Cognitive Science Seminar
Fall 2018

Harnessing the Data Revolution: Science in the Age of AI

Sections: COMP/PHIL/PSYC 7514/8514

Time: Wednesdays 2:20 pm - 5:20 pm

Place: 405 Fedex Institute of Technology

Instructor: Andrew Olney

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Description

All science requires data. Low cost sensors, storage, and cheap computing power have contributed to a flood of scientific data, and new statistical techniques and artificial intelligence are providing the means to analyze it.

These data and methods raise a variety of questions. How can we draw conclusions from data that were not gathered in randomized controlled trials? How much can we trust black box models? Do these methods represent a "dumbing down" or atheoretic development in science?

In this seminar we will explore how the data revolution and AI are transforming fields ranging from business and politics to health and law, with a particular emphasis on methods, conclusions, and limitations.

The public portion of the seminar takes place on Wednesdays at 4pm in FIT 405. Faculty and students who would like to meet with external speakers before or after the seminar are encouraged to contact me.

Objectives

- Learn fundamental statistics and machine learning concepts
- Study previous applications of big data/AI to scientific questions
- Independently apply a big data/AI understanding in an paper/project

Methods and Activities

- Reading assignments completed before class
- Prepare questions before class
- Class lecture and discussions
- Class practical/lab sessions
- Self-directed project/paper

Materials

The primary readings will come from journal articles aligned with the course schedule below. Readings will be distributed via the course website: `https://cogsciseminarfall2018.blogspot.com/`

Computer access is required for most project options, and laptop access during class is necessary for practical sessions. Students without laptops may consult with the instructor for alternatives. Practical sessions will use a browser (Chrome is recommended) and require a free account on Kaggle: `https://www.kaggle.com/`.

The following **free** references may be useful:

- Introduction to statistical learning: `http://www-bcf.usc.edu/~gareth/ISL/`
- R for data science: `http://r4ds.had.co.nz/`
- Machine learning crash course: `https://developers.google.com/machine-learning/crash-course/`
- The elements of data analytic style: `worldpece.org/sites/default/files/datastyle.pdf`
- Mixed effects models and extensions in ecology with R: `https://goo.gl/C3JA6j`
- The R book: `https://goo.gl/Niz9oD`
- Python crash course: `https://goo.gl/EVDHGU`
- Hands-on machine learning with scikit-learn and tensorflow (preview): `https://goo.gl/3Q6wy7`
- Machine learning: a probabilistic perspective (preview): `https://goo.gl/px2Zw3`

Grading

Grades will be on a +/- letter scale (e.g. A+/A/A-) and calculated according to the following percentages.

Research Paper/Project (80%) You must submit a final paper in APA format suitable for conference publication. The paper must report your independent work involving big data/AI. However, within these constraints there are several options.

> **Theoretical papers** are acceptable and must be at least 8 pages long. These papers must contribute some original insight into big data/AI. For example, one could consider the trolley problem in a particular context or set of constraints (a trolley problem is when AI has a no-win scenario and must decide what lives to sacrifice for the common good). Note that though this example is theoretical, it would need to be highly specified in terms of conceptual framework and analysis.

> **Toolbox papers** that use an existing toolbox and report independent computational work must be at least 8 pages long. Many toolboxes exist that provide an environment for big data/machine learning, and these can simplify the process for students with less programming background. However, the model described in the paper can not be a "demo" from the toolbox, nor can it be a minor modification of a demo. The model created must be an independently created model, using the toolbox's primitives. Hint: don't think you can do this at the last minute using a toolbox, because any toolbox will take you a month to learn how to use.

> **Project papers** that write their own code and report independent computational work may be as little as 4 pages, but all supporting source code must also be submitted. Submitted source code will also be graded.

> All papers must include a literature review that describes previous work in that area and motivates the question addressed by the paper. **Prior to beginning work, contact the instructor with your paper idea and which of the 3 categories you believe it fits into**. The instructor will either accept, reject, or modify your proposal. **If you turn in a paper without the instructor's acceptance of your idea and length, your paper may not be acceptable. Unacceptable papers will receive little or no credit, resulting in a low grade for the course.**. During class on **11/7/18**, we will have a roundtable discussion/presentation of topics. You will be expected to give a brief 5-10 minute description of your paper (just verbally, without slides unless you prefer slides) . Your

paper is due in hardcopy on **12/5/18** by midnight CST in PDF form.

Response to Readings (20%) Your response will be a blog entry on the class website: `https://cogsciseminarfall2018.blogspot.com/` BY NOON THE DAY BEFORE CLASS that makes text-to-text, text-to-self, or text-to-world connections and discusses your opinions of these ideas. Each of the readings should be covered to some extent, but the readings can be given different weights in your entry. For instance, you can choose to expand on one reading over the others as long as you deal with all the readings in some way. You can pose a question, e.g.

"I found LASSO confusing. What is beta? Is it just a mathematical idea, or is it something we can easily see in the world around us? For example, if I..." (a brief paragraph)

or you can elaborate on the reading, e.g.

"I'm not sure I agree with LASSO setting coefficients to zero but having a p-value interpretation. It seems to me that this is just variable selection in disguise and that the p-values are invalid. For example..." (a brief paragraph)

"I find LASSO interesting. It actually relates directly to the way I think science should be conducted. For example..." (a brief paragraph)

"If all science just used LASSO, imagine what would happen to someone if we just automatically measured hundreds of thousands of variables and automatically generated models for various dependents. I imagine this might..." (a brief paragraph)

In addition, each paper will have one "lead student" who will prepare a presentation summarizing both the reading and all the comments on the blog for the rest of the class. The presentation will take place at the beginning of the class and serve as the jumping off point for class discussion. A 5-10 minute presentation with or without powerpoint is ideal. Students will bid before the second class for the days on which they want to present at this website `https://doodle.com/poll/ez4ftzazmu4b4gp5`. Click on one day only.

Attendance & Make-up Policy

Since class participation is a significant portion of your grade, tardiness and missing classes will negatively impact your grade.

Work is expected to be turned in on time unless arrangements have been made prior to the due date. No credit will be given for late work. Please plan ahead and arrange to be present for all classes (listed on course schedule below). Extensions are given only under extreme circumstances and with prior permission of instructor.

Electronic communications

Course announcements as well as consultation with the instructor may occur via e-mail. You are required to activate your university e-mail account in order to be a student at the University. The University considers this account to be your official university e-mail address and will use it to disseminate information. You must either check your university e-mail account regularly or forward your university e-mail to a personal e-mail account that you will check regularly. After you have established your university e-mail account, you can use iAM, the University's identity management service, to forward your university e-mail to a personal e-mail account.

Office Hours

If you have any difficulties during the course, let me know immediately. Office hours are the perfect opportunity to discuss teaching and research issues. Do you want to have more information on a certain topic? Do you have difficulties finding a research question or writing a paper? Do you feel uncomfortable about assignments? Are you looking for work in a research lab? Do you have suggestions or comments? See me during office hours or send me an email.

Diversity in the Classroom

Diversity means the fair representation of all groups of individuals, the inclusion of minority perspectives and voices, and the appreciation of different cultural and socioeconomic group practices. We aspire to foster and maintain an atmosphere that is free from discrimination, harassment, exploitation, or intimidation. Academic courses will aim at providing opportunities for students to discuss issues of diversity including, but not limited to, ethnicity, gender, disability and sexual orientation as they can be related to course content. The University of Memphis has adopted policies prohibiting discrimination based upon race, sex, disability, or sexual orientation. In addition, the American Psychological Association has explicit policies regarding the issues of and writing about race, gender, class, sexual orientation, disability, ethnicity, and religion. You may find information on these standards in the APA Publication Manual or on the APA webpage: `http://www.apa.org/pi/oema/`.

If you feel that you have experienced discrimination based on culture, disability, ethnicity, gender, generation, sexual orientation, national origin, privilege, race, and different views on religion, please contact the Office for Institutional Equity at the Administration Building, Room 156 (901-678-2713). To make a report, you may fill out an online form at `http://www.memphis.edu/report`.

Special Accommodations for Disabilities

If you have a disability that interferes with completion of any coursework (including tests) or difficulty in accessing any course materials, (1) notify the instructor privately during the first two weeks of the course and (2) contact Disability Resources for Students (DRS) located in 110 Wilder Tower and at 678-2880. DRS offers a comprehensive program of services and academic accommodations designed to provide access and opportunity to students with disabilities. The instructor will work with you and DRS to determine how best to adapt course materials or instruction.

Academic Integrity

Plagiarism, cheating, and other forms of academic dishonesty will not be tolerated. Students engaging in academic dishonesty will receive a 0 on the associated assignment and may be reported to the chair of the department or the University's Office of Student Accountability, Outreach, and Support and the Academic Integrity Committee. Consistent with these regulations and policies, students are expected to behave in accordance with the American Psychological Association's Code of Ethical Conduct, found here: `http://www.apa.org/ethics/code/principles.pdf`.

Your written work may be submitted to Turnitin.com, or a similar electronic detection method, for an evaluation of the originality of your ideas and proper use and attribution of sources. As part of this process, you will be required to submit electronic copies of your written work, or be given other instructions to follow. By taking this course, you agree that all assignments may undergo this review process and that the assignment may be included as a source document in Turnitin.com's restricted access database solely for the purpose of detecting plagiarism in such documents. Any assignment not submitted according to the procedures given by the instructor may be penalized or may not be accepted at all.

Classroom Misconduct

Students are expected to behave in accordance with the university's Code of Student Rights and Responsibilities, found here: `http://www.memphis.edu/saos/pdfs/csrr.pdf`. Disruptive behavior, use of an electronic or other noise- or light-emitting device that disturbs others, and excessive use of electronic devices for text messaging, telephone, or video-based conversations during instructional time in the classroom will not be tolerated. Students engaging in disruptive behaviors or general conduct that violates the rules and regulations of the university may be removed or excluded from the classroom. The instructor may report classroom misconduct to the Department Chair or the University's Office of Student Accountability, Outreach, and Support.

Sexual Misconduct

All faculty, administrators, and most University staff are mandatory reporters. According to the University's Title IX policy and federal law, I must to report potential incidents of sexual misconduct (harassment, assault, dating violence,

domestic violence, and stalking) to the Office for Institutional Equity. If you tell me about (or if I become aware of) sexual misconduct, I will reach out to Office for Institutional Equity for assistance. For more information, contact the Office for Institutional Equity located in the Administration Building, Room 156 (901-678-2713). To make a report of sexual misconduct, you may fill out an online form at `http://www.memphis.edu/report`. To read the University's Sexual Misconduct policy, follow this link: `https://memphis.policytech.com/dotNet/documents/?docid=465&public=true`.

Student Health

As a student, you may experience a range of issues that can cause barriers to learning, such as physical health problems, strained relationships, increased anxiety, alcohol and drug problems, feeling down, difficulty concentrating, and lack of motivation. These mental and physical health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. The University of Memphis has a range of confidential mental and physical health services available on campus to assist you, including the Psychological Services Center in the Psychology Building, Room 126 (901-678-2147); The University Counseling Center at 214 Wilder Tower (901-678-2068); and The University Student Health Center at 200 Hudson Health Center (901-678-2287).

Syllabus Changes

The instructor reserves the right to make changes as necessary to this syllabus. If changes are necessitated during the term of the course, the instructor will immediately notify students of such changes both by individual email communication and posting both notification and nature of change(s) on the course website.

Course Schedule

Date	Speaker	Title/Working Title*
8/29/18	No talk - class only	
9/05/18	Andrew Olney	Introduction to AI and Big Data
9/12/18	Susan Elswick	ENGAGE: An API Capable Data Collection and Analysis System for Education and Behavioral Health
9/19/18	Phil Pavlik	The Long March: Transforming Education with Adaptive Interactive Systems for Learning
9/26/18	George Deitz	Marketing Analytics*
10/03/18	Esra Ozdenerol	GIS for Health Analytics*
10/10/18	Deepak Venogopal	Markov Logic Networks: Recent Advances and Applications
10/17/18	Remy Debes	Dignitas Ex Machina
10/24/18	Bonny Banerjee	Acoustic and Visual Perception*
10/31/18	Santosh Kumar	Mobile Health Analytics*
		Paper/Project Presentations Due
11/07/18	Ramin Homayouni	Bioinformatics/Text Mining*
11/14/18	Burt Monroe	Big Data and Political Science*
11/28/18	Leah Windsor	Linguistic Analytics of Political Discourse*
		Paper/Project Due
12/05/18	Arash Shaban-Nejad	Epidemiology Analytics*