

AuE 8930 Deep Learning
Midterm Exam Demo
April 2022
Time Limit: 75 Minutes

Name: _____
CUID: _____

This exam contains 21 questions. Total of points is 100.

- Question 1-16 are single or multiple choice and question 17-21 are short answer.
 - This exam is **closed book** i.e., no laptops, notes, textbooks, etc. during the exam.
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Part I Multiple choice

1. (4 points) In order to backpropagate through a max-pool layer, you need to pass information about the positions of the max values from the forward pass.

A. True

B. False

2. (4 points) Which of the following sentence is FALSE regarding regression?

A. It relates inputs to outputs.

B. It is used for prediction.

C. It may be used for interpretation.

D. It discovers causal relationships.

3. (4 points) You are building a model to predict the presence (labeled 1) or absence (labeled 0) of a tumor in a brain scan. The goal is to ultimately deploy the model to help doctors in hospitals. Which of these two metrics would you choose to use?

A. $\text{Precision} = \frac{\text{True positive examples}}{\text{Total predicted positive examples}}$

B. $\text{Recall} = \frac{\text{True positive examples}}{\text{Total positive examples}}$

4. (4 points) If your Neural Network model seems to have high bias, what of the following would be promising things to try? (**Check all that apply**)

A. Make the network deeper

B. Get more test data

C. Get more training data

D. Increase the number of the units in each hidden layer

Part II Short Answer

17. (10 points) Consider an input image of shape $500 \times 500 \times 3$. You run this image in a convolutional layer with 10 filters of kernel size 5×5 . How many parameters does this layer have?

number of input channels = 3

number of weights per kernel = $5 \times 5 \times 3 = 75$ (5×5 weights per channel)

number of kernels = 10

number of weights = $75 \times 10 = 750$ (75 weights per kernel)

number of biases = $1 \times 10 = 10$ (1 bias term per kernel)

total number of parameters = number of weights + number of biases = 760

18. (10 points) Consider an input image of shape $500 \times 500 \times 3$. You flatten this image and use a fully connected layer with 100 hidden units. (1) What is the shape of the weight matrix of this layer? (2) What is the shape of the corresponding bias vector?

input (**X**) size = flattened image shape = $500 \times 500 \times 3 = 750,000 \times 1$

output (**Y**) size = 100×1

input to output mapping: $\mathbf{Y} = \mathbf{w}^T * \mathbf{X} + \mathbf{b}$

\implies size of $\mathbf{w}^T = 100 \times 750,000$ (so that $\mathbf{w}^T * \mathbf{X}$ is of size 100×1)

\implies size of $\mathbf{w} = 750,000 \times 100$

\implies size of $\mathbf{b} = 100 \times 1$