

CS P556: Applied Machine Learning

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Instructor

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Please see Canvas for up-to-date list, contact information, and office hours.

Contacting course staff and other students: Communication between you, us, and other students is really important. Help us make this more efficient by following these guidelines!

- For general questions about course material, assignments, etc., please use the Q&A Community tool on Canvas so that others can benefit from the answers. You can expect a response within 24 hours. We encourage you to actively monitor and participate in Q&A Community discussions.
- For more informal interactions with other students in the class, e.g., for coordinating group projects, sharing interesting AI news items, etc., you can use Slack, which you can join using your IU email at <https://p556-fa23.slack.com>. Using Slack is optional, but encouraged.
- For alerting us to problems or concerns with grading, see Regrade Requests, below.
- For more sensitive personal matters, email the instructor directly (ztiganj@iu.edu).

Our lectures are in-person on Monday and Wednesday 4:45-6:00pm in room EP 257 (Ernie Pyle Hall). We will livestream and record the lectures via Zoom (see Canvas for details) so that students can join remotely when they are not able to come in person. Lectures will include interactive exercises using TopHat platform.

Office hours: Instructor and AIs will hold weekly open office hours, either in person or online via Zoom. Please see Canvas for up-to-date times and URLs. If you cannot make office hours, contact an instructor or AIs via email or slack to make a separate appointment.

Course overview: This course covers applications of machine learning and is aimed at M.S., Ph.D., and advanced undergraduate students in Computer Science and Data Science, as well as students in other related fields who have a strong computing background. The main aim of the course is to provide skills to apply machine learning algorithms on real applications. We will consider fewer learning algorithms and less time on math and theory and instead spend more time on hands-on skills required for algorithms to work on a variety of data sets. Topics will include (tentatively):

- *Introduction to Machine Learning:*
- *Linear regression*
- *Logistic regression*
- *Support vector machines*
- *Decision trees*
- *Dimensionality reduction*
- *Gaussian mixtures*
- *Introduction to deep neural networks*
- *Convolutional neural networks*

- *Recurrent neural networks*
- *Autoencoders*
- *Generative adversarial networks*
- *Transformers*
- *Reinforcement learning*

Applications will include time-series prediction, data visualization, computer vision, natural language processing and robotics.

Prerequisites: Experience with programming, data structures, and algorithms will be assumed (CS C343 or equivalent). Assignments will involve substantial amount of programming in Python. If you do not know Python, we will expect you to learn it outside of class; Python has a reputation for being easy to learn, and those with programming background in another general-purpose programming language (like C/C++, Java, Ruby, etc.) can usually learn it within a few days. In addition, we will encounter math of various kinds, including linear algebra, probability theory, and basic calculus. We will review the key mathematical concepts as we go, but students with limited math backgrounds may need to do additional reading outside of class.

Textbook (optional): The lectures will primarily follow *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* book by Aurélien Géron (2nd or 3rd edition is recommended). An electronic or e-book copy is fine for the purposes of the class. You will not need the book for the exams, so it is practical to share a book with other students in the class. Schedule, readings, and resources will be available via Canvas.

Grading and requirements:

- *Assignments* (40%), total of 4 assignments, most of which will require substantial programming projects. The assignments can be done individually or in groups of two or three.
- *Quizzes, attendance and in-class activities* (20%). These are not meant to be stressful events, but ways to give you practice understanding course concepts while rewarding regular class participation and attendance. They also give instructor feedback on how well the class is progressing.
- *Midterm exam* (15%), in class. If you have an unavoidable conflict with the midterm day or time, please notify us at least one week before the midterm date.
- *Final exam* (25%), in class. If you have an unavoidable conflict with the final day or time, please notify us at least one week before the final date.

Final course letter grades: Students whose final course scores (reflecting all assignments, exams, etc.) are above 90% are guaranteed at least an A-, above 80% are guaranteed at least a B-, and above 70% are guaranteed at least a C-. Detailed grading scale will be determined based on the median performance of the class. Students should thus view their grades not as absolute numbers but relative to the performance of the rest of the class; we will publish the median and mean scores for assignments and exams to facilitate this. Students with concerns about their grades are welcome to consult with the instructor at any time.

Groups: We encourage students to work in small groups for the programming assignments (up to 3 students per group), because: (1) in a good group, students bring complementary strengths and weaknesses, allowing them to learn from one another, (2) a good group can accomplish much more in a short period of time than a single person can, and (3) working in groups is a fact of life in both industry and academia, and developing good teamwork skills is crucial to succeeding in most computing-related careers. At the same time, we understand that finding and building good teams is difficult and we will allow students flexibility to choose their teammates and to change their groups throughout the semester, if they wish.

Late submission policy: Assignments and quizzes will be accepted after the due date, but with 10% late penalty per day of delay (e.g., if you are 4 days late, you will receive 40% less points than what you would receive if you submitted the assignment or quiz on time). Note: All assignments must be submitted according to the instructions given on the assignment hand-outs, which will typically require electronic (online) submission. We use the time that submissions are received by the servers to judge timeliness. It is a very good idea to make early submissions and then upload updates as the deadline approaches; we will grade the last submission received before the deadline.

Attendance policy: Students are expected to attend all class sessions. We will use Quizzes and TopHat to determine class attendance. Students attending more than 90% of the classes will earn maximum attendance points, students attending between 80% and 90% of classes will earn 90% of attendance points etc. In addition, missing the class in the following situations will be excused: if (1) a student is missing class for a valid academic or religious event (such as a job interview or conference) and notifies the instructor and presents substantiating documentation at least 3 days ahead of time, or (2) a student misses class for health reasons (involving themselves or a dependent child), notifies the instructor within 24 hours of missing class, and presents written documentation.

Regrade requests: We follow a formal process for requesting regrades to ensure fairness to all students. If you have a question about the grading of an assignment, or believe you have discovered an error in our grading of one of your assignments, then, within one week of when the grade was released: (1) write a specific, precise, self-contained, well-reasoned explanation, including evidence (e.g. screenshots of program output, etc.) if appropriate; (2) submit this write-up as a **private** Q&A Community post using the “regrade-request” tag; (3) within two weeks, a grader will examine your request and make any corrections; (4) if you are not satisfied, you may appeal by posting a follow-up comment on Q&A Community, and the lead instructor will regrade the entire assignment from scratch to determine a final grade. Note that regrade requests may result in either positive or negative grade adjustments.

Technology requirements: You will likely want to use a Python development environment on your local computer. There are many free and commercial options, and you can choose whichever you’d like. See <https://wiki.python.org/moin/IntegratedDevelopmentEnvironments> for a list; popular choices include PyCharm (which is free for academic use), IDLE (a simple IDE that comes built-in to most Python distributions), and XCode (which is free but available only for Macs). We will use TopHat for interactive exercises during lectures. TopHat is available for free for IU community and can be used on a variety of electronic devices, including smartphones, tablets and laptops.

Available software: Although not required, other software may be helpful (e.g. graphing programs, word processors, etc.). Get no-cost access to hundreds of software programs and applications through IUware and IUanyWare. All you need is your IU email address. Use IUware to install software directly onto your hard drive. Use IUanyWare to stream 400+ apps on your desktop or through the mobile app with your IU login. Visit iuware.iu.edu and iuanyware.iu.edu, or contact the UITs Support Center to learn more. Students in this class are invited to use Boost, a free smartphone app developed at IU that provides notifications and reminders about schoolwork in Canvas. It is designed to help students keep track of assignment deadlines, important announcements, and course events all in one easy-to-use app. For more information, see <https://kb.iu.edu/d/atud> or <https://boost.iu.edu>.

Academic Integrity Policy: We take academic integrity very seriously. You are required to abide by the Indiana University policy on academic integrity, as described in the Code of Student Rights, Responsibilities, and Conduct, as well as the Computer Science Statement on Academic Integrity (<http://www.soic.indiana.edu/doc/graduate/graduate-forms/Academic-IntegrityGuideline-FINAL-2015.pdf>). It is your responsibility to understand these policies. Briefly summarized, the work you submit for course assignments, projects, quizzes, and exams must be entirely your own (or entirely that of your group, if groupwork is permitted). If you use the ideas (including text, source code, algorithms, concepts, diagrams, slides, etc.) of others, you must give proper credit with a prominent citation and an explicit indication of which idea(s) or material(s) you borrowed so that another person (e.g. a grader) can easily separate your contribution from the work of others. You may discuss assignments with other students (or students in other groups) at a high level, by for example discussing general methods or strategies to solve a problem, but you must cite the other student in your submission. Looking at someone else’s code related to an assignment, whether online or from another student, will almost certainly lead to academic dishonesty. Sharing your assignment code with another student also almost certainly constitutes academic dishonesty.

The consequences of academic dishonesty are extremely serious. We respond to plagiarism and academic misconduct according to university policy. In assigning sanctions, we follow CS Program policy: “The ordinary departmental level penalty for cheating is failure in the course” but “in all cases, the penalty will be more severe than not turning in the assignment.” In addition, “the student will no longer be eligible for the guaranteed financial aid.” Moreover, University policy requires us to report the incident to the Dean of Students, who may apply additional sanctions, including expulsion from the university.

Students agree that by taking this course, papers and source code submitted to us may be subject to textual similarity review, for example by Turnitin.com. These submissions may be included as source documents in reference databases solely for the purpose of detecting plagiarism of such papers or codes.

Religious Holidays: Indiana University respects the right of all students to observe religious holidays and will make reasonable accommodation, upon request, for such observances. Students missing class for a religious observance can find the officially

approved accommodation form by going to the Vice Provost for Faculty and Academic Affairs webpage for religious accommodations. The form must be submitted at least 2 weeks prior to the anticipated absence.

Disabilities: Every attempt will be made to accommodate qualified students with disabilities (e.g. mental health, learning, chronic health, physical, hearing, vision neurological, etc.). You must have established your eligibility for support services through the appropriate office that services students with disabilities. Note that services are confidential, may take time to put into place and are not retroactive; captions and alternate media for print materials may take three or more weeks to get produced. Please contact Disability Services for Students at <http://disabilityservices.indiana.edu>, 812-855-7578, or in Wells Library Room W302. Walk-ins are welcome 8 AM to 5 PM, Monday through Friday. You can also locate a variety of campus resources for students and visitors that need assistance at: <http://www.iu.edu/~ada/index.shtml>

Title IX: Our responsibility is to create a positive learning environment for all students. Federal law (Title IX) and IU's Sexual Misconduct Policy prohibit sexual misconduct in any form, including sexual harassment, sexual assault, stalking, and dating and domestic violence. If you have experienced sexual misconduct, or know someone who has, the University can help. If you are seeking help and would like to speak to someone confidentially, you can make an appointment with Sexual Assault Crisis Services (SACS) at (812) 855-8900 (for counseling services), Confidential Victim Advocates (CVA) at (812) 856-2469 (for advocacy and advice services), or IU Health Center at (812) 855-4011 (for health and medical services). Title IX and University policy require us to share any information brought to our attention about potential sexual misconduct with the campus Deputy Title IX Coordinator or IU's Title IX Coordinator. In that event, those individuals work to ensure that appropriate measures are taken and resources are made available. Protecting student privacy is of utmost concern, and information will only be shared with those that need to know to ensure the University can respond and assist. Visit stopsexualviolence.iu.edu to learn more.

Bias-based incidents: Bias incidents (events or comments that target an individual or group based on age, color, religion, disability, race, ethnicity, national origin, sex, gender, gender identity, sexual orientation, marital status or veteran status) are not appropriate in our classroom or on campus. What should you do if you experience, witness, see, or hear a bias incident? Report it by submitting a report online (biasincident.indiana.edu) or calling the Dean of Students Office (812-855-8187).

Emergency Preparedness: Although rare, emergencies can and do occur, and it's important that you know how to handle them. Below is a brief summary; see <http://protect.iu.edu/> for more information.

- Tornado: Seek shelter. Move to an interior room on the lowest level. Stay away from windows and exterior doors. Listen to a weather radio for updates. Stay away from hazardous materials.
- Fire: Evacuate. Pull the fire alarm. Call 911. Leave the building, closing doors behind you. If unable to exit go to the nearest stairwell or place of refuge, don't use elevators. Assemble in designated area.
- Medical emergency: Call 911. Do not move the victim unless in immediate danger. If trained, administer first aid, CPR/AED.
- Suspicious activity, e.g. object is out of the ordinary, person is behaving strangely, gut feeling that something is wrong: If you see something suspicious, call 911.
- Hazardous materials: Stay back. If life-threatening, pull the fire alarm, evacuate and call 911. If non-life-threatening, call 911 and provide information on type of incident and location.
- Bomb threat: Remain calm. Get as much information as possible from the caller: location of device, what it looks like, what will cause it to explode. Note background sounds, gender of caller, other notable characteristics of the caller's voice. Call 911.
- Active shooter: Call 911. Leave the building if possible, otherwise hide in a concealed place. Lock and barricade door, turn off lights. Wait for law enforcement. As a last resort, overpower the shooter.