CSE 404: INTRODUCTION TO MACHINE LEARNING

COURSE INFORMATION

Course: CSE 404 Introduction to Machine Learning
Credits: 3 credit hours
Classroom: Ernst Bessey Hall, Room 304
Zoom Classroom: https://msu.zoom.us/j/92566816332
Meeting ID: 925 6681 6332
Passcode: s21-404
Course Time: Monday & Wednesday, 10:20 AM – 11:40 AM

Instructor: Dr. Kristen Johnson
Zoom Office: https://msu.zoom.us/j/98418658107
Meeting ID: 984 1865 8107
Passcode: 40421
Office Hours: Monday after class; Email in advance for appointments
E-mail: kristenj@msu.edu

Teaching Assistant (TA): Bashir Sadeghi
Zoom Office: https://msu.zoom.us/j/9835414728
Meeting ID: 9835414728
Passcode: 657123
Office Hours: Tuesday & Thursday; Time TBD; Email in advance for appointments
E-mail: sadeghib@msu.edu

Undergraduate Learning Assistant (ULA): Tyler Smith (Piazza)

Office Hours: The instructor will stay in the classroom until 12 PM Mondays after class to answer questions. The TA will be available Tuesday and Thursday afternoons over Zoom. All other office hours must be scheduled in advance using the appointment policy below. For now, it is preferred that all meetings be held over Zoom. If you need to meet the instructor in-person, please request a meeting in a private Piazza post. Note: All Zoom meetings require you to be signed in through MSU.

Appointment Policy: At least 24 hours notice is needed to arrange an appointment by private Piazza post. No appointments concerning homework will be scheduled without at least 48 hours notice. Additionally, the student is required to be prepared with specific questions and the steps they have already taken towards solving the problem. Piazza posts over the weekend will not be answered until Monday. Piazza posts after 7 PM will not be answered until the next day. The instructor or TA may answer before then if possible. Emails will not be answered; all communication should be done through Piazza, privately if needed.

Course Description

An introduction to the field of machine learning, including linear models for regression and classification, generative models, support vector machines and kernel methods, neural networks and deep learning, decision trees, unsupervised learning and dimension reduction.

Prerequisites

In this course you will be required to mathematically prove aspects of machine learning algorithms which will require a mastery of math topics, especially, linear algebra and matrix computation, basics about probability theory and statistics, calculus, and numerical optimization. Python is required for the programming assignments for this course.

Textbooks

Learning from Data (LFD). A PDF copy of the textbook is available on D2L and Piazza.

Course Structure

Classes will meet twice a week, Mondays and Wednesdays from 10:20 AM to 11:40 AM, excluding university holidays. Slides for lectures (if used) will be posted to D2L/Piazza before class. Questions concerning the lectures, assignments, and exams will be answered after class and on Piazza, not over email. Announcements concerning class, homework, or exams will be made on Piazza. Students should use Piazza for all communication to ensure that the instructors can respond promptly.

Technology Policy

Students should not be on their cellphones, tablets, or laptops during class or exams, unless they are using Zoom to attend class or taking notes for class. Because of the mathematical nature of the class, I strongly advise taking your notes by hand. Occasional photos of longer proofs are allowed. Recording the lectures, either as audio or video, is *prohibited* unless a valid reason is provided to the instructor (e.g., a VISA) within the first week of class. See also *Exams* below for more details on technology in the classroom.

COURSE OBJECTIVES

Student learning outcomes include (1) understanding the mathematical foundations, major algorithms, applications, and challenges of machine learning; (2) the ability to prove and code basic machine learning algorithms for solving real-world problems. The learning outcomes will be assessed based on a combination of homework assignments, quizzes, exams, and mini coding projects.

COURSE SCHEDULE

The course schedule is tentative and subject to change. The instructor reserves the right to modify course policies and the course calendar according to the progress and needs of the class. Some topics are given two classes on this schedule, but may only require one. If this is the case, we will proceed to the next topic or potentially cancel class. Similarly, if more time is required for a topic, we will push back the next topic. Due dates will be adjusted accordingly.

Week	Date	Topic	LFD Readings	Assigned/Due
0	*Aug 30*	*No Class*		Self-Assessment
	Sept 1	Syllabus & Intro	Chapter 1	
1	*Sept 6*	*No Class; Labor Day*	(Chapters 2 & 4)	
	Sept 8	Mathematical Concepts	Math Resources	Homework 1
2	Sept 13	Perceptron	3.1	
	Sept 15			HW 1 Due HW 2 Assigned
3	Sept 20	Probability	1.3.2	
	Sept 22	Linear Regression	3.2	HW 2 Due HW 3 Assigned
4	Sept 27			HW 3 Due HW 4 Assigned
	Sept 29	Optimization		
5	Oct 4	Optimization Exam 1 Review		HW 4 Due
	Oct 6	Exam 1		HW 5 Assigned
6	Oct 11	Logistic Regression	3.3	
	Oct 13			HW 5 Due HW 6 Assigned
7	Oct 18	Nonlinear Transformation	3.4	
	Oct 20	*Midsemester*		
8	*Oct 25*	*Midsemester Break;* *No Class*		HW 6 Due
	Oct 27	Decision Tree	x	
9	Nov 1			
	Nov 3	SVM	8	HW 7 Assigned
10	Nov 8			
	Nov 10	Exam 2 Review		HW 7 Due
11	Nov 15	Exam 2		HW 8 Assigned

	Nov 17	PCA	x	
12	Nov 22			HW 8 Due HW 9 Assigned
	Nov 24	*No Class;* *Thanksgiving Break*		
13	Nov 29	Clustering	6.3.3	HW 9 Due HW 10 Assigned
	Dec 1	Neural Networks	7	
14	Dec 6			HW 10 Due
	Dec 8	Last Day of Class		
15	Dec 13	*No Classes*		
	Dec 15	*No Classes*		
16	Dec 17	**Final Exam**		

Grading Policy

The work in this course consists of written and coding assignments (homework), quizzes, exams, and a semester-long series of mini-code projects. Grades are assigned using the MSU numerical system.

Description	**Percent of Grade**
Homework Assignments (10)	50% (5% each)
Exams (3)	29% (10%, 10%, 9%)
Quizzes	1%
Code Projects (10)	20% (2% each)

Regarding the Pass/Fail Option:

To be eligible to earn a non-zero grade in the course, a student must do all the following:

- Earn at least 50% of the total points available for Homework Assignments
  Submit all 10 homework assignments
- Earn at least 50% of the total points available for Code Projects
  Submit all 10 code projects
- Earn at least 50% of the total points available for Exams
  Submit all 3 exams

Final grades for students who achieve the course minimum requirements are based on this scale:

- 90%+: 4.0
- 85%: 3.5
- 80%: 3.0
- 75%: 2.5
- 70%: 2.0
- 65%: 1.5
- 60%: 1.0
- <60%: 0.0

Homework Submission Policy

These rules are intended to make grading faster and easier for the instructors, so that we can get your grades back to you as fast as possible.

1. Submit 1 PDF & separate Python files (1 file per code problem).
2. All assignments must be submitted on D2L in PDF or Mimir in Python format.
3. If you want to include the code in your PDF, this is acceptable, but you must still submit the separate Python files for grading. If there is a code portion of the assignment, you must have one PDF file for all the written answers (including plots and other relevant observations) and one Python file per coding problem.
4. Plots, remarks, and conclusions for coding problems must be reported in the submitted PDF.
5. For long answers, you may type or write your solution. If you are writing your solutions, use the following format. Note that if you do not follow this format and we can't read your answers easily, you will automatically receive a 0 on the assignment.
6. Use dark ink or heavy pencil. Light pencil or light pen colors do not show up well in scans.
7. Use a clear scanner or scanning app. I use CamScanner (https://www.camscanner.com). Avoid too much dark noise on your images.
8. If you submit a collection of images as the PDF, be 100% certain that someone else can read them. Sometimes images are too dark or don't print well. Make sure they're cropped properly.
9. Write as legibly as possible.
10. All scans/typing must be in normal vertical format, as if you are printing it to turn it in. If you submit an image horizontally and we have to rotate it to read it, you will get a 0.
11. If scanned, the submitted PDF should have pages cropped just around the edge of the pages and not exceeding it (so that we don't have to zoom in to see the answers).

Late Work Policy

Homework assignments are due **before** class begins on the due date and code will be submitted through Mimir unless otherwise specified. All homework must be done as specified (either with your team or individually), or *you will be penalized for plagiarism*. The instructor and the TA will be carefully looking into your code.

Most homework contains a written component and a programming component. Therefore, most homework submissions should include a report and some `Python` code. The single PDF report must be submitted on D2L the day the homework is due and code submitted to Mimir.

The late penalty is 10% points deduction **per day for the first three days**, after which the submission will not be accepted. Exceptions/extensions can be given to students with a documented and valid excuse. Students need to provide evidence for their excuse and must notify the instructor **at least two days** before the original due date. A student may request up to **2 unexcused (late penalty applies) and 2 excused extensions (late penalty does not apply)**.

Exams

Students will be required to complete two in-class exams and one final exam. In-class exams will focus on topics taught since the last exam. The final exam will be comprehensive but more focused on the last third of the class material.

If a student is unable to make the exam, a documented and valid excuse must be given to the instructor in order to schedule a make-up exam. Make-up exams must be scheduled within one week of the original exam date. Make-up exams will be administered as both a written and an oral exam (i.e., you will be required to solve problems on paper and you will be asked questions and your answer will be graded at that moment).

During testing the only electronics allowed are simple calculators, your laptop for Zoom, and a webcam. No cell phones, smart watches, tablets, additional laptops, e-readers, head/earphones, etc. are allowed. Hats, hoodies, etc. should not be worn. Any student violating this policy will be given a grade of 0 for the exam. For Zoom exams, all students will be required to have their cameras on during the exam, their workspace and active desktop visible, and allow screensharing with the instructor and TA. The instructor and TA will randomly check your monitors to ensure that no one is using Google Docs, Discord, etc. to cheat.

Viewing Grades

Grades will be posted to D2L as soon as possible after submission. If the student has questions about the grade they received, they should first meet with the TA to discuss their grade. After speaking with the TA, if there are still concerns, then the student should bring the problem to the attention of the instructor. If a regrading of the problem/assignment/exam is necessary, then the second score will be the one used, even if it results in a lower score.

Participation

Students are encouraged to ask questions in the format that is most beneficial for their learning whether this is during class, after class, during office hours, or on Piazza. If questions are posted on Piazza and another student can answer their classmate's question, please do so. Students are required to attend all classes and actively participate in discussions.

When posting questions on Piazza, do not: post your solutions or code, ask general "what do I do?" questions, etc. Be specific with what you have tried to solve the problem and where you are stuck in your thought process so that we can best assist you.

Academic Honesty

Students are responsible for adhering to the MSU Academic Honesty policy (see the last page of the syllabus) and violation will result in a grade of 0 for the course. Furthermore, copying, paraphrasing, or plagiarizing someone else's work, including their code, or allowing your own work to be copied or paraphrased, even if only in part, is not allowed and will result in an automatic grade of 0 for the copied assignment. Using websites such as allmsu.com or websites that allow you to get help from or pay someone else to write your code or solve the homework

assignments are also prohibited and will result in a grade of 0 for the assignment. Recording or copying any class materials or lectures and making these materials available to others is strictly prohibited. When assignment collaboration is allowed: if students collaborate on an assignment, i.e., discuss the assignment in any way, the following must be included in the homework write-up: names of students and what was discussed.

This course has adopted the Chegg and Similar Sites policy. Submission of student work (e.g., assignments and/or exam solutions) based on those found on Chegg, Brainly, Quizlet, and other similar websites will result in an Academic Dishonesty Report (ADR) and an automatic failing grade of zero (0.0) for the course. The ADR for students personally posting questions from assignments or exams to these sites will request additional sanctions.

MSU Course Policies

Build Rapport
If you find that you have any trouble keeping up with assignments or other aspects of the course, please notify the instructor **as early as possible**. Building rapport and effective relationships are key to becoming an effective professional. Make sure that you are proactive in informing your instructor when difficulties arise during the semester so that I can help you find a solution.

Understand When You May Drop This Course
It is the student's responsibility to understand when they need to consider un-enrolling from a course. Refer to the Michigan State University Office of the Registrar for important dates and deadlines.

Disruptive Behavior
Article 2.III.B.4 of the Academic Freedom Report (AFR) for students at Michigan State University states: The student's behavior in the classroom shall be conducive to the teaching and learning process for all concerned. Article 2.III.B.10 of the AFR states that: The student has a right to scholarly relationships with faculty based on mutual trust and civility. General Student Regulation 5.02 states: No student shall ... interfere with the functions and services of the University (for example, but not limited to, classes ...) such that the function or service is obstructed or disrupted. Students whose conduct adversely affects the learning environment in this classroom may be subject to disciplinary action through the Student Judicial Affairs office.

Inform Your Instructor of Any Accommodations Needed
Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. If you have a documented disability and verification from the Resource Center for Persons with Disabilities (RCPD), and wish to discuss academic accommodations, please contact your instructor as soon as possible. It is the student's responsibility to provide documentation of disability to RCPD and meet with an RCPD specialist to request special accommodation ***before*** classes start. Once your eligibility for an

accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to the instructor at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date will be honored if possible.

Academic Honesty (continued)

Article 2.3.3 of the Academic Freedom Report states that "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the CSE Department adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations. (See Spartan Life: Student Handbook and Resource Guide and/or the MSU Web site: www.msu.edu.) Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com website to complete any course work in this course. Students who violate MSU academic integrity rules may receive a penalty grade, including a failing grade on the assignment or in the course. Contact your instructor if you are unsure about the appropriateness of your course work. (See also http://www.msu.edu/unit/ombud/dishonestyFAQ.html)

Additionally, examples of academic dishonesty include (but are not limited to):

- Copying another student's code or exam answers
- Using code implemented by someone else intended to solve this class's assignments (i.e., don't get someone else to do your assignment for you!).
- Using code independently implemented by someone else without attributing credit (i.e., you can use tools, libraries, or code snippets from the web, but only with proper citation.)
- Writing code that deceptively passes the test cases, but doesn't solve the problem given. In other words, abusing automatic grader mechanisms to gain unearned points.
- Using websites and sources, whose purpose is to provide assignment solutions (e.g. using sites such as Chegg.com for any purpose regarding this class).
- Distributing course content without instructor permission.
- Submitting a solution that you don't understand / can't explain to an instructor.
- Providing false information to the instructor about matters related to the course.
- Facilitating another student in any of these activities.

If using online revision control systems such as github.com, ensure your code is not publicly accessible. Failing to do so may allow someone to easily copy your code putting yourself at risk.

MSU Course Catalog Description

CSE 404 Introduction to Machine Learning
Semester: Fall of every year
Total Credits: 3
Lecture/Recitation/Discussion Hours: 3
Prerequisite: CSE 331 and (STT 351 or STT 380 or STT 430 or STT 441)
Recommended Background: Linear Algebra
Restrictions: Open to juniors or seniors in the College of Engineering or in the Computer Science Minor or in the Lyman Briggs Computer Science Coordinate Major or in the Lyman Briggs Computer Science Major.
Description: Core principles and techniques of all machine learning model design and programming algorithms.
Interdepartmental with: Statistics and probability, computational mathematics, science, & engineering
Administered by: Computer Science and Engineering
Effective Dates: Fall 2019 – open