# CS378: Natural Language Processing
# Lecture 1: Introduction


Greg Durrett

# Administrivia

- Lecture: Tuesdays and Thursdays 9:30am - 10:45am
- Course website (including **syllabus**): http://www.cs.utexas.edu/~gdurrett/courses/sp2019/cs378.shtml
- Piazza: link on the course website
- My office hours: Tuesday 1pm-2pm (**starting next week**), Wednesday 11am-noon (starting tomorrow), GDC 3.420
- TA: Jiacheng Xu; Office hours: Monday + Wednesday, 1pm-2pm GDC 1.302
- TA: Shivangi Mahto; Office hours: Thursday, 2pm-3pm GDC 1.302

# Course Requirements

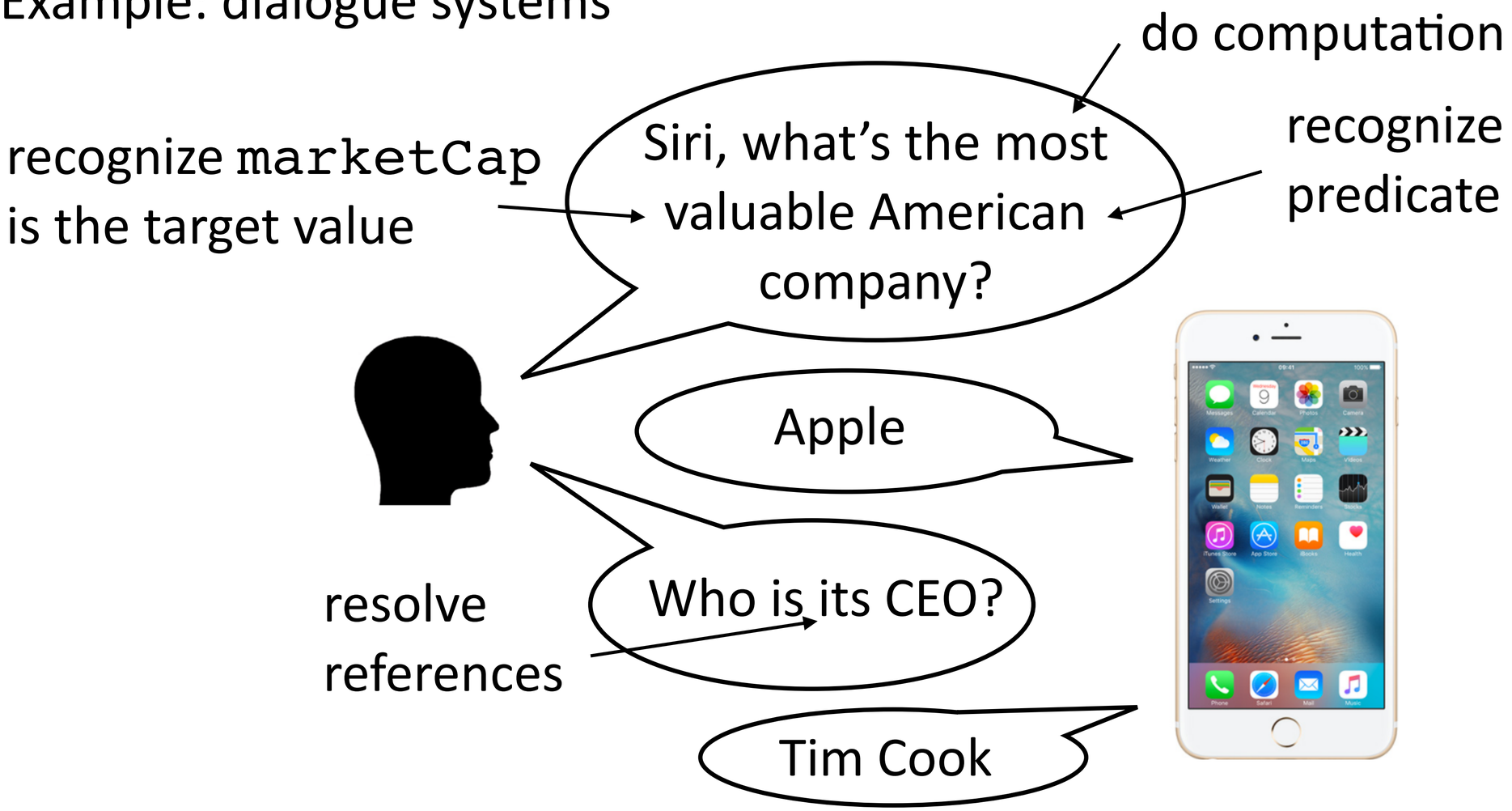
- CS 429
- Recommended: CS 331, familiarity with probability and linear algebra, programming experience in Python
- Helpful: Exposure to AI and machine learning (e.g., CS 342/343/363)

# Enrollment

- I want everyone to be able to take this class!
- Assignment 0 is out now (due Friday):
  - Please look at the assignment well before then
  - If this seems like it'll be challenging for you, come and talk to me (this is smaller-scale than the other assignments, which are smaller-scale than the final project)
  - If you get in and didn't do the assignment because you weren't registered, you will be able to make it up
- If you are past 20 on the waitlist, you have a low chance of getting into the class, but we have to see how it progresses

# What's the goal of NLP?

- Be able to solve problems that require deep understanding of text
- Example: dialogue systems



# Automatic Summarization

POLITICS

## *Google Critic Ousted From Think Tank Funded by the Tech Giant*

WASHINGTON — In the hours after European antitrust regulators levied a record $2.7 billion fine against Google in late June, an influential Washington think tank learned what can happen when a tech giant that shapes public policy debates with its enormous wealth is criticized.

...

But not long after one of New America's scholars posted a statement on the think tank's website praising the European Union's penalty against Google, Mr. Schmidt, who had been chairman of New America until 2016, communicated his displeasure with the statement to the group's president, Anne-Marie Slaughter, according to the scholar.

...

Ms. Slaughter told Mr. Lynn that "the time has come for Open Markets and New America to part ways," according to an email from Ms. Slaughter to Mr. Lynn. The email suggested that the entire Open Markets team — nearly 10 full-time employees and unpaid fellows — would be exiled from New America.

compress text

provide missing context

One of New America's writers posted a statement critical of Google. Eric Schmidt, Google's CEO, was displeased.

The writer and his team were dismissed.

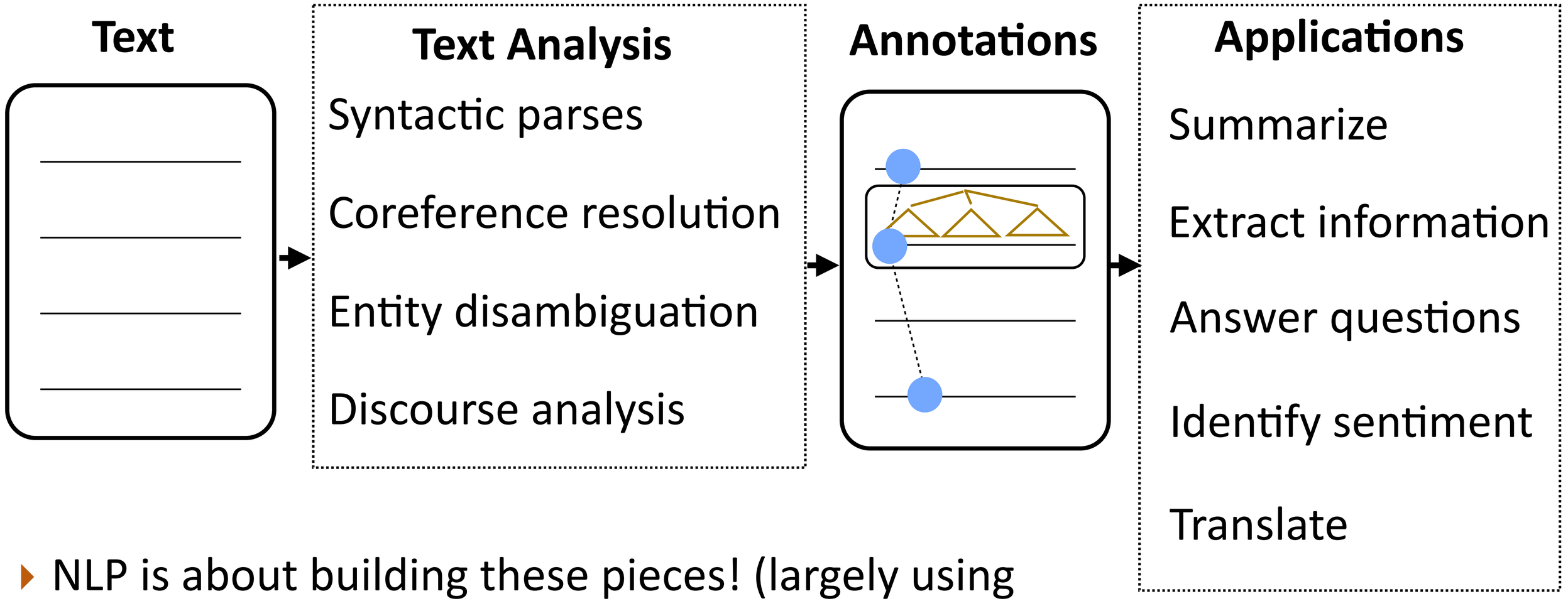
paraphrase to provide clarity

# Machine Translation


People's Daily, August 30, 2017

Trump Pope family watch a hundred years a year in the White House balcony

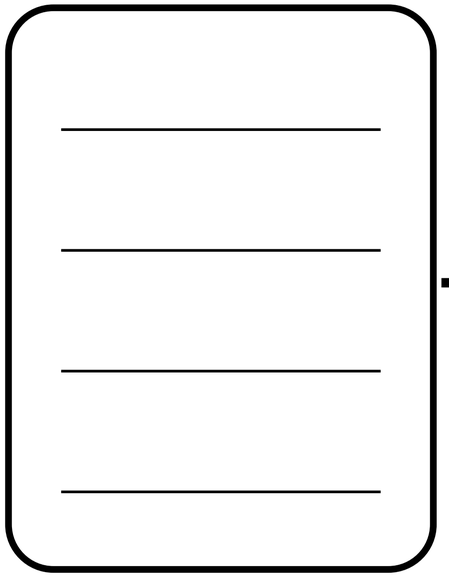
# NLP Analysis Pipeline




- NLP is about building these pieces! (largely using statistical approaches)

# How do we represent language?

**Text**



**Labels**

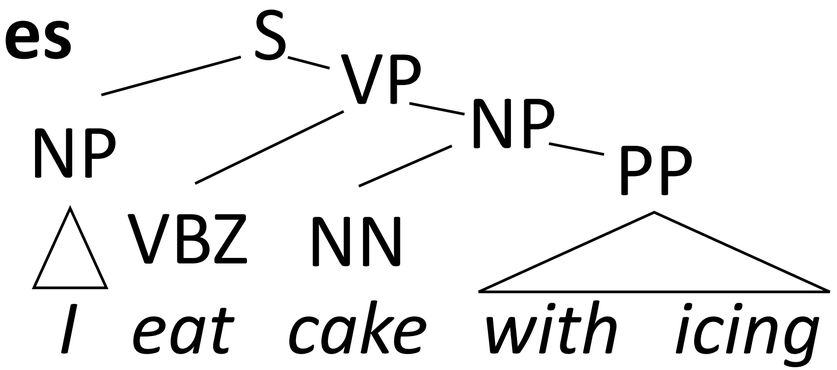
*the movie was good* +

*Beyoncé had one of the best videos of all time* **subjective**

**Sequences/tags**

**PERSON** *Tom Cruise* *stars in the new* **WORK_OF_ART** *Mission Impossible* *film*

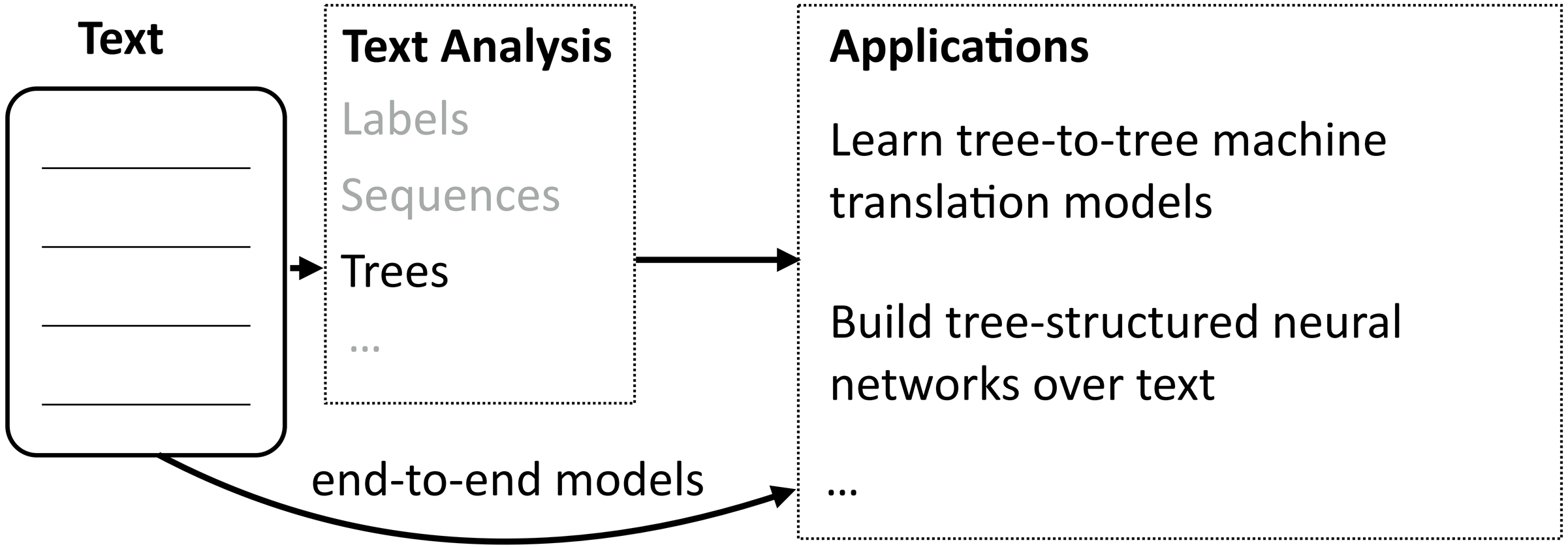
**Trees**




$\lambda x.\ flight(x) \wedge dest(x)=Miami$

*flights to Miami*

# How do we use these representations?




- Main question: What representations do we need for language? What do we want to know about it?
- Boils down to: what ambiguities do we need to resolve?

# Why is language hard?
## (and how can we handle that?)

# What do we need to understand language?

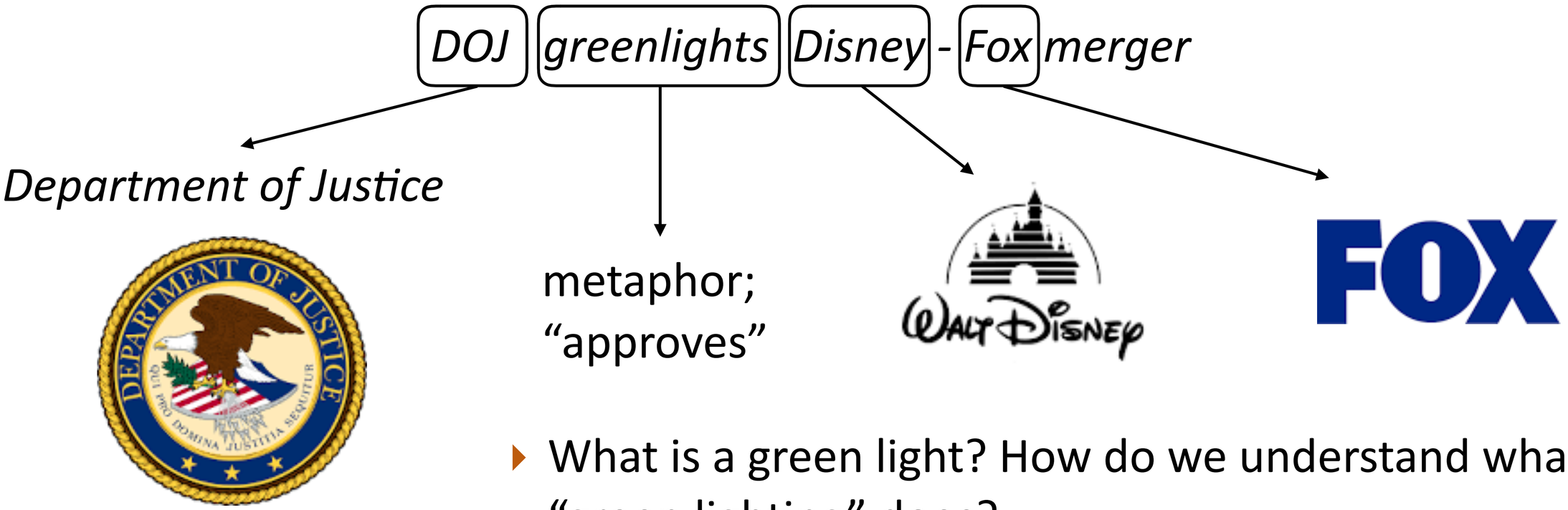
- Lots of data!

| | |
|---|---|
| SOURCE | Cela constituerait une solution transitoire qui permettrait de conduire à terme à une charte à valeur contraignante. |
| HUMAN | That would be an interim solution which would make it possible to work towards a binding charter in the long term . |
| 1x DATA | [this] [constituerait] [assistance] [transitoire] [who] [permettrait] [licences] [to] [terme] [to] [a] [charter] [to] [value] [contraignante] [.] |
| 10x DATA | [it] [would] [a solution] [transitional] [which] [would] [of] [lead] [to] [term] [to a] [charter] [to] [value] [binding] [.] |
| 100x DATA | [this] [would be] [a transitional solution] [which would] [lead to] [a charter] [legally binding] [.] |
| 1000x DATA | [that would be] [a transitional solution] [which would] [eventually lead to] [a binding charter] [.] |

slide credit: Dan Klein

# What do we need to understand language?

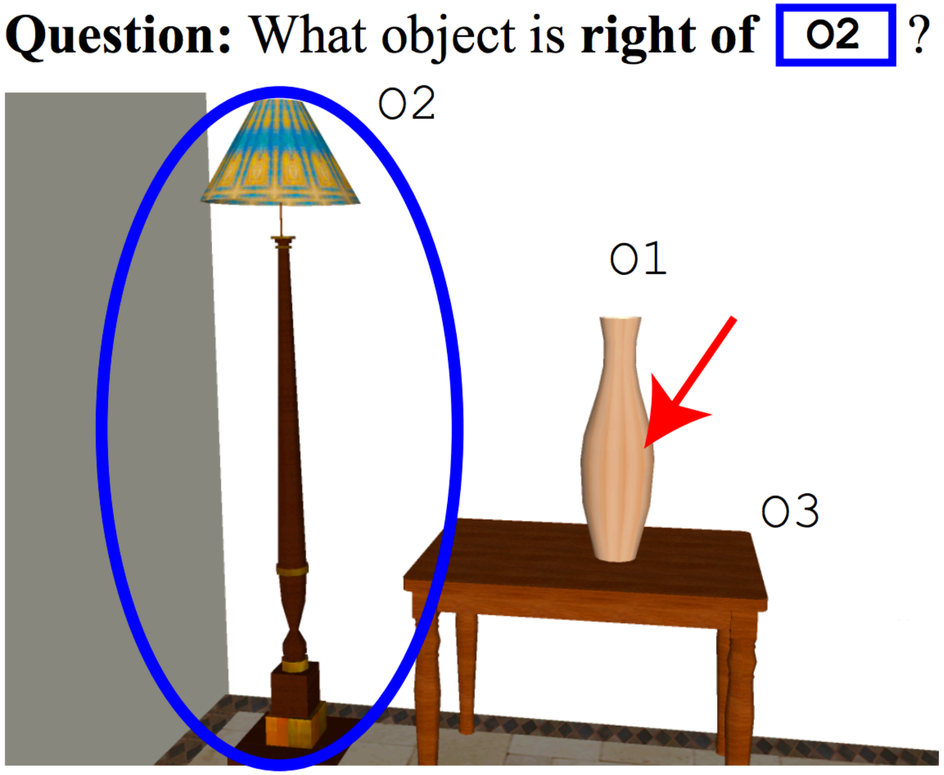
- World knowledge: have access to information beyond the training data



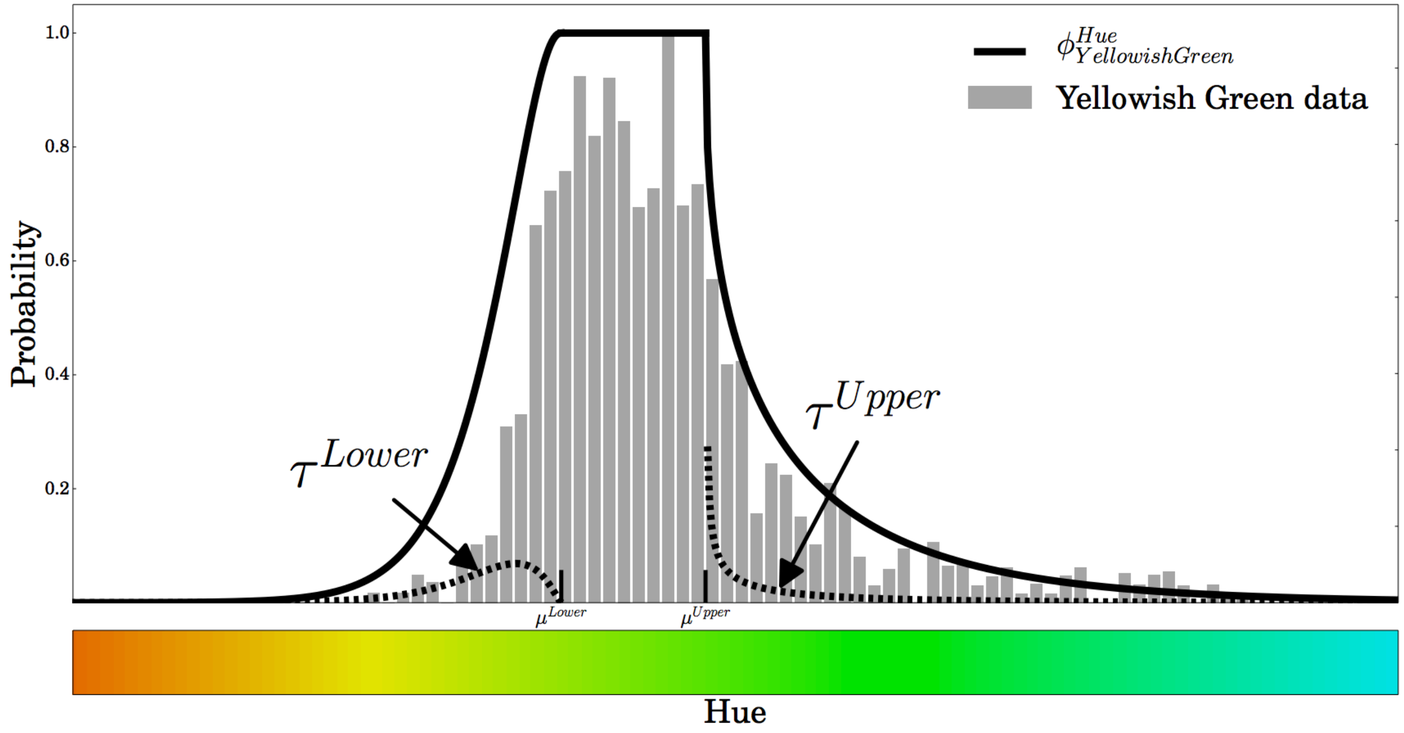

- What is a green light? How do we understand what “green lighting” does?

# What do we need to understand language?

- Grounding: learn what fundamental concepts actually mean in a data-driven way




Golland et al. (2010)




McMahan and Stone (2015)

# What do we need to understand language?

- Linguistic structure
- …but computers probably won't understand language the same way humans do
- However, linguistics tells us what phenomena we need to be able to deal with and gives us hints about how language works

a. John has been having a lot of trouble arranging his vacation.

b. He cannot find anyone to take over his responsibilities. (he = John)
$C_b$ = John; $C_f$ = {John}

c. He called up Mike yesterday to work out a plan. (he = John)
$C_b$ = John; $C_f$ = {John, Mike} (CONTINUE)

d. Mike has annoyed him a lot recently.
$C_b$ = John; $C_f$ = {Mike, John} (RETAIN)

e. He called John at 5 AM on Friday last week. (he = Mike)
$C_b$ = Mike; $C_f$ = {Mike, John} (SHIFT)

Centering Theory
Grosz et al. (1995)

# What techniques do we use?

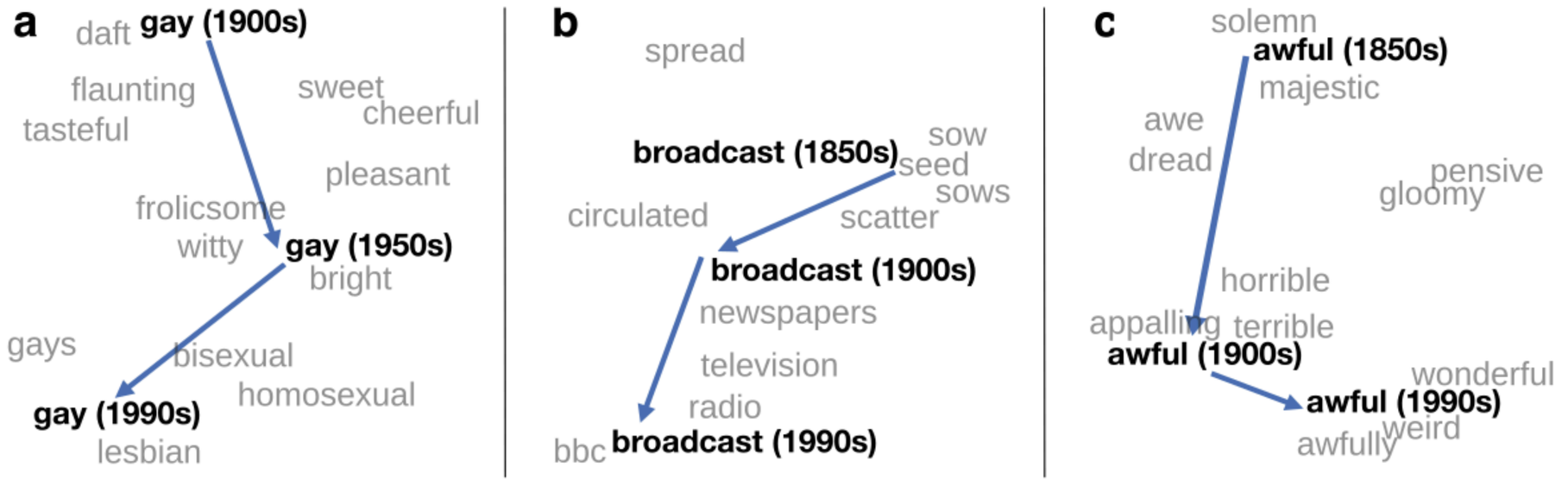
(to combine data, knowledge, linguistics, etc.)

# Where are we?

- NLP consists of: analyzing and building representations for text, solving problems involving text
- These problems are hard because language is ambiguous, requires drawing on data, knowledge, and linguistics to solve
- Knowing which techniques use requires understanding dataset size, problem complexity, and a lot of tricks!
- NLP encompasses all of these things

# NLP vs. Computational Linguistics

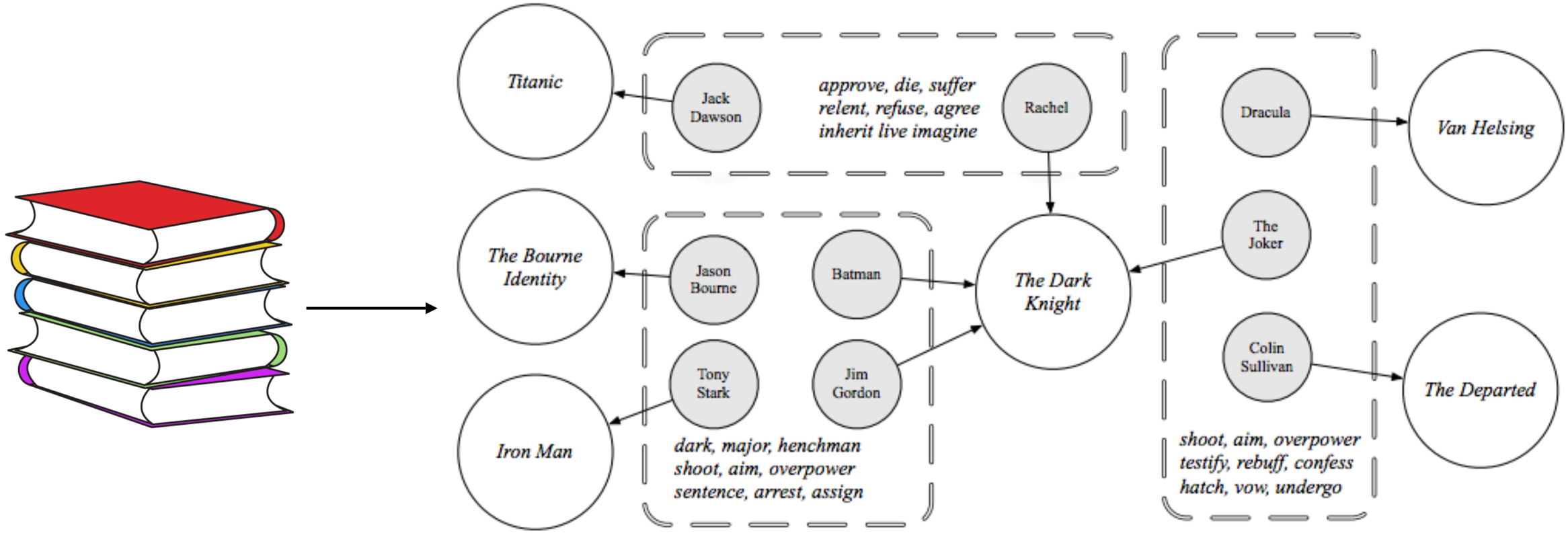
- NLP: build systems that deal with language data
- CL: use computational tools to study language




Hamilton et al. (2016)

# NLP vs. Computational Linguistics

- Computational tools for other purposes: literary theory, political science…




Bamman, O'Connor, Smith (2013)

# Outline of the Course

- Classification: conventional and neural, word representations (3 weeks)
- Text analysis: tagging, parsing, information extraction (3.5 weeks)
- Generation, applications: language modeling, machine translation, dialogue (4 weeks)
- Other applications: question answering, TBD (3 weeks)
- Goals:
  - Cover fundamental techniques used in NLP
  - Understand how to look at language data and approach linguistic phenomena
  - Cover modern NLP problems encountered in the literature: what are the active research topics in 2018?

# Coursework

- Five assignments, worth 45% of grade
  - Mix of writing and implementation;
  - Assignment 0 is out NOW, due Friday
  - ~2 weeks per assignment after Assignment 0

These assignments require understanding of the concepts, ability to write performant code, and ability to think about how to debug complex systems. **They are challenging, so start early!**

# Coursework

- Midterm (25% of grade), in class
  - Similar to written homework problems
- Final project (30% of grade)
  - Groups of 2 preferred, 1 is possible
  - (Brief!) proposal to be approved by course staff
  - Open-ended *or* there will be a few more structured options (around translation and dialogue)

# Academic Honesty

- Assignments and exams are to be completed *independently* (except for the group final project)
- Don’t share code with others — we will be running Moss

# Conduct


**A climate conducive to learning and creating knowledge is the right of every person in our community.** Bias, harassment and discrimination of any sort have no place here. If you notice an incident that causes concern, please contact the Campus Climate Response Team:
**diversity.utexas.edu/ccrt**

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# Survey

1. Your name
2. Fill in: I am a [CS / _____] undergrad in year [1 2 3 4 5+]
3. Which of the following have you taken?
    1. CS 342/343/363
    2. Another class which taught classification
    3. A class which taught SVD
4. Which of the following have you used?
    1. Python
    2. numpy/scipy/scikit-learn
    3. Tensorflow/PyTorch
5. One interesting fact about yourself, or what you like to do in your spare time