Tentative Syllabus

Introduction to Speech and Language Processing (CS 4390/5319)

Fall 2018

Monday & Wednesday, 10:30 - 11:50, CCSB 1.0202

Instructor: Nigel Ward
Office: CCS 3.0408
Phone: 747-6827
E-mail   nigel@utep.edu
Office Hours: Tuesdays & Thursdays 2:30-3:30, or by appointment, and usually when the door is open

Speech and language processing has recently seen tremendous advances, and the core technologies of speech recognition and speech synthesis are now mature, with readily-usable APIs available for developers and well-designed systems used by millions of people every day. At the same time, the range of viable applications is currently very limited, due to a large number of challenging open problems.

This class will provide a survey and sampling of the techniques and issues in speech and language processing. Students will design, implement and evaluate a project applying these techniques to a problem of their choosing.

Main Topics   **Language**: Basic properties of human language, along with feature-based, vector-space and other representations of each level (acoustics, phonetics, prosody, morphology, syntax, meaning, pragmatics), with attention to differences across languages, genres, and speakers.

Models and Algorithms: Standard and for-purpose models and algorithms for speech and language processing components, including techniques for knowledge discovery and model training.

Systems and Applications: The design and development of large-scale systems for search, question-answering, conversational interaction, and machine translation, and of other applications including language identification, emotion and speaker-state detection, language-proficiency assessment, entity detection and information extraction, filtering, tutoring systems, sentiment detection etc.

Prerequisites: Linear Algebra (Math 3323 or equivalent), Probability and Statistics (Stat 3320 or equivalent), strong programming and systems-integration skills (CS 3331 or equivalent). Knowledge of machine learning techniques and of linguistics concepts is helpful but not required. Graduate students from other departments may receive prerequisite waivers; see the instructor for permission.

Format Lectures, student presentations, discussions, in-class design exercises, lab time, project activities, project presentations, etc.

Textbook *Speech and Language Processing*, Daniel Jurafsky and James H. Martin, 2nd edition, Prentice-Hall, 2008. We will be skipping back and forth in the book as we follow the topics listed above. Please bring the textbook to class.   It will be supplemented by readings handed out in class.

Course Website http://www.cs.utep.edu/nigel/slp/

Assignments There will be a number of structured assignments, designed to give experience with various tools and methods. Most assignments will be done in teams. Assignments due at the start of class will be collected after a one minute grace period; late assignments will receive at most two-thirds credit. Assignments are to be handed in as hardcopy unless otherwise specified. Writing quality is important, and rework may be required if not up to standard. Graduate students will have two additional assignments.

Grading Approximate weighting:
  assignments, including presentations 25%
  project 25%
  tests 40%
  quizzes and participation 10%

To achieve these weights, a point on an assignment will typically be worth 1.1 to 1.3 times as much as a point on a quiz or test. Grading will be on a points-earned basis (points above zero), rather than a points-off basis (points below expectation). Letter grades will be assigned accordingly; in the past, the A/B break has been around 80% and the B/C break around 70%.

Conduct, etc.   Students are expected to be punctual, and to follow the spirit and letter of the UTEP Standards of Student Conduct and Academic Integrity policy https://www.utep.edu/student-affairs/osccr/student-conduct/academic-integrity.html . In particular, cooperation among students and among teams is encouraged, but not to the extent that it interferes with each individual's understanding or with learning-by-doing. Help given to and received from other students and sources should be noted in the assignment write-up.

If you have or suspect a disability and need accommodation please contact CASS at 747-5148 or at cass@utep.edu or visit Room 106 Union East Building.

 Tests will be closed-book, except that one page of hand-written notes may be brought in for the first test, two for the second test, and three for the final. If you leave the classroom for any reason, your test will be graded on only what you did up until that time. No make-up exams or assignments will be given except under the conditions set forth in the Catalog. Students are free to attend class or not, bearing in mind that absence may annoy other students, interfere with learning, and result in a lower grade.

Important Dates
  August 27: Class begins
  September 3: Labor Day (no class)
  September 16: Test 1 (tentative)
  October 29: Test 2 (tentative)
  Dec 14: Final Exam, 10:00-12:45

Tentative Schedule

A. **Introduction** (Chapter 1)   (1 day)
1. Historical Perspective
2. Possible Futures
3. Course Overview
Assignment A: Observe Language in Use (1hr)

B. **Pattern Matching and Regular Expressions** (Chapters 2 and 3)   (2 days)
1. Morphology
2. Tokenization
Assignment B: Regular Expressions and Chatbots (4 hours)

C. **Disambiguation, Language Modeling and Tagging** (Chapters 4 and 5)   (3 days)
1. Lexical Ambiguity (Chapter 19)
2. Dependencies, Constituency and Syntactic Structures (Chapters 12 and 13)
3. Representing Context: Ngrams, Syntax
4. Review of Probability
5. Sentiment Analysis
Assignment C: Prepositional Phrase Attachment Disambiguation (3 hours)
Assignment D: Authorship Attribution (2 hours)

                                                           Test 1
D. **Representations of Meaning**   (3 days)
1. Bag-of-Words Models
2. Logic-Based Meaning Representations   (Chapter 17)
3. Review of Linear Algebra
4. Word Embeddings and Context Vectors (Chapter 20)
Assignment E: PP Disambiguation Redux, Lexical Disambiguation (1 hour)
Assignment F: Sentiment Analysis (2 hours)

E. **Search Engines**   (Chapter 23)   (4 days)
1. Link analysis
2. Vector-space similarity
3. Indexing and other Components
4. Evaluation of Ranking Algorithms
Assignment G: Extend a Search Engine (8 hours)

F. **Speech Recognition**   (3 days)
1. Articulatory Phonetics (Chapter 7)
2. Acoustic Phonetics and Spectral Representations
3. The Noisy Channel Model
4. Search-based and Transducer-based Models
5. Speech Recognition Methods and Issues (Chapter 9)
Assignment H: Build a Small Speech Recognizer from Scratch (4 hours)

                                                           Test 2
G. **Speech Analysis and Synthesis**   (3 days)
1. Prosody
2. Inferring Speaker Straits and Traits
3. Speech Synthesis   (Chapter 8)
Assignment I: Lexical, Phonetic, and Prosodic Transcription of Dialog (2 hrs)
Assignment J: Detecting Depression from Speech (4 hours)

H. Dialog Systems   (Chapter 24)   (3 days)
1. Finite-state dialog management
2. VoiceXML
3. Endpointing and Turn Taking
4. Inferring Dialog Acts and User Intentions
5. Response Selection and Natural Language Generation
6. API Interactions

Assignment K: Train an Endpointer (2 hours)
Assignment L: Reverse Engineer Siri, Alexa or Google Now (1 hour)
Assignment M: Build a Spoken Dialog System (10 hours)
Assignment N: Evaluate a Popular Dialog System (1 hour)

I. Other Applications for Text and Speech Processing   (1 day)
1. Machine Translation   (Chapter 25)
2. Entity Detection and Information Extraction (Chapter 22)
3. Language Proficiency Assessment
4. Tutoring Systems
5. Language Identification
6. Collaborative Filtering
7. Summarization

Assignment O: Ethical Issues (1 hour)
Assignment P: The Business Landscape (1 hour)

Other Assignments
Q. Final Project (30 hours)
Z1. Present a Research Paper (graduate students only) (6 hours)
Z2. Formulate a.Research Proposal (graduate students only) (8 hours)