Syllabus: CS 5703-001: Machine Learning Practice - In Person (Fall 2024)

Machine learning is the data-driven process of constructing mathematical models that can be predictive of data observed in the future. In this course, we will study the use of a range of supervised, semi-supervised and unsupervised methods to solve both classification and regression problems. In particular, we will focus on methods that can robustly address data that are non-linear, noisy, heterogeneous and/or high-dimensional. We will also study methods for evaluation of the resulting models. In our homework assignments, we will make use of several Python-based tool kits, including Scikit-Learn, Pandas, Numpy and Matplotlib.

Topics

Topics will include:

- Representing information and preparing data for use with ML methods
- Classifiers and feature importance, including K-nearest neighbors, logistic regression, support vector machines
- Decision trees: ensemble methods, random forests, and boosting
- Regression and combating over-fitting: ridge regression, Tikhonov regression, lasso, elastic nets, polynomial regression, support vector regression
- Nonlinear dimensionality reduction: kernel PCA, local linear embedding, ISOmap, multidimensional scaling
- Semi-supervised learning: label spreading, label propagation
- Unsupervised learning: mixture models
- Evaluation in ML: metrics, cross-validation, statistics, addressing the multiple comparisons problem

Teaching Approach

Applying machine learning methods out in the real world requires one to develop a solid intuition about the different types of ML problems, how the different ML algorithms solve these problems, the conditions in which each algorithm applies, and how to formally evaluate and interpret the results of applying the algorithms to a data-set. Over the course of the semester, we will talk about a wide range of algorithms and practice their use with various data-sets. Students will be expected to apply this knowledge by working with existing Python code and developing their own. The homework assignments that we will assign are intended to exercise all of these skills, often requiring extrapolation of the base knowledge. This approach is intended to be challenging. However, you are not on your own. The instructor and the teaching assistant are here to answer questions, discuss solutions and offer general guidance. We expect that everyone will be proactive when they are stuck on something.

General Information

- This is the In-Person of the course.

- Meeting location/time: Devon Energy Hall 130. T/Th 3-4:15pm

- Prerequisites:
  - We rely on a background that includes programming (including object-oriented programming), regression and hypothesis testing

- - Specific prerequisites: Artificial Intelligence (CS 4013/5013) OR Data Mining (CS 5593) OR Intelligent Data Analytics (ISE/DSA 5103) OR permission of the instructor (presuming similar background).
- NOTE: If you have already taken the CS Machine Learning course (CS 4033/5033), then you really should be taking one of our higher-division ML courses.

- Reading Materials:
  - Aurélien Géron (2020) *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow (Concepts, Tools, and Techniques to Build Intelligent Systems), 2nd edition*, ISBN-13: 978-1492032649, O'Reilly Media
  - Various papers and other network resources.

- The teaching staff is dedicated to helping you have a meaningful and quality experience in this class. We ask that you talk to us any time that you are having difficulty. However, please work to meet us part way: keep up with the readings and videos, and try writing bits of code to help clarify ideas. And - don't be afraid to fail in some of the things that you do for this class. Often, we learn a lot more failing than when we are succeeding.

- Other key materials:
  - Class schedule: https://symbiotic-computing.org/fagg_html/classes/mlp_live/schedule.html

  - Python 3 API Reference

  - Pandas data analysis package

  - Matplotlib

  - Numpy

  - Scikit-Learn

  - Jupyter Lab: https://jupyterlab.readthedocs.io/en/stable/

- Course web page: https://symbiotic-computing.org/fagg_html/classes/mlp_live

- We will also be making heavy use of Canvas

- Instructor: Dr. Andrew H. Fagg
  - Office: DEH 243
  - Office hours will be held in person and on GatherTown. See the Canvas syllabus for the invitation link
  - Phone: 325-8606 (note that I do not receive voicemail from this phone)
  - Homepage: https://symbiotic-computing.org/fagg_html
  - Email: andrewhfagg--gmail.com
  - Office hours: see the office hours web page https://symbiotic-computing.org/fagg_html/office.html

- Teaching Assistant: Averi Bates
  - Office hours will be held in DEH 115 and on GatherTown
  - Email: Averi.J.Bates-1 -- ou.edu
  - Office hours: see the office hours web page https://symbiotic-computing.org/fagg_html/office.html

Course Policies

- **Lectures**:

- In-Person: Lectures are T/Th 9-10:15 in Carson 441.
- **Class Web Page:** Most of the material that you will need can be found on the class web page located at: https://symbiotic-computing.org/fagg_html/classes/mlp_live

- **Canvas:** This class will also use Canvas, located at: http://canvas.ou.edu

  Login with your 4+4 (typically the first four letters of your last name followed by the last four digits of your student number), using your standard OU password. If you have difficulty logging in, call 325-HELP. This software provides a number of useful features, including a list of assignments and announcements, an electronic mailing list, newsgroups, and a grade book.

  I may update the main web site and the Canvas page several times a week. When I update the site in any significant way, I will post an announcement on Canvas telling you what has been added and where it is located. You are responsible for things posted on the site within 48 hours of the post.

- **Class Communication:**
  - Slack: We will have a Slack page dedicated to the course. The invitation is time-sensitive and available on the Canvas syllabus page.

  - I will hold regular, weekly office hours using GatherTown and in person, as will the teaching assistant. Office hours are listed on my office hours page

  - Matters of personal interest should be directed to email instead of to the Slack page, e.g. informing me of an extended illness.

  - Announcements will be posted to the Canvas announcement board.

  - It is your responsibility to have Canvas configured so that you receive these messages in a timely fashion. Note that Canvas can be configured so that it will forward messages, discussion posts and announcements directly to your email address.

  - Homework assignments and associated code will be posted on our JupyterHub.

- **Final Exam:** There is no final exam for this course.

- **Proper Academic Conduct:**
  - Homework assignments must be your own work.

  - While the net may be used as a reference, downloading code that solves all or a substantial portion of any assignment from the net is prohibited.

  - Services based on Large Language Models (e.g., chatgpt, bing chat, and alpaca) can be good sources of ideas, as well as detailed code examples. However, their output should always be treated skeptically, as these tools rely entirely on identifying common patterns across large text and code bases. You should always take the time to understand the suggestions that are being made and confirm that any code actually accomplishes what is needed. Nonetheless, using these services to solve all or a substantial portion of any assignment is prohibited.

  - Programs will be checked by software designed to detect improper copying. This software is extremely effective and has withstood repeated reviews by the campus judicial processes.

  - Upon the first documented occurrence of inappropriate collaborative work or downloading of solutions, I will report the academic misconduct to the Campus Judicial Coordinator. The procedure to be followed is documented in the University of Oklahoma Academic Misconduct Code (http://integrity.ou.edu).

- Examples
    1. You and a friend in the class discuss the details of a project, including drawing ML algorithms on a whiteboard. Is this a case of academic misconduct? **No**

    2. You and a friend discuss the details of a project and share snippets of code that illustrate how to use Python or Scikit-Learn. Is this a case of academic misconduct? **No**

    3. You and a friend discuss the details of a project and share snippets of code that solve parts of the project. Is this a case of academic misconduct? **Yes**

    4. In the presence of the instructor or TA, you share snippets of code that solve parts of the project in order to receive advice; other students are present for the conversation. Is this a case of academic misconduct? **No,** but we may decide to move the conversation out of sight of the other students.

    5. A friend who took the same class in a prior semester offers to provide homework solutions. Is it academic misconduct to accept this code? **Yes**

    6. You store your homework code on a service such as **Github**. The code is searchable and downloadable by anyone. Is this a case of academic misconduct? **Yes**

    7. You store your homework code on a service such as **Github**. The code is not searchable, but you share a link with someone else in the class. Is this a case of academic misconduct? **Yes**

    8. You store your homework code on a service such as **Github**. The code is not accessible by others. Is this a case of academic misconduct? **No**

    9. You post homework problems to a service such as **Chegg**. Is it misconduct to receive help on these problems or to provide answers to these problems to the service? **Yes**

    10. You discuss the solution of problems similar to what can be found in a homework assignment. Is this a case of academic misconduct? **No**

    11. You submit the text of an assignment to ChatGPT and then submit the resulting code as a solution to a homework assignment. Is this a case of academic misconduct? **Yes**

    12. You submit parts of assignment text or code to ChatGPT and ask for explanations or for ideas about possible solutions. You use the output as inspiration for your own solution. Is this a case of academic misconduct? **No**

- **Incompletes:** The grade of "I" is intended for the rare circumstance when a student who has been successful in a class has an unexpected event occur shortly before the end of the class. I will not consider giving a student a grade of "I" unless the following three conditions have been met.
    - It is within two weeks of the end of the semester.
    - The student has a grade of C or better in the class.
    - The reason that the student cannot complete the class is properly documented and compelling.

- **Accommodation of Disabilities:** The University of Oklahoma is committed to providing reasonable accommodation for all students with disabilities. Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. Students with disabilities must be registered with the [Accessibility and Disability Resource Center](#) prior to receiving accommodations in this course.

Grades

- **Final course grades** will be based on two factors:
  - 85%: 11 homework assignments, and
  - 15%: Regular, in-class activities and quizzes.

  The lowest of the homework assignment grades and the lowest of the in-class activity grades will be dropped from the final grade computation.

- **Homework assignments** are due on the day indicated on the [course schedule](#) at 11:59pm. Each assignment must be turned in the following way:
  - To Gradescope: turn in the notebook file itself (.ipynb).

- **Late policy:**
  - Homework assignments will be accepted one day late with a 10% penalty or two days late with a 20% penalty.

General Grade Issues

- **Grade questions:** If you have a question about grading (including assessment of points), you may address these during office hours or in email. Note that if you are asking me to reconsider a grade, then I will likely re-examine the entire assignment. You have one week from the point that you receive feedback to address grading questions.

- **Canvas Grade Summary:** Canvas has a grade book that is used to store the raw data that is used to calculate your course grade. It is the responsibility of each student in this class to check their grades on Canvas after each assignment is graded. If an error is found, please bring it to my attention.

Inclusive Learning Environment

Computer Science, Data Science and Machine Learning require many different voices and perspectives. It is my intent that our learning environment be open and accepting to all students, no matter their background, who they are or how they identify themselves. Please help me create this environment by being friendly, supportive and patient.

Food Pantry

As a member of the OU community, you have access to the [University of Oklahoma Food Pantry](#) and can receive free supplemental food, as well as other necessities such as menstrual hygiene products. All students, faculty, and staff, with an OU ID, are eligible. Visit their website to stay up to date on hours of operation, as well as to access additional information about other basic needs resources, including financial and budget assistance through the OU Student Financial Center. For those who are able to, the Food Pantry will accept donations.

Land Acknowledgment

Long before the University of Oklahoma was established, the land on which the University now resides was the traditional home of the Hasinais Caddo Nation and the KirikirÊ"i:s Wichita & Affiliated Tribes. We acknowledge this territory once also served as a hunting ground, trade exchange point, and migration route for the Apache, Comanche, Kiowa and Osage nations. Today, 39 tribal nations dwell in the state of Oklahoma as a result of settler and colonial policies that were designed to assimilate Native people. The University of Oklahoma recognizes the historical connection our university has with its indigenous community. We acknowledge, honor and respect the diverse Indigenous peoples connected to this land. We fully recognize, support and advocate for the sovereign rights of all of Oklahoma's tribal nations. This acknowledgment is aligned with our university's core value of creating a diverse and inclusive community. It is an institutional

responsibility to recognize and acknowledge the people, culture and history that make up our entire OU Community.

Course Evaluations

The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these forms are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty uses these forms to improve their own teaching effectiveness. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions.

Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where necessary and similar in scope to accommodations based on temporary disability. Please see https://www.ou.edu/eoo/faqs/pregnancy-faqs.html for commonly asked questions.

Title IX Resources

For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5) or the Sexual Assault Response Team 405-615-0013 (24.7) to learn more or to report an incident.

Registration and Withdrawal

If you choose to withdraw from this course, you must complete the appropriate University form and turn the form in before the deadline. If you stop attending the course and doing the coursework without doing the required paperwork, your grade will be calculated with missed homework and examination grades entered as zero. This could result in receiving a grade of F in the course. Deadlines are shown in the Academic Calendar, which is available from the Office of Admissions and Records or online at https://www.ou.edu/registrar/academic-records/academic-calendars

Emergency Protocol

During an emergency, there are official university procedures that will maximize your safety.

- **Severe Weather:** If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather 1. LOOK for severe weather refuge location maps located inside most OU buildings near the entrances 2. SEEK refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. 3. GO to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. 4. GET IN, GET DOWN, COVER UP. 5. WAIT for official notice to resume normal activities.

  Links: Severe Weather Refuge Areas, Severe Weather Preparedness

- **Armed Subject/Campus Intruder:** If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots: 1. GET OUT: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911. 2. HIDE OUT: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room. 3. TAKE OUT: As a last resort fight to defend yourself.

  Links: OU Emergency Preparedness, Responding to Gunshots

- **Fire Alarm/General Emergency:** If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: 1. LEAVE the building. Do not use the elevators. 2. KNOW at least two building exits 3. ASSIST those that may need help 4. PROCEED to the emergency assembly area 5. ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. 6. WAIT for official notice before attempting to re-enter the building.

  Links: OU Fire Safety on Campus

This page is online at https://symbiotic-computing.org/fagg_html/classes/mlp_live/syllabus.html
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