CSCE 421 Syllabus

TEXAS A&M UNIVERSITY

Dr. Alpaslan Duysak - Summer 2024

Course Information

Course Number: *CSCE 421*
Course Title: *Machine Learning*
Time & Location Canvas
Credit Hours: *3*

Instructor Details

Instructor: ***Alpaslan Duysak***
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Course Description

From the CSCE Course Catalog:

> *Theoretical foundations of machine learning, pattern recognition and generating predictive models and classifiers from data; includes methods for supervised and unsupervised learning (decision trees, linear discriminants, neural networks, Gaussian models, non-parametric models, clustering, dimensionality reduction, deep learning), optimization procedures and statistical inference.*

Machine learning is a sub-field of Artificial Intelligence that gives computers the ability to learn and/or act without being explicitly programmed. Applications of machine learning have permeated many aspects of everyday life and can be found among others in self-driving cars, speech recognition, computer vision, and genomics. Topics include supervised and unsupervised learning (including parametric and non-parametric models, clustering, dimensionality reduction, and deep learning), optimization procedures, and statistical inference.

Course Prerequisites

- *MATH 304*
- *STAT 211,*
- *(CSCE 221 or STAT 404)*

Course Learning Outcomes

The objective of this course is to teach fundamental methods of machine learning with a focus on theoretical underpinnings, practical implementations, and experimentation. Upon completion of the course, students will:

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.

2. Gain an understanding of the strengths and weaknesses of many popular machine learning approaches.

3. Uncover the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning.

4. Be able to design and implement various machine learning algorithms in a range of real-world applications.

5. (Students in the Honor sections) Be able to conduct research to find the best method for a given problem, implement different algorithms and prepare a report indicating the advantages and disadvantages of each method along with suggestions.

Textbook and Resources

Textbook

Books as pdf are available.

- Machine Learning Refined, 2nd Edition, Watt, Borhani, and Katsaggelos
- Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig.
- Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
- Reinforcement Learning: An Introduction, Sutton and Barto, 2nd Edition.
- Introduction to Machine Learning, 3rd edition, MIT Press by Ethem Alpaydin

Canvas

Canvas will contain class materials, assignment descriptions, and grades. You can access the course on Canvas through your Howdy portal.

Grading

This class will use a standard A, B, C, etc. scale for final grades; depending on the distribution, a curve may be applied. The instructor reserves the right to raise grades near a borderline to the next highest letter, based largely on the student's perceived effort and participation.

A	B	C	D	F
90 - 100%	80 - 89%	70 - 79%	60 - 69%	< 60%

Description	Percentage	Category
Programming Assignments (10)	60%	60% Assignments
Exams (2)	20%	40% Exams
Final Exam	20%	

- **Assignments:**

  Programming Assignments comprise the single largest portion of the course grade. There will be 10 written and related programming assignments. These will require programming a solution to the given prompt and submitting your code and, if applicable, a discussion of the results.

- **Exams:**

  Two regular **Exams** and one **Final Exam** represent the summative portion of the course. Because this is a foundational class for the field, exams will include conceptual and applied problems.

Policies

- **Attendance:**

  The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

  Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

- **Absences and Make-up Work:**

  University rules related to excused/unexcused absences and make-up work are located in Student Rule 7: http://student-rules.tamu.edu/rule07. In general, you must notify the instructor at least a day prior to missing class, or within 2 days after if not possible, and provide documentation of excused absences within 3 days. Make-up work for excused absences cannot be accepted more than 30 days after the deadline. An unexcused absence on an exam will result in a zero.

  You may notify the instructor using the form located in Canvas.

- **Late Submissions:**

  If an assignment accepts late work, submissions received after the deadline will be subject to a late penalty, which will be computed based on the number of days late. The penalty will be 15% every day, up to 4 days. After 4 days, late work will receive no credit.

  Additionally, you have a pool of 10 late days that you can use to extend an assignment without penalty (max. 3 days per late submission). While the assignments are organized so that you have plenty of time to complete them, late days give you extra flexibility to handle unforeseen circumstances according to your own judgment.

  To use a late day from your pool you need to notify TA. Be sure to specify the affected assignment.

- **Accommodations:**

  The Division of Student Affairs has made a new portal available, Disability Accommodation Portal (AIM), which you can use to request and send accommodation letters. Please book an appointment with me, I want to make the class as accessible as possible, and I would like to talk with you to discuss the best plan for meeting your needs.

- **Changes-Materials:**

  All changes in the schedule will be announced in class and at the class calendar.
  Please see also University Academic Calendar (https://registrar.tamu.edu/Catalogs,-Policies-Procedures/AcademicCalendar).

  Use Canvas to get access to the lecture notes, quizzes and tests, assignments, and check your grades on the regular basis during the semester

Course Schedule

Week	Topic
1	Introduction, Linear algebra review, k-nearest neighbors 1. HW
1	Perceptron Learning 2. HW
1	Naïve Bayes 3. HW
2	Linear Regression, Linear Classification, Logistic Regression 4. HW
2	Gradient Descent, Overfitting, Underfitting, Bias, Regularization 5. HW **EXAM 1.**
2	Linear SVM, Kernels 6. HW
3	Decision Trees 7. HW
3	Ensemble Methods: Bagging, Boosting, Random Forests
4	Neural Networks **EXAM 2.**
4	Neural Networks, Deep Learning 8. HW
4	Convolutional Neural Networks 9. HW
5	Performance Evaluations

Week	Topic
5	Unsupervised Learning, K-means 10. HW
5	Density-Based Clustering, Mixture Models and Expectation Maximization 11. HW (Optional)

Student Rules

Each student has the responsibility to be fully acquainted with and to comply with the Texas A&M University Student Rules. More specific rules, information and procedures may be found in various publications pertaining to each service or department. For more information, please visit

http://student-rules.tamu.edu/

Individual programming MUST be done on your own. You must write assignments in your own words. Plagiarism will not be tolerated, and violations will be reported to the Honor Council.

To help identify possible instances of plagiarism, we may use automated systems for plagiarism detection. Students found to have engaged in plagiarism will be referred to the Aggie Honor System.

Collaboration is important for facilitating learning, and your peers can be a great resource. So, you are encouraged to discuss problems and general approaches with each other (but not actual solutions). Regardless, unless stated otherwise, all assignments must be done on your own. It is okay to share general approaches, directions, and so on. You may not look at someone else's code (online or in person). If you have an issue that needs clarification, contact an instructor or TA. Additional overriding instructions and grading policies on permitted collaboration may be provided in the project documents.

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reasons deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below) Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing available resources and services on your campus

Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.