CSCI-499: Natural Language for Interactive AI
Units: 4
Fall 2022 MoWe 10am-11:50am
Location: SOS B37

Instructor: Jesse Thomason
Office: SAL 244
Office Hours:
   SAL 244
   Tuesdays, 10am-11am
Contact Info: jessetho@usc.edu; Slack preferred

TA: Anthony Liang
Office Hours:
   RTH 4th Floor Lounge
   Tuesdays, 11am-12pm
Contact Info: aliang80@usc.edu; Slack preferred

Course Description
This course will explore how natural language can serve as an interaction medium between users and AI agents. To that end, the course will cover topics in natural language processing, computer vision, and machine learning. Students will become familiar with concepts and methods in natural language processing and linguistics such as syntactic and semantic parsing, structure prediction, distributional semantics and compositional semantics. Students will delve into the intersection of planning and search-oriented machine learning algorithms with such language understanding techniques and paradigms.
Learning Objectives
1. Gain familiarity with a diverse set of NLP concepts and techniques.
2. Gain familiarity with planning formalisms for learning-based AI agents.
3. Become familiar with and develop new techniques and applications for language as an interface between AI agents and human users.

Prerequisite(s): CSCI-270 && (CSCI-360 || CSCI-467 || equivalent experience)

Recommended Preparation: Fluency with python programming.

Course Notes
Lecture notes will be made available online after each class.

Required Readings and Supplementary Materials
All reading material will be posted on the course web page at the beginning of the course. All reading material will be freely and publicly available online.

Course Organization Fall 2022
Course communication planned via slack:
- Workspace: USC Viterbi School of Engineering Classes
  - uscviterbiclass.slack.com
  - Channel: #fall22-csci-499-30052
Course documents shared via Google Drive. Links:
- Course gDrive: https://drive.google.com/drive/folders/1Cn7nUqe1MMiSYTtK0C50D7D-N7D-ab9HEQ?usp=sharing
Description and Assessment of Assignments

Paper reviews
The course will explore the course topics through a series of assigned readings in the form of research papers (and book chapters). Students will select one paper from a set of papers for each review cycle and submit a one page review of it as homework. There will be 8 (+1 optional) such paper reviews assigned through the semester. Reviews will be assessed based on answering the following 5 questions (based on clarity and correctness). In most cases, each question warrants at minimum a paragraph to answer, sometimes more. There are a few papers that are less technical for which these questions aren’t as good of a fit; feel free to reach out to the instructor if you feel what you’re writing about falls into that category.
1. What is the main problem/task addressed by the paper?
2. What was done before, and how does this paper improve on it?
3. What is the one cool technique/idea/finding that was learned from this paper?
4. What part of the paper was difficult to understand?
5. What generalization or extension of the paper could be done?

Coding Assignments
Students will explore course concepts in detail through coding assignments that require implementing core concepts in PyTorch and training and executing models against real data.

Class Presentation
Students will individually present a research paper to the class. The paper can be selected from a list of class papers from any review section, or outside of the selected list with instructor permission. Each presentation will be 10 mins total: 8 minutes for the presentation with 2 minutes for questions. The presentations will be graded on clarity, completeness, and presentation style.

What should you try to convey?
- The **main takeaway** you got from the paper; don’t build suspense, drop the main information on us right away
- A brief **motivation** which can include some **background**; tell the audience why the paper needed to be written
- The **key insight** that overcomes the problems presented in the motivation with what was done before this paper
- The **technical details** behind the insight; go deep for a few slides (~40-50% of your speaking time)
- **Conclude** by summing it up: main takeaway driven by the key insight that resolved the problem presented in the motivation, with a reminder of technical detail/challenges

**gDrive to upload slides:**
[https://drive.google.com/drive/folders/1SQoxsfhaPFYpwY48Q_vES16SvqVJk8Z6](https://drive.google.com/drive/folders/1SQoxsfhaPFYpwY48Q_vES16SvqVJk8Z6)

**gSheet to coordinate paper assignments:**
[https://docs.google.com/spreadsheets/d/1Uc9qvPSYbeUXF17j2pJYsU35qodleB2cdEuduPCKhY/edit#gid=0](https://docs.google.com/spreadsheets/d/1Uc9qvPSYbeUXF17j2pJYsU35qodleB2cdEuduPCKhY/edit#gid=0)

**Semester Project**
Students will work individually or in pairs to carry out a class project. The focus of the class project can be research-focused or application-focused. A research-focused project will develop models and analyze data of an existing problem in NLP, or formulate a new problem altogether. An
application-focused project will train (possibly only fine-tuning) and deploy NLP models to new application areas, while not necessarily developing any novel research question to be answered. Students will leverage tools, concepts, and techniques presented in the class. The project involves identifying a communication or exploration need that language could resolve, data sources available to inform the problem and method, and the techniques needed to approach it. The grade for the project will be based on the successful completion of the agreed upon project objectives. The deliverables include a project proposal (1-2 pages single space), a mid project report (4-8 pages single space), final presentation (15 minutes talk; 5 minutes for questions) and a final report (~8 pages single space for the main document, up to 15 with appendix/figures). Reports will be graded based on clarity, and completeness. The project is total 40% of final grade with the following internal breakdown:

<table>
<thead>
<tr>
<th></th>
<th>Proposal (5%) [12.5 / 100 total pts]</th>
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<tbody>
<tr>
<td></td>
<td>Project Mid Report (10%) [25 / 100 total pts]</td>
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<tr>
<td></td>
<td>Final Presentation (10%) [25 / 100 total pts]</td>
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<tr>
<td></td>
<td>Project/Final Paper (15%) [37.5 / 100 total pts]</td>
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</table>

The project proposal (1-2 pages single space; Arial or LaTeX default font, no smaller than 11pt in any place) should outline the type of project (research-focused or application-focused), and then answer the following questions clearly in a sentence and/or a few paragraphs each, as appropriate.

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
• What is new in your approach and why do you think it will be successful?
• Who cares? If you are successful, what difference will it make?
• What are the risks? What could go wrong, and how will you pivot early on if that happens?
• How much will it cost? That is, what resources will you need in terms of time and computation? Are these reasonable for a semester and what access you have?
• What are the midterm and final “exams” to check for success? That is, what are your milestones?

_The project midterm report_ (about 5 pages single space; Arial or LaTeX default font, no smaller than 11pt in any place) should be broken into the following sections and cover requested content. If you are interested in writing your midterm and final report like a conference paper, you can build on the [ACL Style Files and Templates](#).

- **Introduction:**
  - What are you trying to do? Articulate your objectives using absolutely no jargon.
  - Who cares? If you are successful, what difference will it make?
- **Related Work:**
  - How is it done today, and what are the limits of current practice?
- **Method:**
  - What is new in your approach and why do you think it will be successful?
  - How will you conduct experiments? What hypothesis will these experiments test? How will you evaluate the quality of the results?
- **Preliminary Results:**
  - Look back over the milestones you outlined in your proposal; did you hit your midterm exam to check for success?
○ What have you discovered so far? Did anything go the way you planned? Did anything go wrong in a way you have to change plans for? What are your next steps?

● Timeline to final report:
  ○ Provide a detailed timeline, including labor breakdown, of what your team will do between now and the final report.

*The project final presentation* should be 10-12m in length per group, leaving 3-5m for questions and speaker turnover. The presentations will be graded on clarity, completeness, and presentation style. Each member of the group should present for about equal time.

What should you try to convey?

● The **main takeaway** you have reached or aim to reach with your project; don’t build suspense, drop the main information on us right away.

● A brief **motivation** which can include some **background**; tell the audience why the project needed to be done.

● The **key insight** that overcomes the problems presented in the motivation with what was done before this project.

● The **technical details** behind the insight; go deep for a few slides (~40-50% of your speaking time).

● **Conclude** by summing it up: main takeaway driven by the key insight that resolved the problem presented in the motivation, with a reminder of technical detail/challenges, and an overview of what remains to be done, if anything, before the final report, as well as what you hypothesize the outcomes of those experiments will be.

*The project final report* (no more than 8 pages single space; Arial or LaTeX default font, no smaller than 11pt in any place; up to 15 pages with appendix and additional figures) should be broken into the following sections and cover requested content. If you are interested in writing your
midterm and final report like a conference paper, you can build on the [ACL Style Files and Templates].

- **Introduction:**
  - What were you trying to do? Articulate your objectives using absolutely no jargon.
  - Who cares? If you were successful, what difference would it make?
- **Related Work:**
  - How is it done today, and what are the limits of current practice?
- **Method:**
  - What is new in your approach and why did you think it would be successful?
  - How did you conduct experiments? What hypotheses did those experiments test? How did you evaluate the quality of the results?
- **Results:**
  - What are the results of your experiments? What did you discover? Were you able to support your hypotheses?
- **Conclusions and Future Work:**
  - What are the main takeaways of your project? What would you do next if you wanted to keep working in this space? What new questions can you formulate given the work this semester?

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### Grading Breakdown

<table>
<thead>
<tr>
<th>Assignments</th>
<th>Points</th>
<th>% of Grade</th>
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</thead>
<tbody>
<tr>
<td>Class participation</td>
<td>100</td>
<td>10%</td>
</tr>
<tr>
<td>Paper reviews (x8)</td>
<td>12.5 x 8</td>
<td>10%</td>
</tr>
<tr>
<td>Assignment</td>
<td>Points</td>
<td>Percentage</td>
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<td>-------------------------------------------</td>
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<tr>
<td>Coding Assignments (x3) + Discussions/Participation</td>
<td>30 x 3 + 10</td>
<td>25%</td>
</tr>
<tr>
<td>Class Paper Presentation</td>
<td>100</td>
<td>15%</td>
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<tr>
<td>Final Project</td>
<td>100</td>
<td>40%</td>
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</table>

Final grades will be binned into letters (e.g., A+, A, etc.) with adjustments made for overall point distributions.

**Assignment Submission Policy**
Upload/email to be decided, encouraged by 6pm (aka “quittin’ time”) on the due date; accepted until 11:59pm on the due date. Blackboard “Assignments” will be created through which to turn stuff in.

**Grading Timeline**
Grades will be provided within 2 weeks of submission of the respective assignment.

**Additional Policies**
This is a discussion-based course, hence consistent attendance is expected. Missed classes with a valid excuse are allowed. Class participation will be scored based on engagements in course discussions.

The course will allow for a budget of 5 Late Day Tokens per student. These tokens can be expended on project deliverables (NOT presentations) to extend the deadline for a student. These tokens should be used with no justification or explanation for taking the late time required (i.e., you do not need to explain your reasoning to me). Going over budget (e.g., turning things in late with no Late Day Tokens to expend) will incur grade penalties of 5% per day late. For project teams, each member must expend a Late Day Token for a single day extension to a project-related deadline (i.e., for a team of 2 to push back their midterm report deadline, both team
members must expend a Late Day Token). There are no refunds for late
days: unused late days cannot be converted into credit of any kind. Use
them!

**Project Schedule:**
Week 5: Proposals due Thu Sep 22
Week 10: Midterm Reports Thu Oct 27
Week 14-15: Project Presentations given in class
Final Report: Due Monday, December 12 [USC-scheduled Final Exam Day]

**Course Schedule:**
Everything in the schedule is subject to change except the Project
Schedule. Topics/Daily Activities especially are a very vague outline that
will become concrete as we move through the weeks and identify what
needs to be covered. Homework and review deadlines (“Deliverables”) are
more solidly set. The Project Schedule dates are unlikely to change.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics/Daily Activities</th>
<th>Deliverables</th>
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<tbody>
<tr>
<td>1</td>
<td>Mon Aug 22</td>
<td>Lecture 0: Administrivia</td>
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<td>Lecture 1: Formalizing Dialogue</td>
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<tr>
<td></td>
<td>Wed Aug 24</td>
<td>Lecture 1: Formalizing Dialogue</td>
<td>Coding assignment 1 released to class</td>
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<td></td>
<td></td>
<td>Lecture 2: Text Classification</td>
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<tr>
<td>2</td>
<td>Mon Aug 29</td>
<td>Lecture 2: Text Classification</td>
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<tr>
<td>Week 3</td>
<td>Mon Sep 5</td>
<td>Lecture 2: Text Classification</td>
<td>Paper review 1 DUE Thu Sep 1</td>
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<tr>
<td>Wed Sep 7</td>
<td>Lecture 2: Text Classification Lecture 3: Language Modeling</td>
<td>Coding assignment 1: text classification DUE Thu Sep 8</td>
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<tr>
<th>Week 4</th>
<th>Mon Sep 12</th>
<th>Lecture 3: Language Modeling</th>
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<tbody>
<tr>
<td>Wed Sep 14</td>
<td>Coding Assignment 1 Debrief and Discussion</td>
<td>Paper Review 2 DUE Thu Sep 15</td>
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<thead>
<tr>
<th>Week 5</th>
<th>Mon Sep 19</th>
<th>Lecture 3: Language Modeling</th>
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<tbody>
<tr>
<td>Wed Sep 21</td>
<td>Lecture 4: Word Embeddings</td>
<td>Paper Review 3 DUE Thu Sep 22</td>
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<td>Project Proposal DUE Thu Sep 22</td>
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<tr>
<th>Week 6</th>
<th>Mon Sep 26</th>
<th>Lecture 4: Word Embeddings</th>
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<tbody>
<tr>
<td>Coding assignment 2 released to class</td>
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<tr>
<td>Week 7</td>
<td>Student Paper Presentations</td>
<td>Paper Presentations DUE</td>
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<tr>
<td>Mon Oct 3</td>
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<tr>
<td>Wed Oct 5</td>
<td>Student Paper Presentations</td>
<td>Optional Paper Review DUE Thu Oct 6</td>
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<td>Paper Presentations DUE</td>
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<tr>
<td>Week 8</td>
<td>NO CLASS [Indigenous People’s Day]</td>
<td>NO CLASS</td>
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<td>Mon Oct 10</td>
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<td></td>
<td>Models + Coding Assignment 2 open discussion ahead of turn in</td>
<td>Coding assignment 2: Word Embeddings DUE Thu Oct 13</td>
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<td>Week 9</td>
<td>Detour Lecture: Language Grounding</td>
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<td>Mon Oct 17</td>
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<td>Wed Oct 19</td>
<td>Lecture 5: Sequence-to-Sequence Models</td>
<td>Paper Review 6 DUE Thu Oct 20</td>
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<tr>
<td>Week 10</td>
<td>Lecture 5: Sequence-to-Sequence Models</td>
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<tr>
<td>Mon Oct 24</td>
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<tr>
<td>Date</td>
<td>Event</td>
<td>Due Date</td>
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<tr>
<td>Wed Oct 26</td>
<td>Lecture 5: Sequence-to-Sequence Models</td>
<td>Project mid report DUE Thu Oct 27</td>
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<td>Coding Assignment 2 Debrief and Discussion</td>
<td>Homework 3 RELEASED Fri Oct 28</td>
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<tr>
<td><strong>Week 11</strong></td>
<td>Coding Assignment 2 Debrief and Discussion</td>
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<tr>
<td>Mon Oct 31</td>
<td>Lecture 6: NLP for Interaction with a World</td>
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<tr>
<td>Wed Nov 2</td>
<td>Lecture 6: NLP for Interaction with a World</td>
<td>Paper Review 7 DUE Thu Nov 3</td>
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<tr>
<td><strong>Week 12</strong></td>
<td>Lecture 6: NLP for Interaction with a World</td>
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<td>Mon Nov 7</td>
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<td>Wed Nov 9</td>
<td>Lecture 6: NLP for Interaction with a World</td>
<td>Paper Review 8 DUE Thu Nov 10</td>
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<tr>
<td><strong>Week 13</strong></td>
<td>Lecture 6: NLP for Interaction with a World</td>
<td>Coding assignment 3: Seq2Seq DUE Tue Nov 15</td>
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<tr>
<td>Mon Nov 14</td>
<td>Models + Coding Assignment 3 open discussion ahead of turn in</td>
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<tr>
<td>Wed Nov 16</td>
<td>Lecture 7: NLP for Embodied Interaction</td>
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<tr>
<td><strong>Week 14</strong></td>
<td>GLAMOR Lab presentations on NLP for Interactive AI</td>
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<tr>
<td>Mon Nov 21</td>
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### Paper Review Candidates:
Below are suggested papers for each review assignment. If you choose to review a paper outside this area, you must first obtain instructor approval for the candidate outside paper. Papers may be added to these sections through the semester, but we will avoid removing them.

**Paper Review 1**

### Paper Review 2


### Paper Review 3


**Paper Review 4**

• **GloVe: Global Vectors for Word Representation.** Jeffrey Pennington, Richard Socher, Christopher Manning. EMNLP 2014.


• **VQA: Visual Question Answering.** Stanislaw Antol and Aishwarya Agrawal and Jiasen Lu and Margaret Mitchell and Dhruv Batra and C. Lawrence Zitnick and Devi Parikh. ICCV 2015.

• **Information Maximizing Visual Question Generation.** Ranjay Krishna and Michael Bernstein and Li Fei-Fei. CVPR 2019.

• **Grounded Situation Recognition.** Sarah Pratt and Mark Yatskar and Luca Weihs and Ali Farhadi and Aniruddha Kembhavi. ECCV 2020.

**Paper Review 5**

• **Entailment Semantics Can Be Extracted from an Ideal Language Model.** William Merrill, Alex Warstadt, Tal Linzen. CoNLL 2022.

• **Multi-Modal Word Synset Induction.** Jesse Thomason and Raymond J. Mooney. IJCAI 2017.

• **Does Pretraining for Summarization Require Knowledge Transfer?** Kundan Krishna, Jeffrey Bigham, Zachary C. Lipton. EMNLP 2021.


• **ViLT: Vision-and-Language Transformer Without Convolution or Region Supervision.** Kim, Wonjae and Son, Bokyung and Kim, Ildoo. ICML 2021.


**Paper Review 6**


- [https://larel-ws.github.io/accepted-papers/](https://larel-ws.github.io/accepted-papers/) [any paper you like from these proceedings]


### Paper Review 7


- **Asking for Help Using Inverse Semantics**, Stefanie Tellex and Ross Knepper and Adrian Li and Daniela Rus and Nicholas Roy. RSS 2014.


- [https://say-can.github.io/](https://say-can.github.io/) [Post evolves faster than the paper, in this case.]

### Paper Review 8

- **Climbing towards NLU: On Meaning, Form, and Understanding in the Age of Data**, Emily M. Bender and Alexander Koller. ACL 2020.


Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call studenthealth.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.
National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.
Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298
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) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101
diversity.usc.edu
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**

dps.usc.edu, emergency.usc.edu

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) 442-120 – 24/7 on call**

dps.usc.edu

Non-emergency assistance or information.