

Course Syllabus



EM/SYS 623 Data Science and Knowledge Discovery

Spring 2024

Instructor: Dr. Feng Liu

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Course Schedule: Thursday 6:30 pm –9:00 pm

Location: McLean 209

Office Hours: 7-8 pm Monday, 11-12 am Thursday

Zoom session URL: <https://stevens.zoom.us/j/5083594419>


COURSE DESCRIPTION

This course provides an in-depth introduction to data mining and pattern recognition. The basic theories, algorithms, key technologies in data analytics will be discussed. Topics include data representation, feature extraction, feature selection, correlation analysis, classification, pattern recognition, supervised learning (parametric/non-parametric algorithms, support vector machines, kernels, neural networks), unsupervised learning (clustering, dimensionality reduction, recommender systems, deep learning), and algorithm independent machine learning models. The course will discuss many case studies and real-world applications. You will learn how to process massive data and apply the most effective data mining and machine learning techniques to solve challenging engineering and scientific problems. You will gain the practical know-how needed to quickly and powerfully apply these techniques to solve data mining and knowledge discovery problems.

STUDENT LEARNING OUTCOMES

This course has three major objectives. First, to provide students with a sound basis in data mining and pattern recognition tasks and techniques. Second, to ensure that students are able to read, and critically evaluate data mining and analytics research papers. Third, to ensure that students are able to implement and to use important data mining and pattern recognition models and algorithms and to solve interdisciplinary problems for data-driven decision-making problems in engineering and sciences.

COURSE FORMAT AND STRUCTURE

This course is fully online. To access the course, please visit stevens.edu/canvas  (<http://stevens.edu/canvas>). For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

Course Logistics

- You are encouraged to “mentally enroll” in this course as it occurred on Mondays. I will post information (online activities, discussion starters, etc.) for the upcoming week by Sunday evening, so that when you log in on Monday, you can begin the new week.
- When assignments are due, they are due by 11:59 p.m. EST on the due date listed in the course schedule.
- Deadlines are an unavoidable part of being a professional and this course is no exception. Course requirements must be completed and posted or submitted on or before specified due date and delivery time deadline. Due dates and delivery time deadlines are defined as Eastern Standard Time (as used in Hoboken, NJ). Please note, students living in distance time zones or overseas must comply with this course time and time and due date deadline policy. Avoid any inclination to procrastinate. To encourage you to stay on schedule, due dates have been established for each assignment; 20% of the total points will be deducted for assignments received 1-6 days late; assignments received more than 1 week late will receive 0 points.
- An assignment file should be appended by your username, such as “assignment1_LastName_FirstName.doc”. This may make it easier for me to manage assignment files you download to my computer.
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I will be available via email (fliu22@stevens.edu) and will respond as soon as I am available. For the online discussions, I will check in at least 3 times per week. Keep in mind that it is not possible for me to respond to every single posting every week (nor is it pedagogically appropriate), but I will be sure to respond to a variety of postings and students each week and attempt to ensure equality in terms of responses to students. Furthermore, there is a specific discussion forum that you can use to ensure that you have my attention – to ask questions or to call my attention to a particular discussion you are engaged in that you would like me to take a look at. If you feel you are being neglected in any way, please contact me again. When emailing me, please place in the subject line the course number/section and the topic of the email (i.e. Assignment 2 Question). This will help me

tremendously in locating your emails quicker when I scan the many emails that seem to make it into my box each day.

Virtual Office Hours

Office Hours: 7-8 pm Monday, 11-12 am Friday

Virtual Office Hours are a synchronous session to discuss questions related to weekly readings and/or assignments. To join to the virtual office session for questions, go to

<https://stevens.zoom.us/j/5083594419> ➞ <https://stevens.zoom.us/j/5083594419>.

Score weight: Homework 45% (5 homework), Project 43%, Participation 12%

Project: preliminary result presentation: 8 points, final group presentation: 15 points, final report: 20 points. (43)

Participation: 9 for attendance and interactive engagement, 3 points for time spent on Canvas. With 3 point bonus.

Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea but you are not to attack an individual. Our differences, some of which are outlined in the University's inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambience. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- Keep an “open-mind” and be willing to express even your minority opinion.
- Think and edit before you push the “Send” button.
- Do not hesitate to ask for feedback.

TENTATIVE COURSE SCHEDULE (To be updated a lot)

Tentative Course Schedule

Week	Topic(s)	Assignment
Week 01 (Orientation Week)	Introduction	
Week 02	Math foundation	HW 1 released
Week 03	Python/Data Exploration/Visualization	
Week 04	Data Preprocessing	HW 2 released
Week 05	KNN, Trees	
Week 06	Accuracy Metrics, Random Forest	
Week 07	Bayesian Inference	HW 3 released
Week 08	SVM	
Week 09	Feature Selection/Unsupervised Learning	Group presentation requirement released
Week 10	Group project preliminary result presentation	
Week 11	Convolutional Neural Networks	Homework 4 released.

Week 12	Guest Lecture: AI in industry	
Week 13	Graph Neural Networks	Homework 5 released.
Week 14	Case Study in Medical Imaging	
Week 15	Final project presentation	Project report due by the weekend

COURSE MATERIALS

Textbook and Other Course Materials: *No textbook is required and the instructor will provide class materials. The class mainly uses two books:*

Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison-Wesley, 2005. (The first 3-4 weeks)

Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.

Other Recommended Reading Books:

Géron, Aurélien. *Hands on Machine Learning with scikit-learn and Tensorflow*, 2017.

Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning, MIT Press, 2016.

2007. M. Bishop. Pattern Recognition and Machine Learning. Springer, 2007.

TECHNOLOGY REQUIREMENTS

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills

- Navigating Canvas

Technology skills necessary for this specific course

- Live web conferencing using BlackBoard Collaborate
- Recording a slide presentation with audio narration
- Recording, editing, and uploading video via Kaltura

Required Equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

Required Software

- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint

GRADING PROCEDURES

- Assignments: there will be assignments involving short answers, running existing code on provided datasets, mathematical derivations, and writing some code and pseudo code. All programming assignments will be done using Matlab or Python. The students can also use or practice other programming languages, such as R, SAS etc. which are also popular for data mining and data analysis.
- Project and Presentation: once you have seen many examples of data mining methods, you will apply the learned methods in a practical data mining study, and implement the algorithms and ideas using Matlab (or Python/R, etc.). You'll demonstrate that how the data mining methods work and your selected datasets and provide experimental results, and briefly present your work at the end of the class. The students are also encouraged to explore open research questions and data mining problems; a really good job on this part could result in a paper in the end of the class.

Final grades will be awarded in accordance with the following scale:

A	93.7-100
A-	90-93.7
B+	87-89.99
B	83-86.99
B-	80-82.99
C+	77-79.99
C	73-76.99
C-	70-72.99
F	0-69.99

Late Policy

To encourage you to stay on schedule, due dates have been established for each assignment, project reports, 20% of the total points will be deducted for assignments received 1-6 days late; assignments received more than 1 week late will receive 0 points.

Academic Integrity

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/> ➦ (<http://web.stevens.edu/honor/>)

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

“I pledge my honor that I have abided by the Stevens Honor System.”


Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor ➦ (<http://www.stevens.edu/honor>).

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at

www.stevens.edu/provost/graduate-academics  (<http://www.stevens.edu/provost/graduate-academics>).

Exam Conditions




The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

1. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

Material	Permitted?	
	Yes	No
Handwritten Notes	Yes	
Conditions: i.e. size of note sheet		
Typed Notes	Yes	
Conditions: i.e. size of note sheet		
Textbooks	Yes	
Conditions: i.e. specific books		
Readings	Yes	
Conditions: i.e. specific documents		
Other (specify)	Yes	

2. Students are/are not allowed to work with or talk to other students during quizzes and/or exams.

Using LockDown Browser and a Webcam for Online Exams

This course requires the use of LockDown Browser and a webcam for online exams. The webcam can be built into your computer or can be the type that plugs in with a USB cable. [Watch this short video](http://www.respondus.com/products/lockdown-browser/student-movie.shtml)  (<http://www.respondus.com/products/lockdown-browser/student-movie.shtml>) to get a basic understanding of LockDown Browser and the webcam feature. A student [Quick Start Guide](http://www.respondus.com/downloads/RLDB-QuickStartGuide-Instructure-Student.pdf)  (<http://www.respondus.com/downloads/RLDB-QuickStartGuide-Instructure-Student.pdf>) is also available. Then download and install LockDown Browser using the [Stevens Respondus LockDown Browser Link](https://www.respondus.com/lockdown/download.php?ID=389551528)  (<https://www.respondus.com/lockdown/download.php?ID=389551528>) (Don't Google for a download link — it will be for the wrong school!)

To ensure LockDown Browser and the webcam are set up properly, do the following:

- Start LockDown Browser, log into Canvas, and select this course.
- Locate and select the **Help Center** button on the LockDown Browser toolbar.
- Run the **Webcam Check** and, if necessary, resolve any issues.
- Run the **System & Network Check**. If a problem is indicated, see if a solution is provided in the Knowledge Base. Troubleshooting information can also be emailed to our institution's help desk.
- Exit the Help Center and locate the practice quiz named **[NOTE TO INSTRUCTOR: CREATE A BRIEF PRACTICE QUIZ AND INSERT NAME/LOCATION OF QUIZ]**.
- Upon completing and submitting the practice quiz, exit LockDown Browser.


When taking an online exam that requires LockDown Browser and a webcam, remember the following guidelines:

- Ensure you're in a location where you won't be interrupted
- Turn off all other devices (e.g. tablets, phones, second computers) and place them outside of your reach
- Clear your desk of all external materials not permitted — books, papers, other devices
- Before starting the test, know how much time is available for it, and that you've allotted sufficient time to complete it
- Remain at your computer for the duration of the test
- If the computer or networking environment is different than what was used previously with the **Webcam Check** and **System & Network Check** in LockDown Browser, run the checks again prior to starting the test
- To produce a good webcam video, do the following:
 - Avoid wearing baseball caps or hats with brims

- Ensure your computer or tablet is on a firm surface (a desk or table). Do NOT have the computer on your lap, a bed or other surface where the device (or you) are likely to move
- If using a built-in webcam, avoid tilting the screen after the webcam setup is complete
- Take the exam in a well-lit room and avoid backlighting, such as sitting with your back to a window
- Remember that LockDown Browser will prevent you from accessing other websites or applications; you will be unable to exit the test until all questions are completed and submitted

Learning Accommodations

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/office-disability-services>  (<https://www.stevens.edu/office-disability-services>). If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu (<mailto:pgehman@stevens.edu>) or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Mental Health Resources

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression) and who can visit the office in person. CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters; appointments are highly encouraged. For those students who cannot visit the Stevens campus for an in-person appointment, you can contact a local mental health care provider for an in-person appointment, or if you are enrolled in the Stevens Student Health Insurance, you may call Care Connect for 24/7 mental health support at 1-888-857-5462.

Emergency Information

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the well-being of another Stevens student and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu (<mailto:care@stevens.edu>). A member of the CARE Team will respond to your concern as soon as possible.