ELEN 451 – Hands-on Artificial Intelligence and Robotics

Instructor: Dr. Lingxiao Wang
Lecture room: NETH 120
Lecture hours: 9:30 am – 10:45 am MWF
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Office hours: 2:00 pm – 4:00 pm Every Day

Course Description: This course provides an applied introduction to artificial intelligence (AI) techniques and their integration into robotic systems. Students will explore key AI concepts, including machine learning, computer vision, and decision-making algorithms, through hands-on implementation. The course also covers fundamental topics in robotics, such as perception, navigation, planning, and control. A series of small-scale projects will enable students to apply AI methods to real-world problems, enhancing their understanding through practical experience. By the end of the course, students will develop a strong foundation in AI-driven robotics and gain proficiency in designing intelligent robotic systems.

Introduction to basics in artificial intelligence (AI) and robotics, including the following topics:

- Deep Neural Networks,
- Supervised Learning,
- Convolutional Neural networks and Image Classification,
- Transformer and Large Language Models,
- Reinforcement Learning, Deep Reinforcement Learning and its Applications on Robotics,
- Generative Models (GAN),
- Robot Navigation, Planning, and Control.

This course also includes hands-on projects on AI and robotics applications, including the following projects:

- Regression: Covid-19 Cases Prediction
- Classification: Phoneme Classification
- Image Classification: Food Image Classification
- Self-Attention: Identify Speaker Identification for Speech
- Reinforcement Learning: Lunar Lander Control
- Generative Models: Cartoon Image Generation
- Robotic Simulation: Navigation, Planning and Control

Textbook: No Textbook required. Teaching materials are based on lectures.

Recommended Software: Google Colab (no installation is needed. Online Python programming tool).

Course Project Reports: Reports will be submissions of code and results from the course projects. All submissions should be uploaded on the Canvas. No physical submissions will be accepted.

Exams:

- Four take-home exams
- Multi-selection questions

Grading: The weighting of grades is as follows:

- Course Project – 60%
- Exams – 30%
- Attendance – 10%

Grading Scale: The grading scale used for this course is shown below:

- A – 100-90%
- B – 89.99-80%
- C – 79.99-70%
- D – 69.99-60%
- F – below 60%

Class Attendance: This class will adhere to the guidelines for class attendance found in Chapter 3 of the University Catalog, available online at www.latech.edu/registrar/bulletin/. Additionally, attendance will be taken promptly at the beginning of class and any student arriving after attendance has been checked without a reasonable excuse will be considered absent. Reasonable excuses DO NOT include routine doctor visits, car trouble, parking difficulties, oversleeping, or work schedules. Any student who misses three or more classes without university approved excuses may be penalized at the instructor's discretion.

Emergency Class Disruption Policy: In the event that a disaster or other emergency results in campus closure, this course will continue via Moodle and Zoom. You will be required to login to moodle.latech.edu for further instructions. Please enroll in the Emergency Notification System (instructions below) to receive official campus updates. You may also refer to ert.latech.edu for updated information.

Disability Disclosure: Students needing testing or classroom accommodations based on a disability are encouraged to discuss those needs with the instructors as soon as possible. For more information about eligibility for accommodations, contact the Department of Testing and Disability Services, 318-257-4221, www.latech.edu/ods for assistance.

Academic Misconduct: Academic behavior is governed by university policies and guidelines found in Chapter 4 of the University Bulletin. It is the student's obligation to be familiar with and understand these policies, regulations, and guidelines.

- Behavior: Students are expected to maintain a professional classroom environment. Students are to refrain from: verbal or physical violence, threats, improper language, disrespect to classmates and the instructor. Participants of such activities will be asked to leave the class. If you are removed from class for behavioral reasons, you will be considered absent for that class period.
- Cheating: Cheating of any kind will not be tolerated. Collusion during examinations through verbal or electronic communication and/or plagiarism of any kind throughout the course will result in a zero grade for the assignment or exam as well as notification of the proper university officials. Multiple infractions will result in a zero grade for the course.

Emergency Notification System: All Louisiana Tech students are strongly encouraged to enroll and update their contact information in the Emergency Notification System. It takes just a few seconds to ensure that you are able to receive important text and voice alerts in the event of a campus emergency. For more information on the Emergency Notification System, please visit www.latech.edu/administration.ens.shtml.

Schedule:

Date	Day	Topics	Due
12-Mar	Wed	Introduction of Deep Learning	
14-Mar	Fri	**Course Project 1: Colab and Python Tutorial**	
17-Mar	Mon	Supervised Learning and Neural Networks - Part 1	
19-Mar	Wed	Supervised Learning and Neural Networks - Part 2	
21-Mar	Fri	**Course Project 2: CA House Prediction**	CP 1
24-Mar	Mon	Tips in Training a Deep Learning Model	
26-Mar	Wed	Adaptive Learning Rate and Classification	
28-Mar	Fri	**Course Project 3: Phoneme Classification**	CP 2
31-Mar	Mon	Convolutional Neural Networks	
2-Apr	Wed	Computer Vision	
4-Apr	Fri	**Course Project 4: Image Classification**	CP 3, Exam 1
7-Apr	Mon	Transformer - Part 1	
9-Apr	Wed	Transformer - Part 2	
11-Apr	Fri	**Course Project 5: Transformer**	CP 4
14-Apr	Mon	Large Language Models - Part 1	
16-Apr	Wed	Large Language Models - Part 2	Exam 2
18-Apr	Fri	***Easter Holiday***	CP 5
21-Apr	Mon		
23-Apr	Wed	Deep Reinforcement Learning	
25-Apr	Fri	**Course Project 6: Deep Reinforcement Learning**	
28-Apr	Mon	Generative Adversarial Network - Part 1	
30-Apr	Wed	Generative Adversarial Network - Part 2	
2-May	Fri	**Course Project 7: GAN**	CP 6, Exam 3
5-May	Mon	Navigation - Kalman Filter and its Variants - Part 1	
7-May	Wed	Navigation - Kalman Filter and its Variants - Part 2	
9-May	Fri	**Course Project 8: Kalman Filter**	CP 7
12-May	Mon	Planning - Decision-making - Part 1	
14-May	Wed	Planning - Decision-making - Part 2	
16-May	Fri	**Course Project 9: Path Planning**	CP 8
19-May	Mon	Control - Modeling	
21-May	Wed	Control - PID	
23-May	Fri	**Course Project 10: Robot Control Sim**	CP 9, Exam 4
27-May	Tu	No class	CP 10, Graduate Student Tasks

CP: Course Project Report