
 commanly
% because of overfitting to the training set of the data.
```

Deliverable 3cii

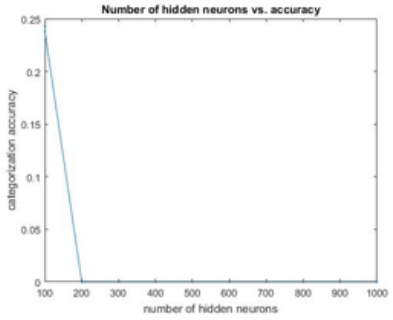
```
%The extraction method that worked better was the one with less inputs
 and
%more information. The extraction of the frequency magnatude
 components
%showed an increased accuraccy at different levels of neurons in the
 sweep.
%This was because the features that were fed to the input had more
%information in them for the neural network.
```

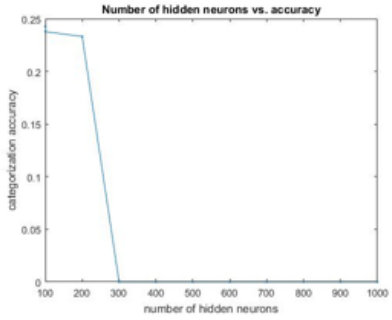
Part 3 Training a machine to understand emtion (The Sweep)

```
%Let it be known that the whole training dataset was not used in
 training
%this neural network. It was modified to only take 15,000 training
 samples
%and use 9,000 of it to sweep for the number of hidden neurons.
```

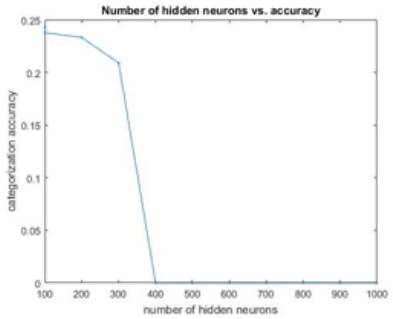
```
image1 = imresize(imread('./Final/100.jpg'), 0.5);
image2 = imresize(imread('./Final/200.jpg'), 0.5);
image3 = imresize(imread('./Final/300.jpg'), 0.5);
image4 = imresize(imread('./Final/400.jpg'), 0.5);
image5 = imresize(imread('./Final/500.jpg'), 0.5);
image6 = imresize(imread('./Final/600.jpg'), 0.5);
image7 = imresize(imread('./Final/700.jpg'), 0.5);
image8 = imresize(imread('./Final/800.jpg'), 0.5);
image9 = imresize(imread('./Final/900.jpg'), 0.5);
image10 = imresize(imread('./Final/1000.jpg'), 0.5);
final = imread('./Final/1000.jpg');
plot = [image1 image2];
plot2 = [image3 image4];
plot3 = [image5 image6];
plot4 = [image7 image8];
plot5 = [image9 image10];
figure; imshow(plot); title('100 and 200 hidden neurons sweep');
figure; imshow(plot2); title('300 and 400 hidden neurons sweep');
figure; imshow(plot3); title('500 and 600 hidden neurons sweep');
figure; imshow(plot4); title('700 and 800 hidden neurons sweep');
figure; imshow(plot5); title('900 and 1000 hidden neurons sweep');
figure; imshow(final); title('Final System Accuracy');

%Below shows each sweep iteration from 100 to 1000, incrementing by
 100
%each time. The fluctuation that we are seeing is due to
%the fact that the neural network is being trained with a different
 number
%of neurons each iteration. As can be seen, the accuracy per neurons
%decreases until it reaches 400 where it spikes to a 25% accuracy and
 then
%continues to decrease until the final iteration. This means that
 training
%the neural network with 400 neurons would give us the most accurate
%outputs. The final system accuracy is shown below also. As you can
 see,
%400 neurons is the most accurate in our sweep.

image_p = imread('./Final/percentage.jpg');
figure; imshow(image_p); title('Accuracy after percentage change');

%We also manipulated the percentage of data going to training and
 testing
%in the sweep iteration for loop in the hopes that we would correct
%overfitting more. However, the results yielded less accuracy as seen
%below.
```

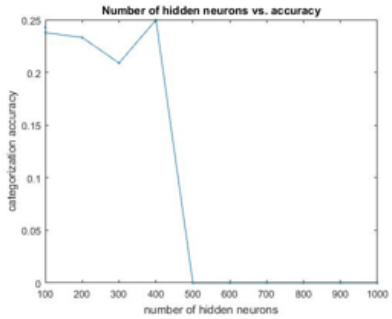
100 and 200 hidden neurons sweep



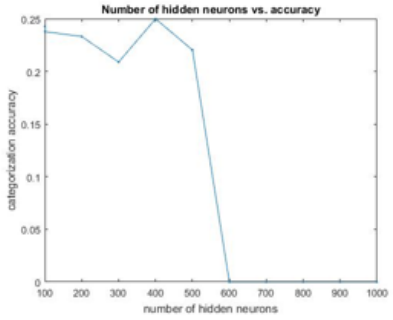


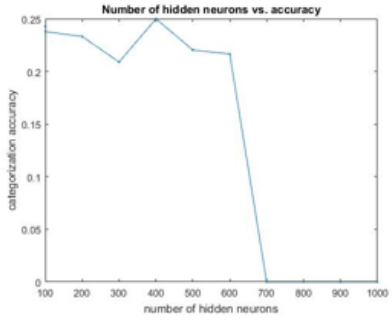
300 and 400 hidden neurons sweep



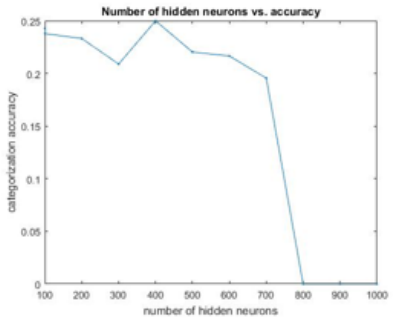


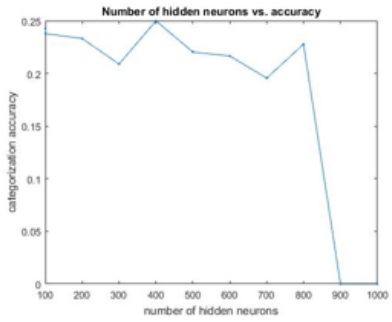
500 and 600 hidden neurons sweep



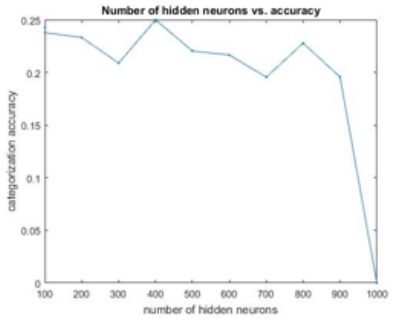


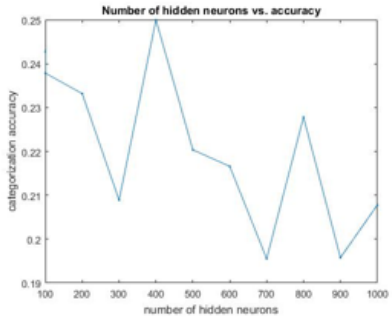
700 and 800 hidden neurons sweep



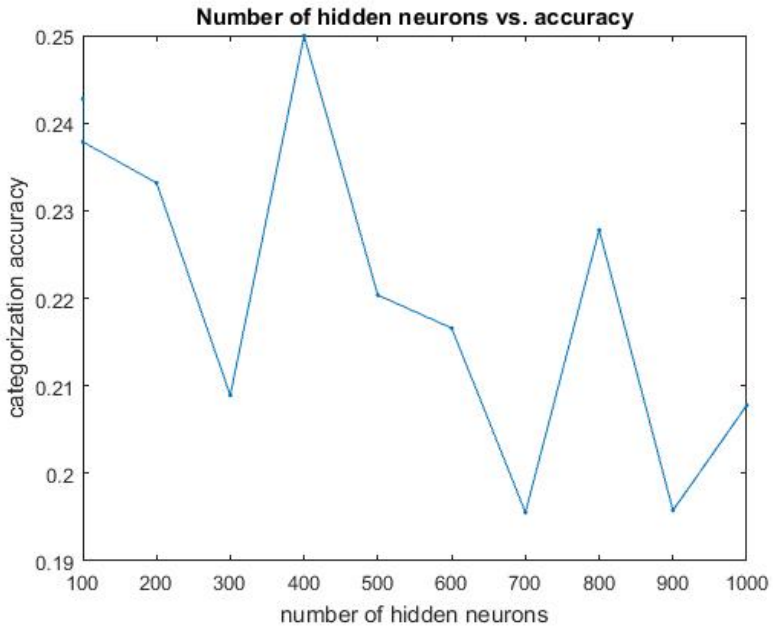


900 and 1000 hidden neurons sweep

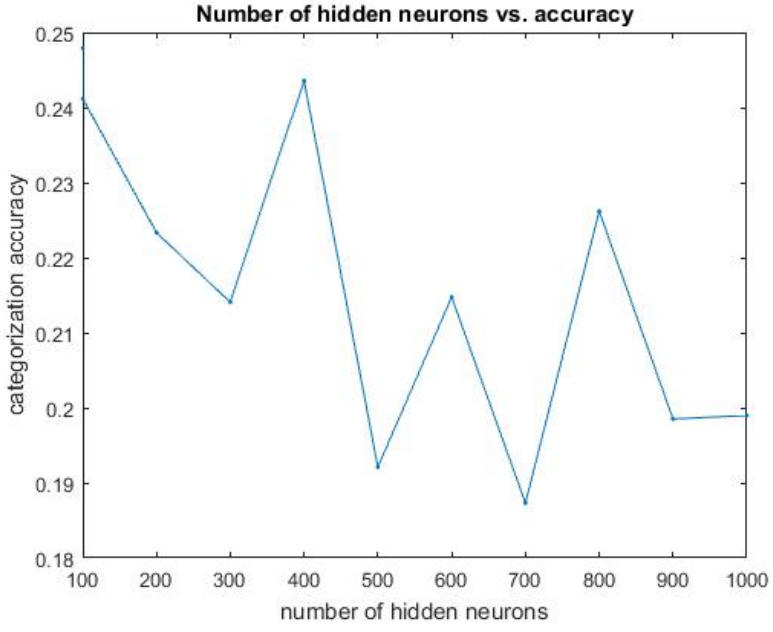




Final System Accuracy



Accuracy after percentage change

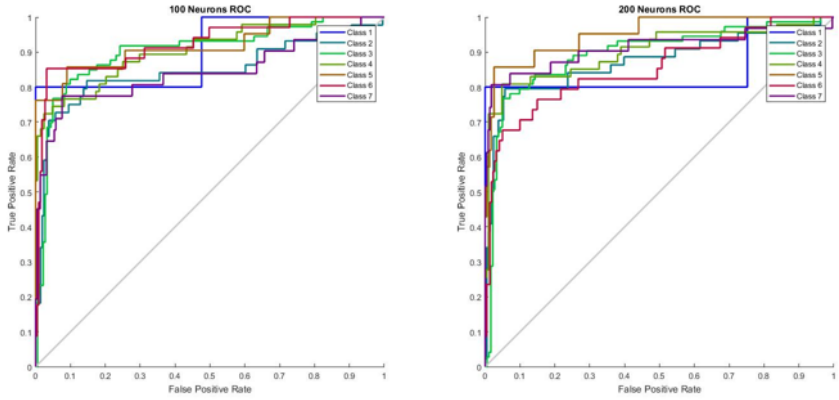


Part 3 ROC curves of each iteration

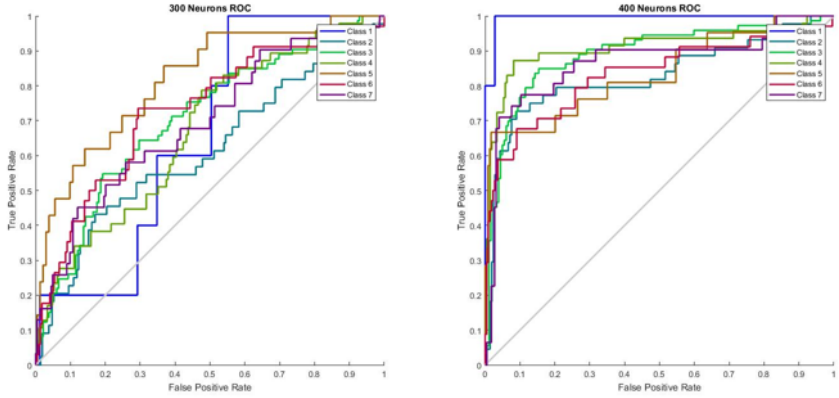
```
image1_n = imresize(imread('./Final/100 neurons.jpg'), 0.5);
image2_n = imresize(imread('./Final/200 neurons.jpg'), 0.5);
image3_n = imresize(imread('./Final/300 neurons.jpg'), 0.5);
image4_n = imresize(imread('./Final/400 neurons.jpg'), 0.5);
image5_n = imresize(imread('./Final/500 neurons.jpg'), 0.5);
image6_n = imresize(imread('./Final/600 neurons.jpg'), 0.5);
image7_n = imresize(imread('./Final/700 neurons.jpg'), 0.5);
image8_n = imresize(imread('./Final/800 neurons.jpg'), 0.5);
image9_n = imresize(imread('./Final/900 neurons.jpg'), 0.5);
image10_n = imresize(imread('./Final/1000 neurons.jpg'), 0.5);
final_n = imread('./Final/ROC_sweep.jpg');

plot_n = [image1_n image2_n];
plot2_n = [image3_n image4_n];
plot3_n = [image5_n image6_n];
plot4_n = [image7_n image8_n];
plot5_n = [image9_n image10_n];
figure; imshow(plot_n); title('100 and 200 hidden neurons ROC curve');
figure; imshow(plot2_n); title('300 and 400 hidden neurons ROC
 curve');
figure; imshow(plot3_n); title('500 and 600 hidden neurons ROC
 curve');
figure; imshow(plot4_n); title('700 and 800 hidden neurons ROC
 curve');
figure; imshow(plot5_n); title('900 and 1000 hidden neurons ROC
 curve');
figure; imshow(final_n); title('Final ROC curve');

%Each of the ROC curves shown below represent the performance of the
 neural
%network when being trained with the specified number of hidden
 neurons.
%Each emotion is represented by a class, as can be seen on each graph:
%(7=Angry, 1=Disgust, 2=Fear, 3=Happy, 4=Sad, 5=Surprise, 6=Neutral)
%What we are looking for is the ROC curve with the most classes
%located primarily in the upper left hand quadrant of the plot. This
 will
%indiacte that the neural networks performance, with respect to each
%class, is good.It can be seen that the plot utilizing 400 hidden
 neurons
%shows the best ROC curve.
%The final ROC curve is the overall ROC curve for the neural network.
```

Warning: Image is too big to fit on screen; displaying at 67%

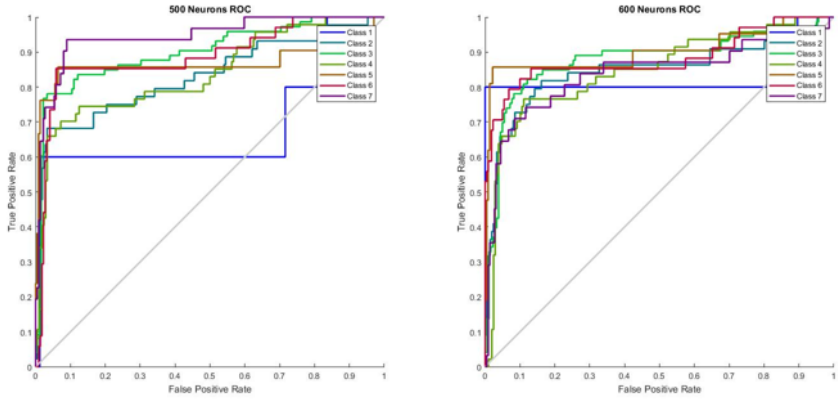
100 and 200 hidden neurons ROC curve



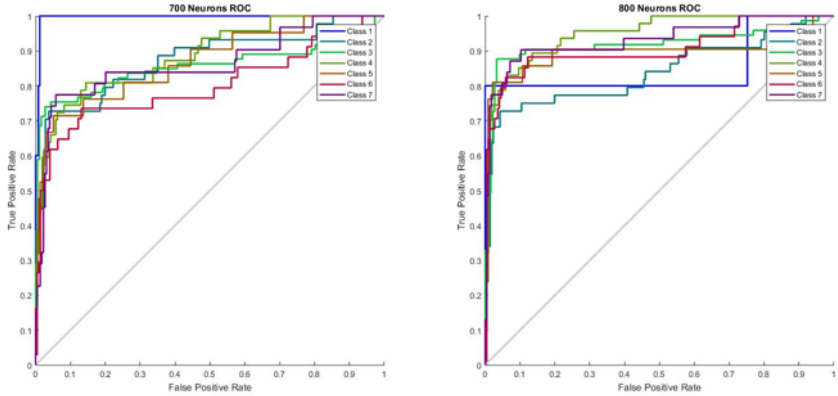
300 and 400 hidden neurons ROC curve



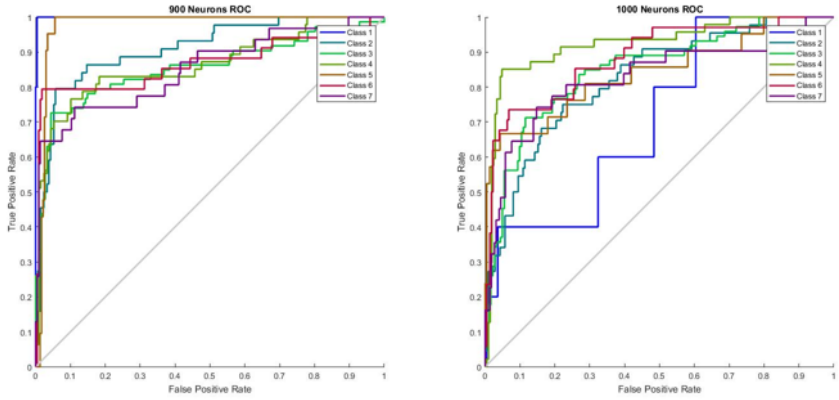
500 and 600 hidden neurons ROC curve



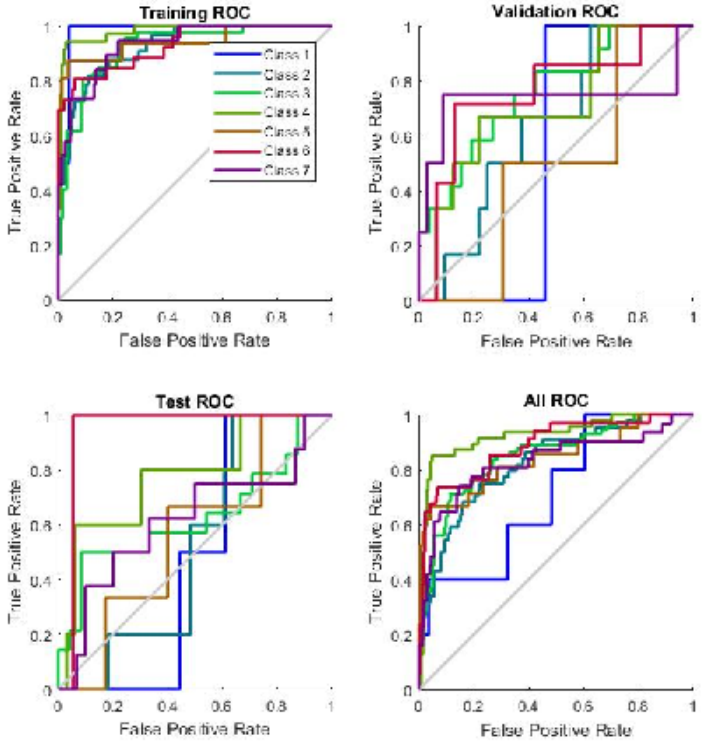
700 and 800 hidden neurons ROC curve



900 and 1000 hidden neurons ROC curve



Final ROC curve



Part 4 Methods to reduce complexity

```
%Three different methods that could be used to reduce the complexity
 of the
%system are:
%1. wavelet: using wavelet transform would take out a lot of the noise
 in
%the images, allowing the neural network to grab better pixel values
 from
%the data sets.
%2. frequency domain: by taking the frequency domain, we could take
 lower
%values of an image and create a more precise data set for training
 and
%testing
%3. downsize image: downsizing an image would decrease the size of the
%dataset which could decrease the chance of overfitting the training
 set.
%This could reduce the complexity of the training set and increase the
%accuracy.

%All three of the above methods would manipulate the input images and
%create a more precise training and testing set for the neural network
 to
%be trained with. This would create a better performing and more
 accurate
%neural network.
```

Part 5 Sweep ROC

```
sweep = [10,10:10:250];

for i = 1:21
    formatSpec = "./Q5figSaves/N%dRoc";
    savefigpath = sprintf(formatSpec,sweep(i));
    openfig(savefigpath);

end
% close all
```

```
Error using openFigure
The value of 'Filename' is invalid. It must satisfy the function:
 ischar.

Error in openfig>localGetFileAndOptions (line 98)
ip.parse(args{:});

Error in openfig (line 37)
[filename, reuse, visibleAction] = localGetFileAndOptions(varargin);

Error in report2 (line 130)
    openfig(savefigpath);
```

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