CSCI 644: Natural Language Dialogue Systems
Units: 4
Spring 2025 – Wednesdays 2:00-5:20pm

Location: THH 109
Course webpage: http://people.ict.usc.edu/~traum/cs644s25

Instructor
David Traum, traum@ict.usc.edu
Office Hours: Wed 10-12, after class, or by appointment

Teaching Assistant
Philip Eibl
Office Hours: TBA

Course Description
This course will introduce students to existing computational techniques and active research areas in the design and development of natural language dialogue systems. Natural language dialogue involves extended communication between two or more participants using a natural language such as English. Dialogue systems are designed to participate in extended natural language interactions with human users, and have been developed for a variety of interactive settings where a conversational interface offers advantages. Natural language dialogue systems have many applications, for example, chat-based dialogue, providing information, tutorial dialogue (and generally dialogue for training, e.g., leadership skills, interviewing skills, etc.), healthcare applications (e.g., virtual human interviewers that interact with people who suffer from depression or post-traumatic stress), storytelling, controlling smart homes, companions for the elderly, etc.

Dialogue systems leverage a range of natural language processing and modeling techniques to help them serve as fluent and efficient conversational partners. This course will introduce students to these techniques, with topics to include dialogue system architectures (module-based vs. end-to-end), different types of dialogue systems (task-oriented vs. chatbots), spoken language understanding, modeling dialogue genres, dialogue management and representing context, dialogue response policies, natural language generation, embodied conversational agents, multi-party dialogue, incremental speech processing, user modelling, dialogue corpora and annotation, dialogue system evaluation, conversational speech recognition, and conversational speech synthesis.

Dialogue systems are both an old topic in AI and Computer Science (with famous early examples such as Eliza, Lunar, and SHRDLU) and a topic of much current interest and research. Indeed, dialogue systems are now a commercial reality, with companies such as Google, Amazon, Nuance, Microsoft, IBM, Apple, and others providing ubiquitous speech recognition services and voice-driven information access

systems. These services are increasingly accessible (on the web, mobile devices, and in the cloud), and they provide exciting new possibilities for dialogue systems to be made available to large user populations. More recently, OpenAI's ChatGPT and Google's Gemini have made headlines with their impressive capabilities. Throughout the course, students will acquire an appreciation for some of the capabilities and potential of these new technologies, as well as their current limitations.

Learning Objectives
After completing the course, students should have a basic understanding of dialogue system design, implementation, and evaluation, and the tradeoffs between different approaches to dialogue system creation (given goals and available resources), and be able to:

- design and implement a dialogue system for a specific purpose;
- read and assess research papers in the area;
- embark on new research on dialogue modelling, and dialogue system design and development.

Recommended Preparation
Students should have some experience with natural language processing or AI, and be comfortable with medium-sized programming projects. Recommended background would be at least one of the following courses: CSCI 544 (Applied Natural Language Processing) or CSCI 561 (Foundations of Artificial Intelligence) or CSCI 662 (Advanced Natural Language Processing) or EE619 (Advanced Topics in Speech Recognition). Students who have not taken one of these courses should request permission from the instructors.

Course Notes
The course lecture periods will consist of approximately 1/2 lectures by the instructor, and 1/2 group discussion of research papers, mostly led by students. For all class periods, students will be responsible for sending in discussion questions on the readings, as well as participating in class discussions. Each student will have to co-lead the discussion of one advanced research topic, including a short review presentation on the topic. Students will also complete several small assignments, and carry out a main project on a topic agreed by the instructor. Brightspace will be used for submitting assignments. Lecture notes will be posted on the course webpage or Brightspace site. Discussion questions should be posted on the course slack or Piazza site.

Technological Proficiency and Hardware/Software Required
Students are expected to know how to program in a language such as Python, Java, or C++. Students are also expected to have access to their own laptop or desktop computer where they can install and run software to do the homework assignments.

Required Readings and Supplementary Materials
The primary readings for this course will be a set of technical papers to accompany each lecture session and student-led topic. These papers will be made available on the course webpage.

Description and Assessment of Assignments
Basic comprehension of the material will be assessed by student's class participation and sending in questions and comments about the readings. In-depth understanding of one area will be assessed by the student leading a discussion of the area, including a summary lecture presentation. Practical understanding of simple evaluation and system building will be assessed through a set of assignments of one to three weeks duration. In-depth research capability to be assessed through completion and presentation of a class project.

Grading Breakdown

There will be no exams in this class. Grades will be determined based on:

1.	reading and reviewing assigned papers (sending in questions and comments)	5%
2.	participation in class discussions	5%
3.	leading one discussion topic based on assigned readings	10%
4.	rapporteur on one discussion topic	5%
5.	3-4 assignments	35%
6.	main project (including whitepaper, proposal, presentation & writeup)	40%

Assignment Submission Policy

Assignments are to be submitted electronically in Brightspace. Questions should be submitted to Piazza early enough to give adequate time to the instructors and the teaching assistant to respond.

Additional Policies

Students are expected to miss no more than 2 classes throughout the semester. Students may use up to five days for late assignments, otherwise grades will be reduced by 20% per day.

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment or what information requires citation and/or attribution.

Use of Generative AI

In this course, I encourage you to use artificial intelligence (AI)-powered programs to help you with assignments that indicate the permitted use of AI. You should also be aware that AI text generation tools may present incorrect information, biased responses, and incomplete analyses; thus they are not prepared to produce text that meets the standards of this course. To adhere to our university values, you must cite any AI-generated material (e.g., text, images, etc.) included or referenced in your work and provide the prompts used to generate the content. Using an AI tool to generate content without proper attribution will be treated as plagiarism and reported to the Office of Academic Integrity. Please review the instructions in each assignment for more details on how and when to use AI Generators for your submissions.

- Be thoughtful about when AI is useful. Consider its appropriateness for each assignment or circumstance. The use of AI tools requires attribution. You are expected to clearly attribute any material generated by the tool used.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonestly and is strictly prohibited. (Living our Unifying Values: The USC Student Handbook, page 13).

Course Schedule

Approximate, check the webpage for up to date details

	Topics/Daily Activities	**Selected Readings/Preparation**	**Assignements & Projects**
Week 1	Class intro, overview of dialogue, dialogue systems, architectures	Traum 2016 "Computational Approaches to Dialogue" Traum 2022 “Socially Interactive Agent Dialogue” Jurafsky and Martin, Chatbots & Dialogue Systems (Draft of Jan 2025)	Assignment 1 distributed
Week 2	Discourse & Dialogue Structure	Grosz & Sidner 1986, Mann & Thompson 1988, Bunt et al 2021 ISO 24617-2, Traum 1999 “Speech Acts for Dialogue Agents”	Assignment1 due Assignment 2 distributed
Week 3	Dialogue System Evaluation	Walker et al 2000 Ai et al 2007, Liu et al 2016 Shikib & Eskenazi, 2020	
Week 4	Logic and plan-based approaches	Traum & Larson 2003 Perrault & Allen 1980 Sadek et al 1996 Rich, Sidner & Lesh 2001	Assignment 2 due, Assignment 3 distributed
Week 5	Conversational grounding and error handling	Clark & Marshall 1981, Allwood et al 1992 Clark and Schaefer 1989 Traum 1999 Shaikh et al 2024	Choose topics & dates for student presentations and rapport
Week 6	Ethical Issues & Data Collection	Allwood et al 2000 “Cooperation, dialogue and ethics” Sun et al 2023 Brandel et al 2024	Assignment 3 due

Week 7	Reinforcement learning and simulated users	Williams & Young 2007 Georgila et al 2006 Kreyssig et al 2018	Project whitepaper due
Week 8	Multiparty & Multi-floor dialogue	Traum 2004 Issues in multi-party dialogues Bohus & Horvitz 2009 Gu et al 2022 Traum et al 2018	
Week 9	Dialogue & Identity	Traum et al 2015 New Dimensions in Testimony Collins & Traum 2018 Fillwock &Traum 2018 Zhang et al 2018	
Week 10	Student topic presentations		
Week 11	Student topic presentations		Project proposal due
Week 12	Student topic presentations		
Week 13	Student topic presentations		
Week 14	Student topic presentations		
Week 15	**Student project presentations**		
FINAL	**Student project presentations (continued)**		Final project report due

Student topic presentations will be chosen from the below list (or others proposed by students and accepted by instructor). Presentations will cover at least one paper in depth and relation to others in the area. Discussions will be led by another student rapporteur, who will ask the presenter questions, comment on the topics, and stimulate other class discussion.

- turn-taking
- mixed-initiative
- referring in dialogue
- dialogue act modeling
- dialogue act recognition
- prosody and information structure
- Argumentation & persuasion
- incremental speech processing
- multi-modal dialogue
- Tutorial dialogue
- Multi-task dialogue
- embodied conversational agents
- human-robot dialogue interaction
- dialogue tracking in other language-processing systems (machine translation, summarization/extraction)
- Team dialogue
- non-cooperative dialogue systems (negotiation, deception)
- affective dialogue systems
- dialogue with different user populations (children, elderly, differently abled)
- Enculturated Dialogue Agents
- Dialogue "in the wild"
- Long-term Dialogue Companions
- Speech synthesis for dialogue
- Low-resource dialogue systems

Statement on University Academic and Support Systems

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:

To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the Financial Aid Office webpage for undergraduate- and graduate-level SAP eligibility requirements and the appeals process.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-2500

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.