DS 110: Basic Foundations of Artificial Intelligence

Course Description: This course introduces essential and basic artificial intelligence (AI) tools in Python, which has four units: sensor stream, AI operating system, AI cognitive core, and AI symbolic compositional models. Sensor Stream: Gathers raw data from the environment through senses. AI Operating System (AIOS): Manages basic AI cognitive and AI physiological processes, integrating sensory input and regulating AI behavior. AI Cognitive Core: Engages in higher-level reasoning, decision-making, and learning. AI Symbolic Compositional Models: Facilitates symbolic tasks, such as language, mathematics, and creativity, by combining abstract representations. Students will learn basic program skills in Python and solve problems mimicking the basic building blocks of cognition – modern AI mapping.

No prerequisites are required to enroll.

Learning Goals:

1. Formulate a simplified cognition-AI mapping problem involving quantified, specified inputs and desired outputs in various application domains.

2. Design a precise and complete step-by-step AI solution (algorithm) that produces a desired output from a specified input, including data understanding, problem formulation, problem-solving, and result interpretation.

3. Implement a solution to an algorithmic AI problem using Python's syntax and semantics.

4. Using concrete case studies, obtain an essential foundation for recent artificial intelligence (AI) developments.

5. Collaborate effectively in developing a small AI application, primarily through teamwork efforts and result analysis.

First Term to be Offered: Fall 2025

Pre-requisites: No prerequisites are required to enroll.

Instructors: Hai Phan, Mengjia Xu, Shuai Zhang, Lingxiao Wang
Canvas: Instructional material and resources will be found on the class website on Canvas. It will be modified and updated and contain the most recent information as the course progresses.

Schedule: The following is a tentative schedule and is subject to change.

Course outline (15-week schedule)

Unit 1: Introduction to Python

Week 1. Introduction to Python Programming: Installation and Jupyter, Anaconda

Week 2. Basic Data Structures: Sets, Functions, Sequences, basic data structures, and NumPy, Multiarray

Unit 2: The Sensory Stream

Week 3. Introduction to the Simplified Cognition and AI

Week 4. Neural Networks and Generalization

Unit 3: The AI Operating System

Week 5. Vision and Convolution

Week 6. Sound and Sense Analysis and Generalization

Week 7. Recurrence with Vision and Sound, and Attention

Week 8. Mid-term Exam

Unit 4: The AI Cognitive Core

Week 9. Memory, Forgetting, and Reinforcement AI

Week 10. Cognitive Modeling and Unsupervised Learning

Week 11. Generative AI: Applications and Development Stack

Unit 5: AI Symbolic Compositional Models

Week 12. Basic Natural Language Processing

Week 13. Modern Large Language Models

Week 14. Final Exam

Week 15. Collaborative Term Projects

Credits: 3

Grade: Final Grades will be based on:
Class participation – 5%
Assignments – 30%
Term Project – 30%
Midterm – 15%
Final – 20%

The final letter grades for the semester are based on points according to Table 2.

Grade	Points
A	90-
B+	86-90
B	80-85
C+	70-79
C	60-69
D	50-59
F	0-49

Table 2: The final letter grade conversion table

POLICIES:

Assignments (Homework and Project)

Homework for this class is usually due about one week after being issued. They aim to help you keep up with the material and assess your readiness for the midterm and final.

Homework is due before midnight (11:55 pm) on the due date specified on the schedule. It will be submitted via Canvas electronically. Late homework will be penalized 10% of the available points (, and another 10% will be deducted for every 24-hour period after the original due date) unless there is a reason beyond your control.

Makeup Tests

Requests for makeup tests must be made in advance with the instructor and will only be approved if the reason is beyond your control.

Academic Integrity Policy

The NJIT academic honor code is located at: http://integrity.njit.edu/index.html. This honor code applies in its entirety to this class. Violations will not be tolerated. In addition, students should familiarize themselves with NJIT's "Best Practices related to Academic Integrity," which is developed and published on the Provost's website (on the policies page).

Disabilities

If you have a disability that may require some modification of seating, testing, or any other class requirement; please let the Professor know so that appropriate arrangements can be made. Similarly, let the Professor know if you have any emergency medical information about which to be aware or if you need special arrangements in the event of building evacuation. See the Professor after class hours or schedule an appointment. Assistance is available from the Office of Student Disability Services (205 Campbell Hall; 973-596-3420). Be sure to complete appropriate paperwork with this office during the first week of class.