CSE 575: Statistical Machine Learning

subject to change

Instructor:	Yingzhen Yang	**Meeting Times:**	MW 1:30 pm – 2:45 pm
Email:	yingzhen.yang@asu.edu	**Place:**	PSF101

General Course Information

- **Instructor's office hours:** Monday&Wednesday 10am - 11:00am. The instructor's office hours are both online (with Zoom link https://asu.zoom.us/j/9531979310) and in-person (BYENG 590).

  TA office hours: Changyu Liu (changyu2@asu.edu, T 1:30pm – 2:30pm, Th 1:30pm – 2:30pm, BYENG 221 or Zoom link: https://asu.zoom.us/j/81004573515). Please attend the TA office hours through TA's personal Zoom meeting room link or visiting the office in-person. The physical location of TA office hours is BYENG 221.

  Grader Office Hours: Dheeraj Reddy Vemula (dvemula1@asu.edu), Monday&Wednesday 11am - 12pm, Zoom link: https://asu.zoom.us/j/87059521649

- **Prerequisites:** Basics of linear algebra, probability, statistics algorithm design and analysis, proficient programming in one of the following languages (Matlab, Python, C++ or Java).
- **Text book:** Pattern Recognition and Machine Learning, Christopher M. Bishop, 2006.
- **Reference book:** The Elements of Statistical Learning: Data Mining, Inference, and Prediction (2nd Edition). Trevor Hastie, Robert Tibshirani and Jerome Friedman. Springer-Verlag, 2009.
- Note that class sessions may be recorded, and recordings provided to enrolled students, instructors or instructional support personnel. If you have concerns about being recorded, please contact the course instructor. Recordings may be used to accommodate student absences. Recordings of all class sessions will be posted in Canvas for all students to access for reviewing course materials.

Catalog Description

Probability distributions, maximum likelihood estimation, regression, classification, decision tree, boosting, kernel methods, clustering, mixture models, graphical models, dimensionality reduction, Bayesian networks, Hidden Markov Models, and heterogeneous learning.

Course Objectives

The objectives of this course is to provide an in-depth introduction to machine learning and statistical pattern recognition by

- studying foundational concepts such as classification, regression, etc.;
- experimenting with important and representative machine learning algorithms (such as K-means clustering, Gaussian Mixture Model);
- applying the methods&concepts studied in the lectures to a course project.

Expected Learning Outcomes

Students are expected to perform the following upon completion of this course:

- understand the principles of representative machine learning algorithms;
- implement popular machine learning algorithms;
- propose machine learning approaches for challenging tasks in practice.

Grade Policies

- 40%: Two exams (midterm01=20%, midterm02=20%)
- 30%: Three written Assignments. There will be three assignments, with equal weight.
- 30%: Projects. Five to six students form a group to carry out a research project. It can be an implementation and a comparative study of existing methods, a review of a specific topic, or the development of new ideas. Each team will submit a proposal (10%), make a 15-minute presentation at the end of the semester (10%), and submit a project report (10%). All team members will receive the same grade for the project.
- Final Letter Grade: the following are the most likely cutoffs for the letter grade: A ($\geq$ 93%); A- ($\geq$ 90%); B+($\geq$ 85%); B ($\geq$ 80%); B-($\geq$ 75%); C+($\geq$ 70%) C ($\geq$ 65%); D ($\geq$ 60%); E ($<$ 60%).

Topics to Cover (tentative)

- Probability Basics, MLE
- Classifications (KNN, Bayes Classifier, Naïve Bayes Classifier, Logistic Regression and SVM)
- Clustering (K-means, GMM, Spectral clustering)
- Feature Selection and Dimension Reduction (PCA and SVD)
- Model Selection: Variance and Bias, Cross-validation
- Hidden Markov Model
- Advanced topics (when time permits, e.g., AutoML, sparse learning, etc.)

Absence & Make-Up Policies

Excused absences for classes will be given without penalty to the grade in the case of (1) a university-sanctioned event ACD 304-02; (2) religious holidays ACD 304-04; a list of religious holidays can be found here `https://eoss.asu.edu/cora/holidays`; (3) work performed in the line-of-duty according to SSM 201-18. Students who request an excused absences must follow the policy/procedure guidelines. Excused absences do not relieve students of responsibility for any part of the course work required during the period of absence.

All homework assignments are due by its specified due date/time. We have standard **Late Submission Policy**. Without special cases mentioned below, we have a standard 10% deduction policy for each late day, i.e. we have to deduct 10% of the full marks per day for late submissions.

If you fall into one of the special cases stated below, you need to talk to the instructor early. It is the instructor's decision whether or not you will receive an extension or an opportunity for makeup without penalty.

I will honor the following special cases (rules stated):

1 Medical Problems: Within two days, you need to submit a statement with the signature of the doctor and the seal of the hospital saying that you cannot come to class and perform academic activity during a particular time.

2 Travel Accident: Within two days, you need to submit a police report stating that you are involved in an accident.

3 Death of an Immediate Family Member: If you need to attend the funeral of an immediate family member (defined as grand-parent, parent, spouse, sibling or child), you need the instructor's prior approval. Proof is required.

Policy regarding expected student behavior

Students in this class are expected to acknowledge and embrace the FSE student professionalism expectation located at: https://engineering.asu.edu/professionalism/.

Generative AI

Generative AI is a technology that can often be useful in helping students learn the theories and concepts in this course. However, unless explicitly allowed by your instructor, the use of generative AI tools to complete any portion of a course assignment or exam will be considered academic dishonesty and a violation of the ASU Academic Integrity Policy. Students confirmed to be engaging in non-allowable use of generative AI will be sanctioned according to the academic integrity policy and FSE sanctioning guidelines.

Academic Integrity

All engineering students are expected to adhere to the ASU Student Honor Code and the ASU academic integrity policy, which can be found at https://provost.asu.edu/academic-integrity/policy. Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. If you have taken this course before, you may not reuse or submit any part of your previous assignments without the express written permission from the instructor.

All student academic integrity violations are reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). Withdrawing from this course will not absolve you of responsibility for an academic integrity violation and any sanctions that are applied. The AIO maintains a record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Student Copyright Responsibilities

You must refrain from uploading to this course shell, discussion board, website used by the course instructor or any other course forum, material that is not your own original work, unless you first comply with all applicable copyright laws. Course instructors reserve the right to delete materials from the course shell on the grounds of suspected copyright infringement.

The contents of this course, including lectures and other instructional materials, are copyrighted materials. Students may not share outside the class, including uploading, selling or distributing course content or notes taken during the conduct of the course. Any recording of class sessions is authorized only for the use of students enrolled in this course during their enrollment in this course. Recordings and excerpts of recordings may not be distributed to others. (see ACD 304–06, "Commercial Note Taking Services" and ABOR Policy 5-308 F.14 for more information).

Policy against threatening behavior, per the Student Services Manual, SSM 104-02

Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services (see SSM 104-02). Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students.

Disability Accommodations

Suitable accommodations are made for students having disabilities. Students needing accommodation must register with the ASU Student Accessibility and Inclusive Learning Services office and provide documentation of that registration to the instructor. Students should communicate the need for an accommodation in enough time for it to be properly arranged. See ACD 304-08 Classroom and Testing Accommodations for Students with Disabilities.

Harassment and Sexual Discrimination

Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information.

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling is available if you wish to discuss any concerns confidentially and privately. ASU online students may access 360 Life Services, https://goto.asuonline.asu.edu/success/online-resources.html.

Photo requirement

Arizona State University requires each enrolled student and university employee to have on file with ASU a current photo that meets ASU's requirements (your "Photo"). ASU uses your Photo to identify you, as necessary, to provide you educational and related services as an enrolled student at ASU. If you do not have an acceptable Photo on file with ASU, or if you do not consent to the use of your photo, access to ASU resources, including access to course material or grades (online or in person) may be negatively affected, withheld or denied.