**SysEng 5212/ EE 5370**

**INTRODUCTION TO NEURAL NETWORKS AND APPLICATIONS**

**Spring 2020**

**Final Examination**

**Open Book and Notes, Open Internet**

**Due by midnight on May 9, 2020 at 11:59 PM**

I certify that for this exam, I did not receive any material and/or help in any form or by any means - electronic, mechanical, recording or otherwise, from anybody. All the information provided in this test is mine. Sources and due credit are provided for all the reference material that I utilized from the Internet.

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Ryan Patton\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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**QUESTIONS**

**Question I:** Develop a classifier that divides the interval between 0 and 1 into five classes using SOM network.

1. Use MATLAB to generate 100 values in the interval specified with a uniform distribution. Use these values as inputs for the SOM.
2. Now square each number so that the distribution is no longer uniform. Use these values as inputs for the SOM.
3. How are the weights of the SOM distributed?
4. Is there some relationship between how the weights are distributed and how the squared input values are distributed?

(40 points)

Question II: Use the confusion matrix shown below to answer the following questions. The matrix was generated using the results of a neural network classifier.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Actual Class | Predicted Class | | | Total |
|  | C1 | C2 | C3 |  |
| C1 | 45 | 12 | 0 | 78.9% |
| C2 | 6 | 36 | 8 | 72.0% |
| C3 | 2 | 32 | 11 | 24.4% |
| Total | 84.1% | 55.0% | 57.9% |  |

1. Find the overall accuracy of the classifier.
2. Is this a good measure of the classifier's performance? Why or why not?
3. Can you compute a better measure of the classifier's overall performance? Show your computations.
4. If a cost of 2 is associated with each misclassified sample, what is the total cost of misclassification based on the given confusion matrix?
5. Consider another model where the costs of misclassification are as follows,

C1 - 4, C2 - 2, C3 - 1

Would you select this model over the one in part (4)? Show your work.

(25 points)

Question III: Based on what you have learned during the semester, briefly comment on the following points with respect to artificial neural networks.

1. Ease of model development
2. Speed of training and testing
3. Scalability of model
4. Interpretability of model
5. Handling non-numerical inputs

(20 points)

Question IV: Consider a training sample that consists of positive and negative examples that are linearly separable. Justify the following statement:

*The support vectors contain all the information needed to classify the positive and negative examples.*

(15 points)