MEEN5800

Artificial Intelligence in Mechanical Engineering

Instructor Information

- **Name:** Jiho Lee
- **Pronouns:** he, him, his
- **Office Location:** F115-K
- **Class Meetings:** (NTDP B142) Tue/Thu 08:30 AM - 09:50 AM
- **Office Hours:** Tue/Thu 02:30 PM – 04:30 PM
- **Email:** jiho.lee@unt.edu
- **Communication Expectations:**

  The instructor will communicate primarily through email and Canvas. Please use my email to contact me with any questions, and I will get back to you within **two business days**. Feedback on assignments will be provided within **two weeks** of the due date.

  All course materials will be available on Canvas:
    - **Lecture slides (PDFs)** will be posted directly on Canvas.
    - **Lab materials (Python notebooks)** will be shared via **Google Colab** links announced on Canvas.
    - **Homework assignments** will be distributed as Colab notebooks, with both announcements and submissions managed through Canvas.

  Canvas announcements and email through Canvas will be the primary channels for communication with students. All graded homework and exams will also be posted on Canvas.

Welcome to UNT!

As members of the UNT community, we have all made a commitment to being part of an institution that respects and values the identities of the students and employees with whom we interact. UNT does not tolerate identity-based discrimination, harassment, and retaliation. UNT's full Non-Discrimination Policy can be found in the UNT Policies section of the syllabus.

Course Description

This course introduces practical applications of Artificial Intelligence (AI) across mechanical engineering domains, with a particular emphasis on data-driven insights for real-world systems and processes. Students will learn how to implement machine learning and deep learning methods using Python to analyze and interpret engineering data — including datasets collected from manufacturing processes and industrial Internet of Things (IIoT) sensors. Designed as a lab- and project-based course, it equips students with the tools and hands-on experience needed to bridge basic AI concepts with practical engineering challenges.

Course Schedule

The schedule and topics covered are subject to change during the semester.

Week	Date	Module	Type	Content
1	19-Aug	Intro.	Lecture	Course Overview & Expectations
	21-Aug		Lecture	AI in Mechanical Engineering and Manufacturing: Case Studies
2	26-Aug	Data Analysis	Lec+Lab	Introduction to Google Colab & Python Basics
	28-Aug		Lab	Data Handling, Indexing, and Plotting
3	02-Sep		Lecture	Sensor Data Basics & Frequency-Domain Analysis
	04-Sep		Lab	FFT, STFT, and Wavelet Transform (WT)
4	09-Sep		Lec+Lab	Feature Extraction for Sensor Data
	11-Sep		Lec+Lab	Feature Selection with t-Test (p-value)
5	16-Sep		Lecture	Dimensionality Reduction for Data Visualization
	18-Sep		Lab	PCA and t-SNE for Visualization
6	23-Sep	ML/DL Modeling	Lecture	Artificial Neural Networks: Concepts
	25-Sep		Lab	Multi-Layer Perceptron (MLP)
7	30-Sep		Lec+Lab	Convolutional Neural Network (CNN)
	02-Oct		Lec+Lab	Autoencoder: Unsupervised Learning
8	07-Oct		Lab	Hyperparameter Tuning with Grid Search
	09-Oct		Lab	Multi-Class Classification
9	14-Oct		Lab	Time Series Data Segmentation
	16-Oct		Lec+Lab	Long-Short Time Memory (LSTM)
10	21-Oct	Data Challenge	**Exam**	**Midterm Data Challenge (In-Class)**
	23-Oct			
11	28-Oct	Advanced AI Topics	**Project**	**Final Project Launch: Datasets & Problem Statements**
	30-Oct		Lec+Lab	Regressions for Continuous Targets
12	04-Nov		Lecture	Transfer Learning: Concepts & Strategies
	06-Nov		Lab	Transfer Learning: Model Fine-Tuning & Layer Freezing
13	11-Nov		Lecture	Generative AI and Foundation Models: Concepts
	13-Nov		Lecture	Reinforcement Learning: Concepts & Engineering Use Cases
14	18-Nov	Final Project	**Project**	**Project Studio: Team Mentoring & Work Session**
	20-Nov		**Project**	**Project Studio: Team Mentoring & Work Session**
-	25-Nov		Break	*No Class (Thanksgiving Break)*
	27-Nov			
15	02-Dec		Lecture	Engineering AI Case Studies: End-to-End Workflows
	04-Dec		Lecture	Reading & Writing Engineering AI Papers: How to Read & Publish
16	09-Dec		**Project**	**Final Presentations**
	11-Dec		**Project**	

Course Objectives

By the end of this course, students will be able to:
- Explain foundational principles of data analysis, machine learning and deep learning.
- Apply sensor data processing (FFT, STFT, WT) and feature extraction methods to engineering datasets.
- Build and train supervised and unsupervised models (MLP, CNN, LSTM, Autoencoders).
- Implement advanced methods such as transfer learning, and describe concepts and strategies of GenAI.
- Develop a final project portfolio demonstrating applied AI solutions for real-world industrial challenges.
  - **(ABET)** Communicate effectively with a range of audiences.
  - **(ABET)** Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

Lab: Hands-On Coding

- Coding is performed in **Google Colab** using **Python**.
  - Students are required to have a **Google account**.
- Students can use their own laptop or desktop PC in the classroom (B142).
- Starter codes are provided; **no advanced coding experience is required**.

Assessing Your Work: Grading Elements and Weights

Assignment	Percentage of Final Grade
Homework (10)	20%
Midterm Data Challenge	30%
Final Project	30%
Individual Project (Research Proposal)	10%
Attendance	10%
Total Points Possible	100%

- A: 90-100% (Outstanding, excellent work. The student performs well above the minimum criteria.)
- B: 80-89% (Good, impressive work. The student performs above the minimum criteria.)
- C: 70-79% (Solid, college-level work. The student meets the criteria of the assignment.)
- D: 60-69% (Below average work. The student fails to meet the minimum criteria.)
- F: 59% and below (Sub-par work. The student fails to complete the assignment.)

Inclusive Learning Environment

I value the many perspectives that students bring to this class, and I hope we can work together to create a learning community built on open communication, mutual respect, and a sense of belonging. Healthy disagreements and debates are encouraged as part of the learning process, but personal attacks or disrespectful behavior are not acceptable. These expectations are consistent with the UNT Code of Student Conduct (Policy 07.012). Together, we can make this classroom a safe and welcoming space for everyone. If you ever feel that this is not the case, please reach out to me so we can talk about it. We are all learning together.

Course Policies

[Attendance Policy]

Attendance is required for all class meetings, and beginning in Week 3 attendance will be formally recorded each week. Attendance contributes 10 points, or 10% of the total course grade. **Each unexcused absence will result in a deduction of 1 point** from the attendance grade. To qualify as an excused absence, students must **provide official documentation at least 24 hours prior to the absence**, unless it is an emergency covered by the University's excused absence policy. Arriving 15 minutes or more after the start of class will be considered a tardy, and **each tardy will result in a deduction of 0.5 points** from the attendance grade. This policy is consistent with the UNT Student Attendance and Authorized Absences Policy (06.039).

[Late Work Policy]

- Each homework assignment is worth **3 points (3% of the total course grade)**.
- Late submissions will be penalized as follows:
    - **-1 point per day** (or part of a day) past the deadline.
    - **3 days after the deadline**, the assignment will receive **0 points**.
- No exceptions will be made unless the student has a university-excused absence and provides documentation with 48 hours of the missed deadline.

[Examination Policy]

The midterm evaluation in this course will be conducted as a **Midterm Data Challenge**, held in the classroom using the PCs provided. Students will be required to apply the codes and methods practiced during class to solve assigned problems. Solutions must be implemented by writing original code and submitted through Canvas within the designated time limit. The use of **Generative AI tools (including, but not limited to, ChatGPT, Claude, Gemini, or similar platforms) is strictly prohibited during the examination**. Any use of such tools will be considered a violation of academic integrity and will result in an **immediate score of zero for the exam**.

[Generative AI (GenAI) Use Policy]

In this course, the use of Generative AI (GenAI) tools such as ChatGPT, Claude, Gemini, or similar platforms is **permitted for learning support**, including clarifying course concepts, reviewing lecture materials, and analyzing or debugging sample code from class. This use is encouraged as a way to deepen your understanding and to help you build skills for a GenAI-oriented workforce.

However, you are **not permitted to rely on GenAI tools to complete and submit homework assignments in their entirety**. Submitting GenAI-generated output as your own work without substantial modification and understanding undermines the learning process and will be considered a violation of academic integrity. If there is reason to believe that an assignment was generated primarily by GenAI, the instructor reserves the right to request additional verification, such as asking you to explain how you wrote the code or derived the results.

During the **Midterm Data Challenge**, the use of GenAI tools is **strictly prohibited**. Any use of such tools during the exam will result in an immediate score of zero and may be reported as an academic integrity violation in accordance with the UNT Student Academic Integrity Policy (Policy 06.003).

In line with the UNT Honor Code, all work you submit must ultimately be your own. Responsible and transparent use of GenAI to support your learning is allowed, but unauthorized or unacknowledged reliance on GenAI for graded work will not be tolerated. If you are ever uncertain whether a particular use of GenAI is acceptable, please ask the instructor for clarification before proceeding.

[Syllabus Change Policy]
This syllabus is subject to change at any time during the semester with changes to be announced in class.

[Instructor Responsibilities and Feedback]
Grade Disputes
The student is required to wait 24 hours before contacting me to dispute a grade. Within that time, the instructor will review the assignment details and reflect on the quality of the work the student turned in.

Communication
Most general questions should go through the Q & A forum in the Discussion Board area. If the student has a private question, he/she can contact the instructor, who should be able to respond within 2 business days (usually sooner).

Instructor Feedback on Assignments
The instructor should return feedback on all assignments within 2 weeks of the due date. If the instructor is unable to return feedback, he will post an Announcement to let everyone know when it can be expected.

UNT Policies

[Academic Integrity Policy]
Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to, cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. In this course, responsible use of Generative AI tools is addressed in a separate GenAI Use Policy. Unauthorized use of GenAI tools or misrepresentation of work will be treated as an academic integrity violation.

[ADA Policy]
The University of North Texas makes reasonable accommodations for students with disabilities. To request accommodations, you must first register with the Office of Disability Access (ODA) by completing an application for services and providing documentation to verify your eligibility each semester. Once your eligibility is confirmed, you may request your letter of accommodation. ODA will then email your faculty a letter of reasonable accommodation, initiating a private discussion about your specific needs in the course.

You can request accommodations at any time, but it's important to provide ODA notice to your faculty as early as possible in the semester to avoid delays in implementation. Keep in mind that you must obtain a new letter of accommodation for each semester and meet with each faculty member before accommodations can be implemented in each class. You are strongly encouraged to meet with faculty regarding your accommodations during office hours or by appointment. Faculty have the authority to ask you to discuss your letter during their designated office hours to protect your privacy. For more information and to access resources that can support your needs, refer to the Office of Disability Access website (https://studentaffairs.unt.edu/office-disability-access).

[Prohibition of Discrimination, Harassment, and Retaliation (Policy 16.004)]
The University of North Texas (UNT) prohibits discrimination and harassment because of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law. UNT takes active measures to prevent such conduct and investigates and takes remedial action when appropriate.

[Emergency Notification & Procedures]
UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (e.g., severe weather, campus closing, and health and public safety emergencies). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.

[Retention of Student Records]
Student records pertaining to this course are maintained in a secure location by the instructor of record. All records such as exams, answer sheets (with keys), and written papers submitted during the duration of the course are kept for at least one calendar year after course completion. Course work completed via the Canvas online system, including grading information and comments, is also stored securely for one year. Students have the right to view their individual record; however, information about student records will not be divulged to other individuals without proper written consent, in accordance with the Family Educational Rights and Privacy Act (FERPA).

[Acceptable Student Behavior]
Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive. Students engaging in unacceptable behavior will be directed to leave the classroom and may be referred to the Dean of Students. These expectations apply to all instructional forums, including classrooms, labs, discussion groups, and electronic environments. See UNT's Code of Student Conduct (https://deanofstudents.unt.edu/conduct).

[Access to Information – Eagle Connect]
Students' access point for business and academic services at UNT is located at my.unt.edu. All official communication from the University will be delivered to a student's Eagle Connect account. Please ensure that you check this account regularly or set up forwarding.

[Student Evaluation Administration Dates (SPOT)]
Student feedback is an essential part of participation in this course. The student evaluation of instruction is required for all organized classes at UNT. The survey will be available during weeks 13–15 of the semester. Students will receive an email from "UNT SPOT Course Evaluations via IASystem Notification" (no-

reply@iasystem.org) with the survey link. Once students complete the survey, they will receive a confirmation email. Additional information: http://spot.unt.edu or spot@unt.edu.

[Sexual Assault Prevention and Title IX]

UNT is committed to providing a safe learning environment free of all forms of sexual misconduct, including sexual harassment, sexual assault, domestic violence, dating violence, and stalking. Federal laws (Title IX and the Violence Against Women Act) and UNT policies prohibit discrimination on the basis of sex. Campus resources, including Survivor Advocates, are available to assist students. Survivor Advocates can be reached at SurvivorAdvocate@unt.edu or 940-565-2648. Alleged sexual misconduct can also be reported to the Title IX Coordinator at oeo@unt.edu or 940-565-2759.

[Important Notice for F-1 Students Taking Distance Education Courses]

Not applicable for this in-person course.

[Student Verification]

Not applicable for this in-person course.

[Chosen Names]

Students are welcome to use a chosen name that may differ from their legal name. If you have a chosen name you would like me to use in class, please let me know. UNT provides resources to update your chosen name for class rosters, ID cards, and email accounts. For more information, visit https://edo.unt.edu/chosen-name.

[Use of Student Work]

A student owns the copyright for all work (e.g., software, photographs, reports, presentations, and email postings) created in this class. The University is not entitled to use any student work without the student's permission unless specific conditions are met (e.g., the work is used only once, not in entirety, and the student is not identified). If conditions are not met, written permission from the student is required.

[Transmission and Recording of Student Images]

This course is primarily delivered in person. However, on occasion the instructor may use lecture capture or other recording technologies for instructional purposes, such as reviewing Colab demonstrations or sharing lecture content with the class via Canvas. Students may occasionally appear on video during these recordings. Recordings will be used only for educational purposes within this course and may be reused in future offerings of the course. If you have concerns about appearing in recordings, please contact the instructor to discuss possible accommodations.

[Academic Support & Student Services]

UNT strives to offer a high-quality education in a supportive environment where you can learn, grow, and thrive. As a faculty member, I am committed to supporting you, and I want to remind you that UNT offers a range of mental health and wellness services to help maintain balance and well-being. Utilizing these resources is a proactive way to support your academic and personal success. To explore campus resources designed to support you, check out mental health services (https://clear.unt.edu/student-support-services-policies), visit unt.edu/success, and explore unt.edu/wellness. To get all your enrollment and student financial-related questions answered, go to scrappysays.unt.edu.