Neural Networks & Deep Learning (Spring 2021, DATA 442)

Schedule

This course is being taught asynchronously. You will be able to choose when to engage with each lecture. Labs and tests can be submitted up until the due date.

Instructor

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ISC 1269

Office Hours: Schedule at https://icss.wm.edu/data442/officehours.html

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Please let me know if you have any documented disabilities that may impact your performance in this class.

Course Description: This course teaches the foundations of Neural Networks and Deep Learning. Students entering into this course should have, at minimum, a background in data preprocessing, cleaning, manipulation, and dimensionality reduction within python. Through an applied learning project, you will learn how to implement a machine learning project from design to implementation in the context of neural networks. Topics we will cover include the basic building blocks of neural networks, RNNs, convolutional networks and computer vision, backpropagation basics and strategies (including inductive transfer approaches), differences between technical implementations (i.e., TensorFlow, Keras, Torch), and more.

Prerequisite(s):

1. **Strong Proficiency in Python.** All class assignments are provided and coded in python.

2. **Basic Statistics.** You should understand distributions, standard deviations, means, and other basic principals. You should be comfortable with basic notation.

3. **Basic knowledge of Machine Learning.** You should have a basic understanding of topics such as cost functions and optimization strategies (i.e., gradient descent).

To achieve the above, we recommend DATA 310 (Applied Machine Learning), **or** a combination of CSCI 241 and an approved statistics or quantitative course as listed in the catalogue. If you believe you have the above knowledge but have not taken those courses, please reach out to the instructor prior to registration.

Credit Hours: 3

Materials:
A free SciClone account is needed in order to access the William and Mary High Performance Cluster (HPC). Registration can be started at https://hpc.wm.edu/acctreq/ .

Please note this course is exceptionally computationally intensive. If you intend to work on your own laptop, please ensure it has at least a dedicated NVIDIA graphics card with CUDA capabilities. If you do not have a laptop with an NVIDIA graphics card, you should consider the use of online services such as Google's Collaboratory or Paperspace's Gradient. Both provide online access to GPUs - sometimes free of cost. Because online services regularly change, I will not be able to provide support specific to those options.

Discussion & Questions: We will be using Piazza for class discussion. The system is catered to getting you help fast and efficiently from classmates, the TA, and myself. I will be checking Piazza *much* more regularly than my email, so if you have a question it should be your go-to; note you can post questions both anonymously and with your name attached (it's up to you!). If you have any problems or feedback for the developers, email team@piazza.com.
Find our class signup link at: piazza.com/wm/spring2021/data442

Submitting Projects and Assignments: We will be using gradescope.com for assignment submission throughout this course. After you create an account, you will need entry code MZ2R7Y.

Grade Distribution:

Assignment 1	20%
Assignment 2	20%
Assignment 3	20%
Midterm	20%
Final	20%

Letter Grade Distribution:

>= 93.00	A	73.00 - 76.99	C
90.00 - 92.99	A-	70.00 - 72.99	C-
87.00 - 89.99	B+	67.00 - 69.99	D+
83.00 - 86.99	B	63.00 - 66.99	D
80.00 - 82.99	B-	60.00 - 62.99	D-
77.00 - 79.99	C+	<= 59.99	F

Late / Poor Performance Policy: Assignments will not be accepted late, excepting in documented circumstances (i.e., an illness with a doctor's note).

Assignments:
There are three lab assignments you will turn in throughout this course; these assignments will make up 60% of your grade. Each assignment will provide you with a series of challenges

to solve using your knowledge of neural networks and machine learning more broadly. You will submit a python file with your solution sets for each assignment; the assignments are by design very challenging, and should take you multiple weeks to complete. You can submit your assignment's python file as many times as you would like to try new solutions; it is highly recommended you get started early.

Midterm and Final: A written midterm and final will test your knowledge of content presented during the course. Both will be worth 20% of your grade.

Important Dates: The add and drop deadline this semester is February 5th, 2021, and withdrawal deadline is March 29th, 2021.

Do not cheat!
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Academic dishonesty is taken very seriously. Make sure to cite all of your work, and do not turn in work that is not yours! Cases of academic dishonesty will be evaluated and acted upon in accordance with William and Mary policies, which can be found at http://www.wm.edu/offices/deanofstudents/services/ student-conduct/
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Course Outline:
The course outline can be found below. The weekly content might change as it depends on the progress of the class.

Week of

Jan 25th	**1**

What to Watch:
Lecture 1: Course Introduction & the History of Deep Learning

What to Work On:
Lab 0: Making Sure You Understand How You Will Be Graded
Lab 0 is due on Feb 8th, and worth 5 bonus points.

What to Submit:
No assignments are due this week.

Feb 1st	**2**

What to Watch:
Lecture 2: Machine Learning in the Context of Computer Vision

What to Work On:
Lab 1: Baseline Computer Vision Algorithms
Lab 1 is due on March 5th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

8th	**3**

What to Watch:
Lecture 3: Linear Classification & Loss in Computer Vision

What to Work On:
Lab 1: Baseline Computer Vision Algorithms
Lab 1 is due on March 5th, and worth 20% of your grade.

What to Submit:
Assignment 0 is due by 11:59PM on February 8th (Monday). It is worth 5 bonus points.

15th	**4**

What to Watch:
Lecture 4: Softmax & Regularization

What to Work On:
Lab 1: Baseline Computer Vision Algorithms
Lab 1 is due on March 5th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

WEEK OF

22nd   **5**

What to Watch:
Lecture 5: Optimization

What to Work On:
Lab 1: Baseline Computer Vision Algorithms
Lab 1 is due on March 5th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

Mar 1st   **6**

What to Watch:
Lecture 6: Backpropagation (BP)

What to Work On:
Lab 1: Baseline Computer Vision Algorithms
Lab 1 is due on March 5th, and worth 20% of your grade.

What to Submit:
Lab 1 is due on March 5th (Friday) by 11:59PM

8th   **7**

What to Watch:
Lecture 7: BP, Heterogeneity and Nets

What to Work On:
Midterm
The midterm is due on March 12th, and worth 20% of your grade.

Once started, you will have 45 minutes to complete the midterm.

The midterm has 7 questions (most of which have sub-questions), and is taken on gradescope.

Points will not be given for technical issues. It is recommended you take the midterm at a location (i.e., the library) with multiple computers you can access. It is up to you to ensure you have a 'plan B' in case of technical issues with your computer.

The midterm must be taken independently (i.e., no groups), but you can use any notes or other resources you would like.
The midterm covers materials up to and including this week - make sure you watch lecture 7 before starting!

What to Submit:
Your Midterm is due on March 12th (Friday) by 11:59PM

Week of	
15th	**8**

What to Watch:
Lecture 8: Convolutional Layers

What to Work On:
Lab 2: Neural Networks
Lab 2 is due on April 9th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

22nd	**9**

What to Watch:
Lecture 9: Building & Optimizing a Neural Network - Part A

What to Work On:
Lab 2: Neural Networks
Lab 2 is due on April 9th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

29th	**10**

What to Watch:
Lecture 10: Building & Optimizing a Neural Network - Part B

What to Work On:
Lab 2: Neural Networks
Lab 2 is due on April 9th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

Apr 5th	**11**

What to Watch:
Lecture 11: Common CNN Architectures

What to Work On:
Lab 2: Neural Networks
Lab 2 is due on April 9th, and worth 20% of your grade.

What to Submit:
Lab 2 is due on April 9th at 11:59PM, and worth 20% of your grade

Week of	
12th	**12**

What to Watch:
Lecture 12: Recurrent Neural Networks (RNN)

What to Work On:
Lab 3: Operational Networks
Lab 3 is due on May 7th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

19th	**13**

What to Watch:
Lecture 13: Generative & Adversarial Networks

What to Work On:
Lab 3: Operational Networks
Lab 3 is due on May 7th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

26th	**14**

What to Watch:
Lecture 14: Understanding & Visualizing Features

What to Work On:
Lab 3: Operational Networks
Lab 3 is due on May 7th, and worth 20% of your grade.

What to Submit:
No assignments are due this week.

May 3rd	**15**

What to Watch:
Lecture 15: All the rest

What to Work On:
Lab 3: Operational Networks
Lab 3 is due on May 7th, and worth 20% of your grade.

What to Submit:
Lab 3 is due on May 7th at 11:59PM, and worth 20% of your grade

Your final examination is due on May 18th by 11:59PM. It is worth 20% of your grade. Once started, you will have 45 minutes to complete the final - the format is identical to the midterm, and it is taken on gradescope.
Points will not be given for technical issues. It is recommended you take the final at a location (i.e., the library) with multiple computers you can access. It is up to you to ensure you have a 'plan B' in case of technical issues with your

computer.

The final must be taken independently (i.e., no groups), but you can use any notes or other resources you would like.

The midterm covers materials from the entire course, inclusive of the first half.