

**GEORGIA INSTITUTE OF TECHNOLOGY  
SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING**

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**ECE 2xxx: AI Foundations (2-3-3)  
Syllabus – Fall 2024**

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**Course Instructors:** Prof. Ghassan AlRegib [alregib@gatech.edu](mailto:alregib@gatech.edu)  
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**TA:** TBA

**Course Days/Times\*:** TBA

**Office Hours:** TBA

**Textbook:** No required textbook but following are excellent references for this class:

- Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson (Fourth Edition) 2020. (<https://aima.cs.berkeley.edu/>) (ISBN-13 9780134610993)
- Chowdhary, K.R., Fundamentals of Artificial Intelligence, Springer, 2020. (ISBN 978-81-322-3972-7)
- <http://openbookproject.net/thinkcs/python/english3e/>

**Prerequisite:** Undergraduate Semester level [MATH 1554](#) Minimum Grade of C **and** Undergraduate Semester level [CS 1301](#) Minimum Grade of C **OR** 1xxx-level COE Course on “Programming for Engineers”

**Course Objective:** An introduction to AI Foundations.

1. To understand the basic concepts of Artificial Intelligence
2. To build on the basic concepts of computer programming in a high-level language
3. To understand the principles of data literacy
4. To understand the math principles for AI
5. To understand the process and skills necessary to effectively deal with problem solving in relation to constructing AI algorithms
6. To be able to test and evaluate AI models and systems
7. To understand the societal and ethical implications of AI systems
8. To become comfortable with common software packages in use today such as numpy and scikit-learn

**Course Description:** Establish AI literacy for all students. Students will gain experience and practice with algorithm design, data structure, logical thinking, reasoning,

explanations, and AI systems. A focus is on developing skills and experience in utilizing the AI Makerspace to perform certain functionalities on real data.

**Course Outcomes:**

1. Formulate real-life problems using data-driven approaches
2. Compute solutions using AI principles and reasoning
3. Analyze data and build AI components that fit the data and the application
4. Assess AI systems from technical as well as ethical perspectives

**Students Outcomes:**

1. ( P ) an ability to identify, formulate, and solve complex problems by applying principles of AI
2. ( P ) an ability to recognize ethical responsibilities of AI systems and assess their decisions in real-world contexts
3. ( M ) develop and conduct appropriate experimentation, analyze and interpret data, and use AI judgment to draw conclusions
4. ( M ) an ability to acquire and apply new knowledge as needed, using appropriate AI strategies.

**Academic Honesty:** All violations of the Georgia Tech Honor Code will be handled by referring the case directly to the Dean of Students for investigation and penalties. Past infractions have included cheating on tests, copying lab results, copying homework, and forging TA signatures. Additionally, you are not permitted to complete any in-class exercises or attendance checks for another student other than yourself. Doing so will be considered a violation of the Georgia Tech Honor Code and be handled accordingly. As a reminder to students, violations of the Honor Code can be met with minimum drop of one letter grade in their final course grade and potentially academic probation. The complete honor code can be found online at: <http://www.policylibrary.gatech.edu/student-affairs/academic-honor-code>

**Grading:**

Homework	25%	Quiz 1	10%	Quiz 2	10%
Studios	25%	Final Exam	25%	Participation	5%

In all cases we will at least follow the basic traditional grading scale where: A=90-100; B=80-89; C=70-79; D=60-69; F=0-59. While in all cases a grade of 90-100 will be assigned an ‘A’, the boundaries/cutoffs for the other grades will be determined at the end of the semester based on the overall class performance. It is impossible to determine what the exact “cutoffs” will be for each grade but you can be assured that your assigned grade will never be lower than the “traditional” grading scale described above based on your final class average.

**Exams:** There will be two quizzes, amounting to **10 course points each out of 100**. Moreover, one final exam will be given at semester end, and it accounts for **30 course points out of 100**.

**Homework:** Written homework will be assigned (approximately) weekly and will be due on Friday of the assigned week (unless otherwise specified). For help, check the course website for office hours with instructors. Solutions will be posted for all HW assignments. Late homework will not be accepted. There will be approximately 12 written homework assignments. Check CANVAS Assignments for submission instructions.

**Programming Language:** We will utilize Python throughout the course.

**Studios** (times vary, check your registered schedule): The studio sections will meet once per week unless otherwise announced. See the lab schedule on the lab page of the class website. The studio has two parts. In the first part, the purpose is to answer questions and facilitate a deeper and more personal interaction with an instructor on the course content. Ideally, this part is student led in that the instructor functions to assist students in the areas they feel most challenging. The second part is to explore hands-on applications of the course concepts using Python. It is a critical component of the course. There will be approximately six written lab reports, including corresponding codes and plots, compiled into a single pdf file. Check CANVAS Assignments for submission instructions. Attendance is expected at each recitation. If you must miss a studio session for any reason, you **MUST** contact your instructor before the session with a valid excuse, or you will get an absence mark for the missed session. You can also schedule and attend another session in the same week. The instructors will be responsible for 5% of your grade. Do discuss grading expectations with your studio instructor.

**Canvas:** Course website on Canvas: when clicking the course, students will see an overall view of all the course components, including Syllabus, Lecture, Homework, Exam, Piazza, Supplements, etc. Go to <https://canvas.gatech.edu/> and if you do not see the class page, make sure you are registered for the course.

**Piazza:** Students are expected to utilize PIAZZA platform to post questions and engage into online discussions. Make sure you enroll into the course site on Piazza. Check for sign-up link at LINK HERE . If you have any problems or feedback for the developers, email [team@piazza.com](mailto:team@piazza.com). Find our class page by clicking the Piazza link on the left navigation menu on Canvas. If Georgia Tech ends Piazza and moves to another platform, we will be utilizing the new platform.

**Attendance:** Your attendance and participation are strongly encouraged. Check the Institute Absence Policy at: <https://studentlife.gatech.edu/resources/class-attendance>. Typically, in the first two weeks, we must submit a report on Verification of Participation. If this applies this year, we will use lecture attendance and/or other metrics (e.g., TurningPoint survey responses, Canvas activities, or Piazza activities) to decide if you are participating or not.

**Communications:** All communication is expected to be conducted on Piazza. One can utilize the private message option. Emails are strongly discouraged.

**Announcements:** Official announcements will be posted on Canvas and/or Piazza or announced during lectures.

**Available Resources:**

- The Center for Academic Success has programs to help students improve their study habits and time management: <https://www.success.gatech.edu/>.
- The Dean of Students Office helps students who have personal or medical issues that impact their academic performance: <http://www.deanofstudents.gatech.edu/>

**Office of Disability Services:** If you are a student registered with the Office of Disability Services (ODS), please make sure the appropriate forms and paperwork are completed with the instructor within the first week of classes. The instructor will abide by all accommodations required by ODS. The schedule for exams is posted in the syllabus and any potential modifications or changes will be made with at least one week's notice. It is the responsibility of the student to properly arrange test accommodations for each exam with ODS in sufficient time to guarantee space for exam administration. ALL exam accommodations must be handled through ODS. If the student does not register accommodations with ODS for the taking of an exam, then they will have to take the exam at the normally scheduled times without any additional accommodation unless the instructor is given specific directive from ODS on the student's behalf due to a mitigating circumstance. (<https://disabilityservices.gatech.edu/>)

**Student Collaboration:**

Students are encouraged to study together for homework, studio problems and exams to openly discuss course topics. However, each assignment that is turned in must reflect the work of each individual student. No copying of work from other students in (or out) of this class is allowed and such activity would represent a violation of the Academic Honor Code. If you are not certain of the nature of a student collaboration you are involved in, please feel free to contact Prof. AlRegib, or your recitation instructor for their expectations.

**Teacher Commitment:**

All of the instructors and graduate teaching assistants commit to dedicating our time and energy to ensure that you have a productive learning environment for this course.

**Student Commitment:**

As the student, you agree to commit your time and energy to learn the material by completing all assignments in a timely manner, attending all class sessions, and seeking help when you require it.

## Topical Outline:

- What is AI?
  - AI Problem Solving
  - Real-world AI Systems and Applications
  - Hardware and GPUs
- Data:
  - Sensing and acquisition; Data structures; Data Exploration with basic statistics ; Representations; Data Modalities
- Knowledge, Logic, and Reasoning
  - Logical operations, Rules of Inference, Logical Consequences, Semantics of Expression, Reasoning Patterns, Interpretations and Inferences, Rule-based reasoning, Forward and Backward Chains, Recursive functions, problem reduction, AND-OR tree, Logic foundation, Biconditional and Boolean operations
- Learning
  - Decision boundary, Markov Decision Process; Inductive, Abductive and Deductive Learning; Learning by Analogy, Explanations-based learning, supervised learning, regression, NNs,
- Search, Decision and Planning
  - mini-max, Adversarial search, mathematical programming, resource allocation using LP, risk/reward optimization using QP, sequential decision making, path planning, dynamic programming
- Ethics and AI:
  - Case studies, Issues and Challenges, Policy making and governance, bias, fairness and trust in AI, uncertainty, adversarial challenges, transparency and explainability, implications on society and individuals