Updated: 01/15/2025

New Jersey Institute of Technology
Ying Wu College of Computing
Computer Science Department

CS 698: ST: Machine Learning for Time Series Analysis and Forecasting

Time: Friday 2:30 PM – 5:20 PM, 2025 Spring
Location: CKB 341
Mode: Face-to-Face

Instructor: Lijing Wang
Office: GITC 2108
Email: lijing.wang@njit.edu
Office Hours: Friday 10:00 AM – 11:25 AM in person. Wednesday 10:45 AM – 11:25 AM, 1:45 PM – 2:25 PM online by appointment. Reserve an online appointment slot by following this calendar link. Please try to do so at least one day in advance. If these hours do not work with your schedule, appointments are also available by email.

Teaching Assistant with Office Hours:

- Hao Zhou, hz394@njit.edu

Note: I will typically respond to direct communications, such as email, within 48 hours (**weekend exclusive**). Allow up to 2 weeks for feedback on submitted assignments. This feedback will be provided in Canvas. For issues with your grades, contact the TA and cc the instructor.

Tutoring. NJIT provides a tutoring service. Please contact one of the available tutors. Please check the website for updates regularly as they may change the information.

Course Description

Time series data appears across domains such as finance, climate science, and healthcare. This course offers an in-depth exploration of machine learning techniques for time series analysis and predictive modeling. Students will address the unique challenges of temporal data, delving into classical machine learning, and advanced deep learning models, including RNNs, LSTMs, CNNs, GNNs, and Transformers. The course emphasizes algorithmic implementation and research-driven applications, preparing students to tackle complex real-world problems and contribute to cutting-edge developments in the field.

Prerequisites

None. However, prior coursework such as DS 675, DS 677, or CS 670 can provide valuable background for understanding the topics in this course. Additionally, a solid foundation in Python programming is essential for success in this course.

Course Textbooks

There is no required course textbook. The course will draw material from several sources, including the instructor's own notes. Some optional resources include:

- Brownlee, Jason. Deep learning for time series forecasting: predict the future with MLPs, CNNs and LSTMs in Python. Machine Learning Mastery, 2018.
- Nielsen, Aileen. Practical time series analysis: Prediction with statistics and machine learning. 1st Edition. O'Reilly Media, 2019.

Learning Outcomes

By the end of the course, you will be able to:

a. Illustrate the fundamentals of time-series analysis and modeling.
b. Apply feature preprocessing and engineering methods for time-series data.
c. Describe and explain a wide variety of time-series modeling algorithms.
d. Design deep learning models for advanced sequence data.
e. Evaluate models using time-series specific metrics and techniques.
f. Adapt learned skills to real-world problems in finance, healthcare, etc.

Grading Policy

Final grades for all assignments will be based on the following percentages:

Class Participation	10%
Midterm Exam	10%
Homework	20%
Paper Presentation	10%
Course Project	50%

Letter to Number Grade Conversions

Raw numerical scores will be converted to letter grades using the following bounds.

A	B+	B	C+	C	F
≥93	≥85	≥70	≥60	≥50	<50

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Coursework, Assessment and Related Outcomes

Class Participation [10%]. You are expected to attend classes and participate in classes by listening and understanding class contents, asking related questions, and conducting in-class activities.
Midterm Exam [10%]. In-person exam, 80 minutes. Students are expected to bring a fully charged laptop, as the exam will be on Canvas with LockDown browser. Each student is allowed to bring at most 5 pages of notes. In the event the exam must take place online, Respondus Monitor will be used for proctoring.
Homework [20%]. Four homework assignments of equal weights, based on research paper reading.
Paper Presentation [10%]. One in class paper presentation on related topics. A list of reading papers will be provided.
Course Project [50%]. The project is expected to be finished in a group. The final project offers you a chance to apply your newly acquired skills towards an in-depth application. Students are required to turn in a project proposal (10%), give a project presentation (10%) and complete a paper written in the style of a conference (e.g., AAAI) submission (30%).

Course Topic Schedule (tentative and is subject to change)

The topics covered in this course include the following, presented in the approximate order in which they will be taught. This list of topics is to be considered a *reference* that can be adjusted through the course of the semester to address changing needs.

Week	Topics	Assignments
Week 1 1/24	Introduction and Overview	hw1 out project out
Week 2 1/31	Time Series Basics	
Week 3 2/7	Classical Time Series Models	hw1 due hw2 out
Week 4 2/14	Classical Machine Learning for Time Series	
Week 5 2/21	Introduction to Neural Networks for Time Series	hw2 due hw3 out
Week 6 2/28	Recurrent Neural Networks (RNN, LSTM, GRU) for Time Series	
Week 7 3/7	Convolutional Neural Networks (CNNs) for Time Series	hw3 due hw4 out
Week 8 3/14	Transformers for Time Series	
Week 9 3/21	Spring Break - No Classes Scheduled – University Open	
Week 10 3/28	Midterm Exam	hw4 due
Week 11 4/4	Graph Neural Networks (GNNs) for Time Series	project proposal due
Week 12	Real-World Applications and Case Studies – Finance	

4/11	Paper Presentation	
Week 13 4/18	Good Friday – No Classes Scheduled – University Closed	
Week 14 4/25	Real-World Applications and Case Studies – Healthcare Paper Presentation	
Week 15 5/2	Real-World Applications and Case Studies – Climate Paper Presentation	
Week 16 5/7	5/7 Wednesday - Friday Classes Meet - Project Presentation	project final report due

* All assignments are due on Sunday, at 23:59.

Course Policies

General

- Please feel free to join the office hours (with me and TA's) to discuss any issues.
- Email is the best way to get in touch with the instructor. Please include "CS XXX" in the subject line of your email.
- Please do not hesitate to contact me if you have any problems, concerns, questions, or issues regarding the course, material, or anything else in the class.
- Please do not hesitate to talk to me if there are situations in your life that are affecting your performance in the class or your life here at NJIT. I might not be able to help, but I might know of resources that might help.

Email

Use of your NJIT email or Canvas inbox is strongly encouraged.

Grading Feedback

Assignment marks will be accompanied with solutions and general feedback summarizing common mistakes. Individual grading feedback will be given whenever possible. Further clarifications can be provided via direct communication with the instructor and the course grader. Check the grades in course work and report errors promptly. Please try and resolve any issue within one week of the grade notification.

Late Work Policy

In the case when a student is unable to complete an assignment or other serious reasons, these must be communicated and documented promptly. In any other case, each hour of delay after the due date will incur a 2% score reduction. No extensions will be granted. However, the lowest programming score and the two lowest quiz assignments scores for each student will be dropped.

Class Attendance Policy. Attendance is MANDATORY! Late by more than 10 minutes for a class will be counted as 'absence' from the class. This is a face-to-face class, I will cold-call you during the class. Attendance sheets will also be used which require students' signatures. In the case when a student is unable to attend the class, these must be communicated and documented promptly. Unless emergency, a student should communicate with the instructor prior to the class time. Check the class calendar carefully before you schedule any activities or trips during the semester. Frequent absences due to regular activities (e.g., doctor appointments, family trips,

homework/project dues of other courses, etc.) should be avoided and may result in a failure of this course.

Exam Policy. Attending (mid and/or final) exams is MANDATORY! Late by more than 10 minutes for an exam will be counted as 'absence'. Unless emergency, in the case when a student is unable to attend the exam, these must be communicated and documented promptly (prior to the exam time). Whether there is a make-up exam is entirely the instructor's decision. NOTE: The final exam date is scheduled by NJIT, which will be announced around the middle of the semester. The instructor cannot change the exam date. Students should check the schedule (https://www.njit.edu/registrar/exams/finalexams.php) carefully before you make a plan for the final week. Exam absences due to regular activities (e.g., academic conferences/events, doctor appointments, family trips, homework/project dues of other courses, etc.) should be avoided and may result in a failure of this course.

Proctoring Policy
See the NJIT Online Course Exam Proctoring page for information on proctoring tools and requirements.

Failure of the Class. In the case when a student is unable to attend the class or exams, these must be communicated and documented promptly. In any other case, a student will fail this course and obtain an F if 1) missing more than three classes; 2) missing any exams; 3) not submitting course project final report; 4) missing more than two homework assignments; 5) obtaining too few points throughout the semester. No exceptions will be granted.

Incomplete
A grade of I (incomplete) is given in rare cases where work cannot be completed during the semester due to documented long-term illness or unexpected absence for other serious reasons. A student needs to be in good standing (i.e., passing the course before the absence) and receives a provisional **I** if there is no time to make up for the documented lost time; an email with a timeline of what is needed to be done will be sent to the student. Note that an I must always be resolved by the end of the next semester.

Collaboration and External Resources for Assignments
Some homework problems will be challenging. You are advised to first try and solve all the problems **on your own**. For problems that persist you are welcome to talk to the course assistant or the instructor. You are also allowed to collaborate with your classmates and search for solutions online. But you should use such solutions only if you understand them completely (admitting that you don't understand something is way better than copying things you don't understand). Also make sure to give the appropriate credit and citation.

Generative AI Tools and Other External Resources
Sometimes you may come across code, text or other helpful information online, or you may be able to generate it using AI tools such as ChatGPT or other Large Language Models (LLMs). In most cases, you will be allowed to integrate this information into your solution. However, if you do, you must always give the appropriate credit and citations (e.g. links) for the material you use (especially when you use the code and text you found online). In the case you use an LLM, you

must say that you did so and present the entire transcript of your 'conversation' with it, which should show what you asked and how you guided it or were guided by it to the delivered solution. Your 'conversation' with it must be entirely yours, and sufficiently different from that of other students. Failure to give appropriate credit when using the work of others (whether human or AI) is considered plagiarism and may lead to disciplinary action under NJIT's Academic Integrity policy.

Requesting Accommodations
If you need accommodation due to a disability please contact Scott Janz, Associate Director of the Office of Accessibility Resources and Services, Kupfrian Hall 201 to discuss your specific needs. A Letter of Accommodation Eligibility from the office authorizing student accommodations is required.

NJIT Services for Students, Including Technical Support
Please follow this link.

Canvas Accessibility Statement
Please follow this link.

Academic Integrity
"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu."

Student Absences for Religious Observance
NJIT is committed to supporting students observing religious holidays. Students must notify their instructors in writing of any conflicts between course requirements and religious observances, ideally by the end of the second week of classes and no later than two weeks before the anticipated absence. All instructors must include a reminder on the course syllabus about this notification process. All instructors are required to provide academically reasonable accommodations, allowing students to complete missed assignments, exams, quizzes, or other coursework within the term. Instructors are encouraged to consider the NJIT religious holiday calendar and exercise cultural sensitivity when scheduling assessments or major assignments. All instructors must ensure that students are not penalized for properly documented absences and maintain confidentiality regarding religious observances. For questions or additional guidance, please review the policy or contact the Office of Inclusive Excellence at inclussiveexcellence@njit.edu.