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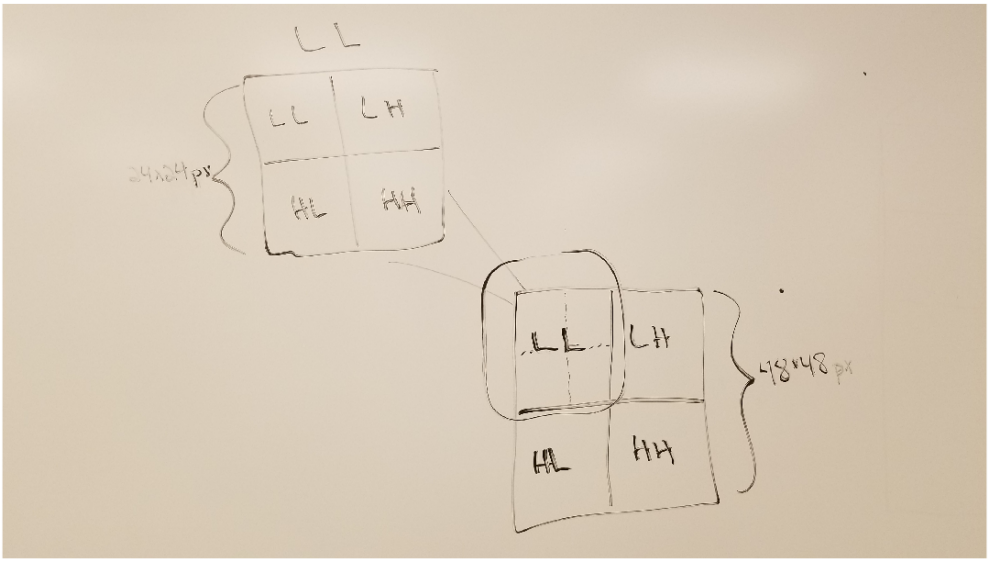
```
clc; clear all; close all;

% This report contains the awnsers to questions posed in the
 Deliverable

%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 250 hidden
 neurons
%shows the best ROC curve.
%The final ROC curve is the overall ROC curve for the neural network.
```

How we got our features.

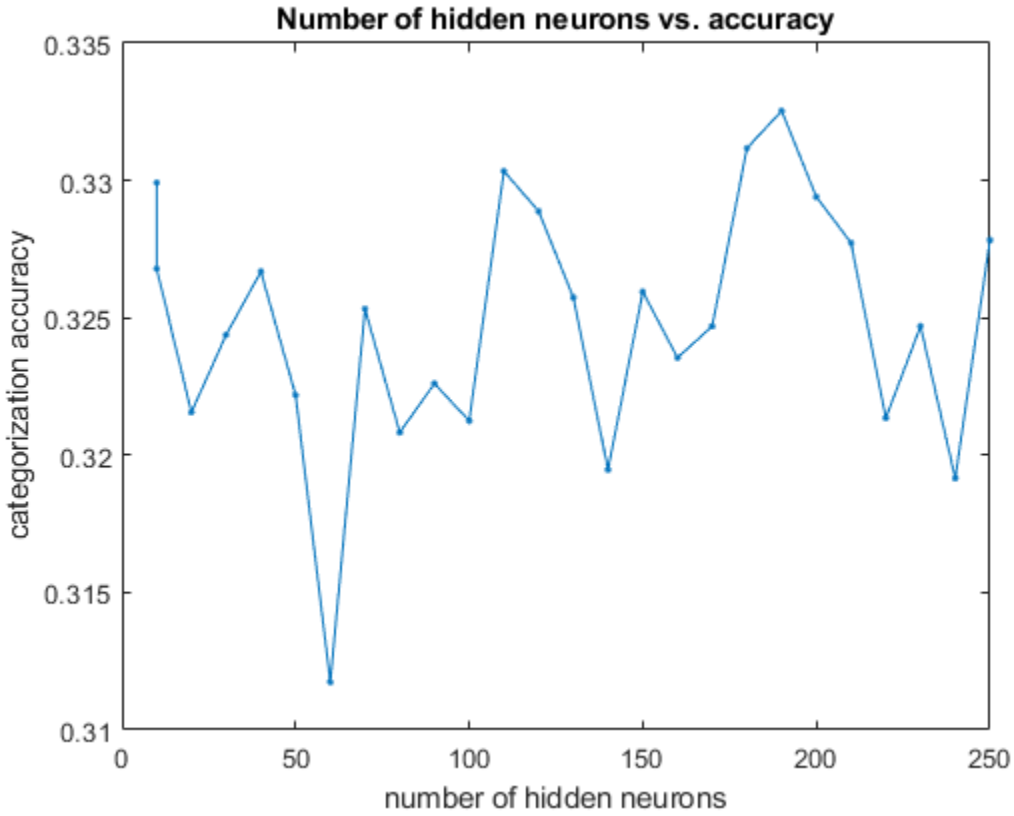
```
% This figure shows what features we use. The LL of the LL using both
% different methods

imds = imageDatastore({'pic.jpg'});
img = readimage(imds,1);
imshow(img)


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

Warning: Image is too big to fit on screen; displaying at 33%



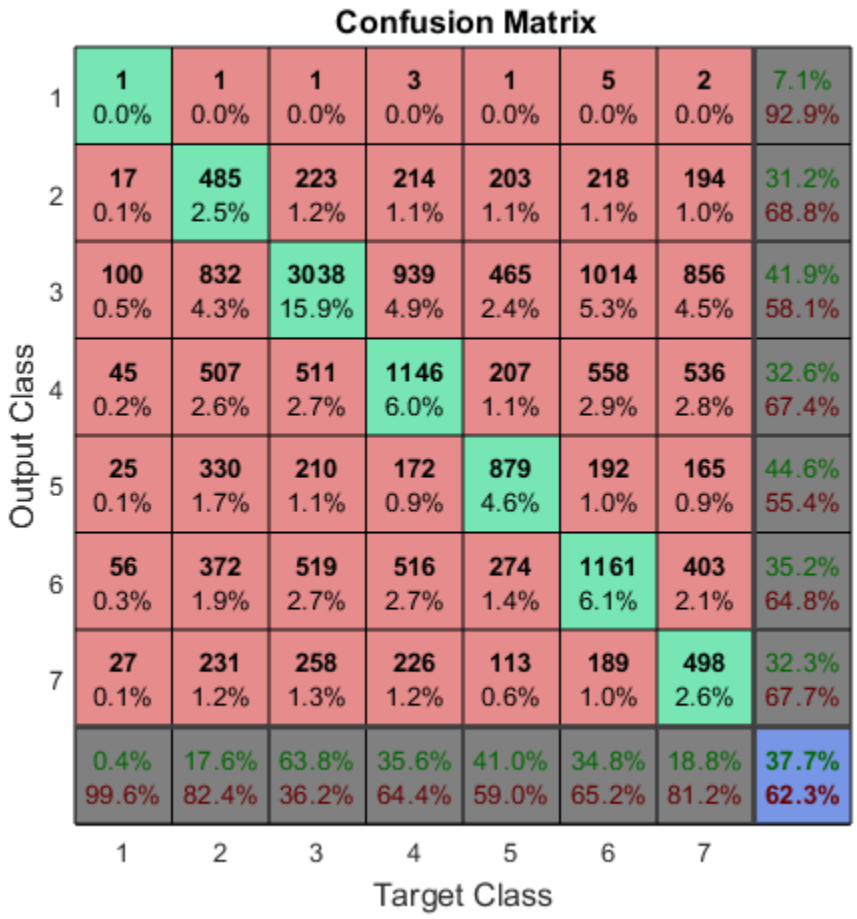
Coif

```
% Below is the accuracy of the sweep.
 openfig("../figSaves/1_SweepResult");
```



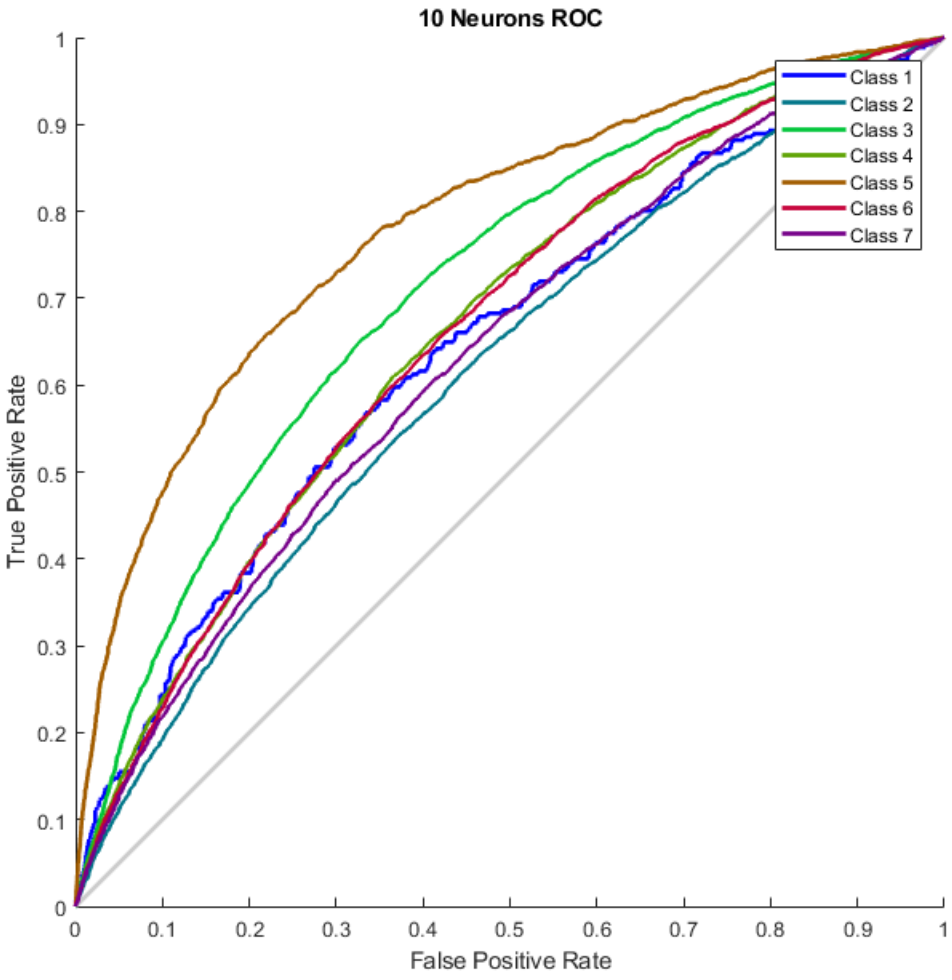
Confusion Matrix

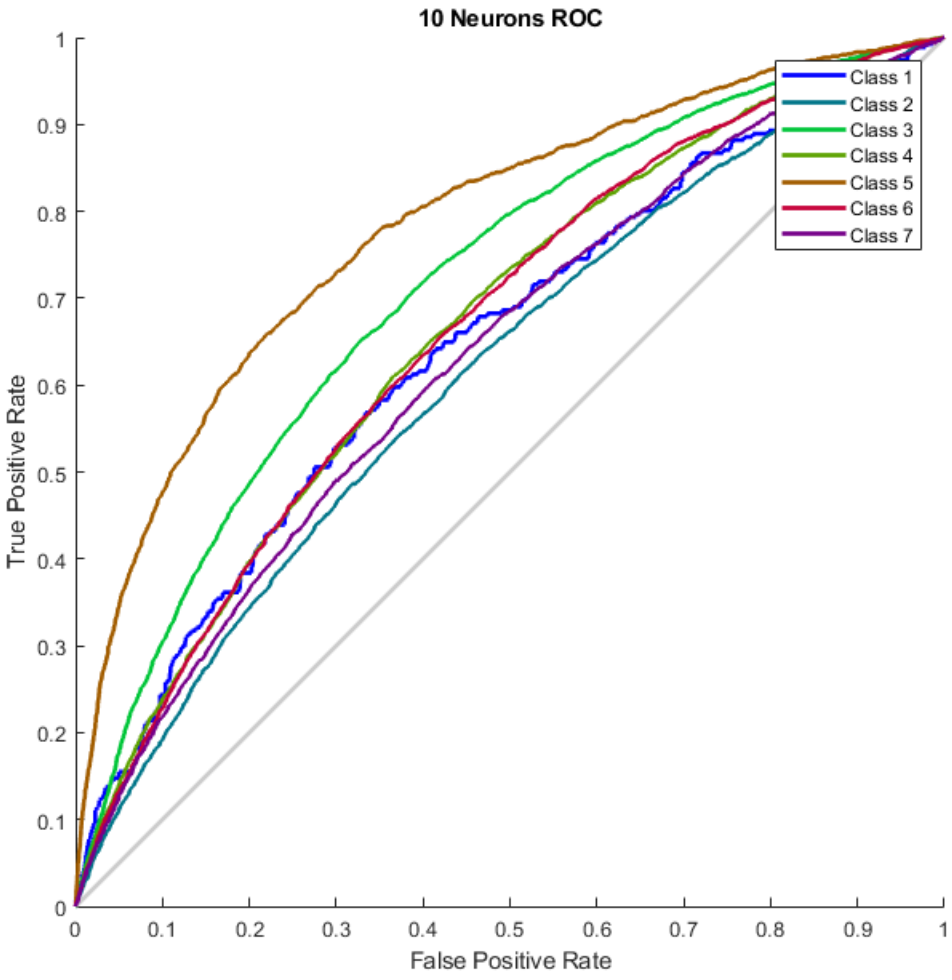
```
openfig("../figSaves/ConfusionMatrix_1");
```

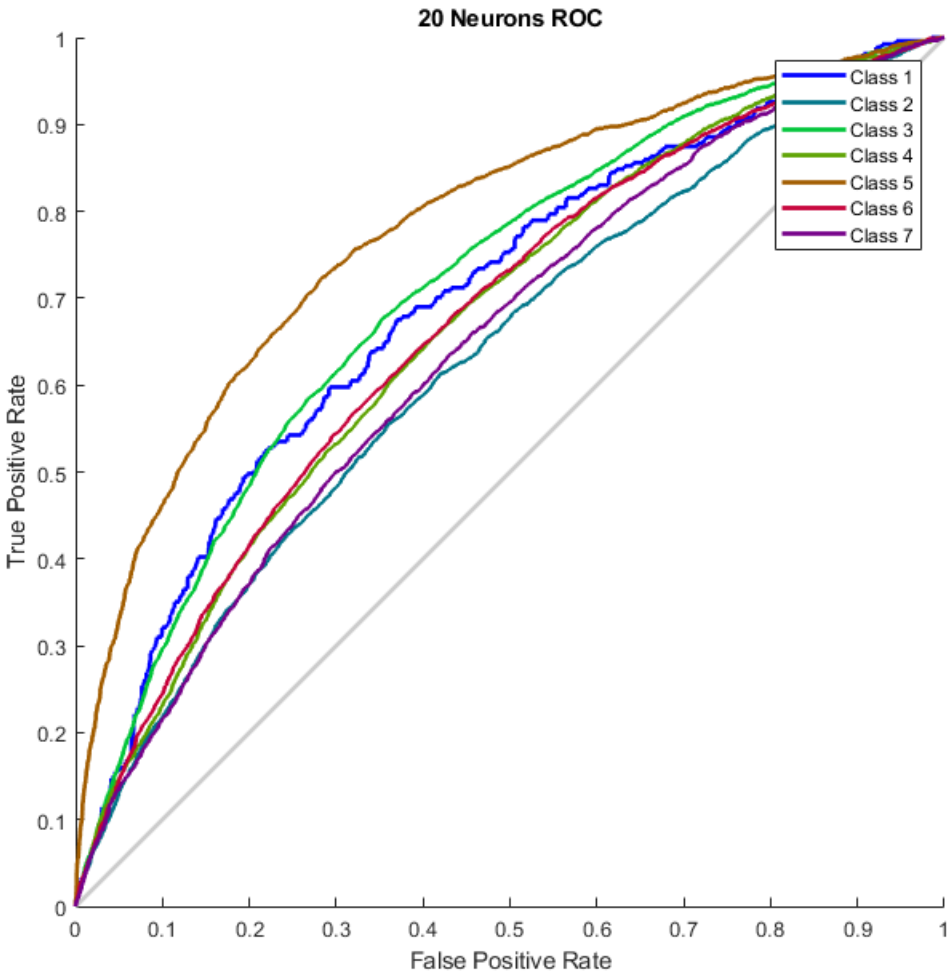


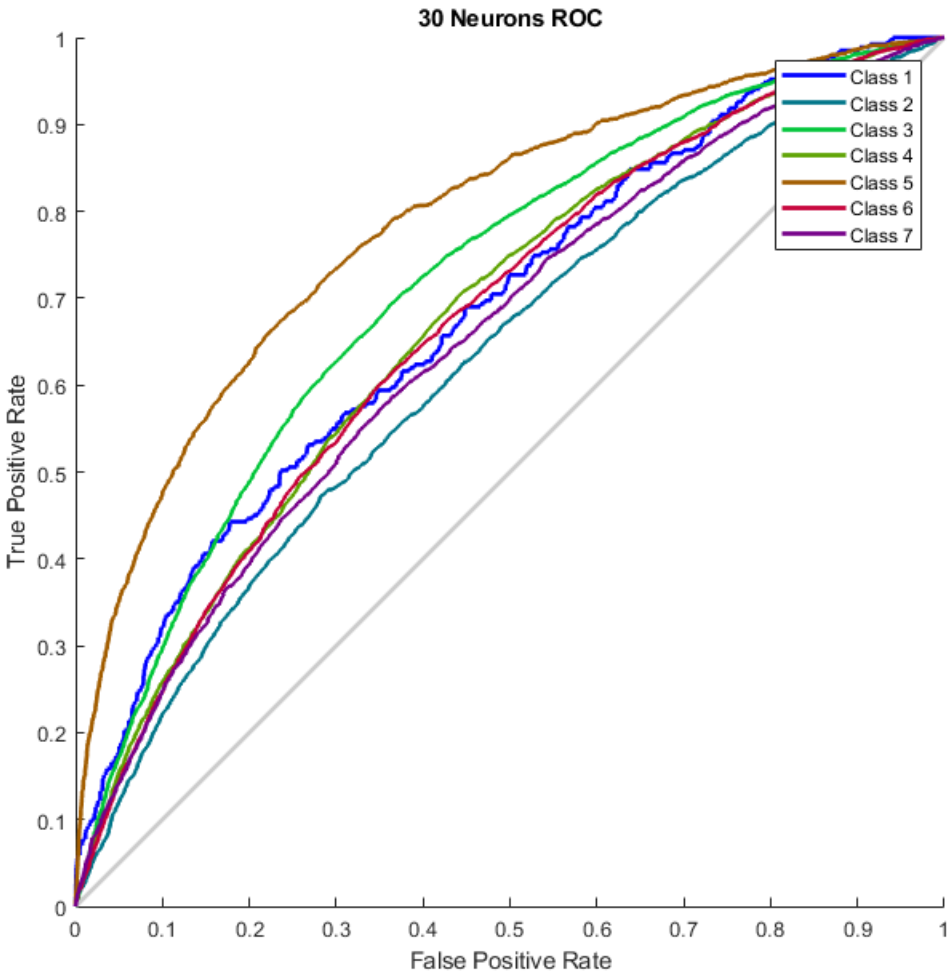
Coif: All ROC

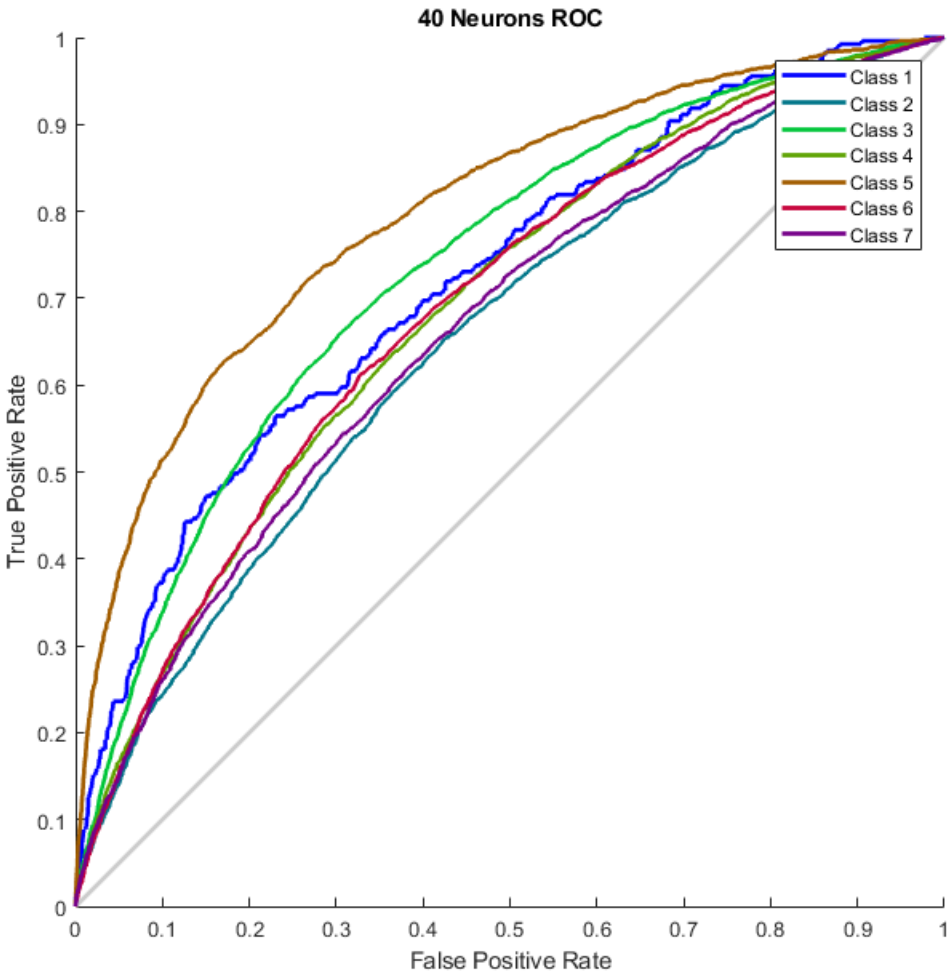
```
for i = 1:21
    formatSpec = "../figSaves/%dN%dRoc";
    savefigpath = sprintf(formatSpec,1,sweep(i));
    openfig(savefigpath);

end

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

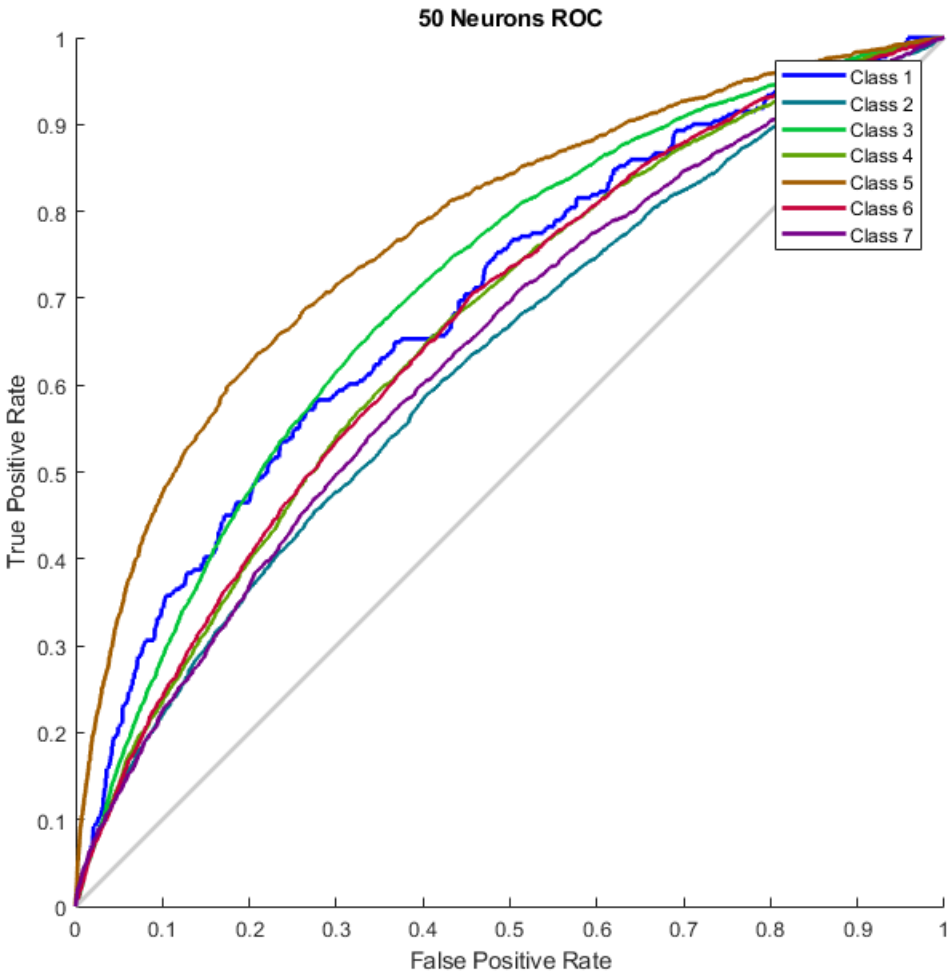

10 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

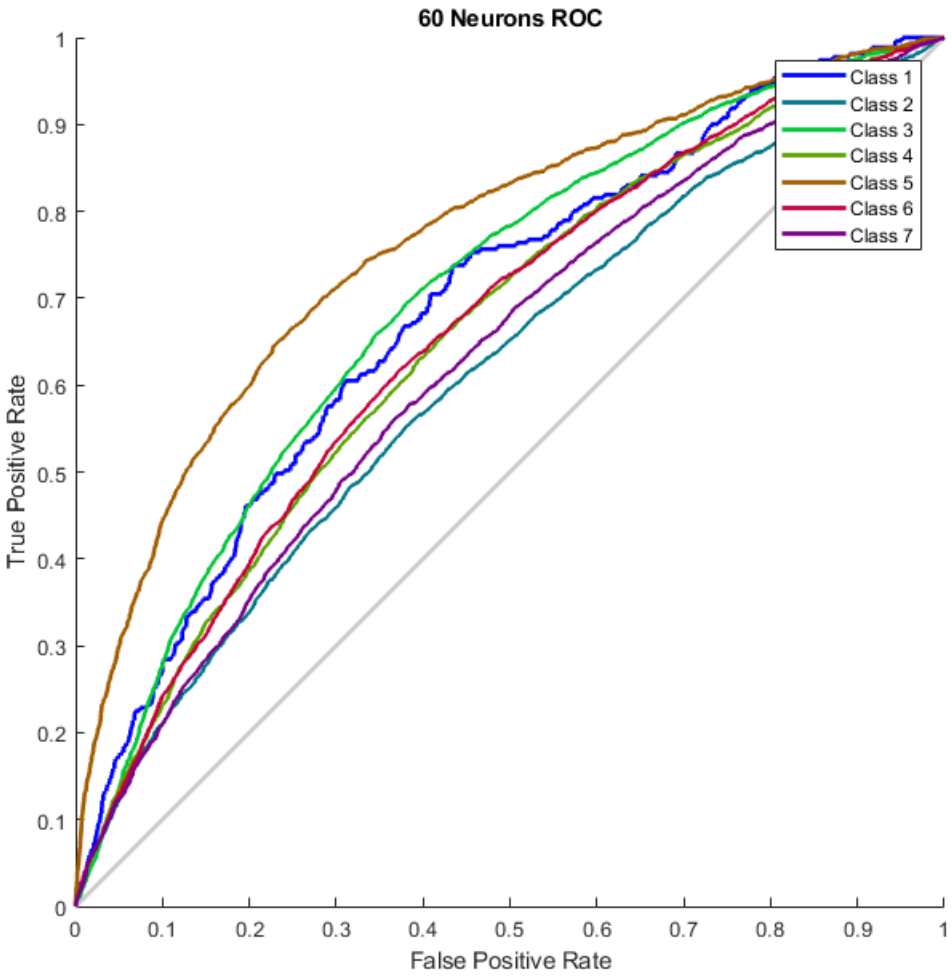

10 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


20 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


30 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7


40 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


50 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


60 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
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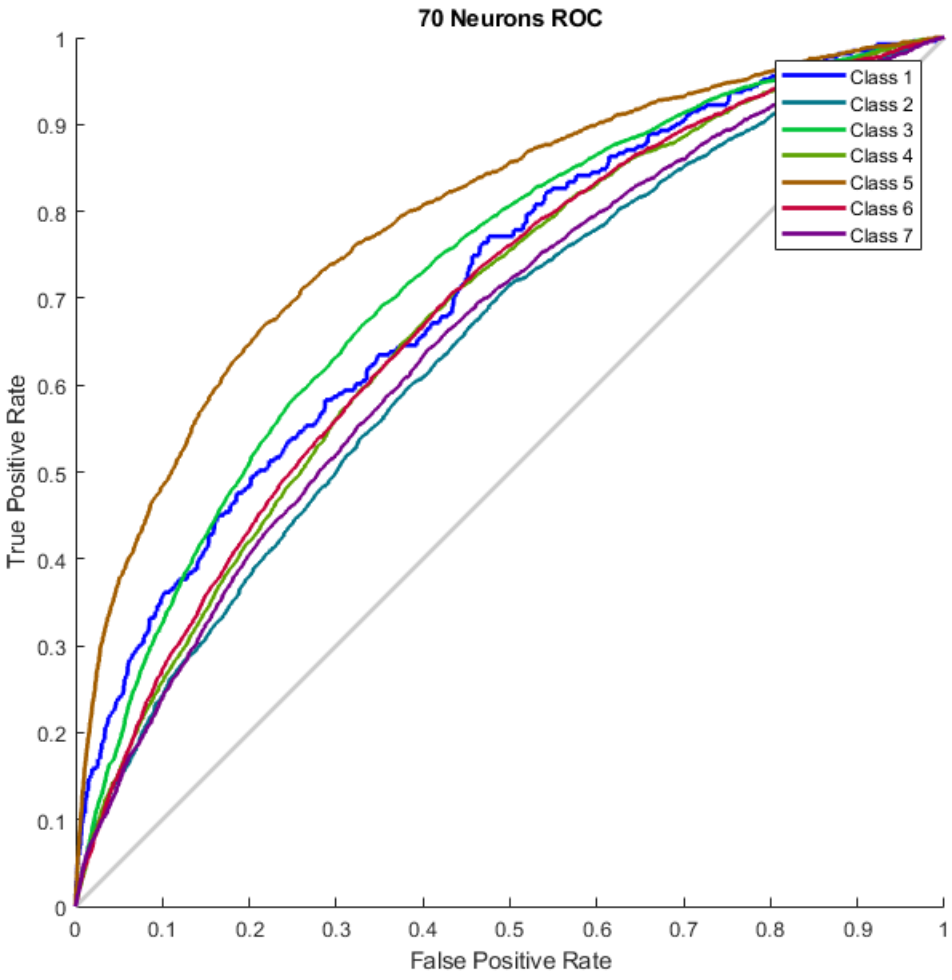
0.6
0.7
0.8
0.9
1


70 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
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0.6
0.7
0.8
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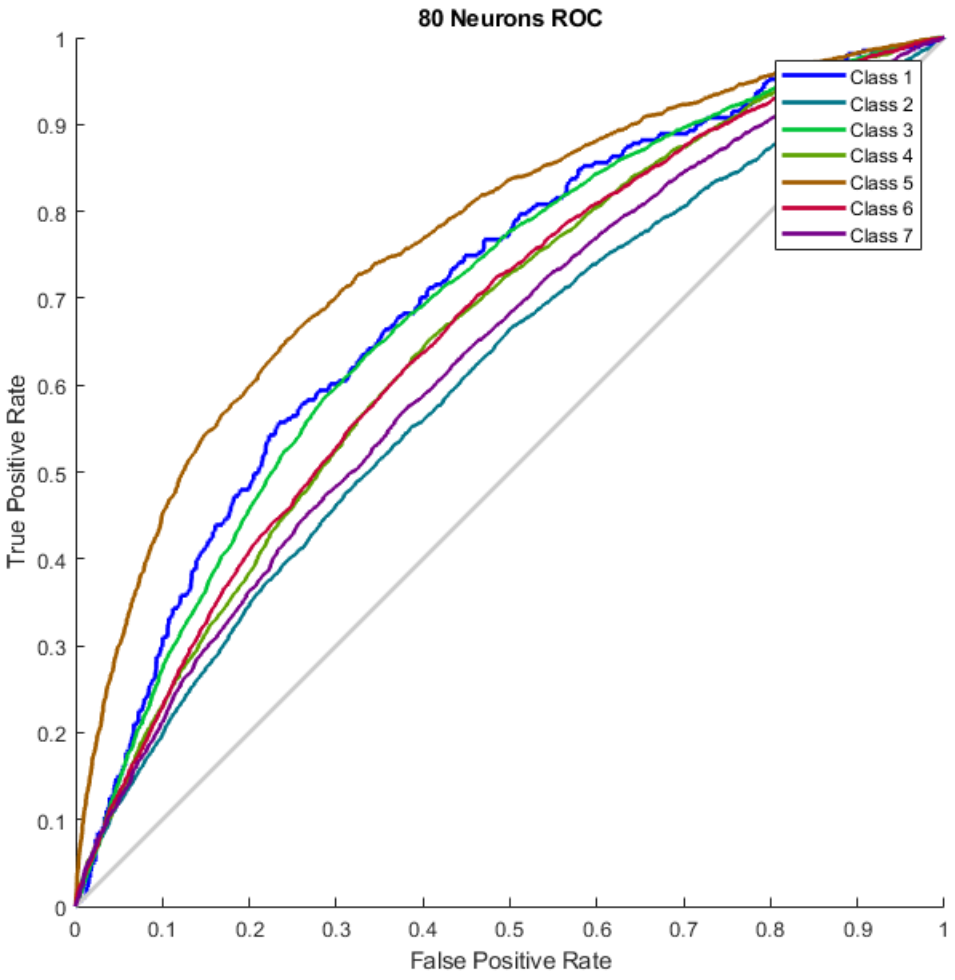
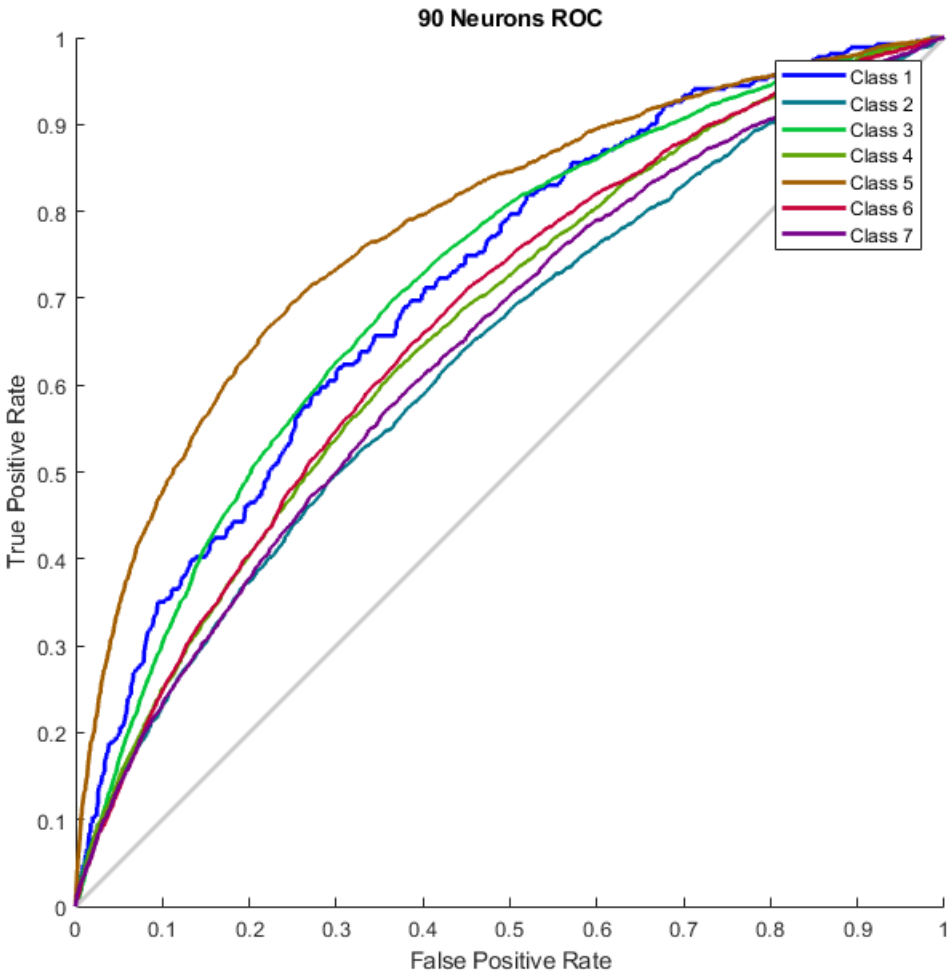
1


80 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


90 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
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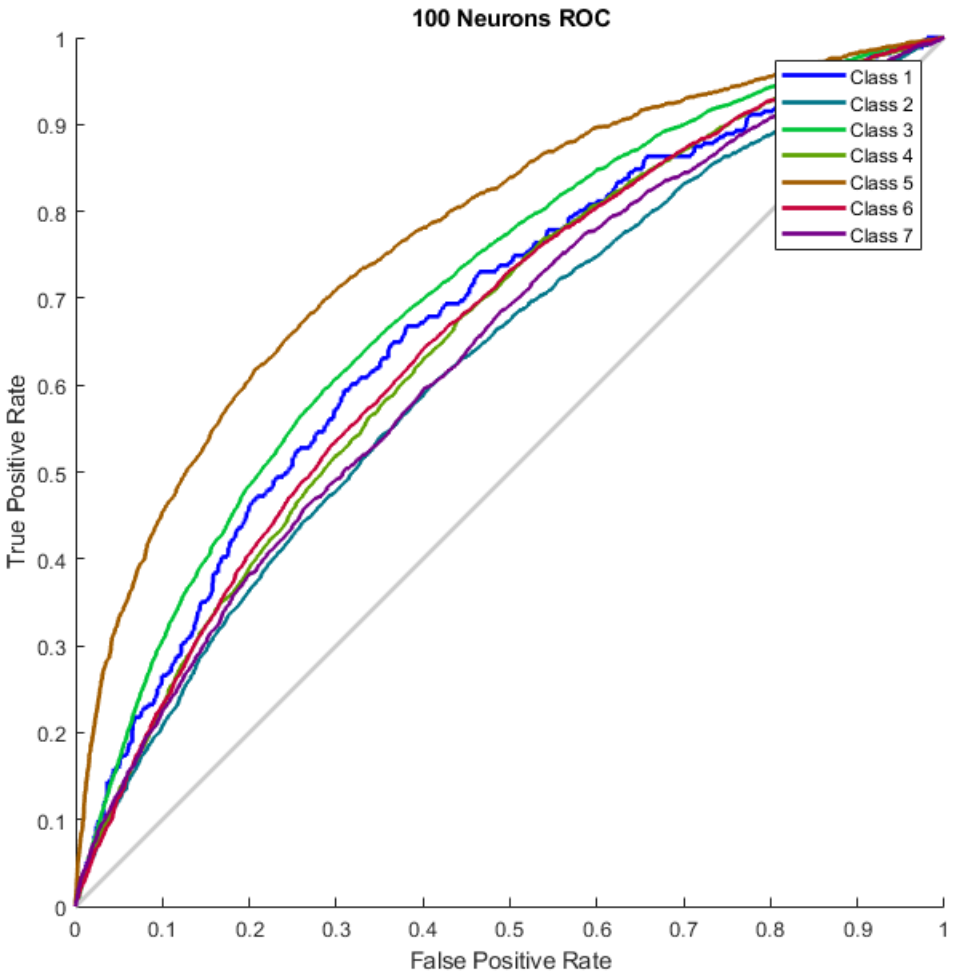
0.5
0.6
0.7
0.8
0.9
1


100 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
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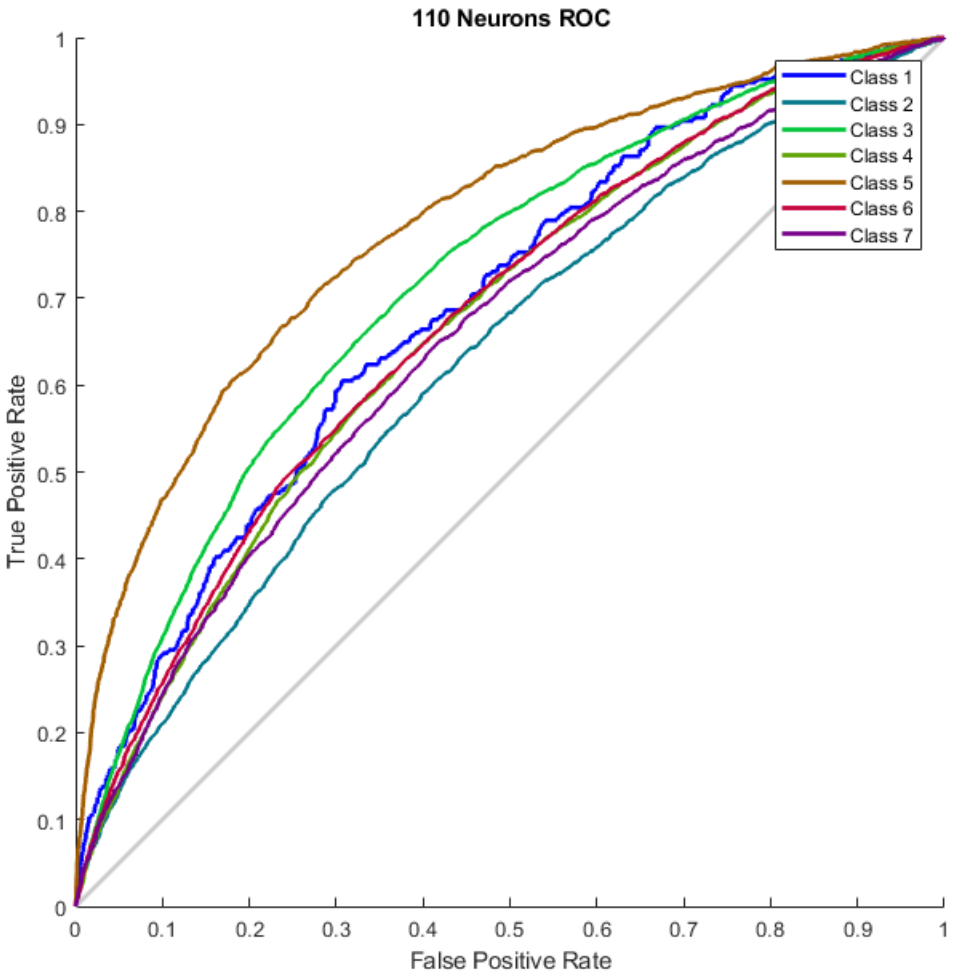
0.6
0.7
0.8
0.9
1


110 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
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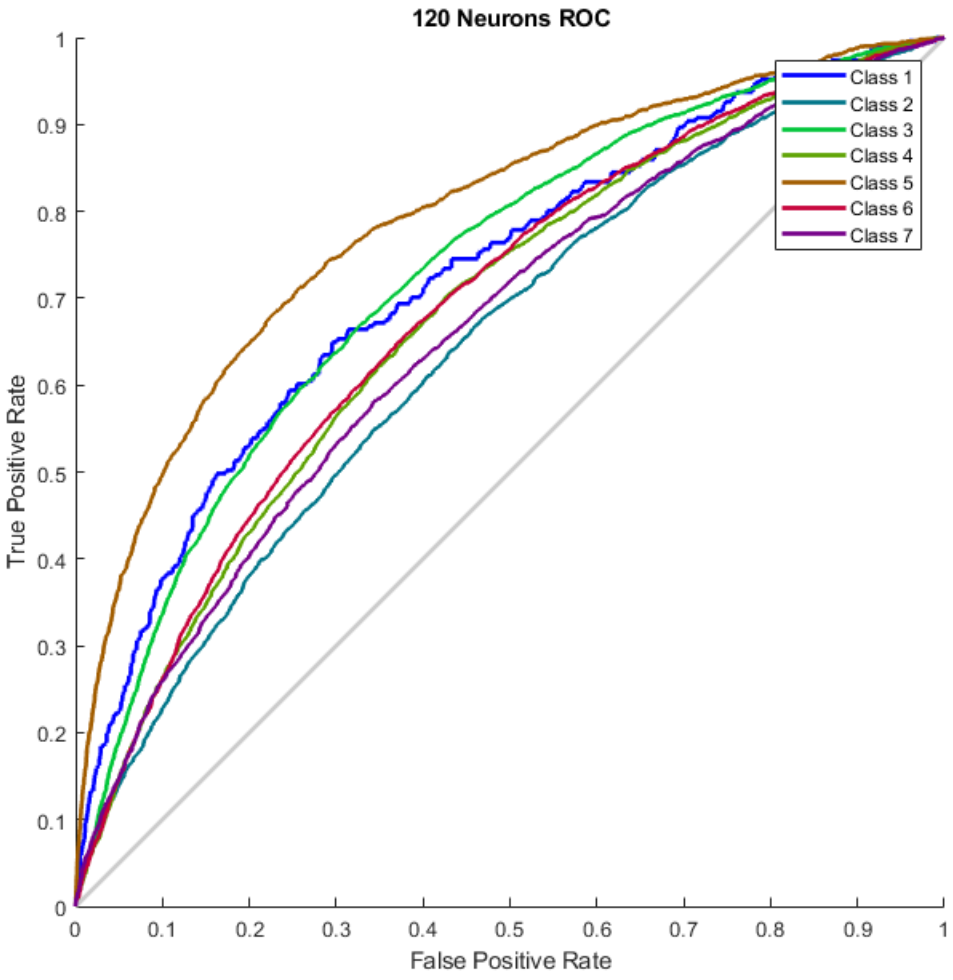
0.6
0.7
0.8
0.9
1


120 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
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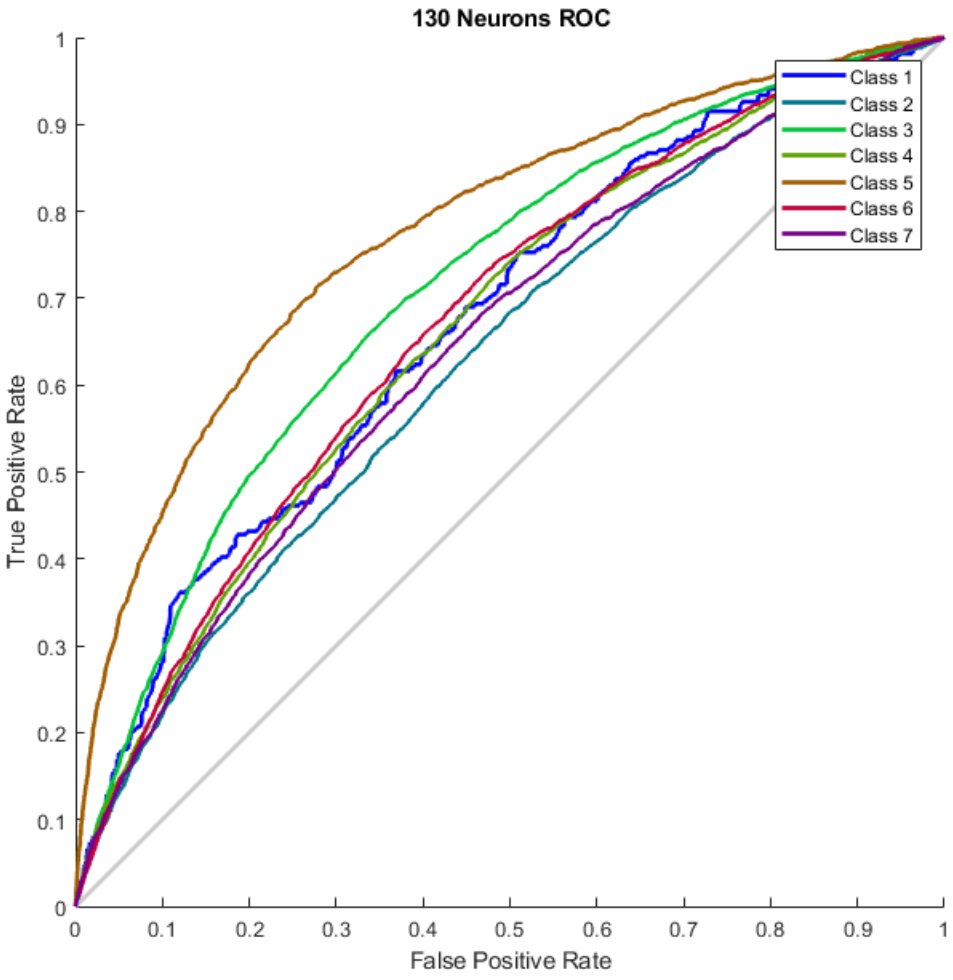
1


130 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
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0.6
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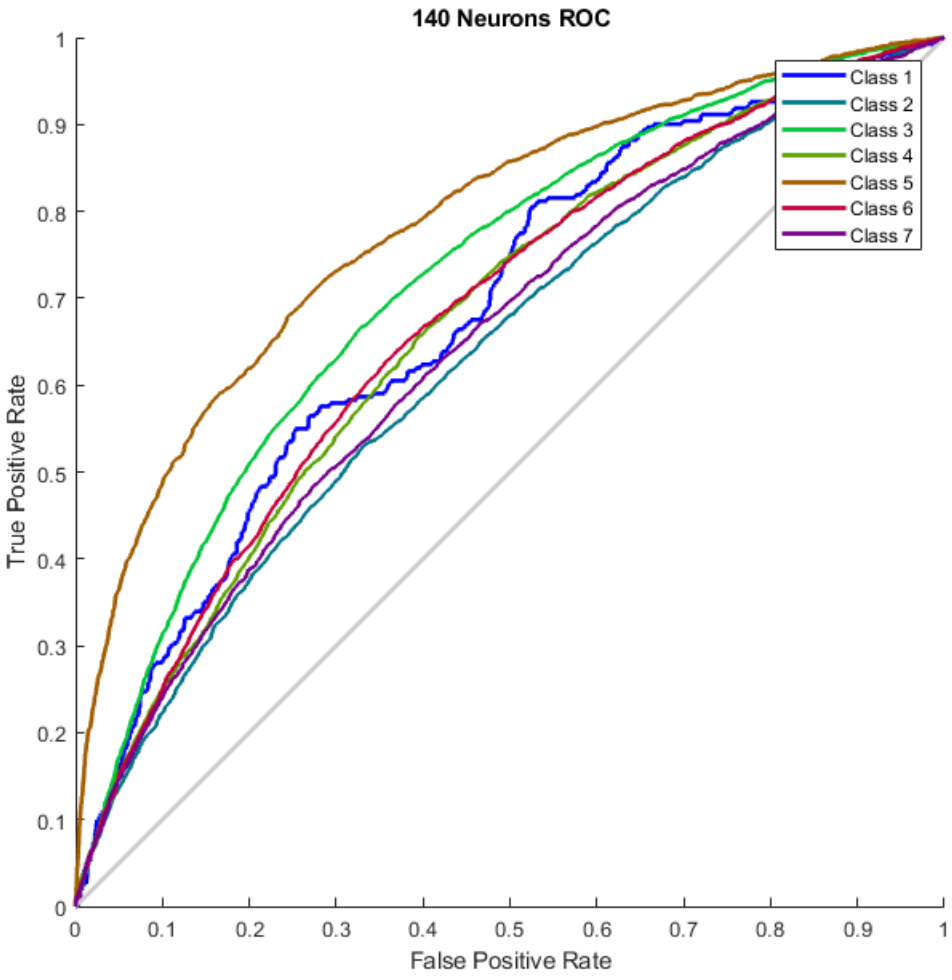
0.9
1


140 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
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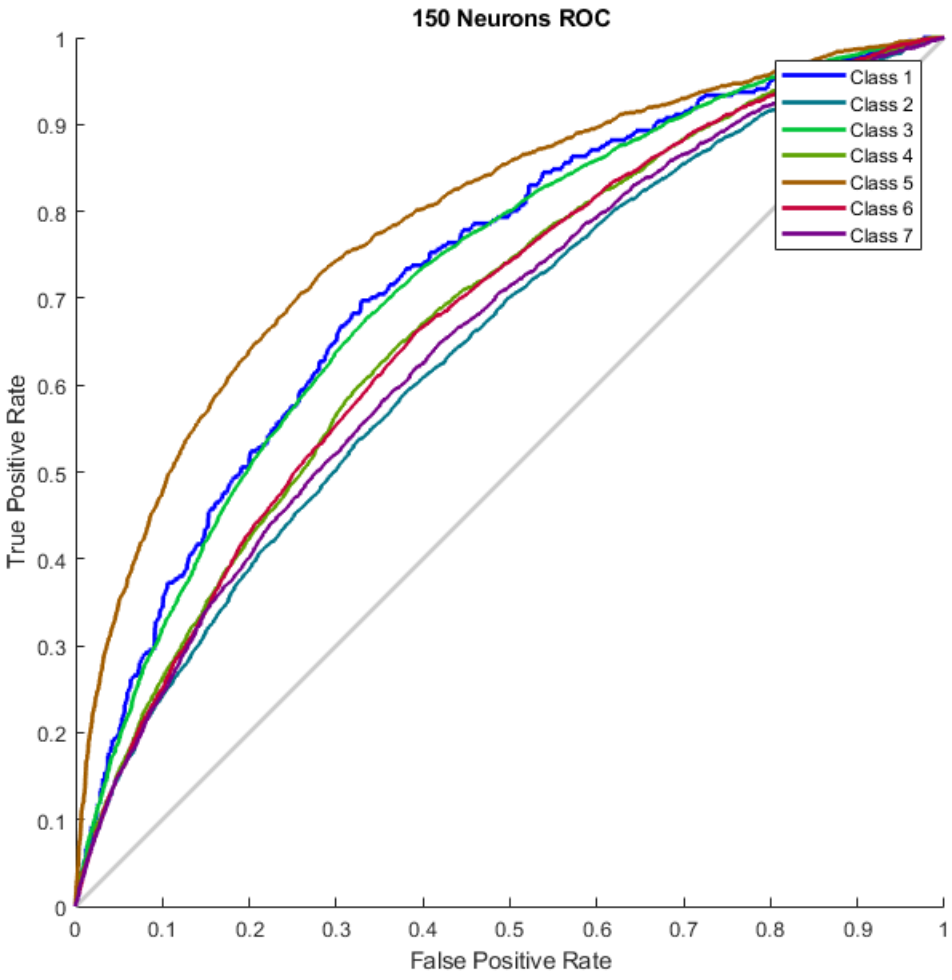
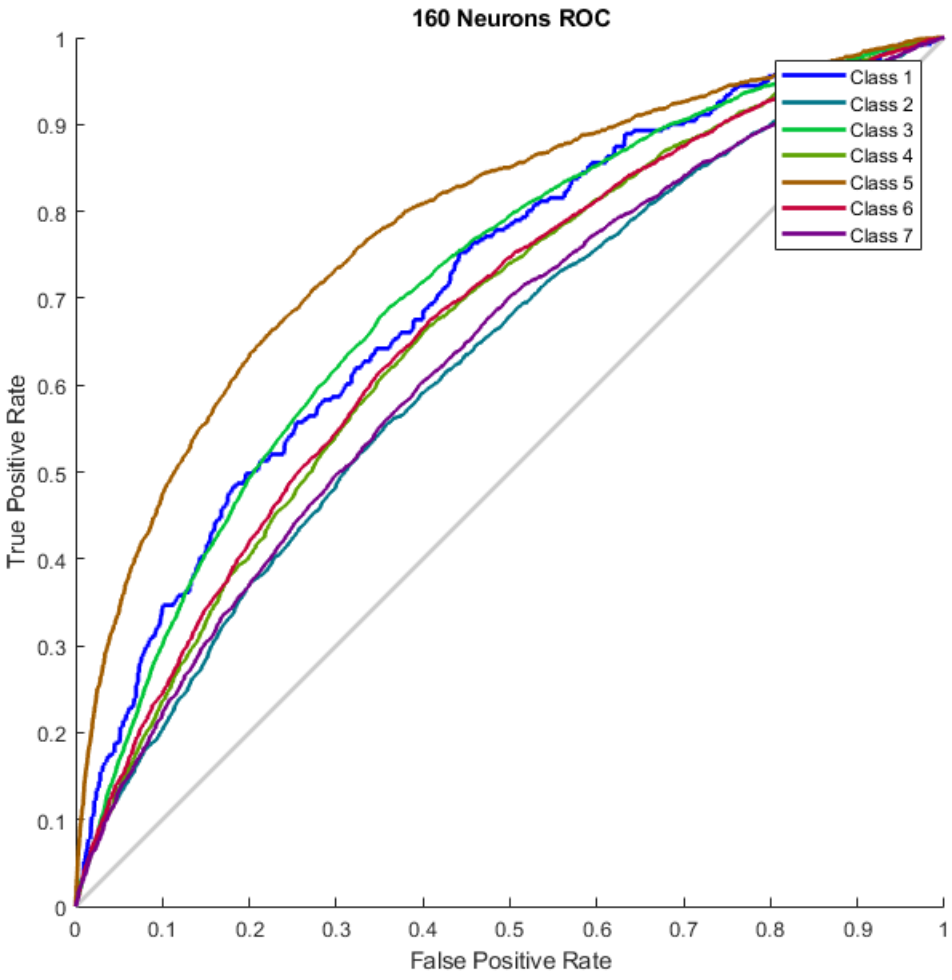
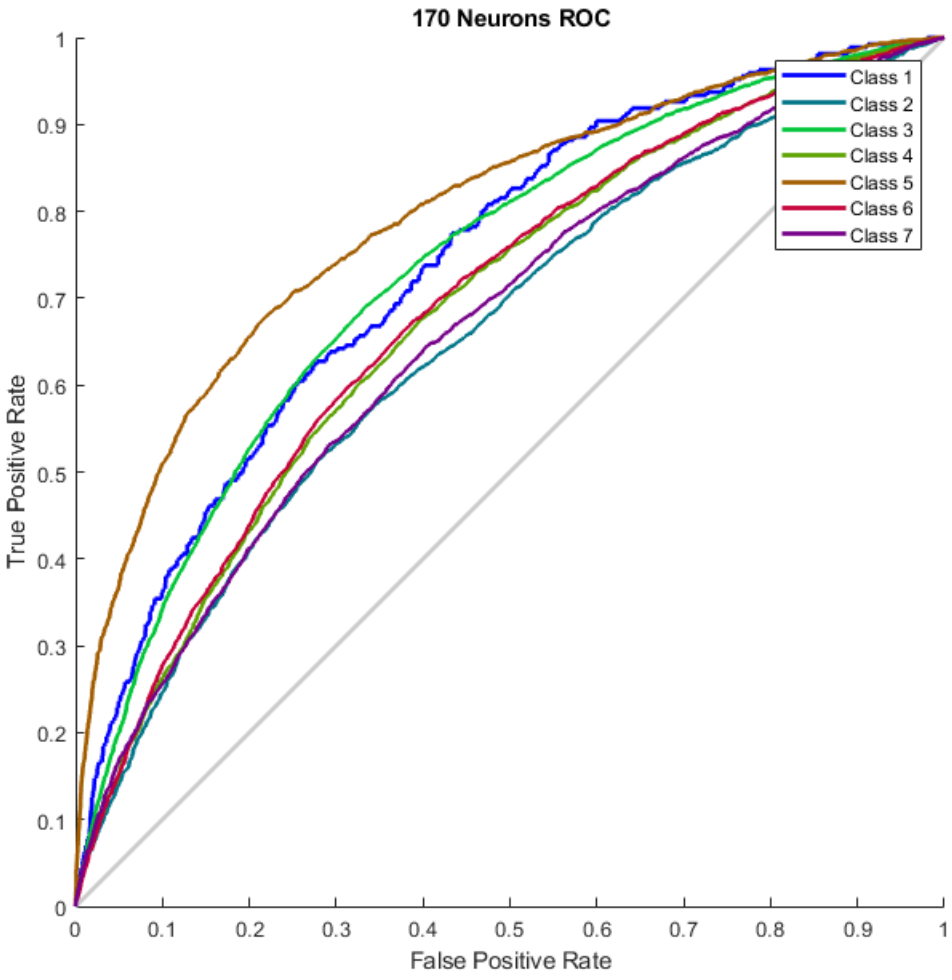
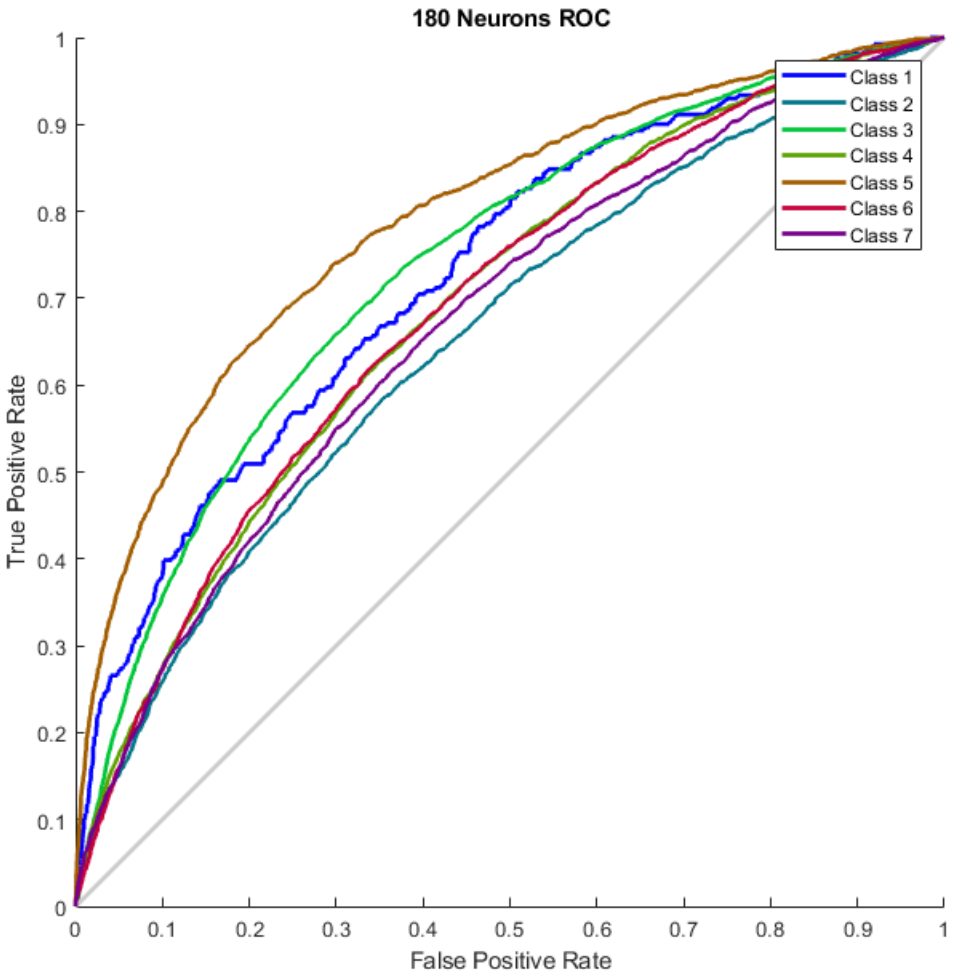
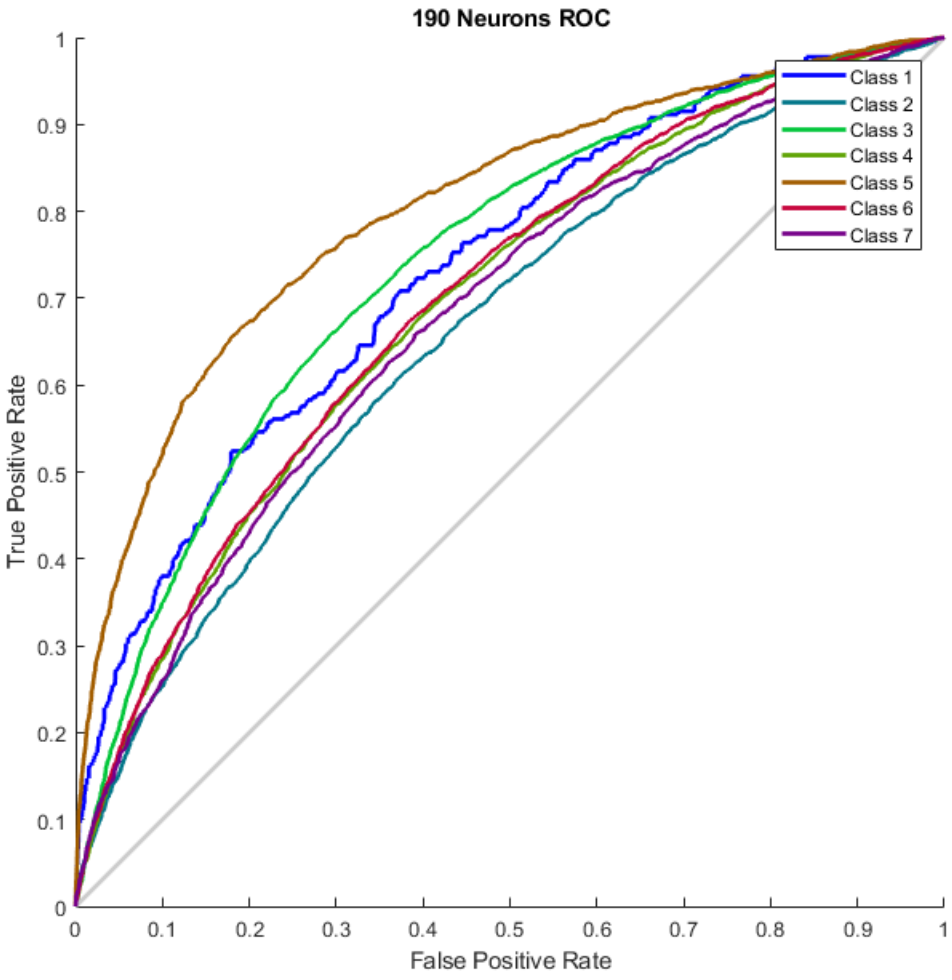
0.6
0.7
0.8
0.9
1

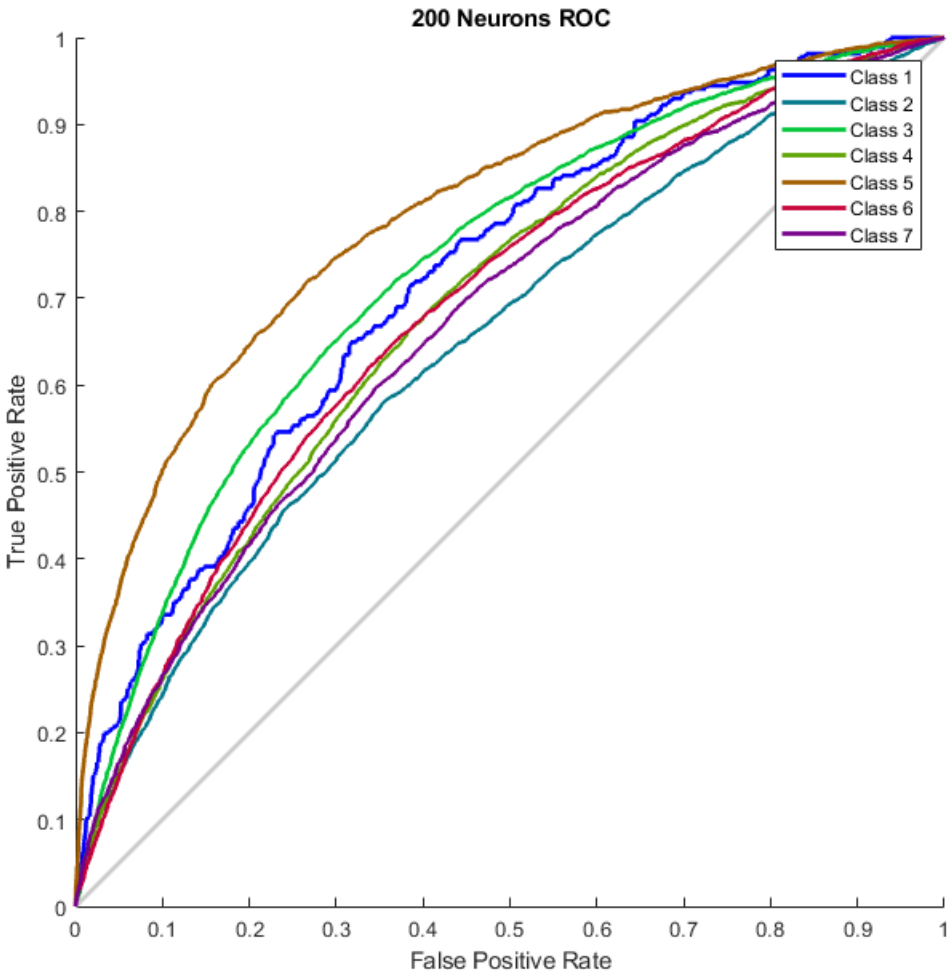

150 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


160 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


170 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

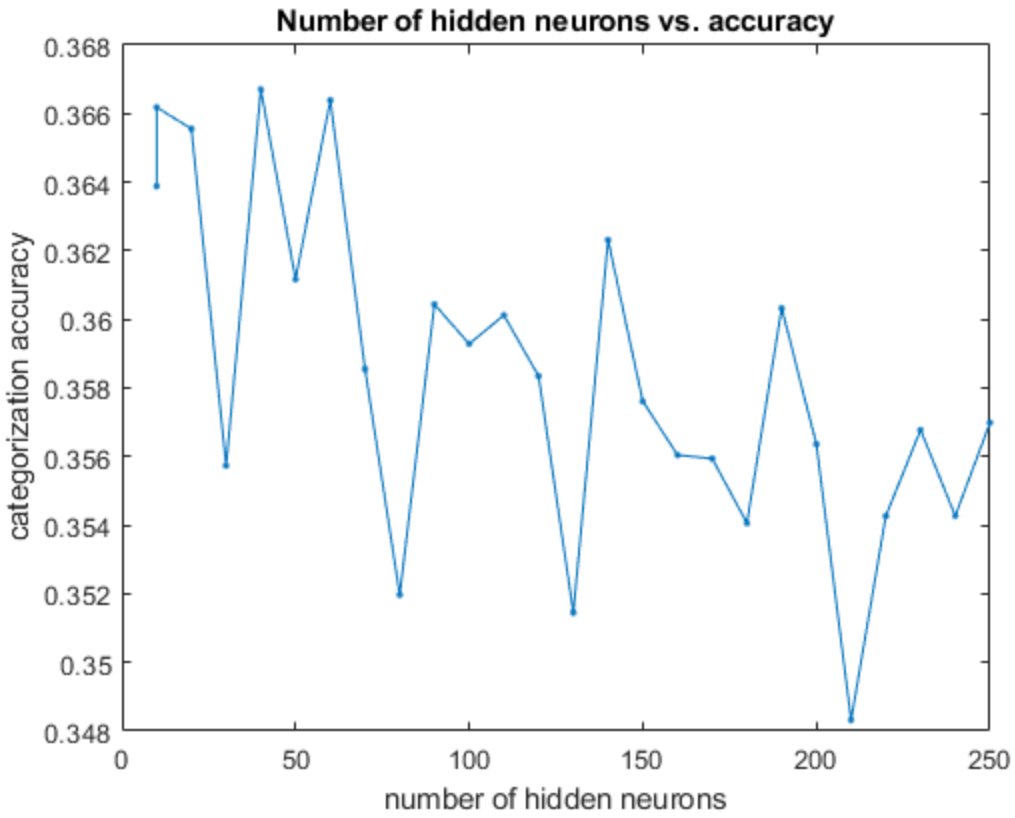

180 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


190 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7



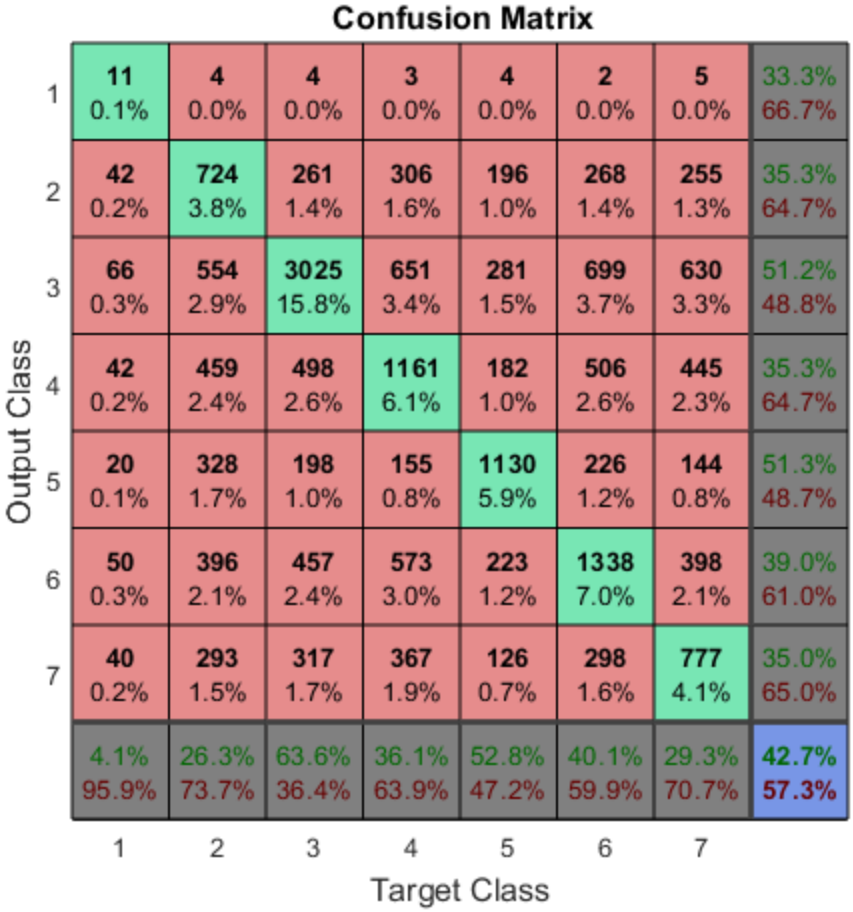
Harr

```
% Below is the accuracy of the sweep.
openfig("../figSaves/2_SweepResult");
```



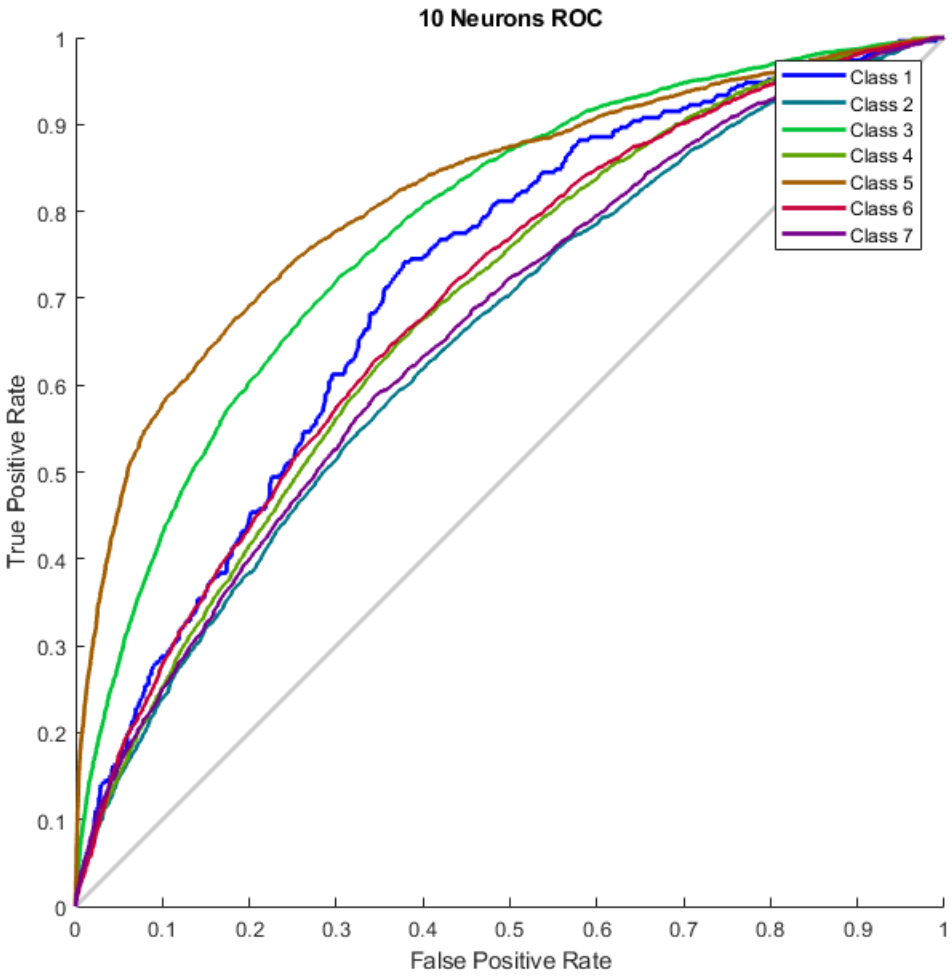
Confusion Matrix

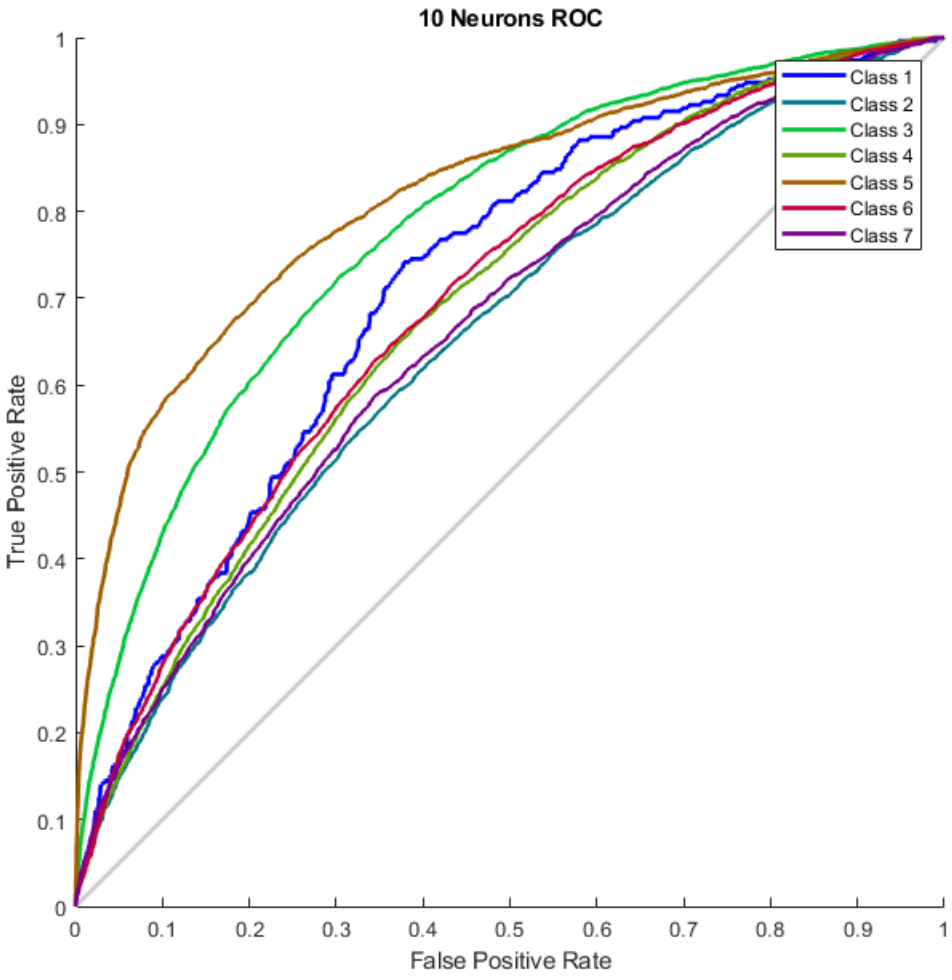
```
openfig("../figSaves/ConfusionMatrix_2");
```

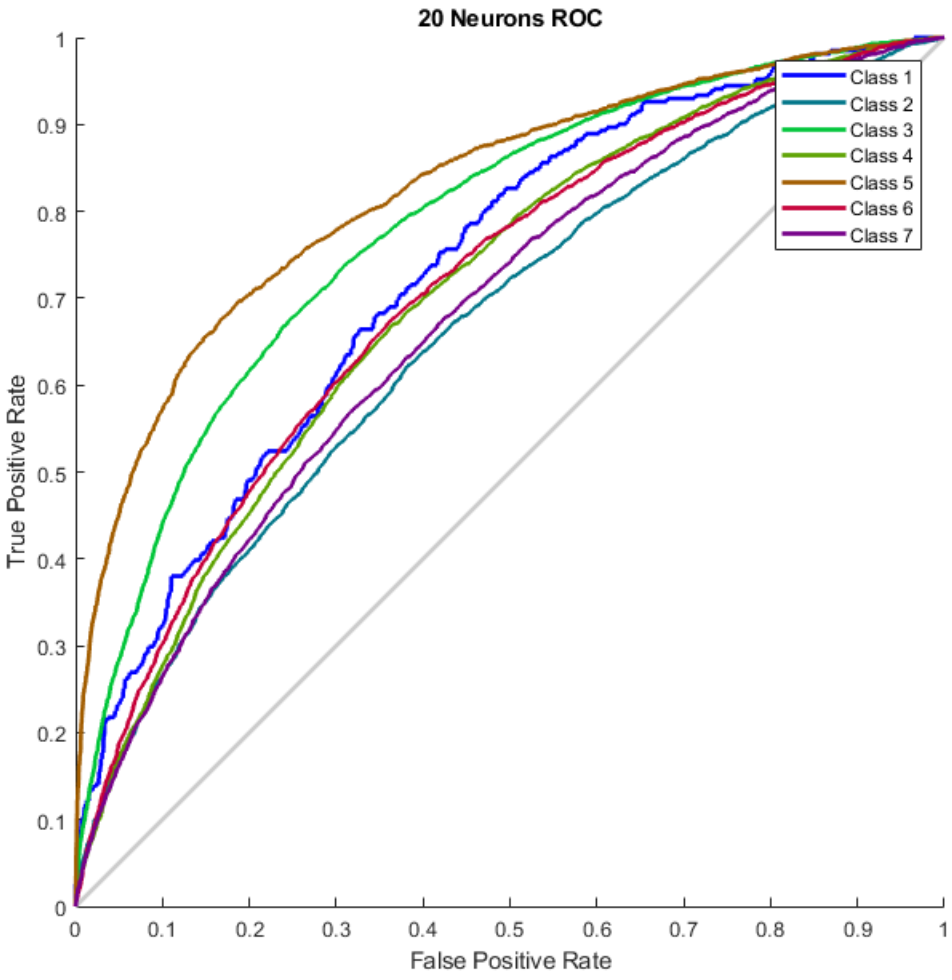


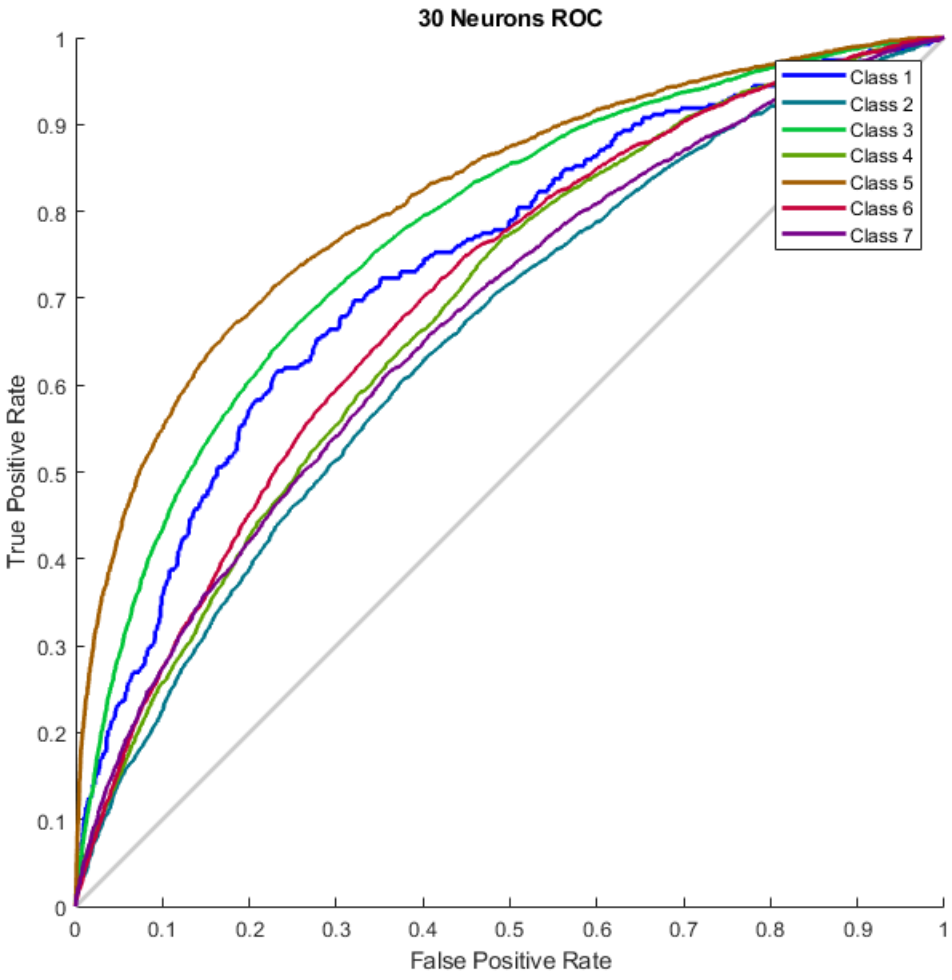
Harr: All ROC

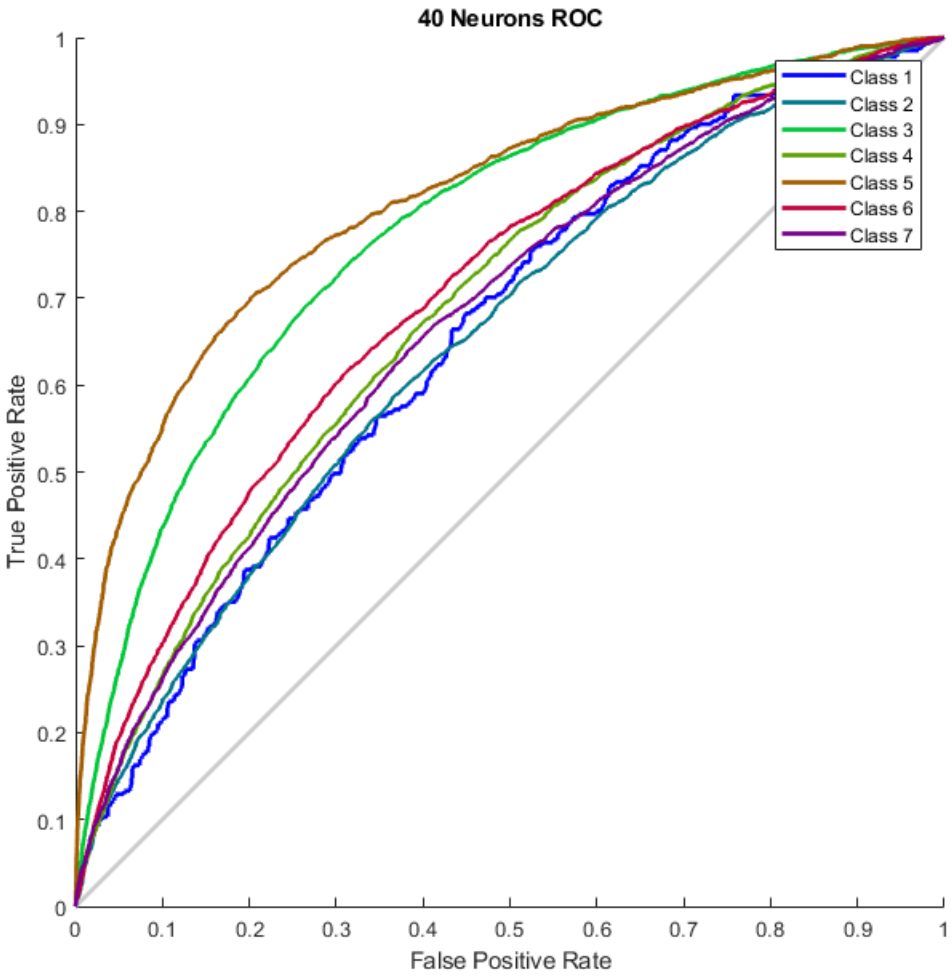
```
for i = 1:21
    formatSpec = "../figSaves/%dN%dRoc";
    savefigpath = sprintf(formatSpec,2,sweep(i));
    openfig(savefigpath);

end
```

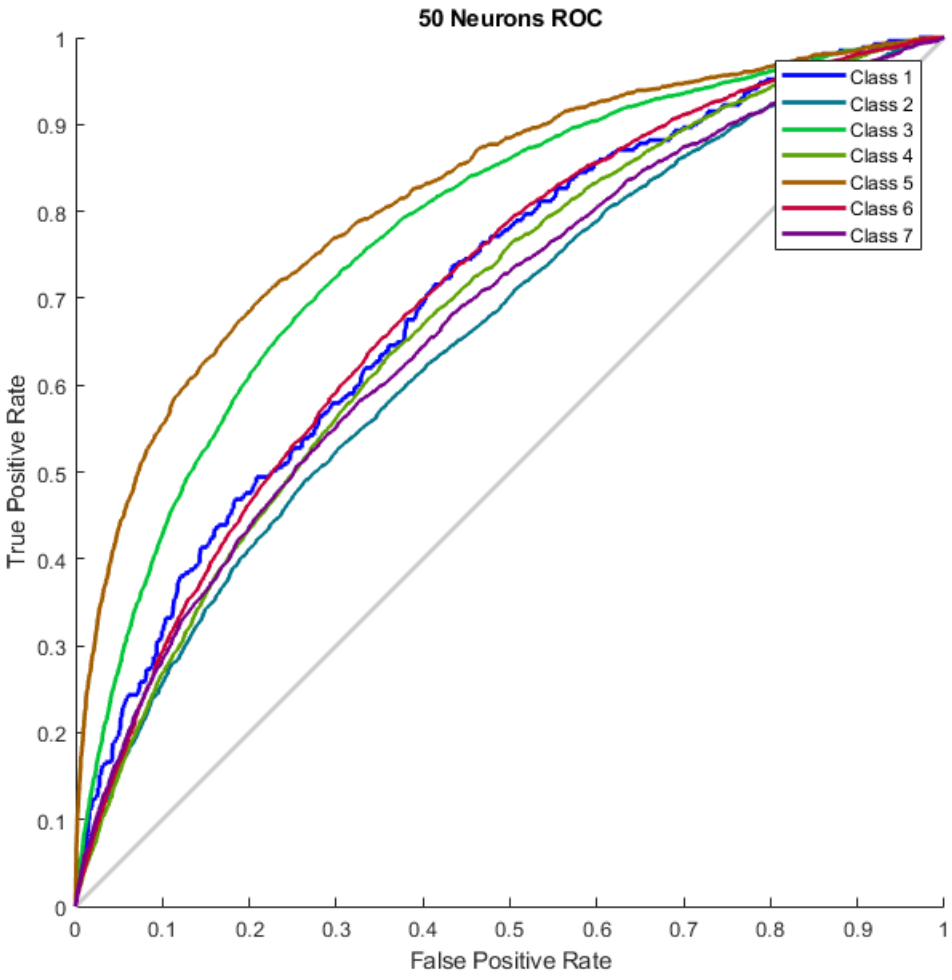

10 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

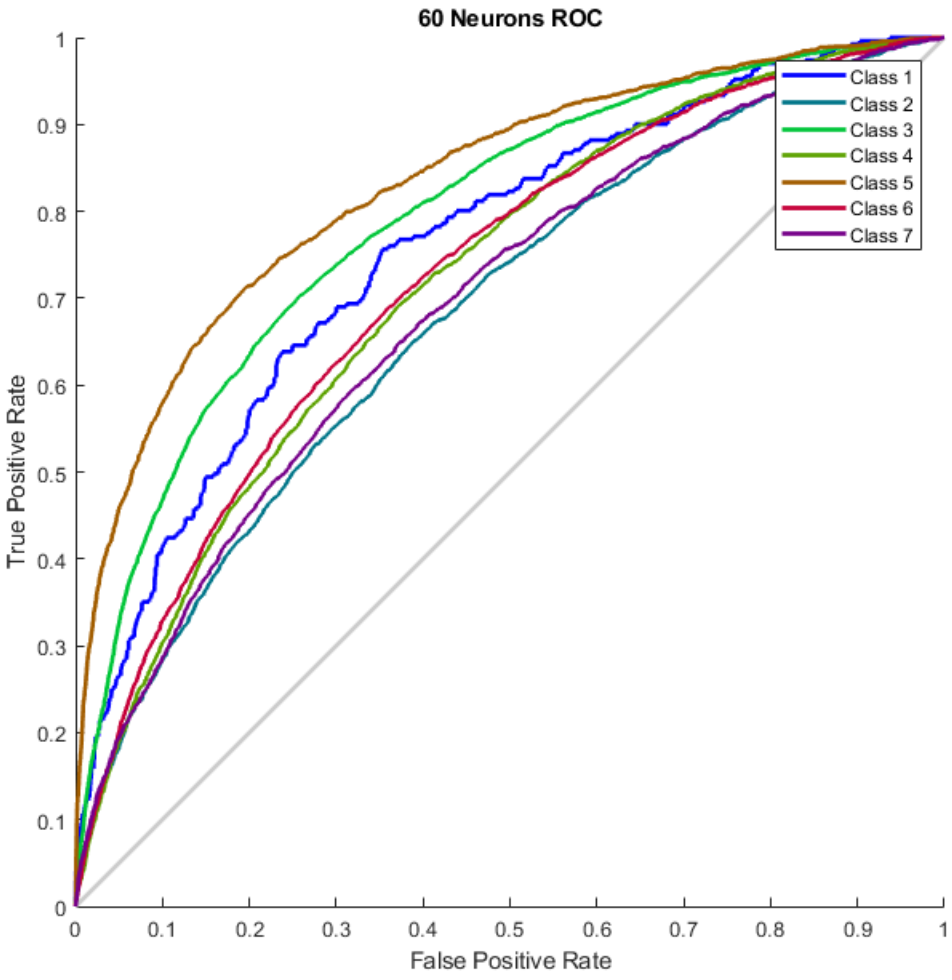

10 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

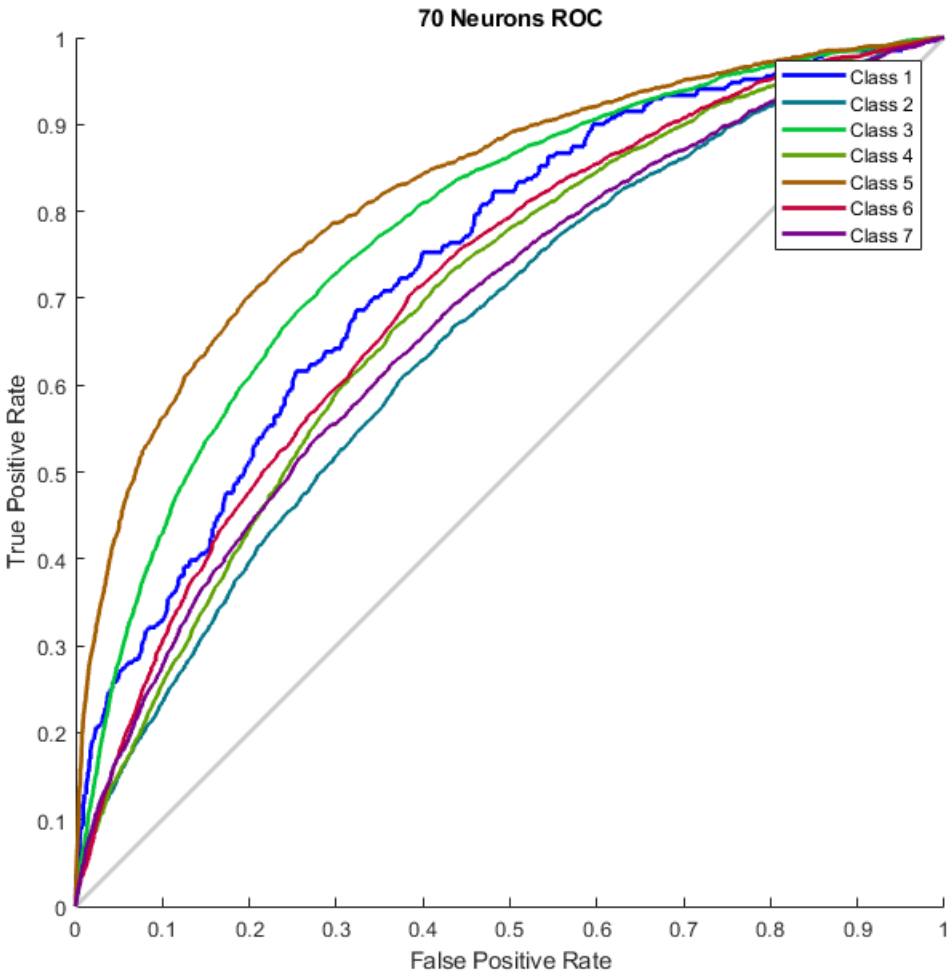

20 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

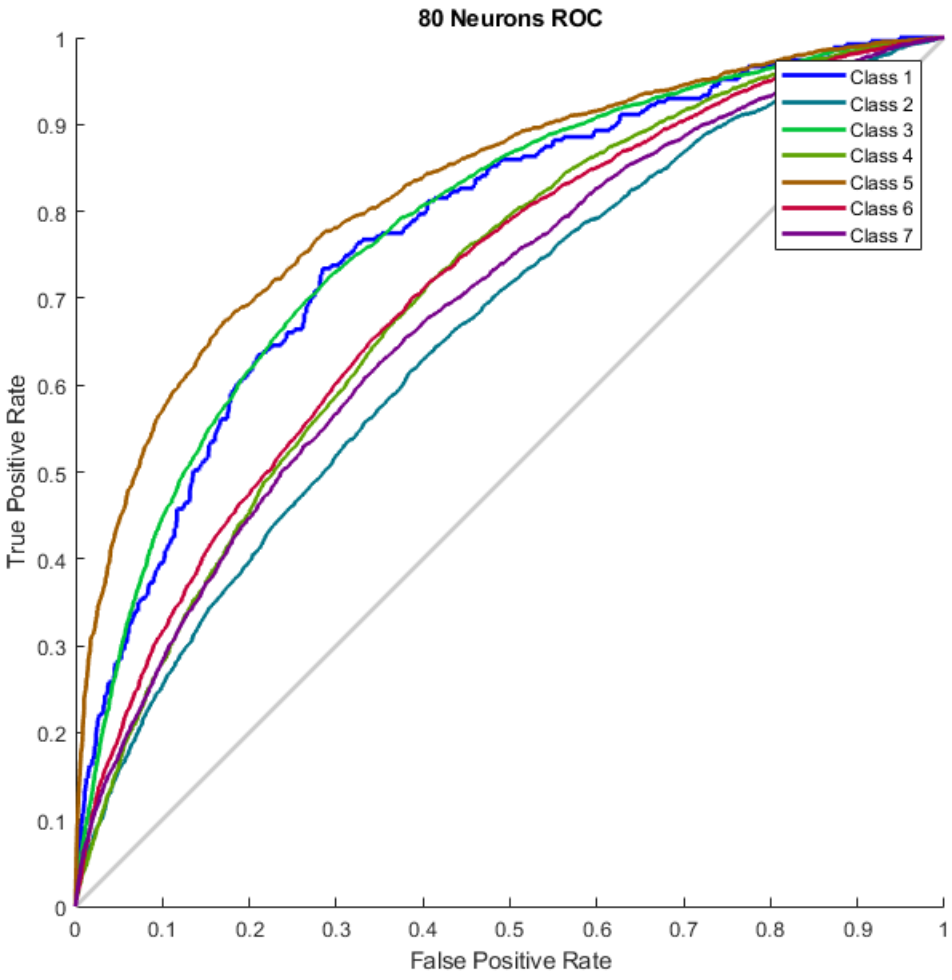

30 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

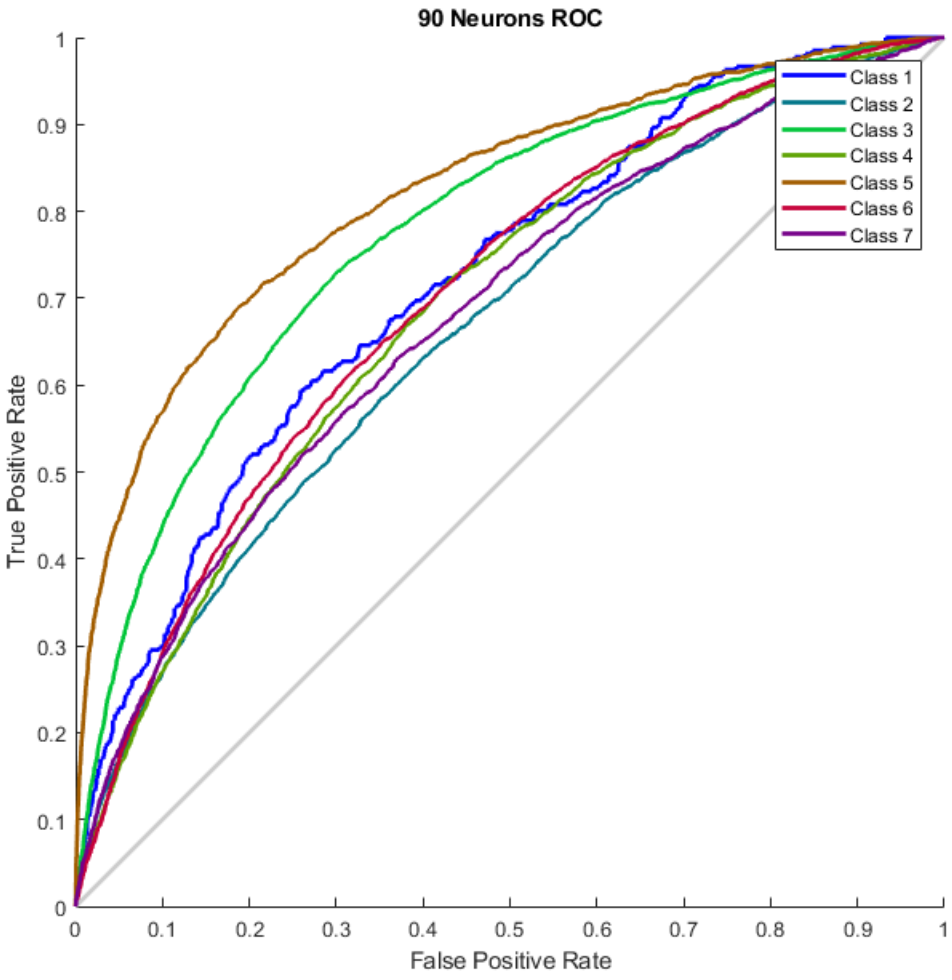

40 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

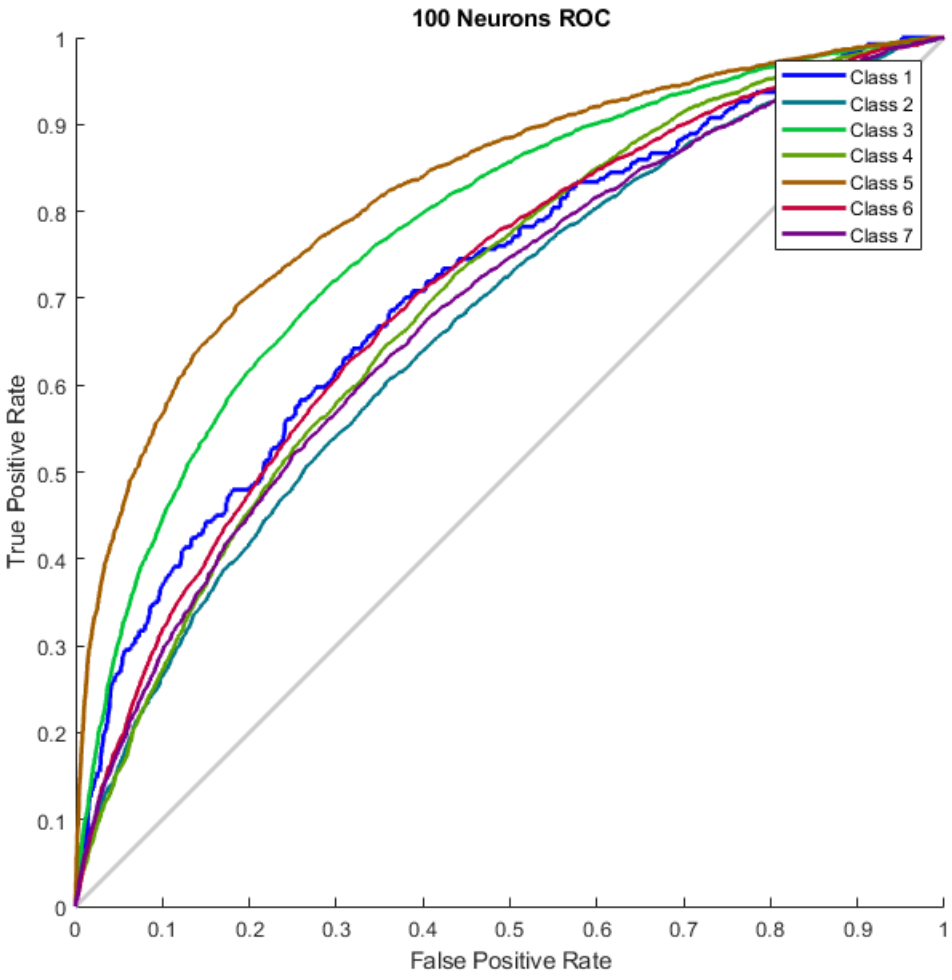

50 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

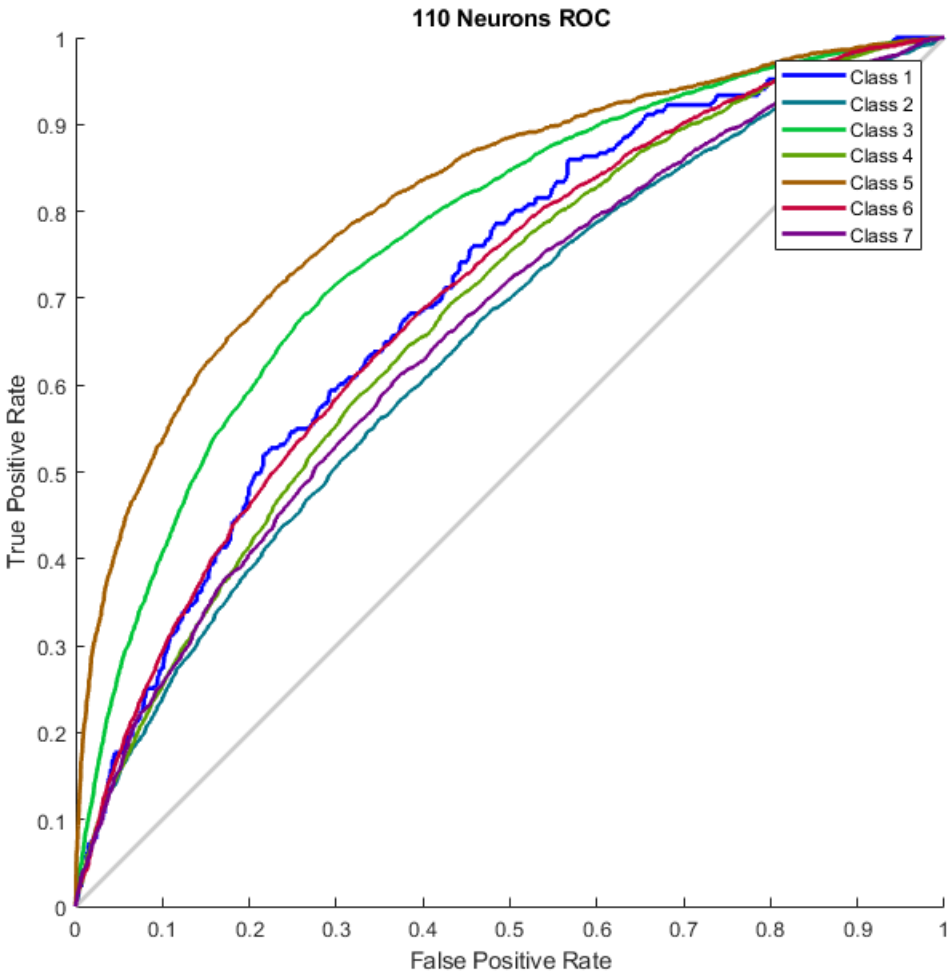

60 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

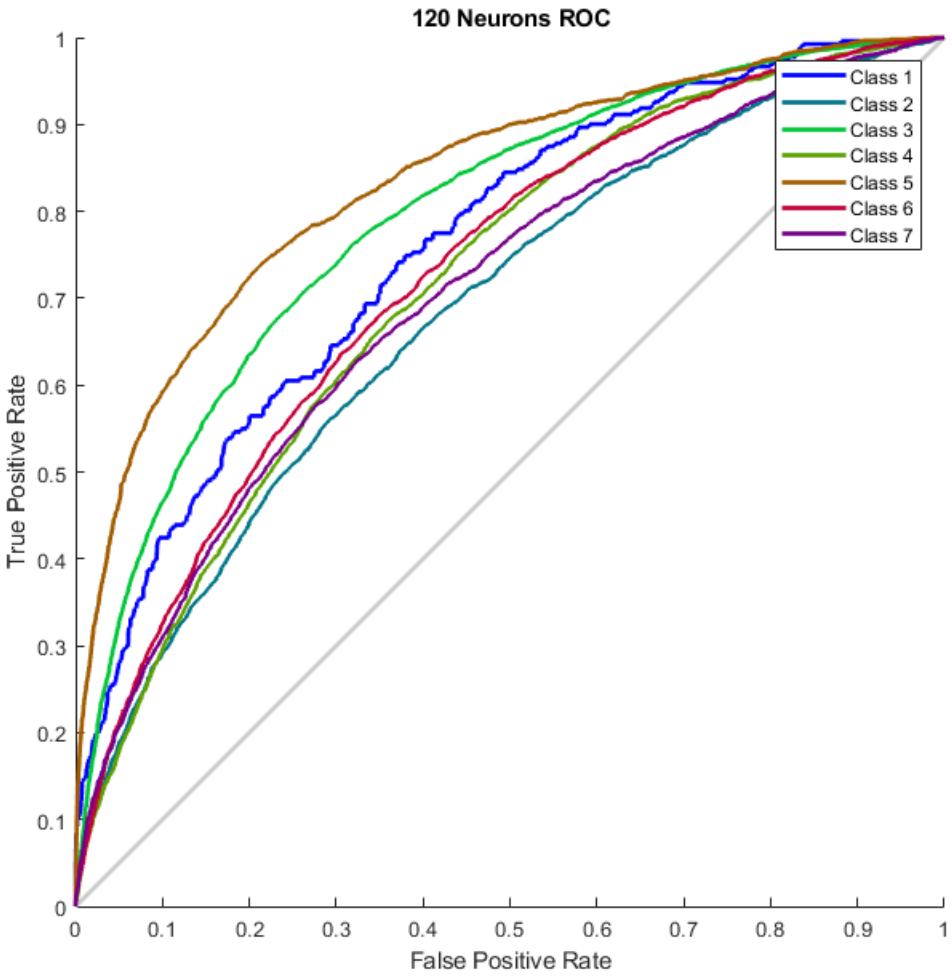

70 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7

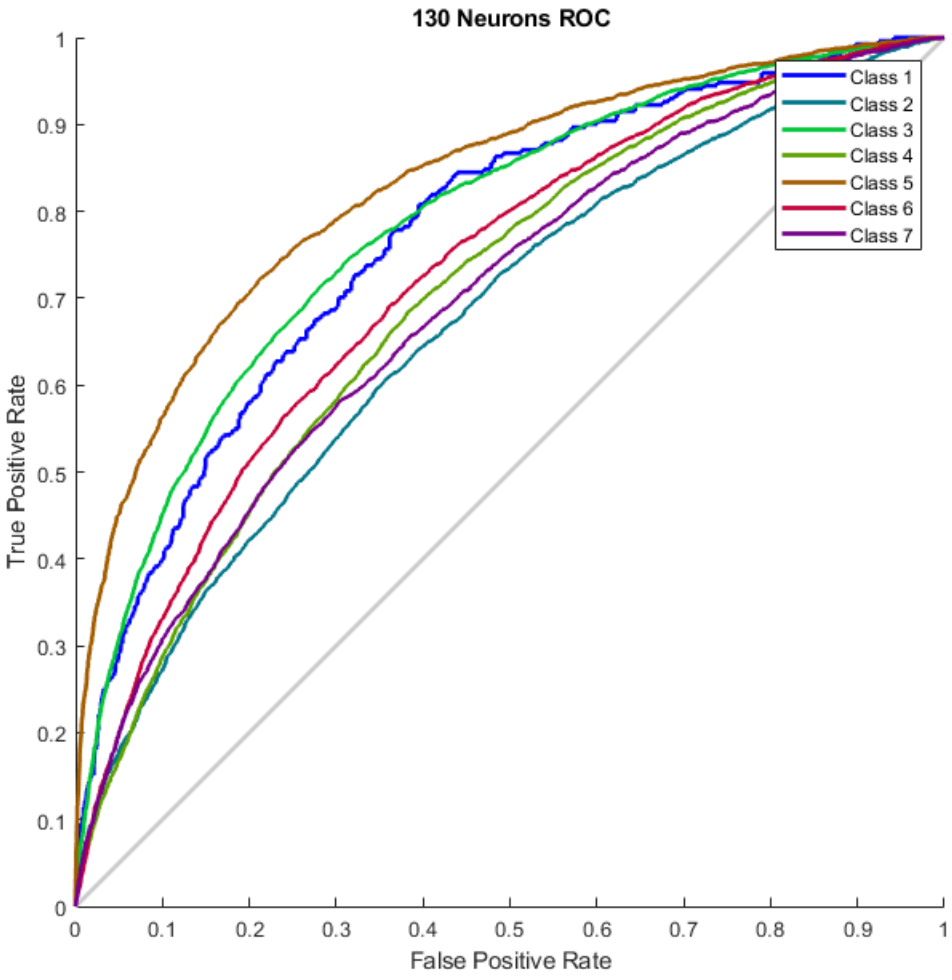

80 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

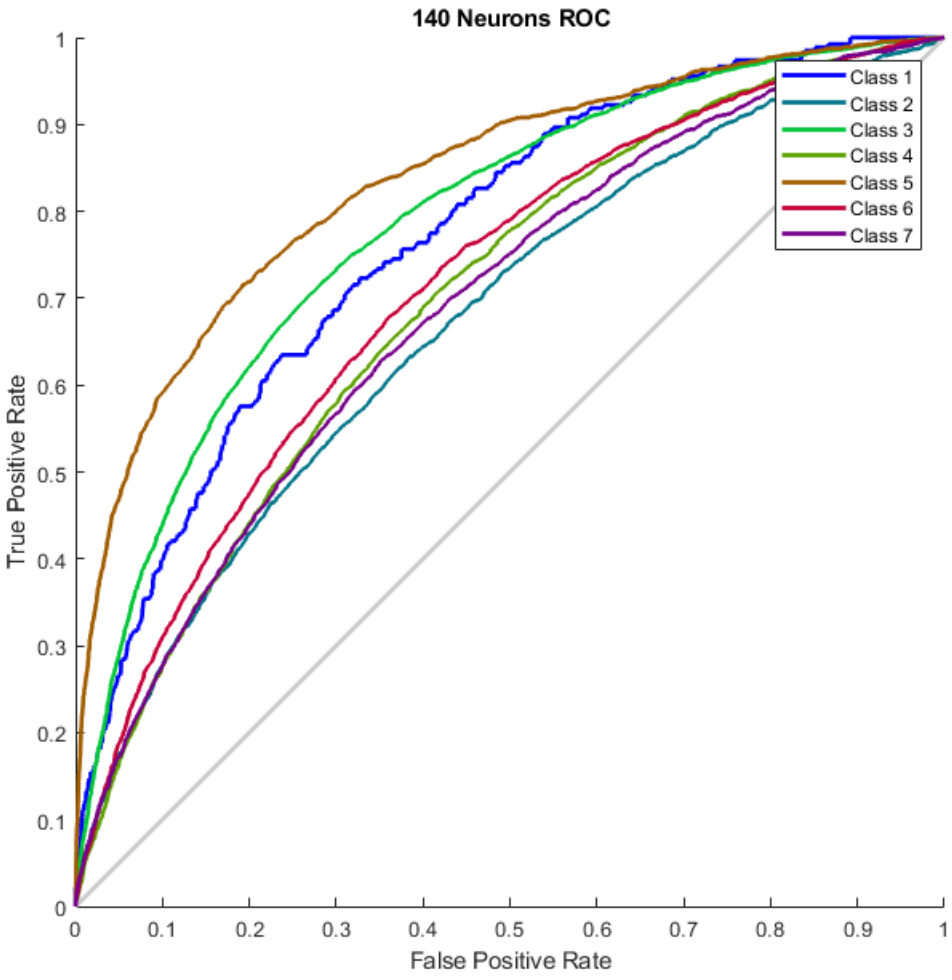

90 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7

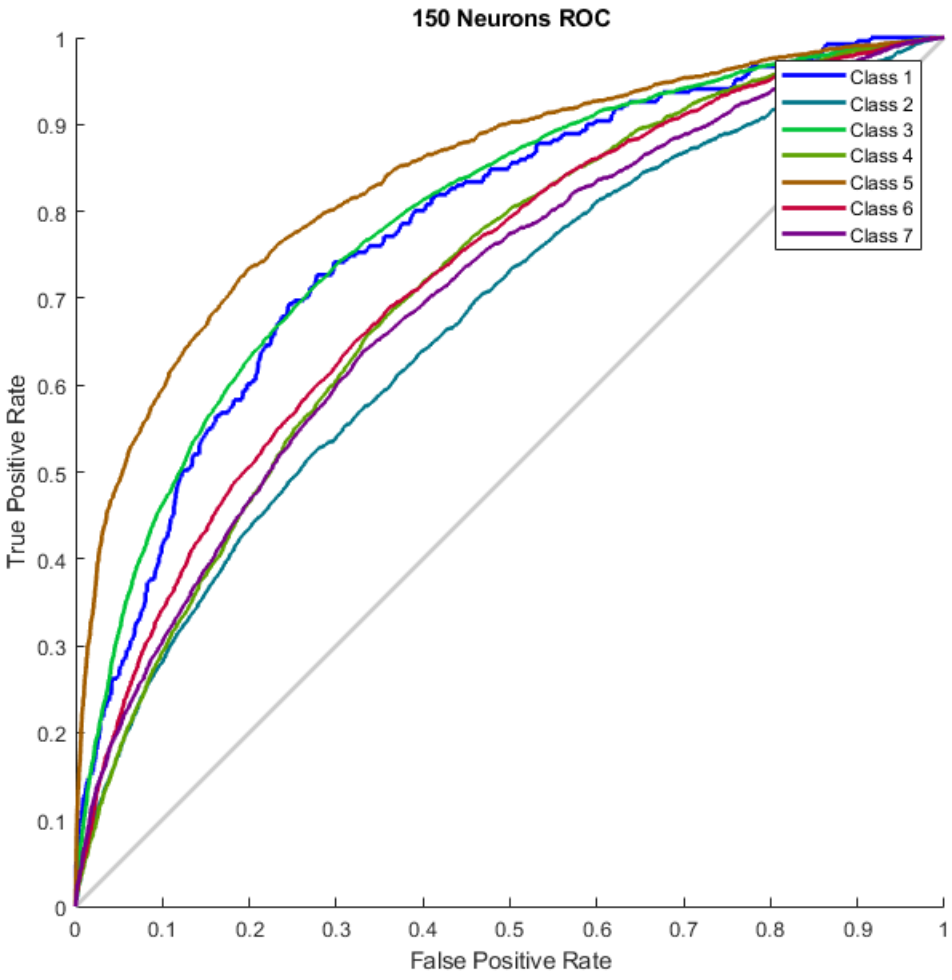

100 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

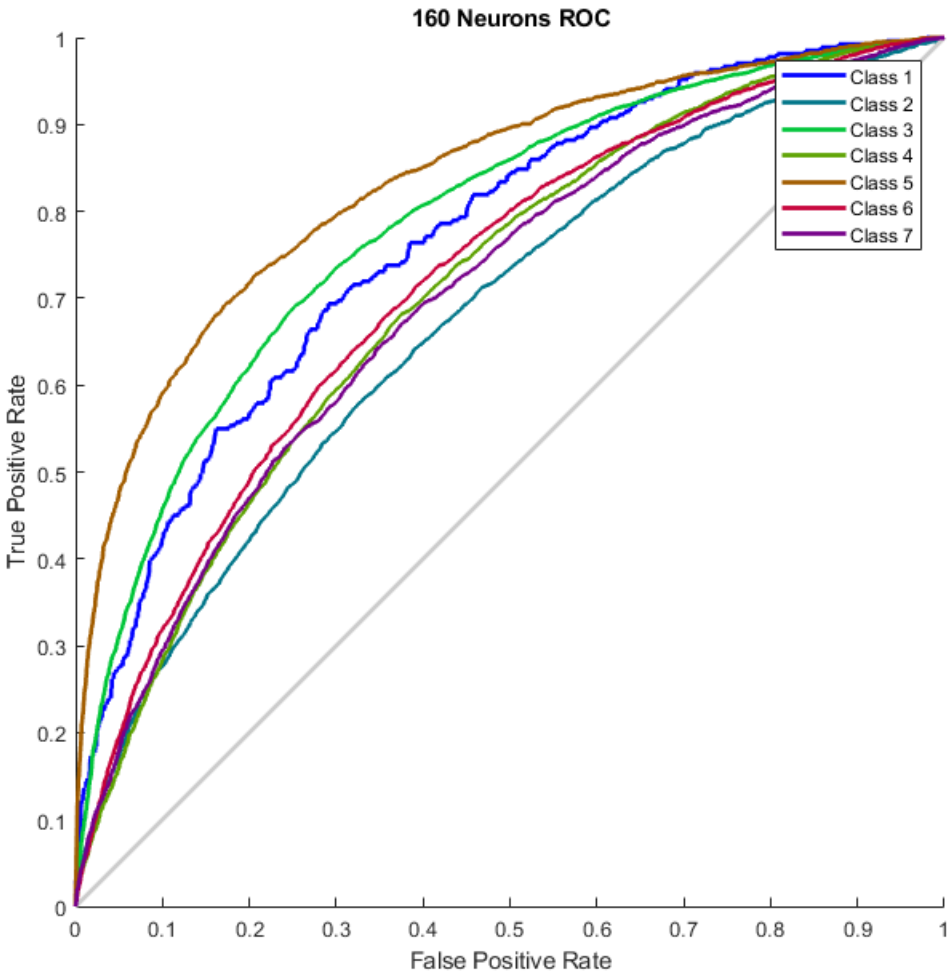

110 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7

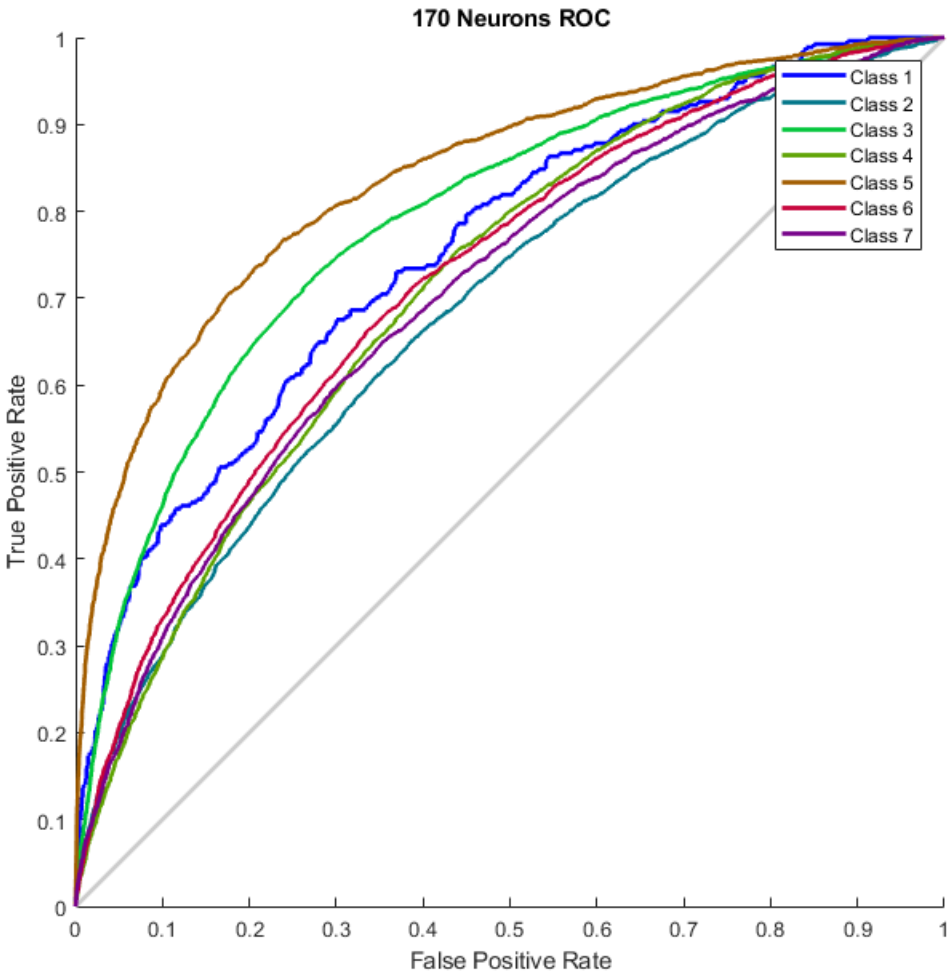

120 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

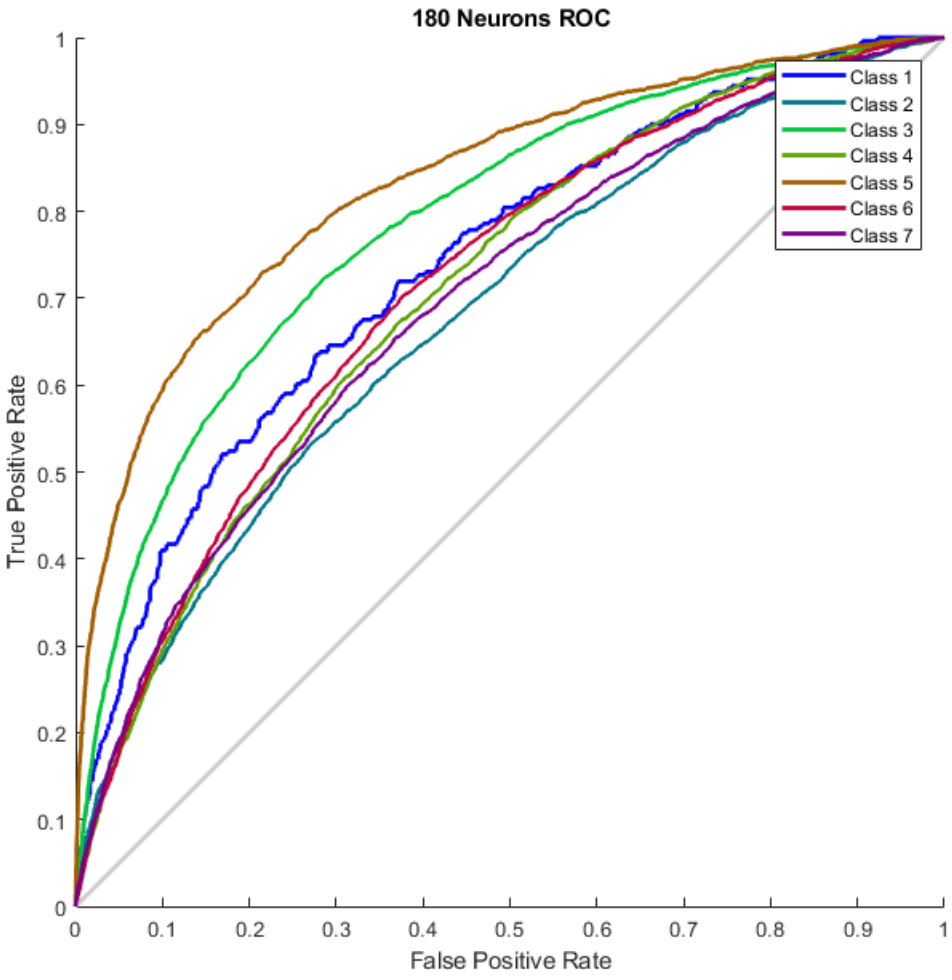

130 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7

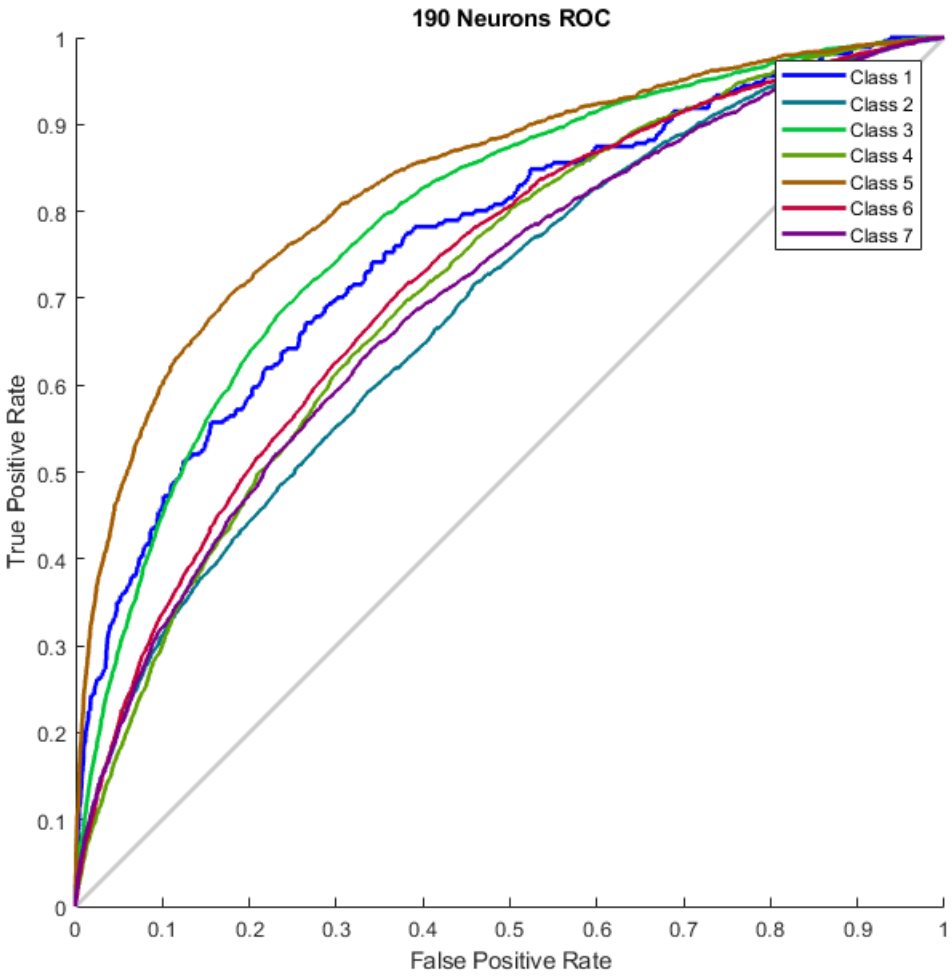

140 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

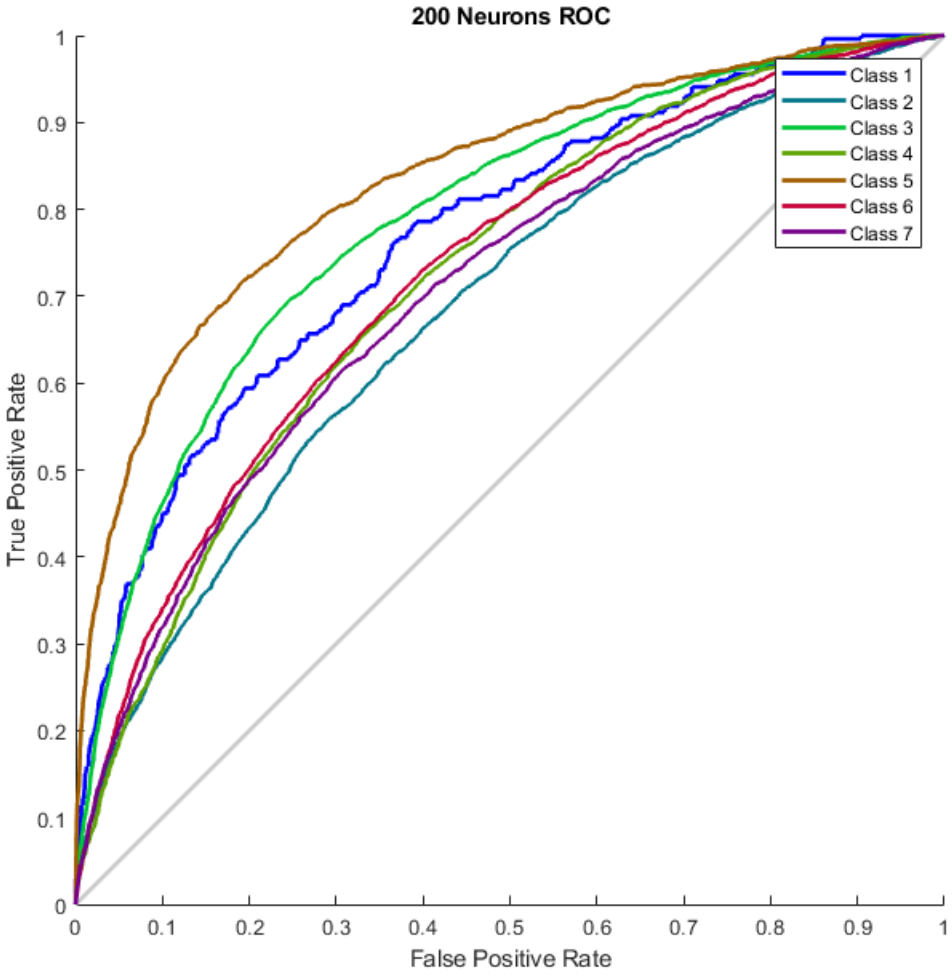

150 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


160 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


170 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7


180 Neurons ROC
True Positive Rate
False Positive Rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7


190 Neurons ROC
True Positive Rate
False Positive Rate
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



Why Haar is more accurate than Coif4

When performing our analysis, we came to the conclusion that our Haar wavelet was more accurate compared to the Coif wavelet that we used. From our research, we found that Haar is the simplest family of the wavelets. Haar wavelets are memory efficient and they do not have overlapping windows, unlike the coiflet family of wavelets. Those wavelets have windows that overlap a lot more. Haar wavelets only reflect changes between adjacent pixel pairs as well. Coiflets, including the Coif4 wavelet, have more computational overhead. This overhead often leads to smoother wavelets. Coiflets are pretty similiar to Haar wavelets computationally, but Coiflets also use the mirroring technique as well. Because our training images were taken in a controlled environent and sudden changes could be detected between them, the Haar ended up peforming better in terms of accuracy. That is what the Haar wavelet was designed for. Coiflets are much better for when an image needs to be processed using smoothing and denoising techniques, which was not something that was necessarily needed for our training set.

```
% close all
```

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