A & S 320 Sec. 1 / A & S 500 Sec. 1 — Spring 2020
MWF 11:00-11:50, Room: CB 341
**Mathematical Introduction to Deep Learning**

**Instructor:** Qiang Ye
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**A New Course in Deep Learning:** This is a new course temporarily offered as A & S 320 / A & S 500. A regular version as **MA 421G** is presently under the approval process. For now, undergraduate students should register for A & S 320 Section 1 and graduate students should register for A & S 500 Section 1.

**Course Description (Bulletin):** This course introduces deep learning with its mathematical foundation, algorithms, and programming tools. Students will learn the basics of deep learning algorithms and gain related foundational knowledge in linear algebra, optimization, and probability and information theory. The students will also get programming experiences in building deep neural networks for some real-world data problems.

**Prerequisites:** MA/STA 320 (or STA 524), MA/CS 321, and MA 322, or consent of instructor. Fluency with the Python programming will be assumed.

**Student Learning Outcomes:** After completing this course, students will be able to:

(1) formulate a deep learning approach to solve a variety of real world data problems;
(2) implement a deep neural network model using a deep learning API (Application Programming Interface) such as Keras;
(3) use linear algebra, optimization, and probability to solve some applied problems.

**Required Materials:** There will not be any required text. The materials will be drawn from various sources. The following book will be a valuable reference for students:

- D͡eep Learning, by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press, 2016. A free online version is available at `http://www.deeplearningbook.org/`

**Course Activities and Assignments**

*Homework:* There will be 8 homework assignments, including programming type problems. Students are encouraged to work on homework problems together, but solutions must be written in their own words and submitted independently.

*Exams:* There will be one midterm exam during the regular class time and a final exam of two hour duration to be scheduled by Registrar's office.

*Expectations for graduate students beyond the expectations for undergraduates :* Students taking this course for graduate credit will be expected to complete a project. The project will involve applying a deep learning model covered in this class to a real-world data problem. The report of the project must be typed and must, at a minimum, include an introduction, a description of data and problem, discussions of models used, summary and discussions of results; and a references list. The project will be due the last day of classes.

**Course Grading:** For undergraduate students, the grade will be based on 8 HW sets, a midterm exam and a final exam with the weights given as follows:

| | |
|---|---|
| Homework | $55\%$ |
| Midterm | $15\%$ |
| Final | $30\%$ |

The following scale will be used to determine a student's final grade:

| | |
|---|---|
| A | 90%-100% |
| B | 80%-89.9% |
| C | 70%-79.9% |
| D | 60%-69.9% |
| E | 0%-59.9% |

For graduate students, the grade will be based on 8 HW sets, a project, a midterm exam and a final exam with the weights given as follows:

| | |
|---|---|
| Homework | $50\%$ |
| Project | $15\%$ |
| Midterm | $10\%$ |
| Final | $25\%$ |

The following scale will be used to determine a graduate student's final grade:

| | |
|---|---|
| A | 90%-100% |
| B | 80%-89.9% |
| C | 70%-79.9% |
| E | 0%-69.9% |