EDUC 261E: Curriculum and Instruction
Elective in Data Science

Spring 2021
Class Meetings: Online via Zoom
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Office Hours: By Appointment

Overview

There is an abundance of data being continually produced and it is transforming practice in academic disciplines and professional life. A whole interdisciplinary field of 'data science' has emerged and spawned training programs and new types of jobs. Whether we are fully aware of it or not, data and data science permeate many aspects of our daily lives. The ability to work with, understand, and use data has already become an essential life skill and a requirement for an ever-expanding range of jobs and careers. It is becoming imperative that both the current and next generation of educators be aware of these changes and prepared for teaching students to thoughtfully engage with data.

While some students currently learn to work with data in statistics, math, and science courses, we are going to see much more integration of data and data science in the K-12 curriculum. We are beginning to see, and should continue to expect, the rise of dedicated courses, units, and modules labeled as 'data science' for secondary students. A number of questions abound with respect to what those will entail. This course will identify and examine some of those questions. Further, it will prepare teacher candidates to integrate instruction with data and data science into their teaching by integrating or designing their own lessons.

Course Objectives

By the end of the course, students will be able to:

- Recognize and respond to common challenges students have when reasoning with data
- Articulate some major topics that would be addressed in related to Data or Data Science in secondary education
- Name, compare, and evaluate tools, platforms, environments, and curricula that are used in data science and data science education
- Design data-intensive lessons and instruction for a target learner population

Course Expectations and Structure

Attendance

Students are expected to attend all class meetings as scheduled unless there is a legitimate and excusable reason for missing class that day. If you know you will be absent, please inform the instructor as soon as possible. Classes will include discussions and learning activities that build off of previous weeks, so consistent attendance is important.

Readings and Other Media

Readings and related class media are listed in the Class Schedule below. All assigned readings and media should be completed and/or reviewed prior to the class meeting for each week. This includes readings and media that should be done prior to the first class meeting (i.e., Week 1 readings should be done before the first class). The instructor reserves the right to change reading assignments as the course progresses. It's possible some readings may be dropped or others may be added. You will have at least a week's notice of any changes to the reading list. When possible (keeping in mind copyright restrictions and availability of electronic versions), electronic copies of course readings will be posted in the course's Canvas site.

Assignments

Class Participation (20%)

Each class session, everyone is expected to actively participate in discussion and activities. Our goal is to develop a learning community that is building shared knowledge and understandings. Bring readings and notes to class to support your discussion.

Dear Data (20%)

The goal of this assignment is to get you involved in collecting and representing data so that you think about the pervasiveness of what can be turned into data. For two weeks, you are to consistently keep track of some behavior or activity and then invent a representational notation that can visually show your week in data. Or you can take inventory of something in your life that can be represented graphically. The representation itself should not emphasize words or numbers, but there should be some separate text to help a viewer decode what you made. Refer to the Dear Data examples for ideas.

Interview Assignment (30%)

You are to pick a data science topic, visualization, or tool and conduct an interview with a student in the target age range that you expect to teach in the future. This interview should last at least 30 minutes and emphasize getting the student to think out loud about the topic. You should design a task for the student to think through, such as making inferences from a data representation, explaining their ideas of how a data process works to produce a given visualization, how businesses collect and use personal data, or the ethics of data. You will submit a copy of your interview protocol, notes taken from the interview, and a reflection document summarizing what you had gleaned from the interview that informs your instruction. Topics can vary and include matters such as: the nature and presence of data, statistical ideas related to measures of center or inference, data visualization techniques, how a machine learning procedure works, correlation and causation, etc.

Data-intensive Lesson (30%)

Prepare a lesson spanning 1-5 days that clearly identifies one or more data-related learning objectives, articulates the activities that would be completed, and provides supplemental materials (slides, worksheets, web forms, data sets, etc). You should also include an assessment

strategy for how determining if your lesson objectives had been met, which can take the form of portfolio requirements, a rubric, or test-like questions.

Late Work and Incomplete Work

It is expected that all work is submitted on time when it is due. A digital version of your assignments should be submitted through Canvas. Assignments should be submitted prior to the start of class of a given week unless otherwise noted in Canvas.

COVID-19 Exceptions

If you or someone close to you is infected with COVID-19, the priority should be health and safety. Exceptions to any of the above policies will be made should a COVID-19 situation arises.

Students with Documented Disabilities

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: http://studentaffairs.stanford.edu/oae).

Academic Integrity and Honor Code

The Honor Code is the university's statement on academic integrity written by students in 1921. It articulates university expectations of students and faculty in establishing and maintaining the highest standards in academic work. The Honor Code is an undertaking of the students, individually and collectively that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading. For more information, see https://communitystandards.stanford.edu/

Plagiarism is a violation of the Honor Code.

> "For purposes of the Stanford University Honor Code, plagiarism is defined as the use, without giving reasonable and appropriate credit to or acknowledging the author or source, of another person's original work, whether such work is made up of code, formulas, ideas, language, research, strategies, writing or other form(s). Moreover, verbatim text from another source must always be put in (or within) quotation marks."

If you are in doubt about what constitutes plagiarism in the context of a particular assignment, talk with the instructor.

Honor code violations will be reported to university administration.

Schedule

Week & Topic	Readings and Media	Assignments
Week 1 Introduction	**Required** Erickson, T. (2017, February 21). *Smelling like data science*. A best case scenario. https://bestcase.wordpress.com/2017/02/21/smelling-like-data-science/ Lupi, G., & Posavec, S. (2016). *Dear data*. Chronicle Books. (Selected Excerpts) Penguin Books UK. (2016, August 31). *Get To Know Someone Through Their Data | Dear Data* [Video]. YouTube. https://www.youtube.com/watch?v=mMJ2wrB8b2Q **Optional** Finzer, W. (2013). The data science education dilemma. *Technology Innovations in Statistics Education*, *7*(2). Levitt, Steve. (2019, October 2). *America's Math Curriculum Doesn't Add Up (Ep. 391)*. Freakonomics Radio. https://freakonomics.com/podcast/math-curriculum/	
Week 2 What is 'Professional' Data Science?	**Required** Mitchell, M. (2019). *Artificial intelligence: A guide for thinking humans*. Penguin UK. Chapter 2: Neural Networks and the Ascent of Machine Learning (pp. 35-42) Geitgey, A. (2014, May 5). *Machine learning is fun!* Medium. https://medium.com/@ageitgey/machine-learning-is-fun-80ea3ec3c471 **Pick one (Required):** *Deep learning* Geitgey, A. (2016, June 13). *Machine learning is fun! Part 3: Deep learning and convolutional neural networks.* Medium. https://medium.com/@ageitgey/machine-learning-is-fun-part-3-deep-learning-and-convolutional-neural-networks-f40359318721#.o6srqap2e *Speech Recognition* Geitgey, A. (2016, December 23). *Machine learning is fun! Part 6: How to do speech recognition with deep learning.* Medium.	

	https://medium.com/@ageitgey/machine-learning-is-fun-part-6-how-to-do-speech-recognition-with-deep-learning-28293c162f7a *Facial Recognition* Geitgey, A. (2016, July 24). *Machine learning is fun! Part 4: Modern face recognition with deep learning.* Medium. https://medium.com/@ageitgey/machine-learning-is-fun-part-4-modern-face-recognition-with-deep-learning-c3cffc121d78 **Optional** Klosowski, T. (2020, July 15). *Facial recognition is everywhere. Here's what we can do about it.* The New York Times. https://www.nytimes.com/wirecutter/blog/how-facial-recognition-works/	
Week 3 Bias, Equity, & Privacy	**Required** O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. Crown. Chapter 5: Civilian Casualties Justice in the Age of Big Data (pp. 84-104) TED. (2017, March 29). *How I'm fighting bias in algorithms | Joy Buolamwini* [Video]. YouTube. https://www.youtube.com/watch?v=UG_X_7g63rY&t=4s Browse this website: International Computer Science Institute. (2014, May). *Teaching Privacy.* https://teachingprivacy.org **Optional:** Hautea, S., Dasgupta, S., & Hill, B. M. (2017). *Youth Perspectives on Critical Data Literacies*. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, Denver, Colorado, USA. https://doi.org/10.1145/3025453.3025823 boyd, d., & Crawford, K. (2012). Critical questions for big data. *Information, Communication & Society, 15*(5), 662-679. doi:10.1080/1369118X.2012.678878 Coded Bias Documentary: https://searchworks.stanford.edu/view/13782783	**Dear Data Assignment Due**

Week 4 Data Platforms	**Required** Nieves, B. (2020). DataClassroom. *The American Biology Teacher, 82*(7), 509-509. doi:10.1525/abt.2020.82.7.509 Reiten, L., & Strachota, S. (2016). Promoting statistical literacy through Tuva. *The Mathematics Teacher MT, 110*(3), 228. doi:10.5951/mathteacher.110.3.0228 Rosenberg, J., Edwards, A., & Chen, B. (2020). Getting messy with data: Tools and strategies to help students analyze and interpret complex data sources. *The Science Teacher, 87*(5), 30-34. Switzer, A., Schwille, K., Russell, E., & Edelson, D. (2012). National Geographic FieldScope: a platform for community geography. *Frontiers in Ecology and the Environment, 10*(6), 334-335. doi:https://doi.org/10.1890/110276	
Week 5 Students' Ideas About Data	**Required** Bowler, L., Acker, A., Jeng, W., & Chi, Y. (2017). "It lives all around us": Aspects of data literacy in teen's lives. *Proceedings of the Association for Information Science and Technology, 54*(1), 27-35. doi:10.1002/pra2.2017.14505401004 Gebre, E. H. (2018). Young adults' understanding and use of data: Insights for fostering secondary school students' data literacy. *Canadian Journal of Science, Mathematics and Technology Education*, *18*(4), 330-341.	
Week 6 Reasoning with Data	**Required** Konold, C., Higgins, T., Russell, S. J., & Khalil, K. (2015). Data seen through different lenses. *Educational Studies in Mathematics, 88*(3). (pp. 308-321) Lee, V. R., & Wilkerson, M. (2018). *Data use by middle and secondary students in the digital age: A status report and future prospects*. (pp. 1-8) Geckoboard. *Data fallacies.* https://www.geckoboard.com/best-practice/statistical-fallacies/	**Student Interview Assignment Due**

Week 7 Data in Social Studies and Humanities	**Required** Craig, K. (2017). Analog tools in digital history classrooms: An activity-theory case study of learning opportunities in digital humanities. *International Journal for the Scholarship of Teaching and Learning, 11*(1). (pp. 4-10) Radinsky, J., Hospelhorn, E., Melendez, J. W., Riel, J., & Washington, S. (2014). Teaching American migrations with GIS census webmaps: A modified "backwards design" approach in middle-school and college classrooms. *The Journal of Social Studies Research, 38*(3), 143-158. Shreiner, T. L. (2019). Students' use of data visualizations in historical reasoning: A think-aloud investigation with elementary, middle, and high school students. *The Journal of Social Studies Research*, *43*(4), 389-404.	
Week 8 Data in Art and Science	**Required** Lamb, G. R., Polman, J. L., Newman, A., & Smith, C. G. (2014). Science news infographics: Teaching students to gather, interpret, and present information graphically. *The Science Teacher*, *81*(3), 25. Lee, V. R., & Wilkerson, M. (2018). *Data use by middle and secondary students in the digital age: A status report and future prospects*. (skim pp. 9-43) Matuk, C., DesPortes, K., Amato, A., Silander, M., Vacca, R., Vasudevan, V., & Woods, P. J. (2021). Challenges and opportunities in teaching and learning data literacy through art. In *Proceedings of the 2021 ISLS Annual Meeting*. Bochum, Germany: ISLS. Stornaiuolo, A. (2020). Authoring Data Stories in a Media Makerspace: Adolescents Developing Critical Data Literacies. *Journal of the learning sciences, 20*(1), 81-103.	
Week 9 Data Science Curricula	**Required** Gould, R., Machado, S., Ong, C., Johnson, T., Molyneux, J., Nolen, S., ... & Zanontian, L. (2016). Teaching data science to secondary students: The mobilize introduction to data science curriculum. *Iase-Web.org*.	

	Krishnamurthi, S., Schanzer, E., Politz, J. G., Lerner, B. S., Fisler, K., & Dooman, S. (2020). Data Science as a Route to AI for Middle-and High-School Students. *arXiv preprint arXiv:2005.01794*. Lee, V. R., & Delaney, V. (2021). *What Is Being Covered in Standalone Secondary School Data Science Curricula?* Paper presented at the 2021 Annual Meeting of the American Educational Research Association.	
Week 10 Messier Data	**Required** Kjelvik, M. K., & Schultheis, E. H. (2019). Getting Messy with Authentic Data: Exploring the Potential of Using Data from Scientific Research to Support Student Data Literacy. *CBE—Life Sciences Education, 18*(2). Lee, V. R., & Delaney, V. (2021). Aesthetics of authenticity for teachers' data set preferences. In *2021 Annual Meeting of the International Society of the Learning Sciences*. Bochum, Germany: ISLS.	**Data-intensive Lesson Plan Due**