

Syllabus

CSC 455 Machine Learning

4 cr.

Instructor	Dr. Fatema Nafa
Email	fnafa@Salemstate.edu
Office Hours	Tuesdays 2:00 PM – 4:00 PM & by appointment
Time	Tuesdays & Thursdays: 9:00 – 10:40
Place	MH 202
Final Exam Thursday December 15, 11:00AM -1:00PM	

Catalog description:

This course provides an introduction to machine learning algorithms. Machine learning is focused on finding patterns in data to solve complex problems. Instead of explicitly programming computers to perform a task, machine learning lets us program the computer to learn from examples and improve over time without human intervention. The course covers a broad cross-section of models and algorithms for machine learning. Topics include data preprocessing techniques, supervised learning algorithms, unsupervised learning algorithms, deep learning algorithms, and reinforcement learning algorithms. Four lecture hours per week.

Prerequisite(s): CSC 260 and MAT 147.

Course Goals:

The purpose of this course is to develop student's knowledge and understanding of various machine learning algorithms. Specific goals are to:

- CG01: present the basic concepts of machine learning
- CG02: understand the importance of data pre-processing techniques
- CG03: understand various supervised learning, unsupervised learning, and reinforcement learning algorithms
- CG04: present the commonly used libraries for performing machine learning tasks
- CG05: discuss the application of machine learning algorithms to real-world problems

Course Objectives:

Upon successful completion of the course, a student will have:

- CO01: developed an appreciation for data-based learning models
- CO02: gained experience with a wide variety of machine learning algorithms
- CO03: developed an understanding of machine learning model evaluation
- CO04: gained hands-on experience in applying the machine learning algorithms to real-world problems
- CO05: demonstrated through projects and written assignments the ability to apply methods and techniques of machine learning

Student Outcome (SO) vs. Course Objectives matrix

SO	CO01	CO02	CO03	CO04	CO05s
SO-1	✓	✓		✓	✓
SO-2				✓	✓
SO-3	✓				
SO-4					
SO-5	✓				
SO-6	✓	✓	✓		✓

Notes:

- SO-1:** Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- SO-2:** Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- SO-3:** Communicate effectively in a variety of professional contexts.
- SO-4:** Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
- SO-5:** Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
- SO-6:** Apply computer science theory and software development fundamentals to produce computing-based solutions.

Tentative Schedule (Subject to Change as Per Instructor's Discretion)

Week	Date	Day	Topic for Lecture
1	09/08	Thur.	Class Introduction Syllabus,
	09/09	Tues.	Module 1: Introduction to machine learning. Examples, types of ML problems. Course logistics. HW: Students should download python, jupyter, github, and do the lab.
2	09/14	Thur.	Module 2: Linear regression
	09/16	Tues.	Linear models, least squares formula; Extensions for non-linear models
3	09/21	Thur.	Module 3: Model selection and regularization.
	09/23	Tues.	Understanding underfitting and overfitting with polynomial fitting; Irreducible error due to measurement noise; Bias and variance tradeoff; Cross validation; Lasso and regularization.
4	09/28	Thur.	Module 4: Logistic regression and classification.
	09/30	Tues.	
5	10/5	Thur.	Module 5: Numerical optimization
	10/7	Tues.	Unconstrained optimization, gradient descent, global vs. local minima, convexity. Example with logistic regression. Implementation with Python
6	10/12	Thur.	Module 6: Support vector machines.
	10/14	Tues.	Image classification; SVM formulation, support vectors; Duality, kernel methods
7	10/19	Thur.	Module 7: Dimensionality reduction.
	10/21	Tues.	Principle component analysis (unsupervised), linear discriminant analysis (supervised), LDA SVDs
8	10/26	Thur.	Midterm Exam on 10/28 during class time
	10/28	Tues.	
9 and 10	11/02	Thur.	Module 8: Machine Learning Feature Extraction, Engineering and Clustering
	11/04	Tues.	
11	11/09	Thur.	Module 9: Neural networks.
	11/11	Tues.	Formulation, motivation; Computation graphs, backpropagation; Introduction to tensorflow and keras; Stochastic gradient descent.
12	11/16	Thur.	Module 10: Convolutional and deep networks.
	11/18	Tues.	Convolutional layers, Pooling, batch normalization; Advanced Tensorflow features; Using GPUs

13	11/23	Thur.	Thanksgiving Break
	11/25	Tues.	
14	11/30	Thur.	Module 11: Unsupervised Clustering. K-means, Mixture models, EM methods
	12/02	Tues.	
15	12/07	Thur.	Module 12: Tree based methods. Decision tree, Random Forest, Boosting. (Material to be uploaded)
	12/09	Tues.	
	12/13	Tues.	Final Project Presentation starts

Format and Procedures:

This course includes **lectures, labs, homework, assigned readings, projects, quizzes, and exams (Mid-term and Final).**

- **Class Participations and Labs:** Lectures will be given in the assigned lecture room twice a week. There is a laboratory associated with each lecture. The lab will complement the lecture and support the application of materials learned. **Attendance and participation are required.** Lectures will be followed by an in-class lab exercise that assists in the learning process. The last 20 minutes of each lecture will be lab work with a score given based on attendance and successful completion of lab exercises. These “labs” will immediately apply material from the lecture and serve as an introduction to the other programming assignments.
- **Written Assignments:** At the end of every other week, we will either have a problem set or a programming assignment. Students must work individually on these assignments.
- **Projects:** paired or individual projects are required by the end of the semester. The time schedule and grading details for the projects will be provided through the classes via iterations.
- **Quizzes:** Quizzes will be given **in class**. Students must work individually on these quizzes.
- **Exams:** Exams are in-class exams (a mid-term of 90 minutes and a final of 120 minutes). There will be one midterm and one final (comprehensive) examination. The midterm will be held on **week 8 or 9** depending on the class progress, and the final will be held on **week 16** depending on class progress. **Please do not arrange any other activities on the posted exam dates.**

Zoom and Lecture Policies (if any)

The Salem State University Student Code of Conduct applies to online behavior as well as in-person or classroom behavior. You are expected to be professional and respectful when attending class on Zoom. **The following are class policies for our meetings with Zoom.**

Please read carefully, these policies are effective immediately and apply for the remainder of the semester. All students are expected to adhere to the policies.

- **LOG in** with your full first name and last name as listed on the class roster. Do not use a nickname or other pseudonym when you log in. (It makes it impossible to know who is in attendance. Using your full name, quickly sorts student into their groups when needed). Users who do not provide their full names will NOT be admitted to class. **Exceptions**
- Since enrolling in the class, some students have changed their names to better reflect their gender identity. If you currently use a different name than what is listed on the official roster, please send me a private Canvas message so I can note this on my roster. Then you can use your current name on Zoom!
- If you do not have access to a computer or smartphone with internet access, call into class from a phone line. This is not optimal; please try to **locate an internet-enabled device to use for class.**
- Stay focused. Please stay engaged in class activities. Close any apps on your device that are not relevant and turn off notifications.
- Need technical help? Contact the IT Help Desk at it-helpdesk@salemstate.edu or 978.542.2036. Or, create a ticket on the help desk portal: [Salem State ITS Help Desk](#).

VIDEO

- Turn on your video when possible. It is helpful to be able to see each other, just as in an in person class. **Exceptions** If you have limited internet bandwidth or no webcam, it is ok to not use video. If you’re unable to find an environment without a lot of visual distractions, it is also ok to turn off your video.
- Keep it clean. Don’t share anything you wouldn’t put up on the projector in class!

AUDIO

- Mute your microphone when you are not talking. This helps eliminate background noise.
- Use a headset when possible. If you own headphones with a microphone, please use them. This improves audio quality.
- Be in a quiet place when possible. Find a quiet, distraction-free spot to log in. Turn off any music, videos, etc. in the background.

CHAT

- **Stay on topic.** Use the chat window for questions and comments that are relevant to class. The chat window is not a place for socializing or posting comments that distract from the course activities. If you fill it up with random comments, I will be unable to sort through the information quickly to address students' real questions/concerns about the course.
- **No disrespect or hate speech.** Just like in our in-person class, respectful behavior is expected. Consider Zoom a professional environment, and act like you're at a job interview, even when you're typing in the chat.
- Student **attendance is MANDATORY**, and student participation is encouraged to facilitate the learning process. **Missing three classes is subjected to be reported**
- Students are expected to attend every class, and to arrive on time. Missing class **more than three times without a legitimate excuse** will be officially acknowledged in an email to you and your advisor. Regardless of the reasons for your absences, the first three will be considered "excused," and every absence thereafter **will not be excused**. Moreover, I will also **subtract 3 points** from your course grade for **each absence** after the third one. If you must miss class for a legitimate reason, please notify me in advance, if possible.
- Students are **responsible for all materials presented in class**, examinations, and other announcements. No excuses of any nature will be construed as relieving you from the responsibility for completion of the work assigned.
- The lecture is the student's responsibility if class is missed; it is in the student's best interests to get the notes from a fellow student. The instructor does not have slides or lecture notes to hand out.
- **No late submissions** will be accepted, and no extensions will be granted except for a family or medical emergency. We will be using the online **Canvas** assignment submission system. You can continue to resubmit your files as many times as you would like up until the deadline, so please feel free to **upload early and often**. If you submit an assignment even one minute past the deadline, then the assignment will be marked as late.
- The assignments will be posted on **Canvas** in the "Assignments" section. Each assignment will include instructions, a due date, and a link for electronic submission.
- Any form of dishonesty or cheating is not tolerated. While all students are encouraged to openly discuss and ask questions, **the final work to be submitted must be the student's own**.
- There will be a series of written assignments from the textbook and other sources: *question-answering and/or short essay-writing*. Reading will be a part of the written assignments. Please note that in addition to these (**written**) assignments there will be (**programming**) projects. There is a deadline to each assignment, and a penalty will be imposed for late submissions.
- **Make-ups** are only allowed under **extraordinary circumstances**. Students must provide a satisfactory reason (as determined by the instructor) along with **proper documentation**.
- I strongly encourage study groups, but I require that each student hand in his/her answers in his/her own words - if two answers are highly similar to each other, neither will receive credit.
- All assignments must be submitted at **Canvas**.
- No **submission will be accepted after the final examination**.

Grading Procedures:

Students' final grades will be determined using the following grading weights:

Class Participations	15%
Labs and Written Assignments	35%
Project	30%
Examination	20%

Grading Criteria:

SCORE	GRADE	SCORE	GRADE
93-100	A	73-76	C
90-92	A-	70-72	C-
87-89	B+	67-69	D+

83-86	B	63-66	D
80-82	B-	60-62	D-
77-79	C+	0-59	F

Important Notes:

- All students are expected to be familiar with the academic regulations, including those regarding Academic Integrity, for Salem State University as published in the college catalog. In addition, each student is responsible for completing all course requirements and for keeping up with all that goes on in the course (whether or not the student is present).
- Students must comply with the **COVID -19** Health and Safety Protocols for the 2020-2021 Academic Year. This includes wearing masks in class and on campus in public spaces, practicing physical distancing where possible, including in-class, engaging in a daily symptom check, notifying Counseling and Health Services at 978-542-6413 if they have any symptoms associated with **COVID-19**, and not coming to campus or to an in-person class if they have any of the symptoms related to **COVID-19** until cleared by the Student Life Wellness Area. Students who have documented disabilities that may prevent them from complying with these policies are required to contact the Disability Services office.
- **Students must comply with any Covid-19 Health and Safety Protocols for the 2022-2023 Academic Year. Students should** review the information found at <https://www.salemstate.edu/covid19>.
- Students are responsible for **notifying faculty** if they need to be absent due to illness or isolation. If students have concerns about their health, please contact counseling and health services at [978 542 6413](tel:9785426413) or [978 542 3240](tel:9785423240)
- In the event of a university declared a critical emergency, Salem State University reserves the right to alter this course plan. Students should refer to Salem State for further information and updates. The course attendance policy stays in effect until there is a university declared a critical emergency. In the event of an emergency, please refer to the alternative educational plans for this course located IN **CANVAS**. Students should review the plans and gather all required materials before an emergency is declared.
- Salem State University is committed to providing equal access to the educational experience for all students in compliance with Section 504 of The Rehabilitation Act and The Americans with Disabilities Act and to providing all reasonable academic accommodations, aids, and adjustments. Any student who has a documented disability requiring accommodation, aid, or adjustment should speak with the instructor immediately. Students with Disabilities who have not previously done so should provide documentation to and schedule an appointment with the Office for Students with Disabilities and obtain appropriate services
- In the event of a university declared critical emergency, Salem State University reserves the right to alter this course plan. Students should refer to [salemstate.edu](https://www.salemstate.edu) for further information and updates. The course attendance policy stays in effect until there is a university declared a critical emergency. In the event of an emergency, please refer to the alternative educational plans for this course located at Canvas (<https://elearning.salemstate.edu/>). Students should review the plans and gather all required materials before an emergency is declared.

Note:

Please remember that if, for any reason, you decide to drop this course, you **MUST** do so officially through the **Registrar's office**. The last day to withdraw from a course this semester is **September 13**

Note: This syllabus represents the intended structure of the course for the semester. If changes are necessary, students will be notified in writing and via all regular class communication mechanisms (class discussion, emails, and/or the course link at **Canvas** (<https://elearning.salemstate.edu/>)).