ANLY-590: Neural Networks and Deep Learning

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Class Hours: Th 6:30-9:00 PM
Class Room: Car Barn 172
Office Hours: Thursdays (prior to class) in Car Barn by appointment

Course Description

This course focuses on the practice and applications of deep learning. We explore foundational concepts, structuring popular networks and implementing models through various technologies such as Tensorflow and Keras. Topics that are explored throughout this course include image recognition, machine translation, and natural language processing. The course provides a high-level overview of many popular network structures and state of the art frameworks. Parallelism, GPU distributed computing and cloud technologies are also introduced along the way given their importance in both inference and parameter fitting phases of model construction in deep networks.

Other Sections

Tuesdays 6:30 - 9:00 in Car Barn 172, taught by Dr. Keegan Hines.It is fine if you need to attend the other section occasionally, just send advanced notice to myself and Keegan.

Textbooks:

- Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning. MIT Press 2016
- Michael Nielsen. Neural Networks and Deep Learning : http://neuralnetworksanddeeplearning.com/
- Francois Chollet, Deep Learning With Python https://www.manning.com/books/deep-learning-with- python

Prerequisites/Corequisites

ANLY-511 (Probabilistic Modeling and Statistical Computing), ANLY-512 (Statistical Learning Theory) or equivalent, Linear Algebra, Multivariable Calculus, comfort with Python.

Course Website

The course will use Canvas, https://canvas.georgetown.edu/. Announcements, home- work assignments and solutions, course material such as documentation, links, data sets and notebooks will all be posted there. You can look up your grades, and online surveys will also be conducted here. It is recommended that you visit this page once a day (or set up notifications), as announcements will usually only appear here.

Software and Computers:

Python will be used throughout the course, with a heavy reliance upon scientific computing libraries such as Numpy, Tensorflow, and Keras. Students are expected to have a strong working knowledge of Python computing and ability to set up their working environment as needed on their own laptop. Additionally, we will leverage computing resources from Amazon Web Services and Google Cloud. Students should ensure they have signed up for a student education account, which provides free credits to AWS services.
We'll be working with github to upload resources and homework assignments. Accordingly, students should sign up for an account. Similarly, students should ensure they have access to Google Collab's environment: https://colab.research.google.com

Course Structure

Topics

- Basic concepts: Model accuracy, prediction accuracy, interpretability, supervised and unsupervised learning, linear and logistic regression, regularization.
- Artificial neural networks, feedforward, activation functions, loss functions
- Non-linear optimization, gradient descent, backpropagation
- Deep learning toolkit: Keras, Tensorflow, AWS
- Autoencoders, Dense Embeddings, Dimensionality reduction
- Convolutional networks, transfer learning, applications in image processing and NLP
- Recurrent networks, LSTM, GRU, applications in NLP
- Potential special topics: GANs, Reinforcement Learning, Multitask Learning, Machine Translation

Grading Policy

Grading will be based on assignments, class participation, a mid-term and final project. There will be no final exam. For class participation, expect to be called up to demonstrate group exercises, explain or suggest code, explain concepts that were discussed previously, formulate questions concerning new material etc. The grade will count the assessments using the following proportions:

- **25%** About 5 homework sets.
- **25%** 1 Hour in class midterm
- **10%** Class Participation
- **40%** Final Project

Grading Scheme

The break points for these grades may be lowered, but will not be raised.

- **A** >95%
- **A-** 90%-94%
- **B+** 85%-89%
- **B** 80%-84%
- **B-** 75%-79%
- **C** 65%-74%
- **D** 55%-64%

Important Dates

08/30/18 ..... First class meeting
09/07/18 ..... Last day for add/drop
11/20/18 ..... Class canceled for Thanksgiving
11/20/18 ..... Last day to withdraw from a course
Week of Dec 6 ..... Final project presentations
The dates for the midterm exam will be announced later

Course Policies

Honor Code

Please be aware of the academic integrity rules. They may be found in ch. VI of the the Graduate Bulletin. Academic misconduct includes plagiarism, unacknowledged paraphrase, cheating, fabrication of data, fabrication, alteration, or misrepresentation of academic records, facilitating

academic dishonesty (i.e. helping or allowing others to violate these rules), unauthorized collaboration. misuse of otherwise valid academic work, misuse of academic resources, and depriving others of equal access to academic resources. Please look at the Graduate Bulletin for a detailed explanation, and stick to these rules.
In this class, you are *encouraged to collaborate* with other students when you study and when you do your homework. Most of our in-class work will be in small groups. When working on a homework assignment or a practice exercise, start by yourself, then talk to other students, ask questions, and share your ideas, then complete the work on your own. Everyone must turn in their own version of assignments. Do not simply copy homework from others and do not permit others to copy your work, as this will be considered plagiarism or facilitating plagiarism. Feel free to seek out help online, there are many great tutorials and code examples. If you work with other students, simply make note of who you collaborator with and you will be in compliance with the Honor Code.
You are *not allowed to collaborate* with other students or seek any human help on the mid-term. Closed notes, closed book, no electronic devices such as computers, smart phones or calculators on any in-class exams.

Instructional Continuity

In case of circumstances that interfere with normal class operations (for example, extreme weather or illness), you will be notified by email and Canvas. I will pre-record lecture videos and we will hold class asynchronously. You will be expected to conduct exercises on your own as noted, and be prepared to present during the next session. Unless you are notified otherwise, deadlines for assignments will remain unchanged.

Class Etiquette:

- Please try to arrive on time (or early). If you must arrive late, please minimize any disruptions as you enter the classroom
- During lecture and during presentations, cell phones and laptops are to be put away. Laptops can be brought out during coding portions of the class session only
- When your classmates are presenting, refrain from any side conversations

Accommodations For Students With Disabilities

Students with documented disabilities have the right to specific accommodations that do not fundamentally alter the nature of the course. Please alert me should you require accommodations.

Title IX: Sexual Misconduct and Sexual Harassment

Georgetown University is committed to providing a safe and hospitable environment for all members of its community. Sexual Misconduct subverts the University's mission, and threatens permanent damage to the educational experience, careers, and well-being of students, faculty, and staff.
Please refer to these University resources: https://georgetown.app.box.com/s/ecqtjvivcuqsnqpbjxtp