Georgia Institute of Technology
ECE 6256 Conversational AI
Fall 2026 Syllabus

Instructor Information

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Learning Objectives

Conversations are the foundation of human interaction. Conversations connect people, bringing us together socially. Conversations have also been a primary mechanism for humans to capture and extend our collective knowledge over the centuries.

Conversational AI is a type of artificial intelligence that can simulate human conversations. This field of AI creates methods and systems to process, understand, and generate human language using methods from Natural Language Processing (NLP) and machine learning (ML). Conversational AI has a long history, with a significant increase in societal impact over the past decade, resulting in voice-enabled personal assistants such as Siri, Cortana, Alexa, Google Assistant, Samsung Bixby, and chatbots like ChatGPT and Bard. Conversational AI is utilized across a wide range of industries today and is becoming a foundational technology that many companies require to remain competitive.

The learning objectives of this course in conversational AI include providing both a historical and current State-of-the-Art (SoTA) perspective on underlying algorithms, data, and implementation methods. From theory to practice, this course will provide students with a broad and solid foundation in the underlying theories and objectives of human-human and human-machine conversational interactions. This course will also have a mix of written and coding assignments with a month-long final project that will provide students with an opportunity to learn to develop and implement state-of-the-art conversational AI technologies.

Prerequisites

Throughout this course, we will take a machine learning perspective, which will require familiarity with basic concepts in probability (e.g., random variables, expectation, independence, joint distributions, conditional distributions, Bayes' rule, and the multivariate normal distribution). We will

also be using the language of linear algebra to describe the algorithms and carry out any analysis, so you should be familiar with concepts such as norms, inner products, orthogonality, linear independence, eigenvalues/vectors, eigenvalue decompositions, etc. as well as the basics of multivariable calculus such as partial derivatives, gradients, and the chain rule. Finally, we will be drawing from the broader field of NLP. If you have had courses on these topics as an undergraduate (or more recently) you should be able to fill in any gaps in your understanding as the semester progresses. Finally, many of the homework assignments and the course projects will require the use of Python.

The "Pre-Homework" assignment posted in Canvas is designed to help you gauge whether you have the required background.

Course Requirements

- **Active Class Participation (5%):** Participation grades will be determined by attendance, class participation, and feedback on and critique of case studies from other project teams.
- **Assignments (40%):** During the term, there will be 5 ± 1 assignments and associated quizzes. These assignments will be a mix of concepts/theory and practical skills, including written questions and coding.
- **Case Studies (15%)** Teams of 4 persons will be determined earlier in the semester. These teams will work together throughout the Case Studies as well as the Final Project. Each case study will be completed with the help of the team's AVA system. The systems will be developed by the team throughout the semester and used for the Final Project. The systems will be (1) a collaborative research assistant that can co-write scientific survey articles with the (human) team members on any topic, and (2) a conversational assessment tool that can evaluate scientific survey articles as well as evaluate the conversational AI research assistant. For each case study, the team is responsible for (a) creating/improving the team's conversational AI research assistant (b) using the research assistant to co-write a survey article on the assigned topic (c) creating/improving the conversational AI assessment tool (d) using the conversational AI assessment tool to score the research assistants and survey articles developed by the team (self-assessment) as well as all other teams in the class.
- **Final Project (40%):** A major component of this course consists of a final project. The final project will be similar to the case studies except a) the topic will be selected by the team and must be a current research problem (unsolved) (b) an initial system will be developed (coded) and evaluated through experiments (c) a scientific paper will be co-written by the team and the team's conversational research assistant (e.g., the Introduction and Background will be similar to the survey papers in the Case Studies). Further details about the project will be provided later in the semester.

Grading Scale

Each student's grade will be assigned as a letter grade according to the scale:
A: 90-100% B: 80-89% C: 70-79% D: 60-69% F: $\leq$ 59%

Course Reading Materials

Given the rapidly evolving nature of the field of conversational AI, I will not use any specific textbook and the material for this course will come from a variety of (recent) scientific publications and presentations. Pointers to this reading material will be provided in the lectures and the Case Studies throughout the course.

Course Topics Selected From:

- Month 1: Foundations of Conversational AI
  - Introduction to Conversational AI
  - Word Vectors
  - Language Models
  - Deep Neural Networks: Basics
  - Dependency Parsing
  - Sequence-to-Sequence Modeling and Machine Translation
  - Recurrent Neural Networks
- Month 2: Large Language Models in Conversational AI
  - Recurrent Neural Networks and Attention
  - Transformer
  - Bidirectional Encoder Representations from Transformers
  - Generative Pre-trained Transformers (GPT)
  - GPT to Dialogue: Pre-training, RLHF, Fine-tuning, evaluation
  - Question & Answering
  - Retrieval Augmented Generation
  - Agents and Virtual Assistants
  - Multimodal Conversational AI
  - Reasoning
- Month 3: Advanced Topics
  - Case Studies (literature exploration of an advanced topic in conversational AI)
  - Final Project (implementation and experiments of an advanced topic)

Course Websites

The course webpage is on Canvas. I will post assignments and make class announcements there.

This term, we will be using Piazza. Each student needs to sign up here for class discussion. The system is highly catered to getting you help fast and efficiently from classmates and me. Rather than emailing questions, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Attendance and/or Participation

Class attendance is essential and graded as part of the Active Class Participation. During the class, it is recommended that you take notes. While supplementary lecture notes will be posted on CANVAS, the notes are not to be considered as a direct replacement for your own class notes and participation. Discussions during lectures are an important part of the learning for this course. If you miss a lecture, review the posted lecture notes on CANVAS. Complete the assignments and attend the office hours.

Collaboration & Group Work

Students are encouraged to work together on assignments and projects. However, for graded material, you must submit your work (and not copy someone else's work). You are expected to complete the quizzes yourself, without any external help or communication.

Extensions, Late Assignments

No late assignments will be accepted. If you have an extreme extenuating circumstance, contact me and the Office of Student Life 2 days before the assignment is due if possible, to discuss solutions.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Please read Georgia Tech's Academic Honor Code and Code of Conduct. Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations. Violating Georgia Tech's Academic Honor Code may result in a grade of zero for the assignment.

Learning Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. Please read the Student-Faculty expectations. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Contacting me

Please contact me (use Piazza) if you want to meet but cannot attend the office hours that week.