PHYS476
Applied Machine Learning
Spring 2018

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PHY 1330
Office hours
Thu 3:00 - 4:00

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Office hours
by appointment

Lecture
Wed 4:00 - 7:00 pm

NOTE: Scheduling details in this syllabus should be taken as tentative. We will notify you when changes are made.

Course Description

This one semester course introduces machine learning techniques that are becoming pertinent in the technology industry. The course will focus on hands-on work using popular high-level libraries.

The course is designed for a broad audience of intermediate students (any CMNS or Econ student) in the sciences.

Homework problem sets and projects will require that students have access to Python and Google Cloud Platform. Students are expected to have some background in functional programming, linear algebra, calculus, and mathematical modeling. Some proficiency in Python is strongly suggested.

The course will be taught using a combined lecture/laboratory approach. Note that individual class sessions will often contain both lecture and laboratory components.

Prerequisites:
MATH141 (through MATH241 or equivalent recommended)
PHYS165 or CMSC216 or ENEE350 or PHYS474 or BIOE241
PHYS274 or MATH240 or MATH246 or MATH340 or BIOE372
PHYS276 or STAT4xx and completion of DSNS and DSNL, or ENEE324 and PHYS260 and PHYS261, or PHYS270 and PHYS271

Resources

The new and changing nature of this subject implies that important resources are also new and changing. There will consequently be no textbook. Most resources will be available on YouTube and will be announced as we get to them. Additionally, the standard online documentation (especially for the PyData stack) will be an important resource.

Assignments

Homework: We will assign homework roughly every week (after a slow start); the homework will be designed to develop your ability to set up and solve codes utilizing machine learning methods to address problems pertaining to the physical sciences or related subjects. You will submit the .py code file(s) themselves via ELMS. Collaboration with classmates is permitted and encouraged.

A late submission without a valid excuse will incur a penalty of 10% per day.

Projects: 3-4 larger (2-3 week) projects will replace the weekly homework periodically. There will also be **one final project** in the end. Each project will involve modeling or otherwise exploring some rather substantial problem in science or technology. Typically the projects may be done with a partner or in groups, with some caveats TBA later. Submission is analogous to homework.

In-class Exercises: We will regularly assign smaller exercises in class to reinforce basic applications and to develop your debugging and collaboration skills. Exercises may be completed in groups or with a partner, with the intention of submitting by the end of class or soon thereafter.

These exercises will be worth 5 points, with scoring largely completion-based. Efforts will comprise your Participation grade. You will have 2 drop grades here to accommodate the occasional absence.

Quizzes: You will have 5-6 quizzes to monitor competency in important concepts. These quizzes will be frequent early in the semester and then become less so as the course material shifts toward application (see schedule). The exact dates will be announced in advance, and they will take place in the first ∼15 minutes of class.

Google Cloud Resources

You will need to have an account on the **Google Cloud Platform** (comes standard with Google account) in order to complete the required portion of the homework assignments. (More info to come here.)

Any major financial obligation involved here should be offset completely by use of free trial access.

Grading Scheme

Participation	20%
Homework/Projects	55%
Final Project	10%
Quizzes	15%

ELMS Posts and Communicating with Us

We will clearly post all announcements, assignments, due dates, and other important information on the course ELMS page. We will also use ELMS to send course-wide emails when necessary. Please check the page regularly for updates.

Please feel free to email at any time with questions about course material, trouble with assignments, etc as they arise.

Attendance, Religious Observances, and University Closures

If you need to miss a deadline or quiz for a religious observance or other legitimate reason, *please notify us in advance, and preferably ASAP.* If you miss a quiz due to illness or emergency, *please get in touch ASAP* after the fact. In most cases, a make up quiz will be arranged.

Making up the in-class exercises will not be generally feasible, but 2 drop grades are provided, and no individual exercise carries substantial weight.

If the university is closed due to inclement weather or some emergency situation on or near an quiz day or other important date, we will contact you on ELMS with further instructions.

Academic Integrity

Learning to solve problems in computing can be a difficult and tedious process; often students find it beneficial to work with others on such problems. This sort of behavior is encouraged, although you should avoid larger groups to discourage stragglers.

That said, it is crucial that all students or groups create and submit their own work. Plagiarizing from external sources or other forms of cheating will not be tolerated and may result in an XF grade for the course and/or further action taken by the Student Honor Council.

Any attempts to hack or sabotage accounts, servers, or grading systems will be taken very seriously. Crashing the grading software will result in substantial deductions, even if not intentional.

Students with Disabilities

Accommodations will be provided to enable students with disabilities to participate fully in the course. Please discuss any needs with me at the beginning of the semester, so that appropriate arrangements can be made. Students who are registered with DSS and plan to take exams at their facilities should provide the pertinent authorization forms (electronic format is fine) *at least* one week prior to each exam date.

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Tentative Schedule Outline
Spring 2018

Wk	*Week of*	*Content*
1	Jan 22	intro, Google Cloud Platform (GCP)
2	Jan 29	neural network theory (quiz)
3	Feb 5	non-neural network theory (quiz)
4	Feb 12	Linux, Python (quiz)
5	Feb 19	Keras
6	Feb 26	scikit-learn
7	Mar 5	TensorFlow I
8	Mar 12	TensorFlow II (quiz)
9	Mar 19	*No class due to Spring Break holiday.*
10	Mar 26	TensorFlow III
11	Apr 2	MapReduce
12	Apr 9	Gensim I
13	Apr 16	Gensim II (quiz)
14	Apr 23	AI: safety and the future (quiz)
15	Apr 30	discuss final project
16	May 7	final project