Syllabus and FAQ
Applied Deep Learning, Fall 2019

Day / Time: Thursdays, 7pm - 9:30pm
Where: 402 Chandler
Instructor: Josh Gordon
Office hours: Thursday 5:30pm - 6:30pm, Mudd 417

TAs and office hours
Benedikt Schifferer: Monday 9:30am - 11am, Mudd CS TA room
Su Ji Park: Tuesday 1:30pm - 3:00pm, Mudd CS TA room
Pratik Dubal: Wednesday 10:00am - 11:30am, Mudd CS TA room
Kunyan Han: Thursday 1:30pm - 3:00pm, Mudd CS TA Room
Pengyu Chen: Friday 11:00am - 12:30pm, Mudd CS TA room

Course description
This course provides a practical introduction to Deep Learning. We aim to help you understand the fundamentals of neural networks (DNNs, CNNs, and RNNs), and prepare you to successfully apply them in practice. This course will be taught using open-source software, including TensorFlow 2.0. In addition to covering the fundamental methods, we will discuss the rapidly developing space of frameworks and applications, including deep learning on the web. This course emphasises fairness, responsibility, and testing - and teaches best practices with these in mind based on lessons from industry.

Syllabus
Subject to change a bit based on your interests.

Date	Topic(s)
9/5	**Intro** Topics: Deep Learning overview, about the course.
9/5	Assignment 1 released
9/12	**AI Responsibility; linear models** Topics: weights, activations, softmax, cross entropy. Famous data-driven incidents, and why they occurred.
9/19	Assignment 2 released
9/19	**Working with images** Topics: Convolution and CNNs, transfer learning, data augmentation, famous architectures (VGG, ResNet, etc), image segmentation, object detection.

9/26	**Optimization** Topics: gradient descent, backpropagation, optimizers (SGD, momentum, Nesterov accelerated gradient, RMSProp, etc)
9/26	Assignment 1 due
10/3	**Medical imaging case studies** Topics: recent work in depth, evaluation..
10/10	**Details of open source frameworks** Topics: Distributed training; nuts and bolts of TensorFlow 2.0; trends in framework design.
10/17	Assignment 2 due
10/10	Assignment 3 released
10/10	**Project description posted** Choose from a suggested project, or propose your own.
10/17	**Deep Learning in Javascript** Topics: interactive and client-side ML.
10/24	**Working with text and timeseries data** Topics**:** RNNs, sequence classification, sequence generation.
10/24	Project proposal due (only if doing a custom project)
10/31	**Working with structured data; testing ML systems** Handing structured data and imbalanced data, interpreting models, testing data-driven applications.
10/31	Assignment 4 released
10/31	Assignment 3 due
11/7	Midterm
11/14	**Guest lecture; optimization continued** Guest lecture, batchnorm, dropout, weight initialization strategies (glorot, etc).
11/21	Assignment 4 due
11/28	*Reminder: no class (university holiday)*
12/5	**Generative models and advanced topics** GANs, VAEs, NMT, image captioning.
12/5	Assignment 5 released

12/20	Assignment 5 due
12/20	Projects due (code, demo, presentation)

FAQ

Prerequisites and difficulty level
Data science students and practitioners come from diverse academic backgrounds. It's important to the instructor that this course is accessible.

- Students should be comfortable programming in Python (including NumPy and Matplotlib). The Python Data Science Handbook is a helpful reference (the content is available for free online).

- The department requires that students have previously taken COMS W4721 (Machine Learning for Data Science) or an equivalent course. We will refresh a few important concepts as we go.

This course is right for you if you're interested in developing practical skills, and learning a bit about how Deep Learning is used in industry. The department also offers theoretical courses if those match your interests.

Workload and grading

- A course project and presentation (25%).

- Five homework assignments (60%). Most will be practical (e.g., develop an image classifier to recognize landmark's on Columbia's campus).

- A midterm (15%). Mostly focused on responsible AI, fairness, and applications.

Course project
The course project gives you an opportunity to create a portfolio of work. Students may choose to complete a suggested project, or propose their own.

The suggested project involves developing a solution to the CAMELYON16 challenge; starter code and data will be provided. Note that it's relatively easy to develop a basic solution, but difficult to develop a good one.

The project may be done in groups of up to two. If you're doing a group project, the grading expectations will be higher. Deliverables include:

- A link to your GitHub repo
- A demo
- An YouTube video (+/- 10 minutes, including a presentation, demo, and code walkthrough). The video can be unlisted, and does not need to be shared publicly.

Textbooks
There are two. Students should purchase a copy of Deep Learning with Python. This is light reading, and full of practical advice. We will supplement this book with Deep Learning by Ian Goodfellow (available for free online).

Software and languages
There are many open-source deep learning frameworks available today. We will use TensorFlow 2.0 (currently in beta). All assignments will be in Python, with a small amount of JavaScript in one (prior experience is not assumed).

Programming environment
We recommend Colaboratory (a web-based Jupyter environment that includes a free GPU). Alternatively, you can install everything locally, or use the cloud platform of your choice.

Late policy
The penalty for late assignments is 10% / day. Due dates are firm.

Class format
We have a long time slot. We will use some time to start on the homework, please bring your laptop.

Collaboration policy
Feel free to study in groups. You may discuss your approach to homework assignments, and help each other debug. That said everyone must write and submit their own code (with the exception of the course project, if you are working in a group). Please keep the university's academic integrity policy in mind.

Exam policy
The midterm is closed-book and closed-notes.

Disability Services
Disability Services facilitates equal access for students with disabilities by coordinating accommodations and support services, cultivating a campus culture that is sensitive and responsive to the needs of students. Students seeking accommodations or support services from Disability Services are required to register with the office. If you are interested in pursuing an evaluation for a learning disability, please visit the referrals and other campus resources page.