Introduction to NLP

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Some slides adapted from slides by
Dan Jurafsky, Luke Zettlemoyer, Ellen Riloff
• "An Aggie does not lie, cheat, or steal or tolerate those who do." For additional information, please visit: http://aggiehonor.tamu.edu.

• Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the TAMU community from the requirements or the processes of the Honor System.
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• Piazza: CSCE 689, NLP


• course page:

• [http://faculty.cse.tamu.edu/huangerh/Spring17/Spring17_nlp_foundation_technique.html](http://faculty.cse.tamu.edu/huangerh/Spring17/Spring17_nlp_foundation_technique.html)
• Five In-Class Quizzes: 20% (4% each)
• Class participation: 10%
• Four Programming Assignments: 40%
• The Final Project: 30% (abstract: 5%)
Late Policy: 20% reduction per day. For both programming assignments and the final project.
Programming Assignments

• Code: has to be runnable

• Report: how to run, results and analysis, remaining issues, known bugs.
The Final Project

• Due by mid semester (02/28): 1-page abstract
• By the end of the semester: submit code data and a report, and a class presentation.
• Report: 8 pages maximum, describe the problem, approaches and evaluation results.
The final Project

• Solving a mini core research problem you have identified by reading recent research papers from top NLP conferences.
• Developing a nice NLP application system.
Basic Recipe of Forming a Project

• Choose a Topic and do a quick survey
• Prepare data
• Think about evaluation methods
• Start to work on it
Core research problems

- Semantics, word sense disambiguation
- Coreference resolution, discourse, pragmatics
Applications

- Question-Answering
- Text Summarization
- Dialogue systems
- Sentiment Analysis
- Machine Translation
- Interdisciplinary applications……
What is NLP?

- Fundamental goal: *deep* understand of *broad* language
  - Not just string processing or keyword matching
- End systems that we want to build:
  - Simple: spelling correction, text categorization…
  - Complex: speech recognition, machine translation, information extraction, sentiment analysis, question answering…
US Cities: Its largest airport is named for a World War II hero; its second largest, for a World War II battle.
Hi Dan, we’ve now scheduled the curriculum meeting.

It will be in Gates 159 tomorrow from 10:00-11:30.

-Chris
Google Knowledge Graph

The Knowledge Graph
Learn more about one of the key breakthroughs behind the future of search.

See it in action
Discover answers to questions you never thought to ask, and explore collections and lists.
Text Summarization

- Condensing documents
  - Single or multiple docs
  - Extractive or synthetic
  - Aggregative or representative

- Very context-dependent!

- An example of analysis with

  WASHINGTON (CNN) -- President Obama's inaugural address was cooler, more measured and reassuring than that of other presidents making it, perhaps, the right speech for the times.

Some inaugural addresses are known for their soaring, inspirational language. Like John F. Kennedy's in 1961: "Ask not what your country can do for you. Ask what you can do for your country."

Obama's address was less stirring, perhaps, but it was also more candid and down-to-earth.

"Staring today," the new president said, "we must begin the work of remaking America."

President Obama renewed his call for a massive plan to stimulate economic growth.

STORY HIGHLIGHTS
- Obama's address less stirring than others but more candid, analyst says
- Schneider: At a time of crisis, president must be reassuring
- Country has chosen "hope over fear, unity of purpose over ... discord," Obama said
- Obama's speech was a cool speech, not a hot one, Schneider says

Obama, too, offered reassurance.

"We gather because we have chosen hope over fear, unity of purpose over conflict and discord," Obama said.

Obama's call to unity after decades of political division echoed Abraham Lincoln's first inaugural address in 1861. Even though he delivered it at the onset of a terrible civil war, Lincoln's speech was not a call to battle. It was a call to look beyond the war, toward reconciliation based on what he called "the better angels of our nature."
Human-machine Dialogs

“What's the best movie to see this weekend”

That would probably start an argument. But here's a list of highly-regarded movies:

- NORTH BY NORTHWEST
  Released July 17, 1959
  100%

- THE TREASURE OF THE SIERRA
  Released January 6, 1948
  100%

What can I help you with?

“You need to start understanding me Siri”

I’ll make a note of that.

“Yeah you better make a note of that”

Noted:

Of that
Machine Translation

- Helping human translators

Enter Source Text:

这不过是一个时间的问题.

Fully automatic

Translation from Stanford’s Phrasal:

This is only a matter of time.
Inter-Disciplinary

**Computer Science:** artificial intelligence, machine learning

**Linguistics:** computational linguistics

**Psychology:** cognitive psychology, psycholinguistics

**Statistics:** probabilistic methods, information theory
Interactions with Linguists (History)

- 70s and 80s: more linguistic focus
- deeper models, toy domains, rule-based systems
- 90s: empirical revolution
- robust corpus-based methods, empirical evaluation
- 2000s: richer linguistic representations used in statistical approaches
Outline

• **Bag** of Words: Text classification

• **Sequence** of Words: language modeling, parts of speech tagging

• **Tree** of Words: syntactic parsing, dependency parsing

• **Semantics**: thesaurus, distributional, distributed

• **Discourse**, coreference, pragmatics
Language Technology

making good progress

mast solved

Spam detection
Let’s go to Agra!
Buy V1AGRA ...
✓
✗

Part-of-speech (POS) tagging
ADJ ADJ NOUN VERB
ADV
Colorless green ideas sleep furiously.

Named entity recognition (NER)
PERSON ORG
LOC
Einstein met with UN officials in Princeton.

Sentiment analysis
Best roast chicken in San Francisco!
The waiter ignored us for 20 minutes.

Coreference resolution
Carter told Mubarak he shouldn’t run again.

Word sense disambiguation (WSD)
I need new batteries for my mouse.

Parsing
I can see Alcatraz from the window!

Machine translation (MT)
第13届上海国际电影节开幕…
The 13th Shanghai International Film Festival…

Information extraction (IE)
You’re invited to our dinner party, Friday May 27 at 8:30

still really hard

Question answering (QA)
Q. How effective is ibuprofen in reducing fever in patients with acute febrile illness?

Paraphrase
XYZ acquired ABC yesterday
ABC has been taken over by XYZ

Summarization
The Dow Jones is up
The S&P500 jumped
Housing prices rose
Economy is good

Dialog
Where is Citizen Kane playing in SF?
Castro Theatre at 7:30.
Do you want a ticket?
Ambiguity !!
Ambiguities inherent in Language

• Language is succinct and expressive.
• Human resolve ambiguities naturally.
Syntax: structural ambiguity

Time flies like an arrow.

**Metaphor:**
Time/NOUN flies/VERB like/PREP an/ART arrow/NOUN

**New Fly Species:**
Time/NOUN flies/NOUN like/VERB an/ART arrow/NOUN

**Stopwatch Imperative:**
Time/VERB flies/NOUN like/PREP an/ART arrow/NOUN
Syntax: structural ambiguity (attachment)

- I saw the Grand Canyon flying to New York.
- I watered the plant with yellow leaves.
- I saw the man on the hill with the telescope.
[Diagram of a syntactic parse tree with the following structure:

S
  NP
    Det the
    N dog
  VP
    V saw
    NP
      Det a
      N man
    PP
      P in
      NP
        Det the
        N park]
But syntax doesn’t tell us much about meaning…

- *Colorless green ideas sleep furiously.* [Chomsky]
- *plastic cat food can cover*
Semantics: Lexical Ambiguity

• I walked to the bank ... of the river.

  to get money.

• The bug in the room ...

  was planted by spies.

  flew out the window.

• I work for John Hancock ...

  and he is a good boss.

  which is a good company.
• Discourse, Pragmatics
President John F. Kennedy was assassinated.

The president was shot yesterday.

Relatives said that John was a good father.

JFK was the youngest president in history.

His family will bury him tomorrow.

Friends of the Massachusetts native will hold a candlelight service in Mr. Kennedy’s home town.
Pragmatics

Rules of Conversation

• Can you tell me what time it is?
• Could I please have the salt?

Speech Acts

• I bet you $50 that the Jazz will win tonight.
• Will you marry me?
NLP: a branch of AI

• Lack of world knowledge
• Inferences
World Knowledge, Inferences

John went to the diner.

He ordered a steak.

He left a tip and went home.

John wanted to commit suicide.
He got a rope.
• Sparsity!!!
Zipf’s Law

- the frequency of any word is **inversely proportional** to its rank: \( f = \frac{K}{r} \)
- fat-tail, most words occur only a couple of times
- high lexical diversity -> data sparseness
Illustration of Zipf’s Law

- Brown Corpus: A balanced corpus of written American English in 1960 (except poetry!), 1 million words.
• the novel: “The Whale”, 44% words: one time
Goals of the class

• Key tasks, algorithms
• Essentially skills to build your system
• (Hopefully) see problems, holes, gaps, start research