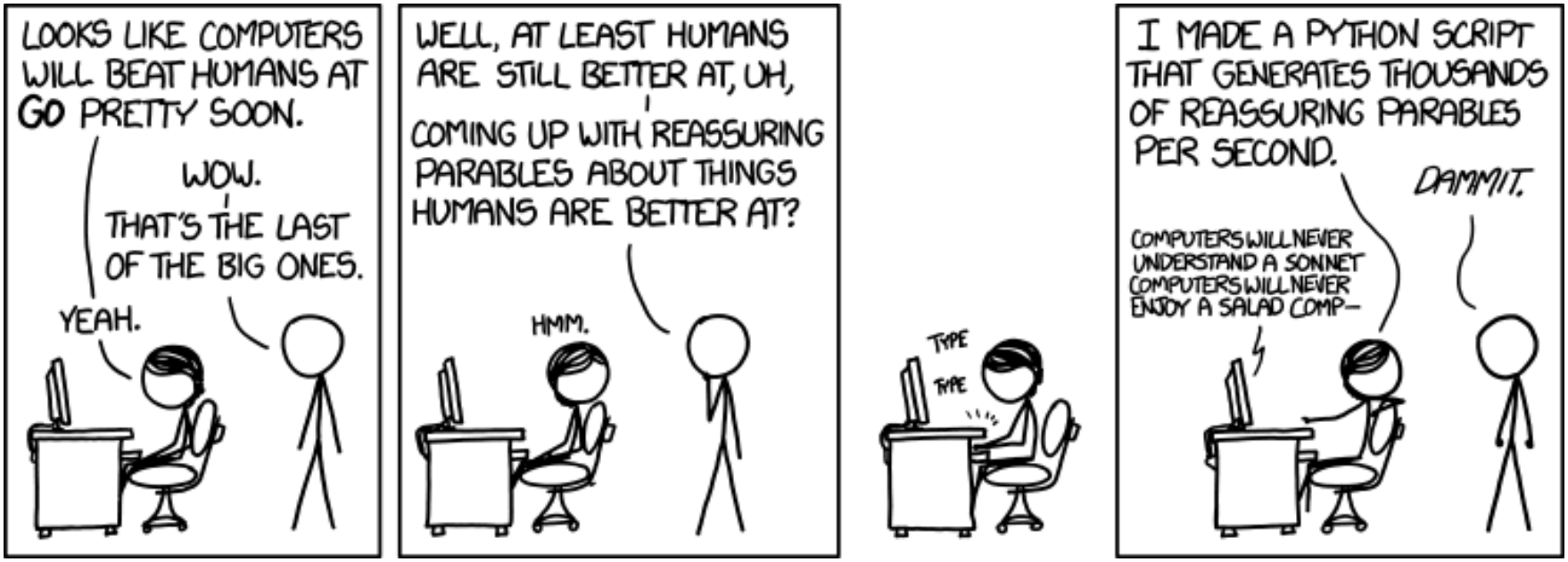
CSE 5525: Speech and Language Processing

Instructor: Wei Xu



Course Webpage

https://cocoxu.github.io/courses/5525_spring17.html

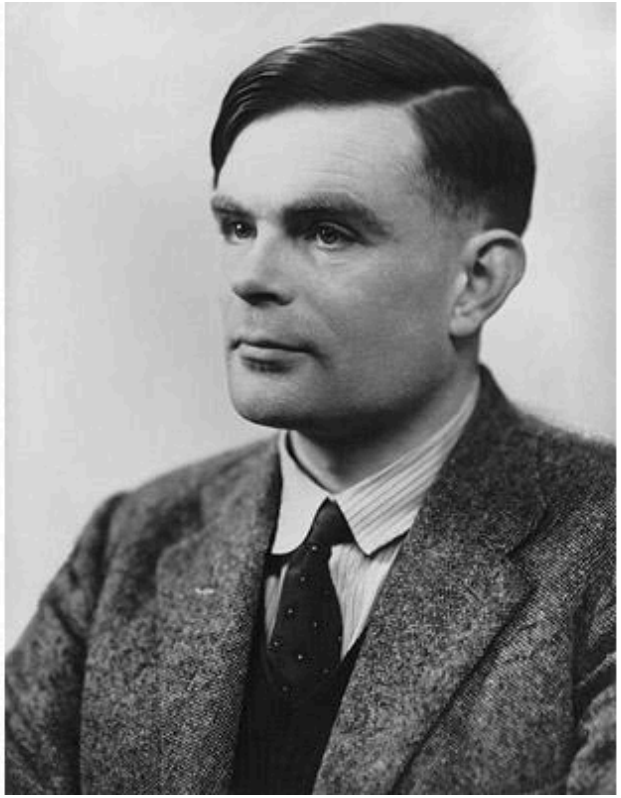
CSE 5525: Speech and Language Processing

Fundamentals of natural language processing, automatic speech recognition and speech synthesis; lab projects concentrating on building systems to process written and/or spoken language.

Details
Instructor: Wei Xu
Time: Wednesday and Friday, 12:45PM- 2:05PM (Spring 2017)
Place: Bolz Hall 317

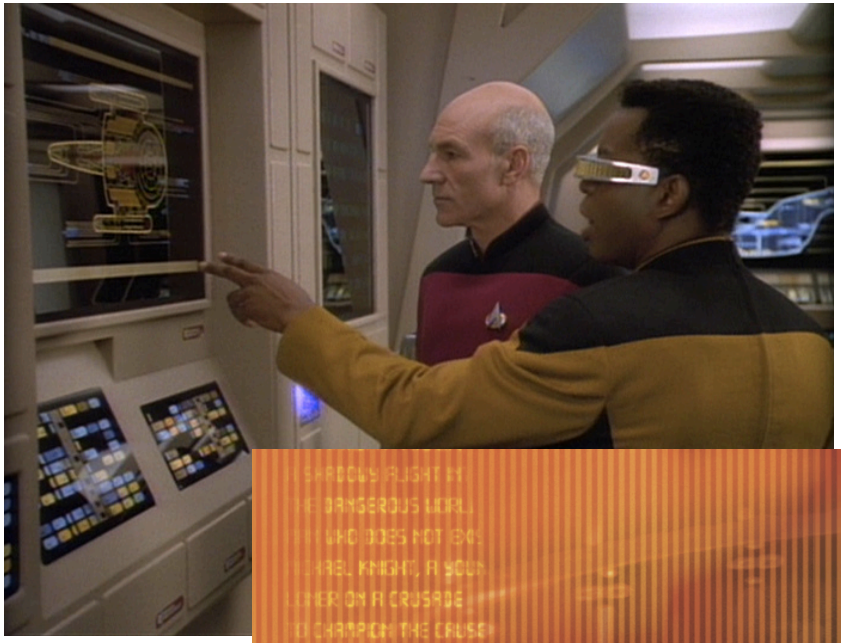
Language, Thought and Artificial Intelligence

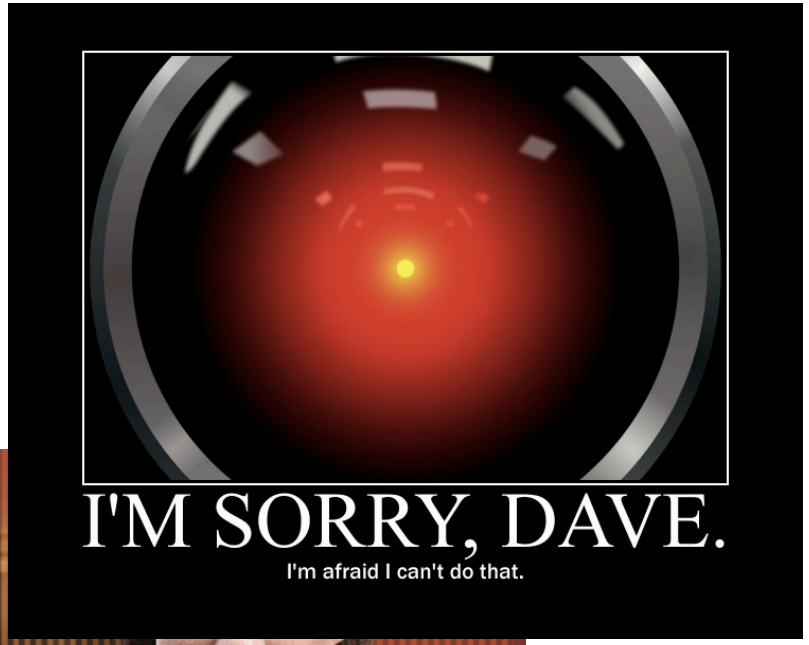
- Goal: give computers the ability to think (and speak)
- Long history in computer science
- Turing Test (Alan Turing 1950)
- Loebner Prize
  - Little interest from NLP community…
  - Very simple programs can fool some judges some of the time



The Chinese Room (Searle 1980)

NLP in Science Fiction

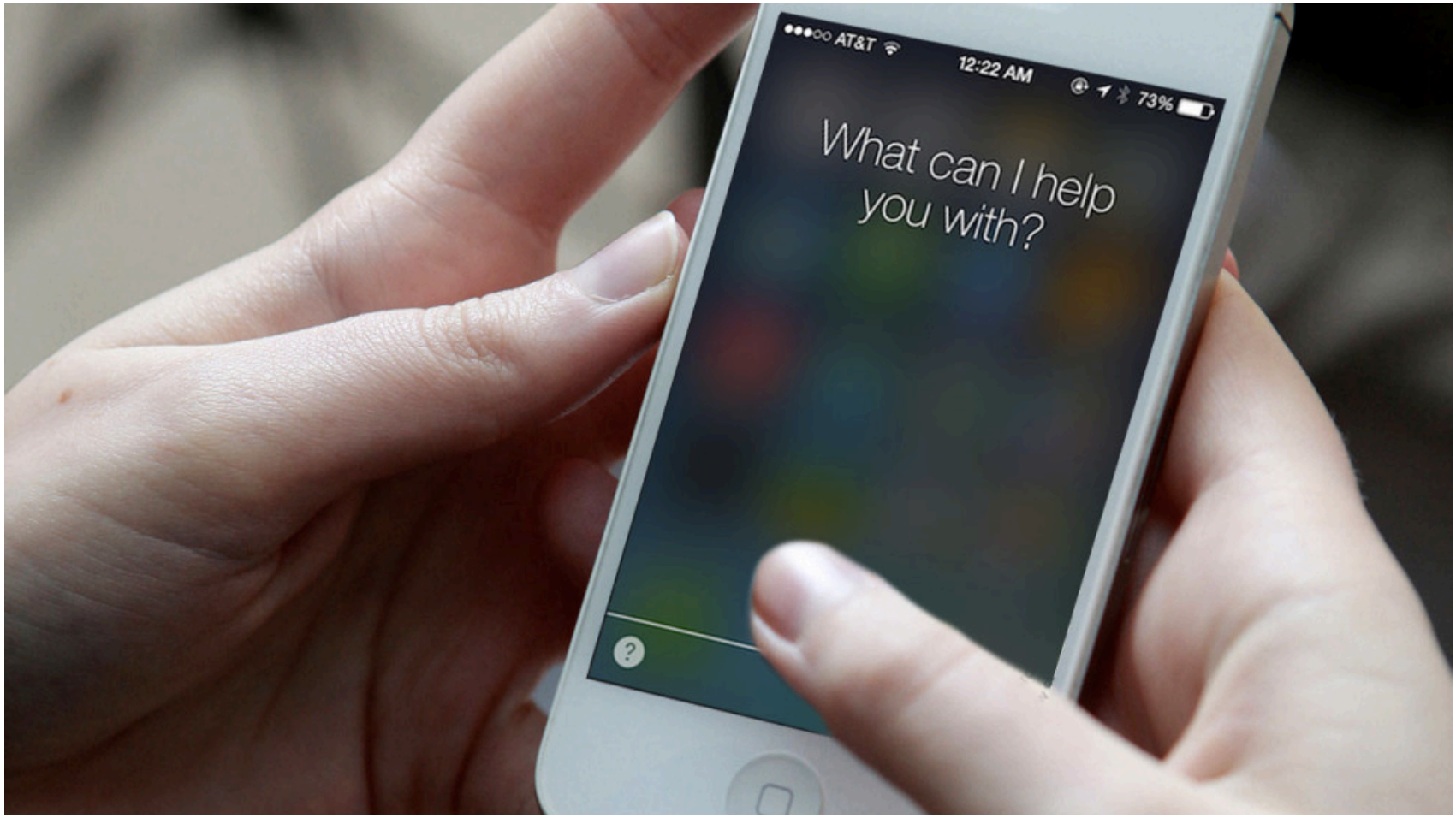




Today's NLP Applications

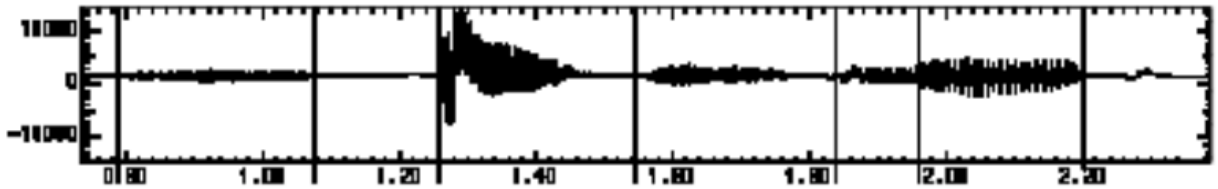
- Speech Interfaces
- Machine Translation
- Search Engines
- Information Extraction
- Summarization
- …

Speech Interfaces



Speech Interfaces

- Automatic Speech Recognition
  - Audio In, text out
  - SOTA: 0.3% error for digit strings, 5% dictation 50%+ for TV

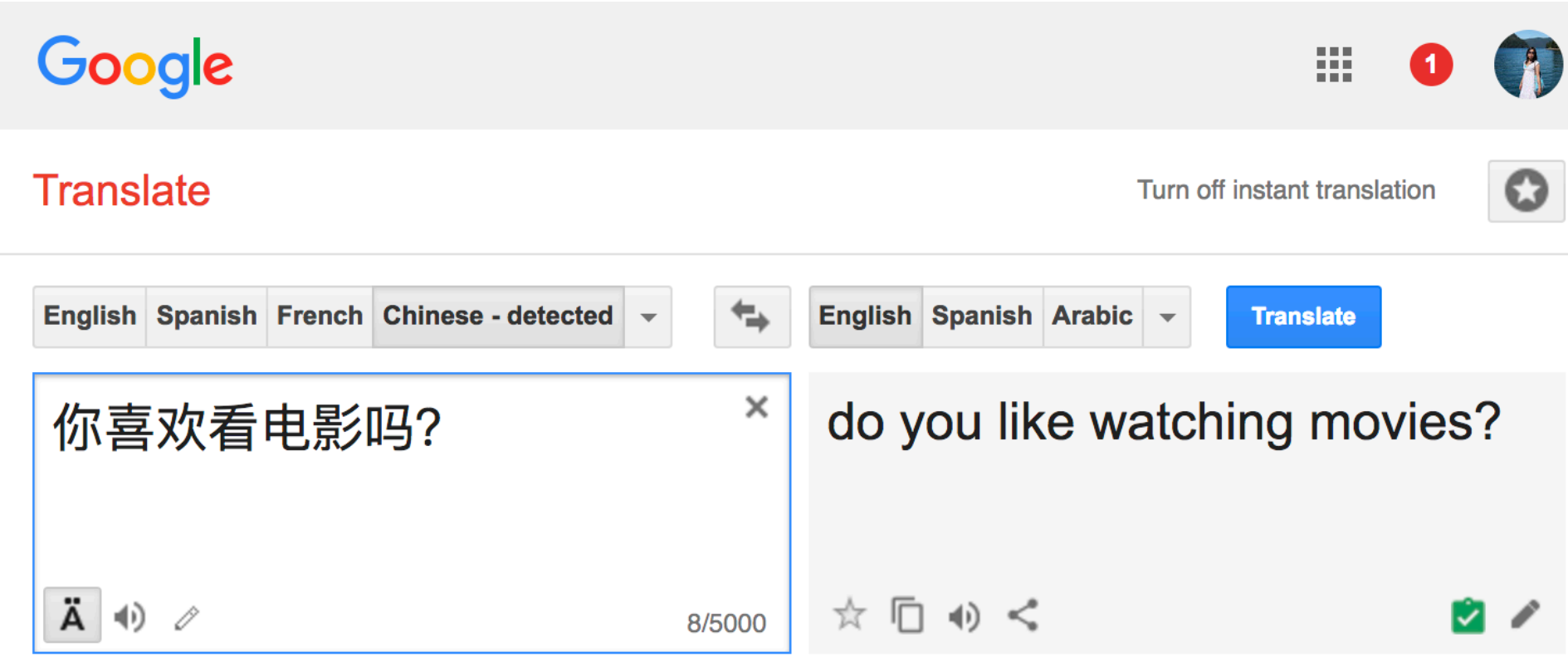


"Speech Lab"

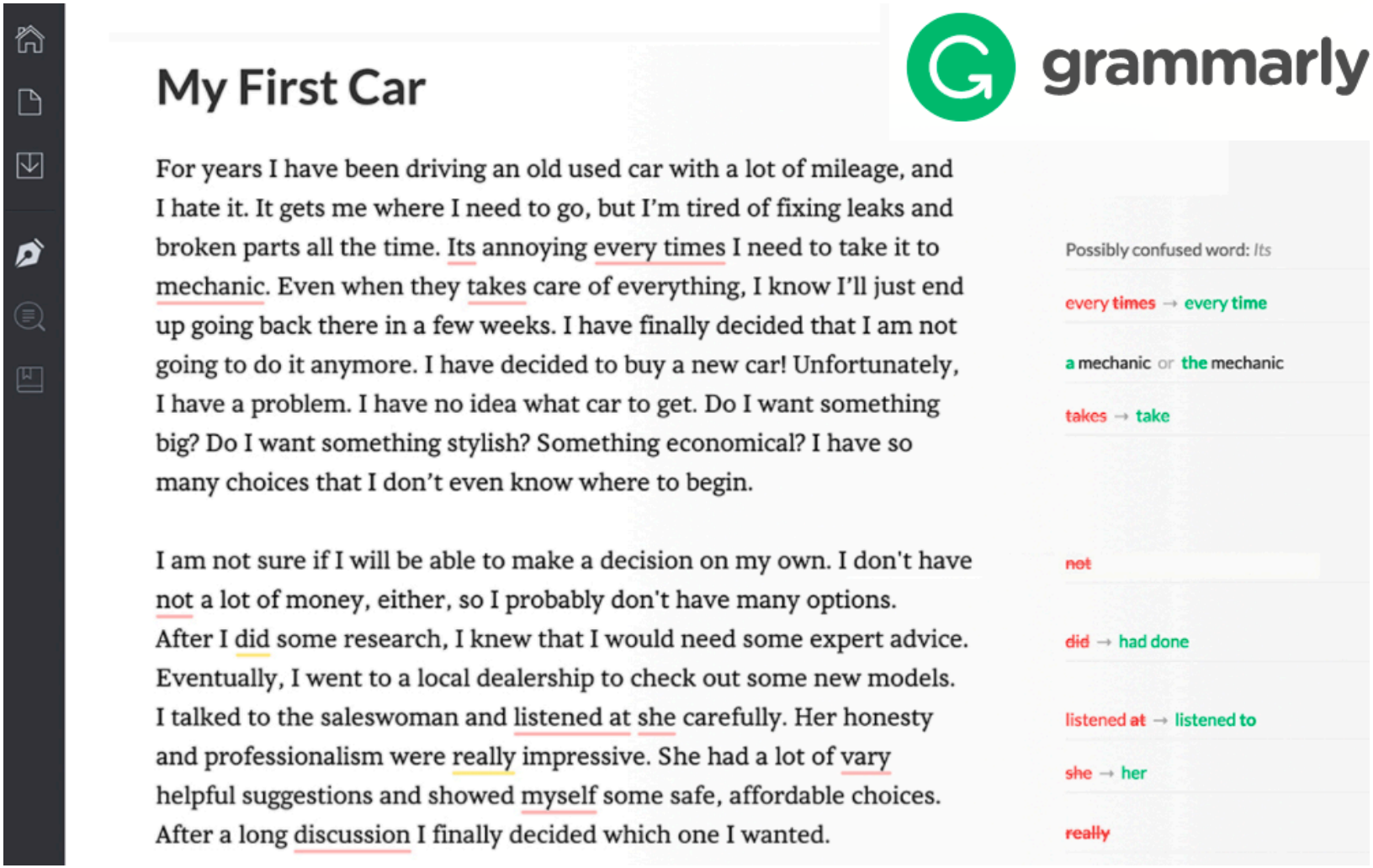
Speech Interfaces

- Text to Speech
  - Text in Audio Out

Machine Translation



Error Correction



Natural Language Understanding

- Convert words into semantic representation that can be used to query a database

cuisine location

Where can I find **Indian** food in **Clintonville**?

1. Mughal Darbar

42 reviews

$$ · Indian

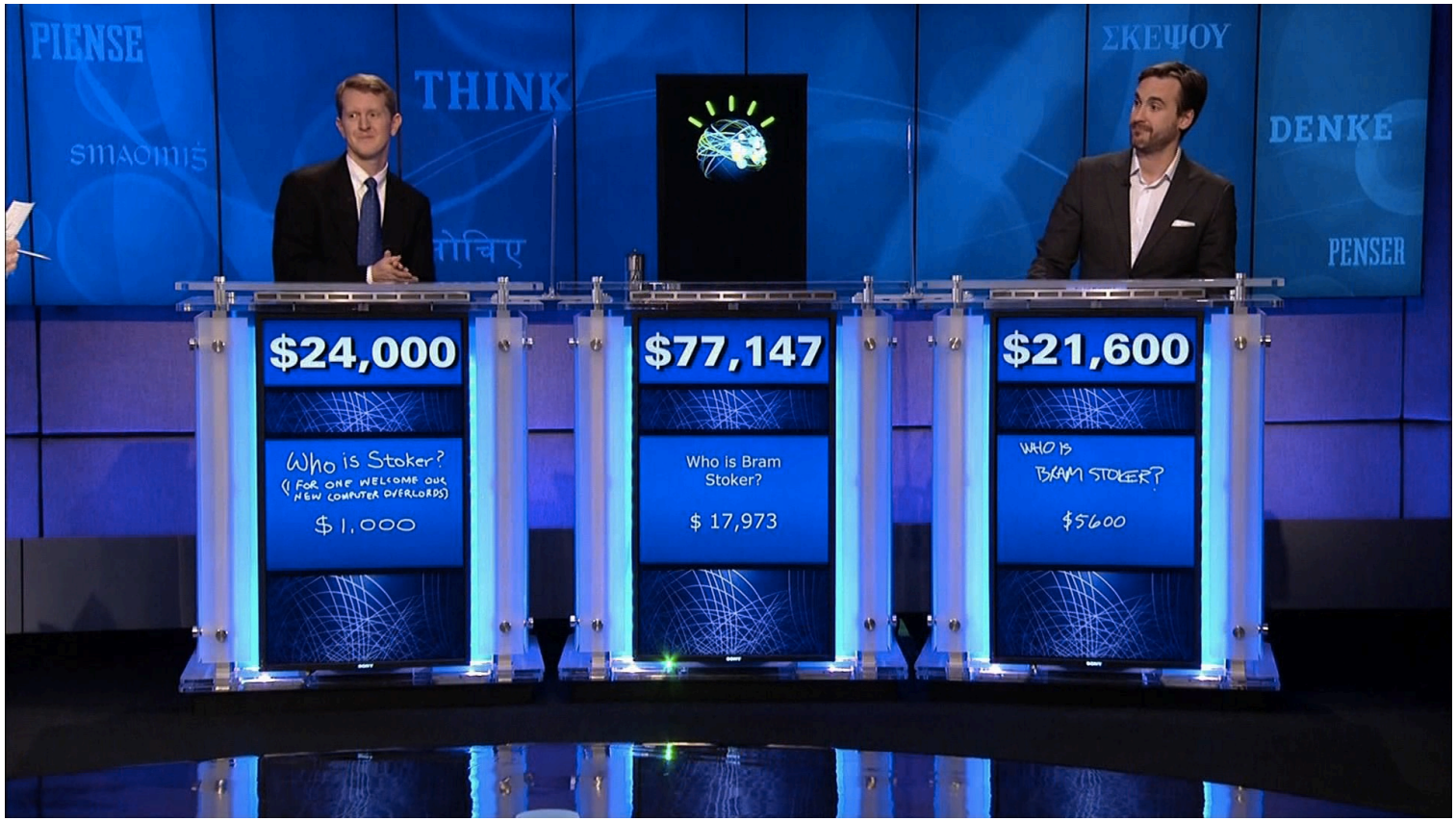
University District

2321 N High St
Columbus, OH 43202
(614) 477-6065

This restaurant takes reservations — Find a Table

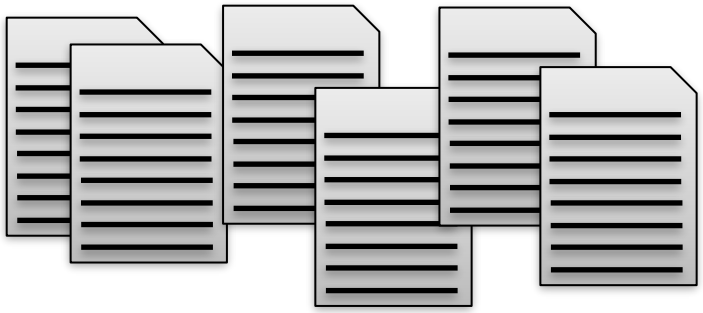
This restaurant accepts pickup orders — Start Order

Question Answering



Summarization

User reviews:



"**Ash** always makes visitors feel like her personal guests and never disappoints as a hostess." in 3 reviews

"Great customer service and **delicious food**." in 2 reviews

"I did opt to eat on their **patio** during the nice summer weather and I would have to say that it was pleasant." in 7 reviews

Outdoor Seating: Yes

Information Extraction

“Yess! Yess! Its official Nintendo announced today that they Will release the Nintendo 3DS in north America march 27 for $250”

Information Extraction

*"Yess! Yess! Its official **Nintendo** announced today that they Will release the **Nintendo 3DS** in **north America march 27** for **$250**"*

Information Extraction

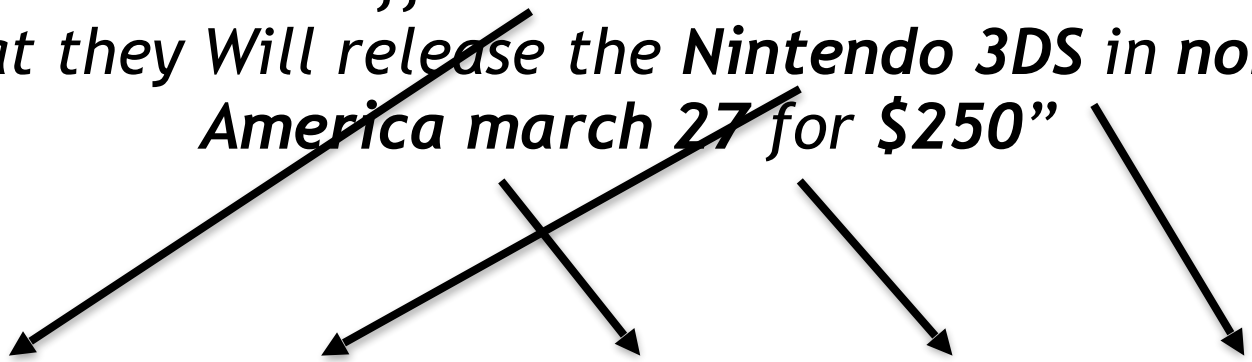
*"Yess! Yess! Its official **Nintendo** announced today that they Will release the **Nintendo 3DS** in **north America march 27** for **$250**"*

COMPANY	PRODUCT	DATE	PRICE	REGION

PRODUCT RELEASE

Information Extraction

*"Yess! Yess! Its official **Nintendo** announced today that they Will release the **Nintendo 3DS** in **north America march 27** for **$250**"*



COMPANY	PRODUCT	DATE	PRICE	REGION
Nintendo	3DS	March 27	$250	North America

PRODUCT RELEASE

Information Extraction

Samsung Galaxy S5 *Coming to All Major* ***U.S.***

- State of the art is maybe 80%, for single easy fields: 90%+
- Redundancy helps a lot!
- Much of human knowledge is waiting to be harvested from the Web!

COMPANY	PRODUCT	DATE	PRICE	REGION
Samsung	Galaxy S5	April 11	?	U.S.
Nintendo	3DS	March 27	$250	North America

PRODUCT RELEASE

NLP as a Field

- Tasks (each have their own datasets and evaluations)
  - Syntactic Parsing
  - Summarization
  - Machine Translation
  - Information Extraction
  - …
- Methods
  - Heuristic / Rule-based Approaches (dominated until the 1990s statistical revolution)
  - Probabilistic Graphical Models
  - Neural Networks (deep learning)
  - …

Q: Why is NLP hard?

- Why is it easy for computers to parse Python, but not English?

A: Ambiguity!

Ambiguity

Example: Some Funny News Headlines

Milk Drinkers Turn to Powder

Shouting Match Ends Teachers' Hearing

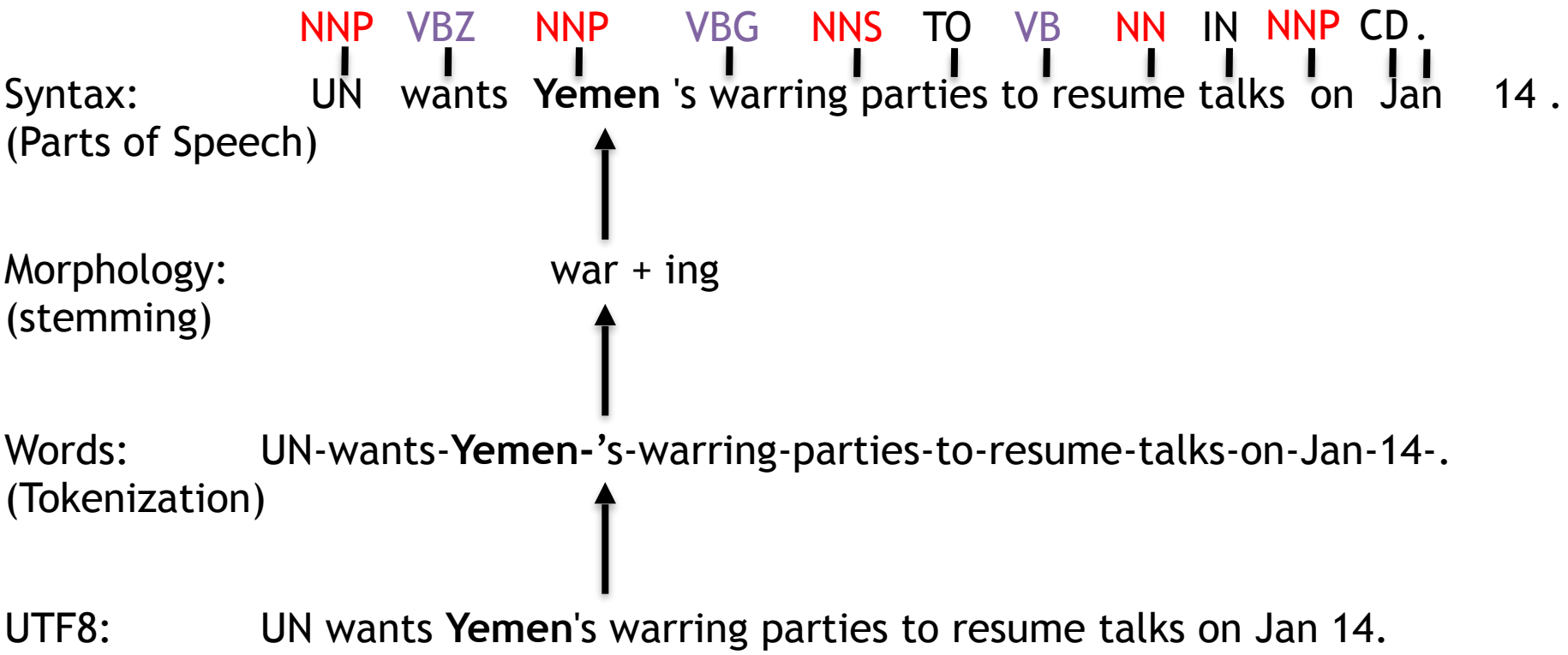
Town OKs Animal Rule

Aging Expert Joins University Faculty

British Left Waffles on Falkland Islands

Local High School Dropouts Cut in Half

Layers of Linguistic Annotation



Layers of Linguistic Annotation

Syntax:
(Constituents)

```
(ROOT
  (S
    (NP (NNP UN))
    (VP (VBZ wants)
      (S
        (NP
          (NP (NNP Yemen) (POS 's))
          (VBG warring) (NNS parties))
        (VP (TO to)
          (VP (VB resume)
            (NP (NNS talks))
            (PP (IN on)
              (NP (NNP Jan) (CD 14)))))))
    (. .)))
```

Layers of Linguistic Annotation

Semantics/
Discourse:

DiplomaticTalks-Event
Between: Yemen's warring parties
Mediator: UN
Date: 1/14/2016

Syntax:
(Constituents)

```
(ROOT
  (S
    (NP (NNP UN))
    (VP (VBZ wants)
      (S
        (NP
          (NP (NNP Yemen) (POS 's))
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        (VP (TO to)
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            (NP (NNS talks))
            (PP (IN on)
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    (. .)))
```

What will you get out of this class?

- Understanding of a major field of Artificial Intelligence
- Basic machine learning skills
- Ideas that you could transform into a startup company or academic research
- Summer interns?

What to Expect

- Lots of math and programming
- A bit of Linguistics
- Computing Resources:
  - Experiments could take hours to run or debug depending the efficiency and quality of your code. We recommend you start **early** on homework assignments and final project.

Prerequisites

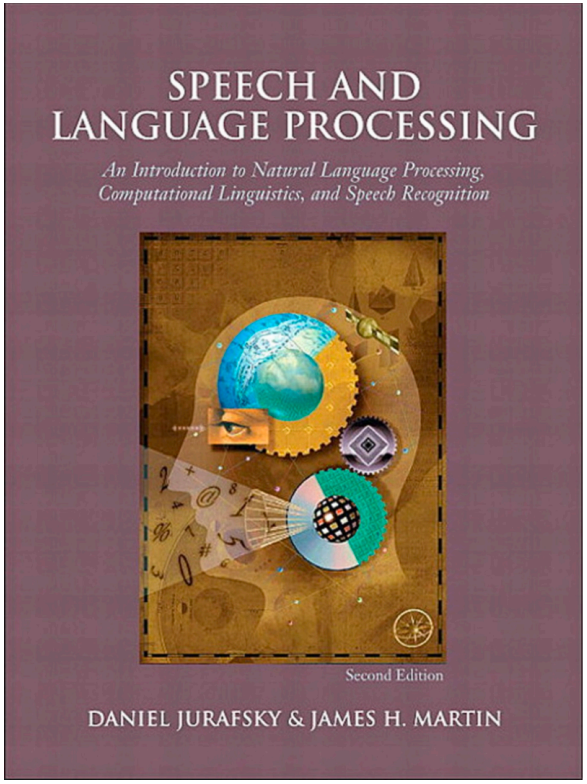
- (CSE 3521 or CSE 5521)
  and (CSE 5522 or Stat 3460 or Stat 3470)

- Math:
  - Basic Probability
  - Basic Linear Algebra

- Programming
  - Python or ability to learn Python quickly
  - Numpy/Scipy (Python libraries for scientific computing)
  - Linux/Unix (for windows users: https://www.cygwin.com/)

Textbook

- Books
  - Jurfasky and Martin (2nd edition and 3rd edition draft)
  - Some other readings as well



Grading

- Participation (5%)
- Homework Assignments (55% individual)
  - one written assignment
  - two programming assignments
  - and market research
- Midterm (20%)
- Final Project (20% group of 3-4)

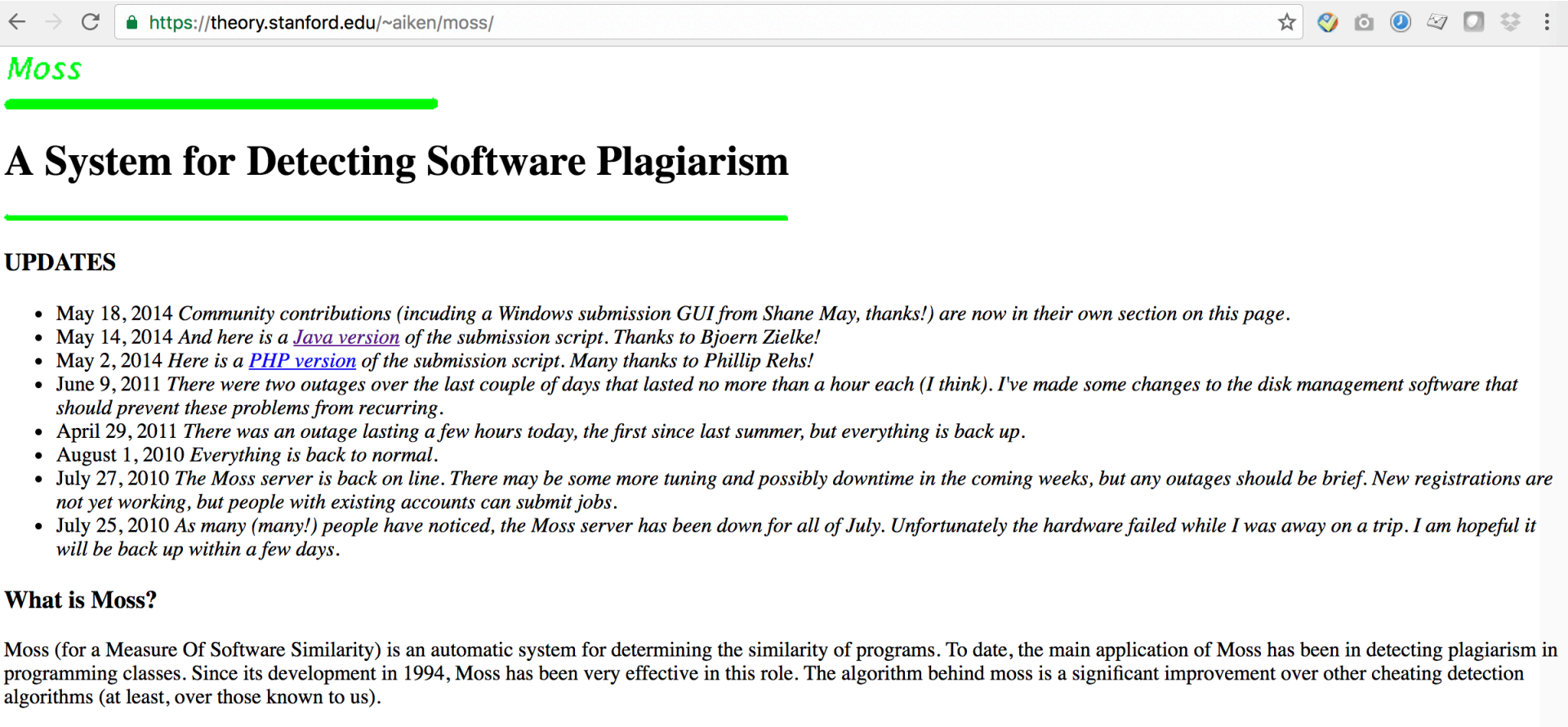
Homework

- #0 written assignment:
  - Probability & Programming Basics
  - Due next week on January 11th

- Programming assignments (subject to change):
  - #1: Text Classification (Naive Bayes)
  - #2: Tagging (Structured Perceptron)

Homework

- Assignments are your individual work.



Office Hours

- Instructor's Office Hours:

  Wednesdays 4:30-5:30pm, Dreese 495

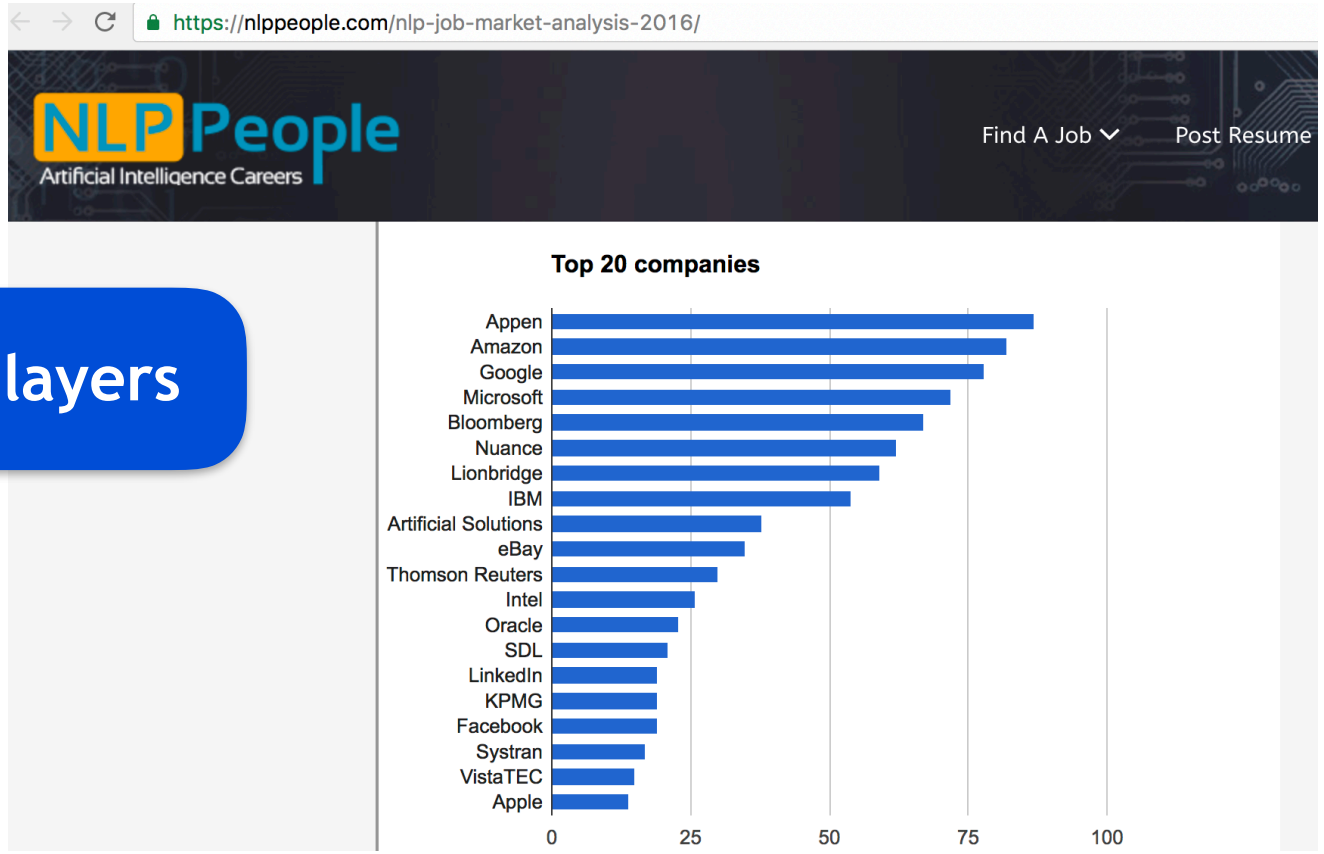
- TA:

Wuwei Lan

Presentation

- **Market Research** on companies that use speech or language technologies.

Major Players



Presentation

- **Market Research** on companies that use speech or language technologies.

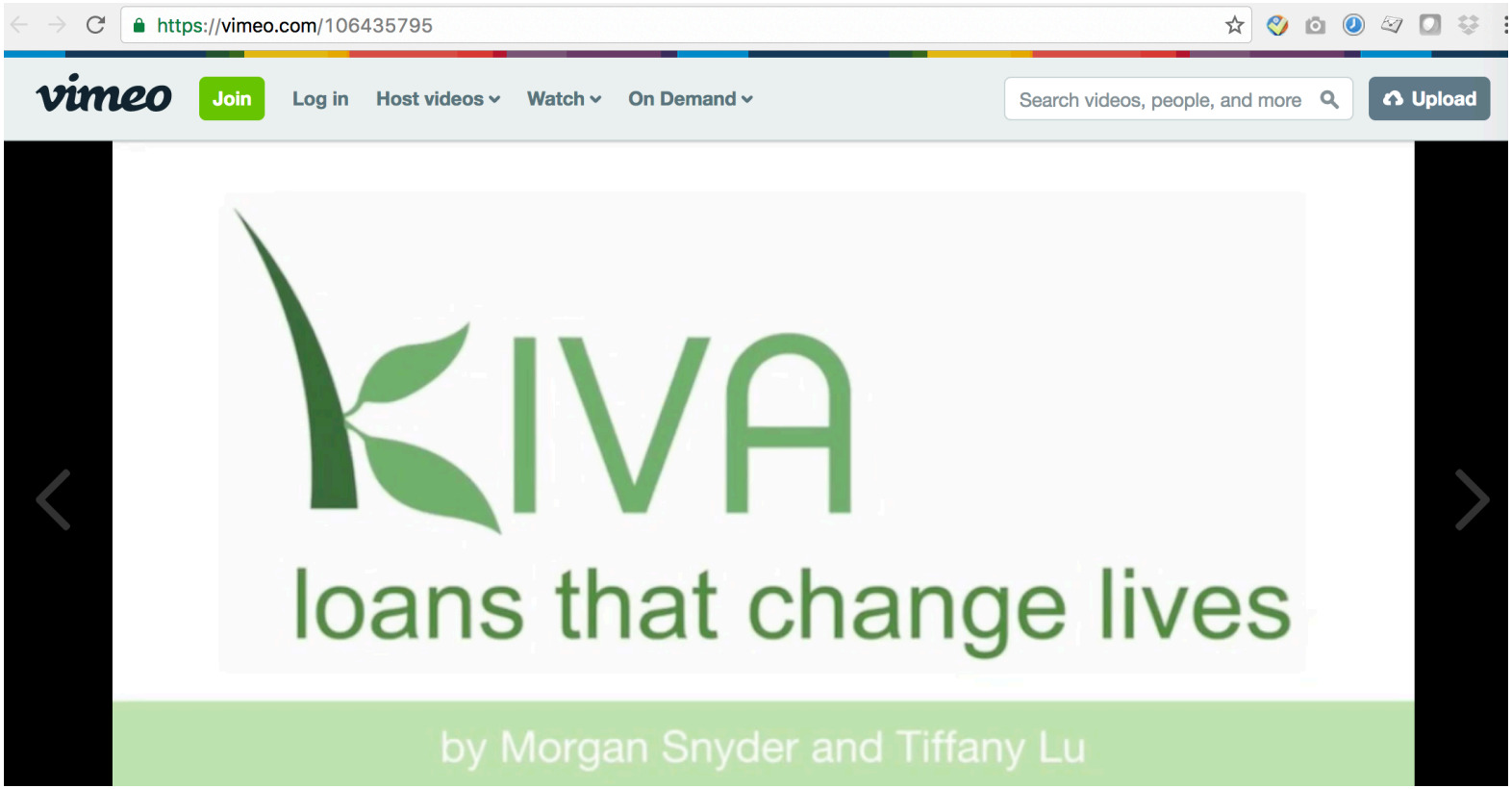
Startups

February 4, 2016

WHAT NLP & TEXT ANALYTICS COMPANIES GOT FUNDED IN 2015?

Presentation

- a short ~5 minute video presentation about a company (due on February 3rd)



Midterm

- In class, the week before spring break

Final Project (group of 3-4)

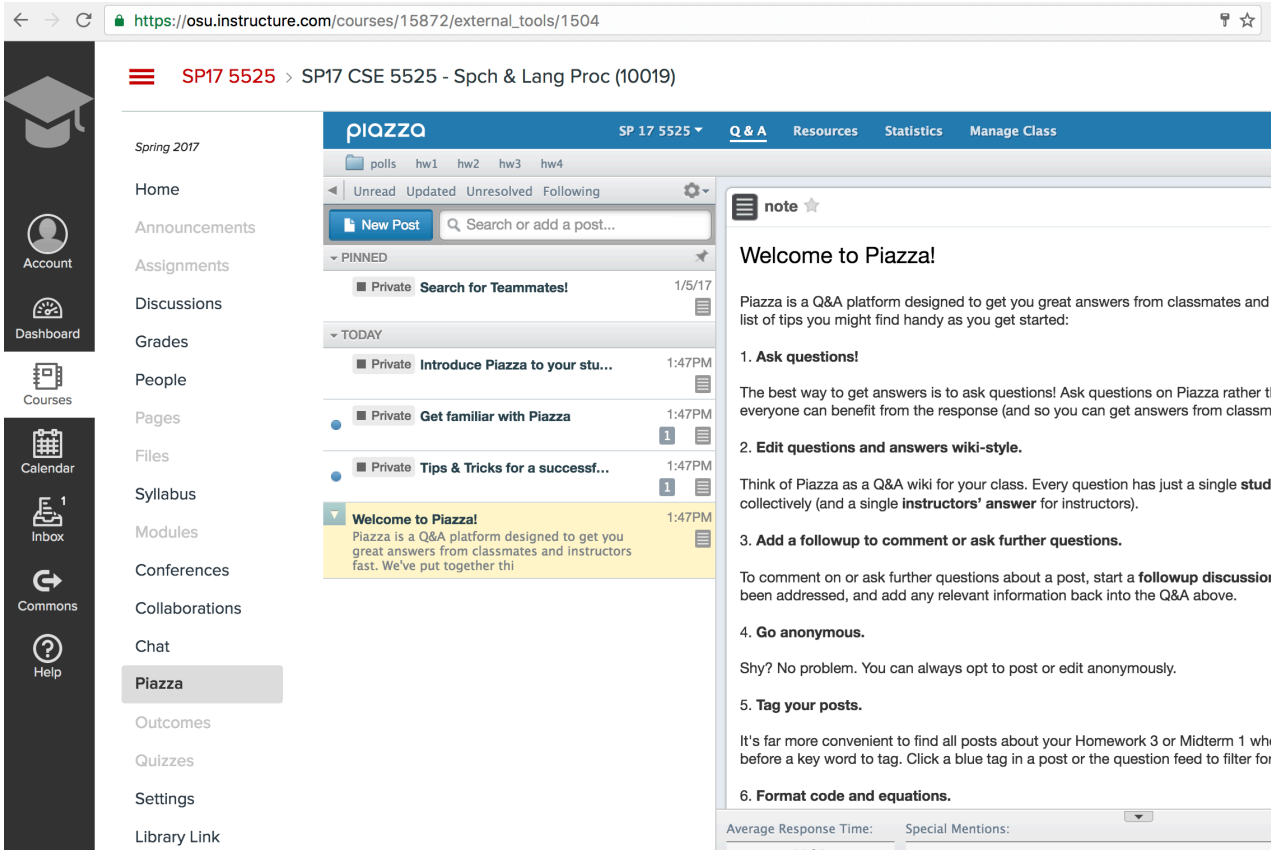
- Step 1: form a team and brainstorm 3 ideas
- Step 2: select an idea (talk to the instructor during office hours) and collect your data
- Step 3: conduct analyses of your data
- Step 4: develop a working system
- Step 5: write a 2-page report and give an in-class presentation (last class of the semester))

Guest Lecture and Invited Talk

- January 13th — Zhou Yu (CMU)
- Late Feb or March — Micha Elsner (OSU)
- March 3rd — Ray Mooney (UT Austin)

QA and Course Resources

- Carmen (homework submission & grades)
- Piazza (discussion and announcements)



By next week, please

- Do Homework #0 (on the course website)
  - due at the beginning of class on next Wed
  - hand in paper copy

- Watch three example video presentations of market research (on the course website)

Market Research

- Example Presentation 1 (Iceland's Crowdsourced Constitution by Abhishek GAdiraju)
- Example Presentation 2 (Silk Road by Shreshth Khilani)
- Example Presentation 3 (Kiva: Loans That Change Lives by Morgan Snyder and Tiffany Lu)