CS378: Natural Language Processing
Lecture 1: Introduction

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WHY DO THEY CALL IT OVEN WHEN YOU OF IN THE COLD FOOD OF OUT HOT EAT THE FOOD
JPM DAVPS 7-13
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Administrivia

- Lecture: Tuesdays and Thursdays 9:30am - 10:45am
- Course website (including **syllabus**): http://www.cs.utexas.edu/~gdurrett/courses/sp2020/cs378.shtml
- Piazza: link on the course website
- My office hours: Tuesday 1pm-2pm, Wednesday 10am-11am, GDC 3.812
- TA: Yasumasa Onoe; Proctor: Shrey Desai. See website for OHs

Course Requirements

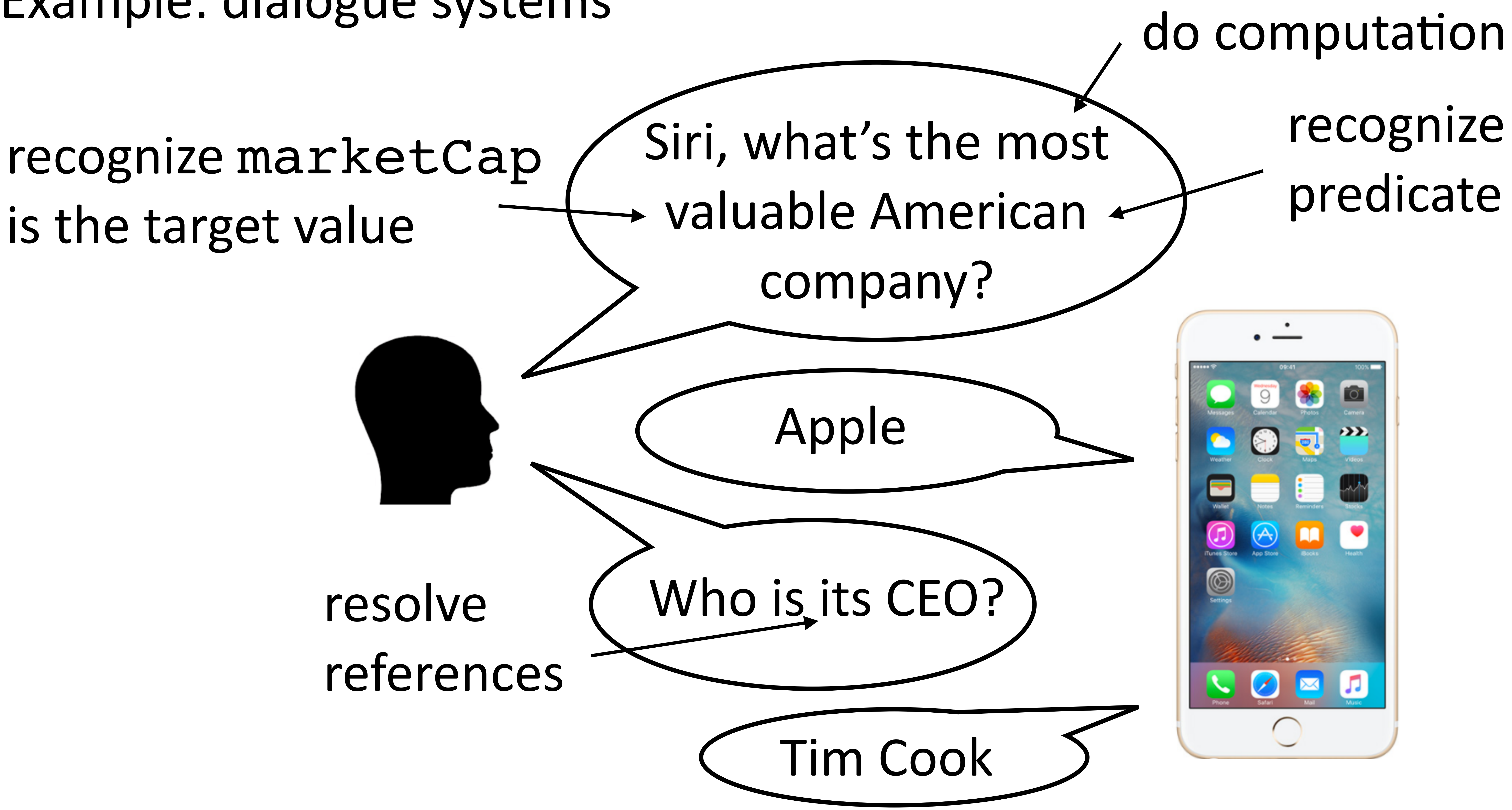
- CS 429
- Recommended: CS 331, familiarity with probability and linear algebra, programming experience in Python
- Helpful: Exposure to AI and machine learning (e.g., CS 342/343/363)

Enrollment

- We've already expanded the cap by 25 students by moving to this room, more is not possible
- 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 submit it late
- 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



do computation

recognize `marketCap` is the target value

Siri, what’s the most valuable American company?

recognize predicate

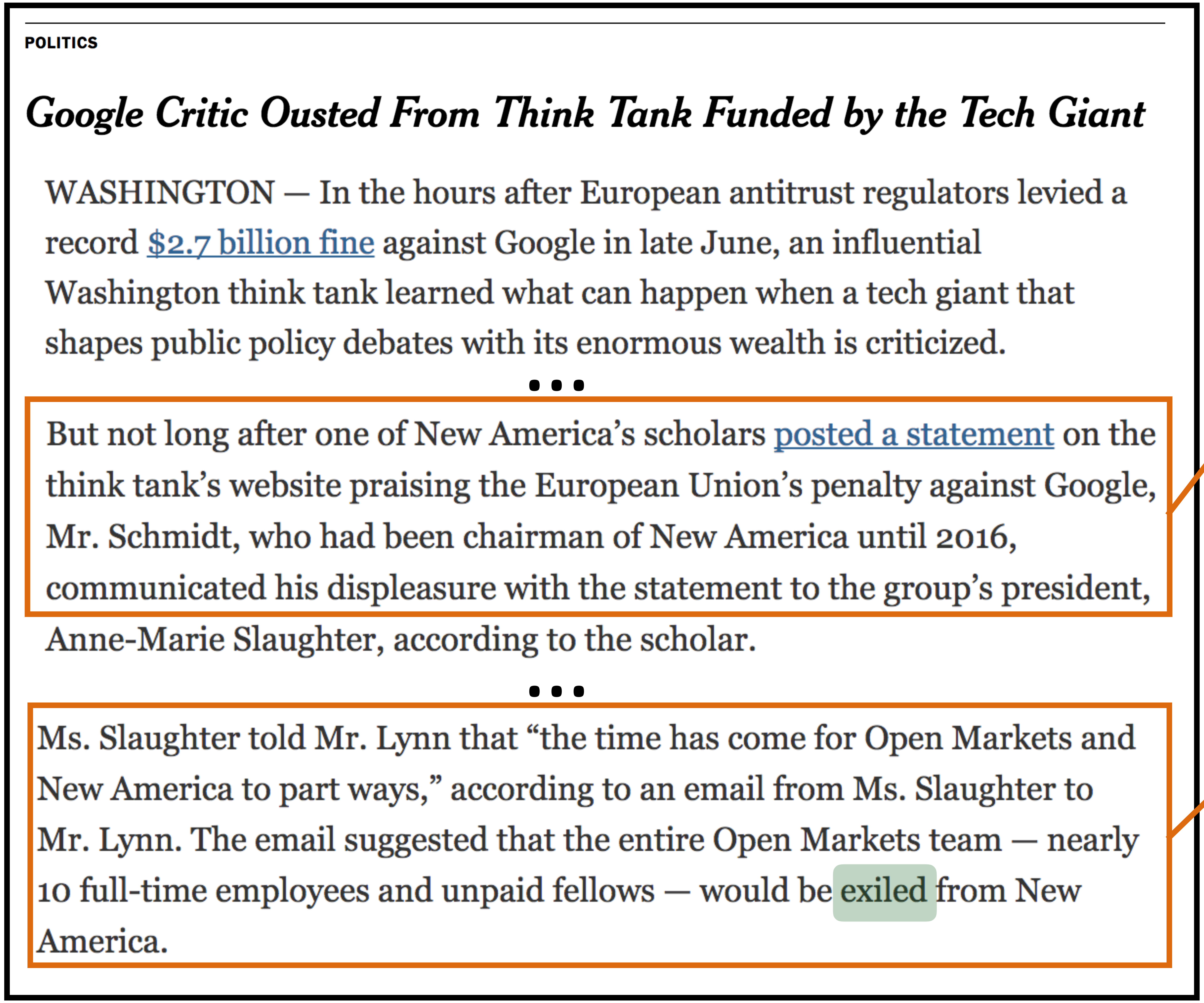
Apple

Who is its CEO?

resolve references

Tim Cook

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

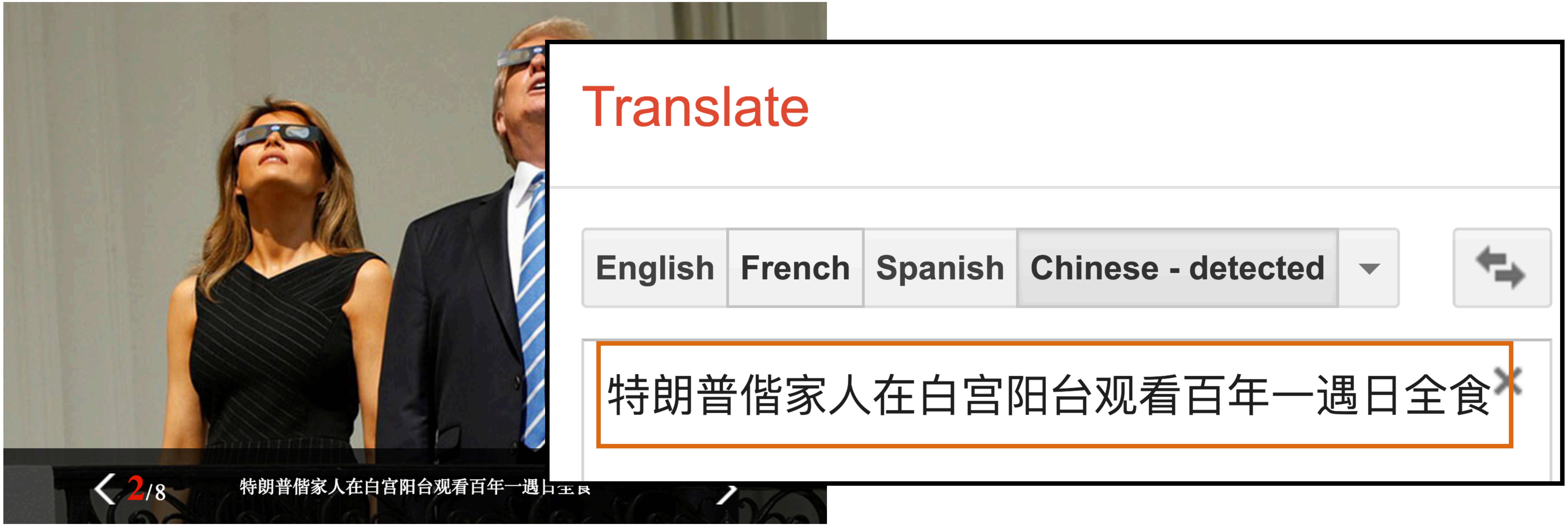
provide missing context

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



Translate

English | French | Spanish | Chinese - detected

特朗普偕家人在白宫阳台观看百年一遇日全食

People’s Daily, August 30, 2017

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

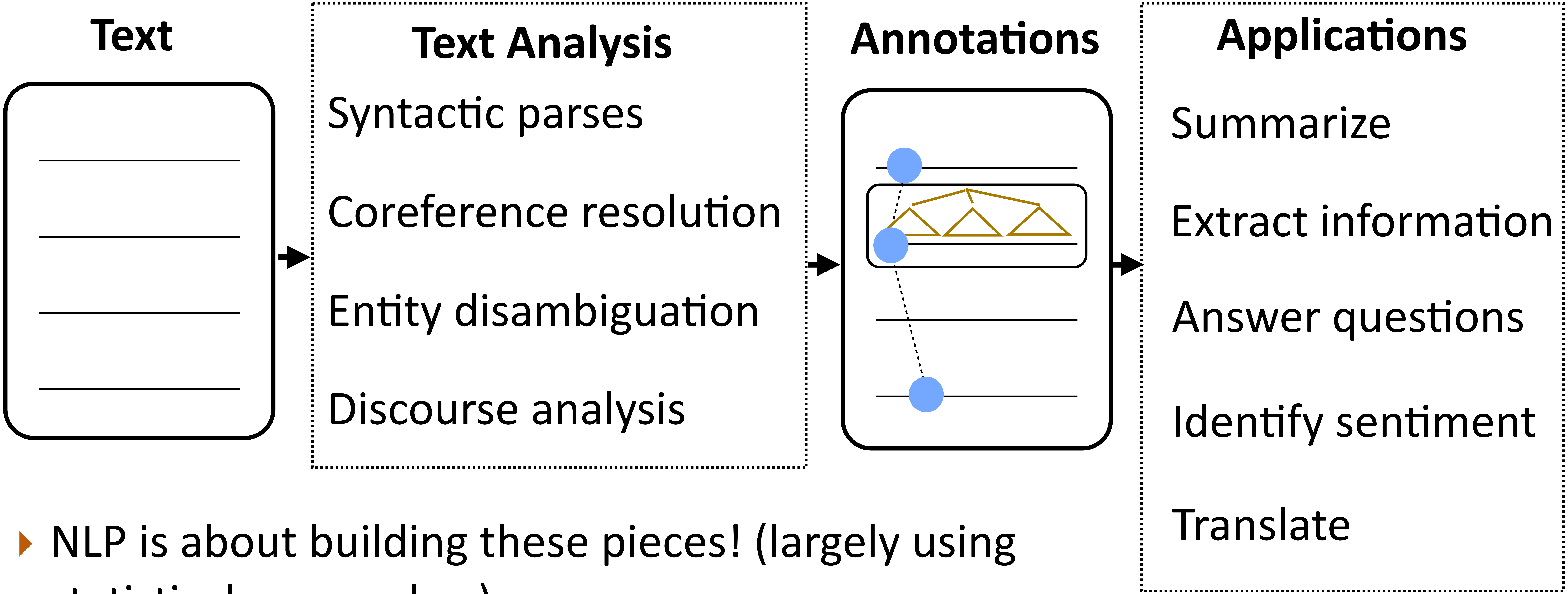
Machine Translation

她强调，要深入贯彻习近平总书记重要指示精神，落实李克强总理批示要求和国务院常务会议部署，压实属地防控责任，强化防控措施落实，切实保障人民群众健康，维护正常生产生活秩序。

People’s Daily, January 20, 2020

She emphasized that it is necessary to thoroughly implement the spirit of General Secretary Xi Jinping ’s important instructions, implement the instructions of Premier Li Keqiang and the implementation of the executive meeting of the State Council, consolidate territorial control responsibilities, strengthen the implementation of prevention and control measures, and effectively protect the people ’s health and maintain normal production and living order.

NLP Analysis Pipeline



Text

Text Analysis

Syntactic parses

Coreference resolution

Entity disambiguation

Discourse analysis

Annotations

Applications

Summarize

Extract information

Answer questions

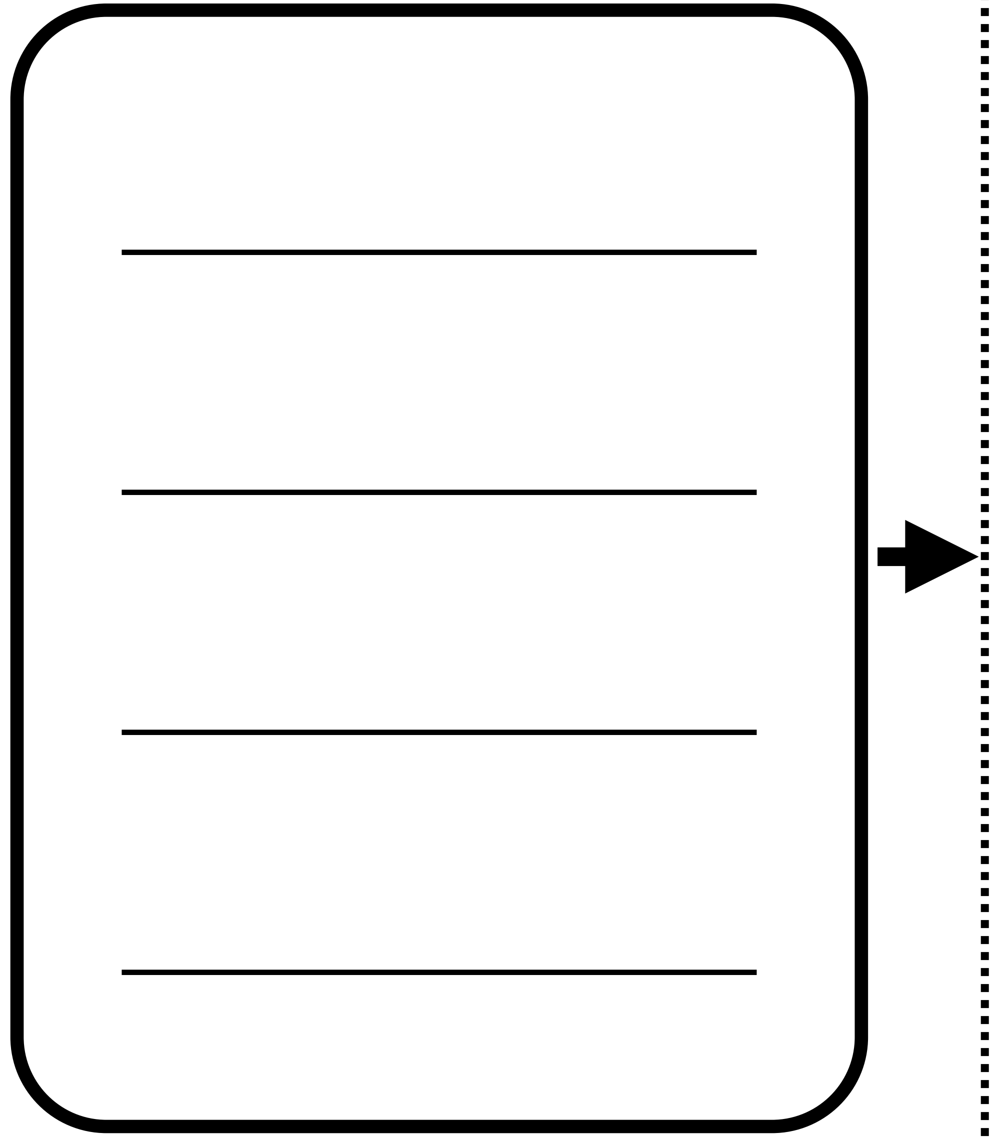
Identify sentiment

Translate

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

How do we represent language?

Text



Labels

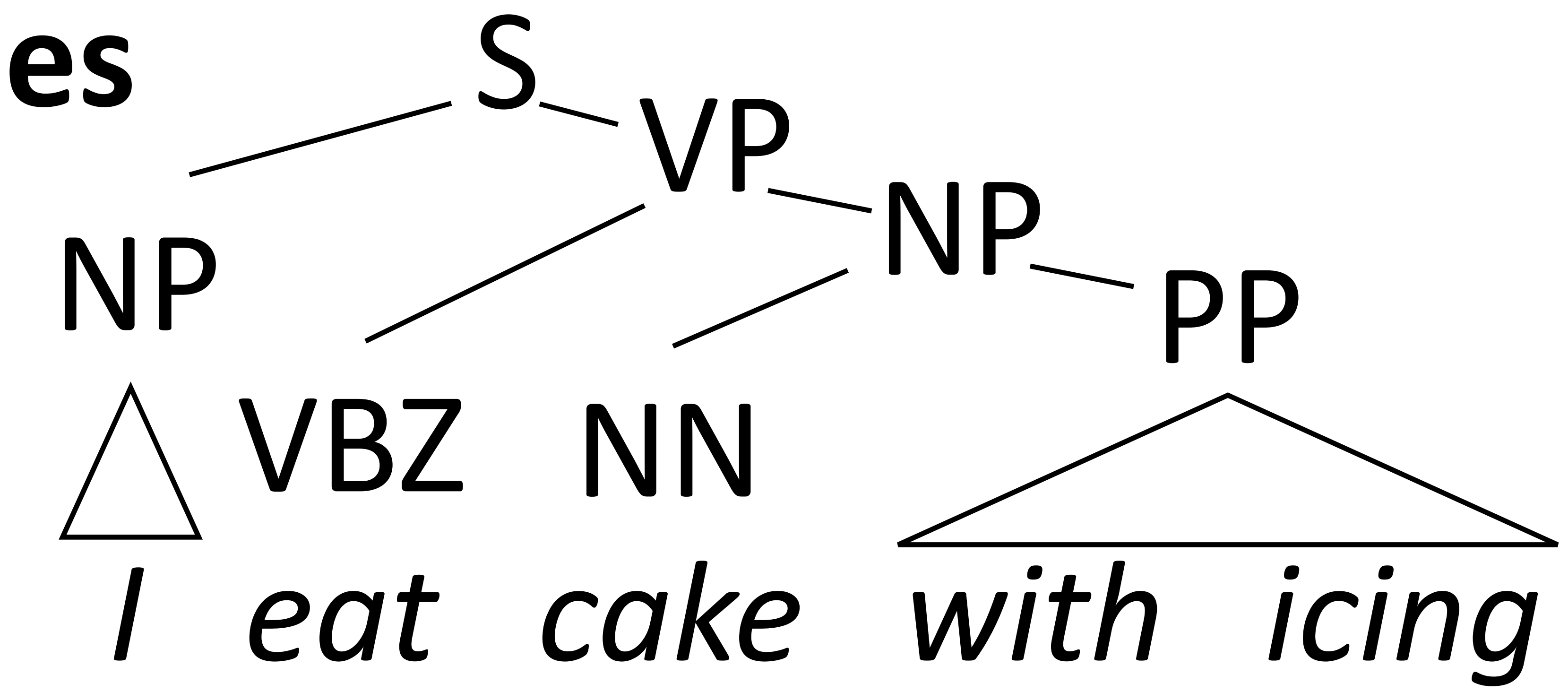
the movie was good **+**

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*

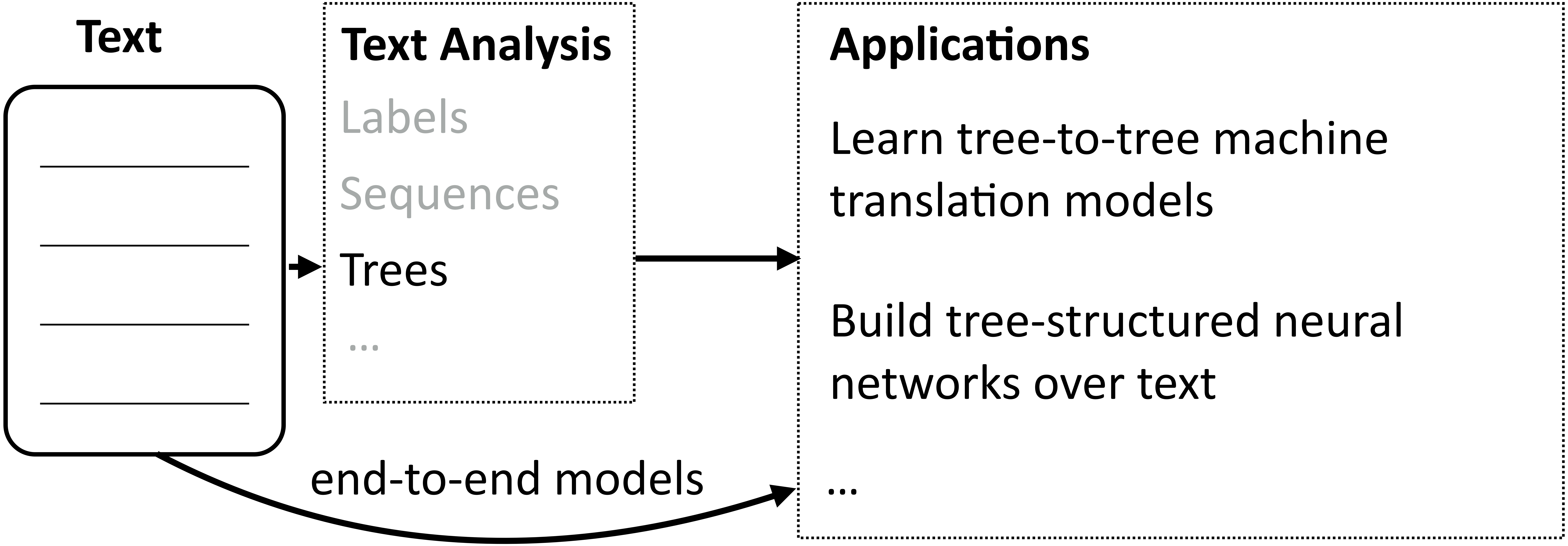
Trees



λx. flight(x) ∧ dest(x)=Miami

flights to Miami

How do we use these representations?



Text

Text Analysis

Labels

Sequences

Trees

…

Applications

Learn tree-to-tree machine translation models

Build tree-structured neural networks over text

…

end-to-end models

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

Why is language hard?

(and how can we handle that?)

What do we need to understand language?

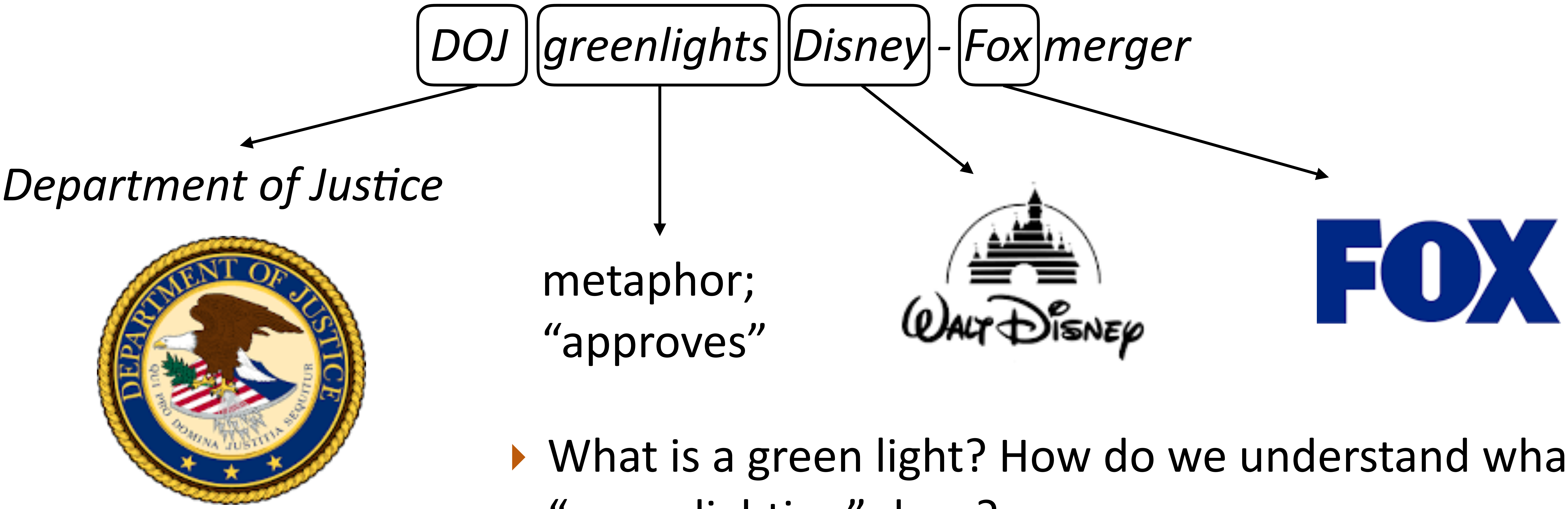
- Lots of data!

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



DOJ *greenlights* *Disney* - *Fox* *merger*

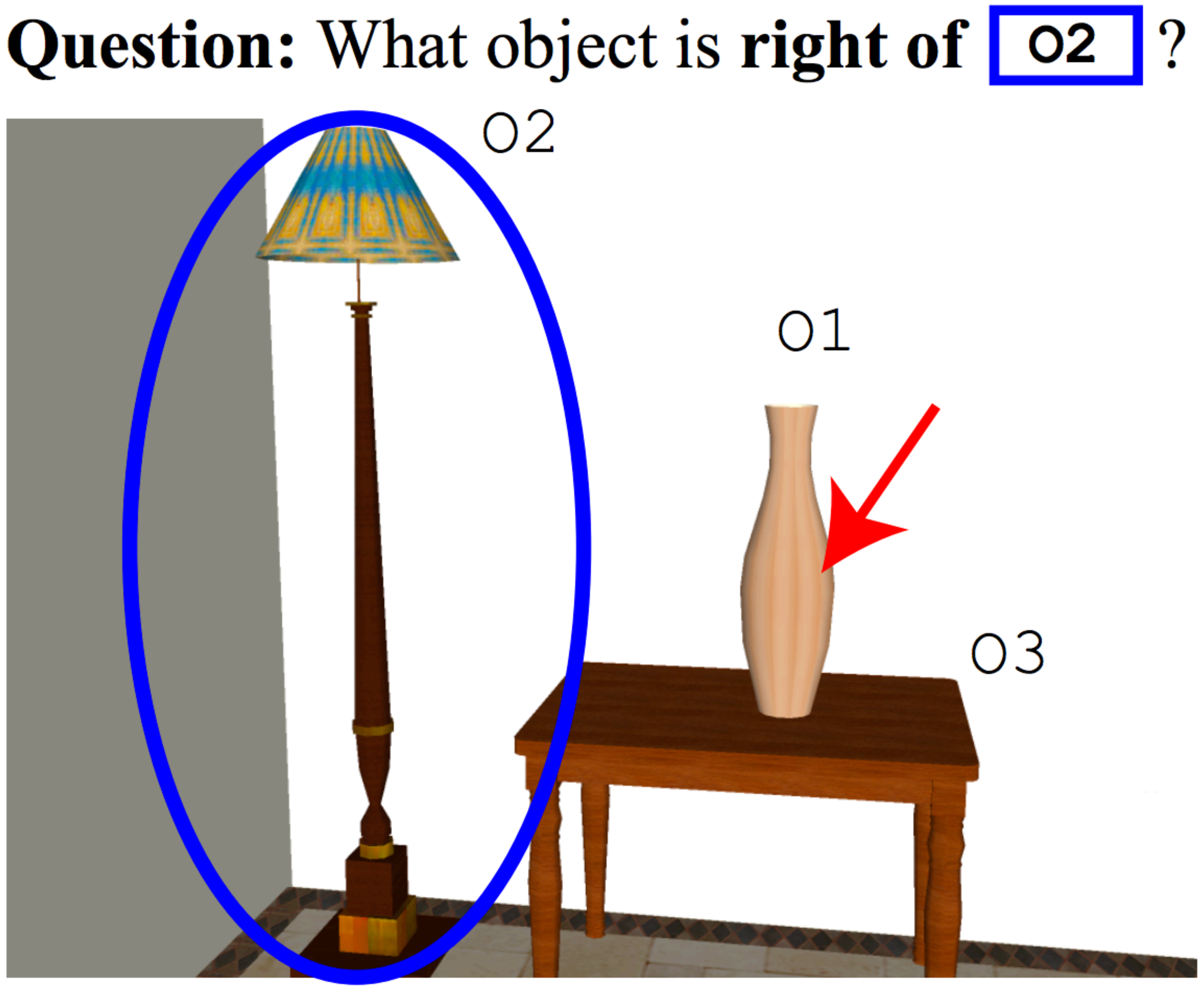
Department of Justice

metaphor;
"approves"

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

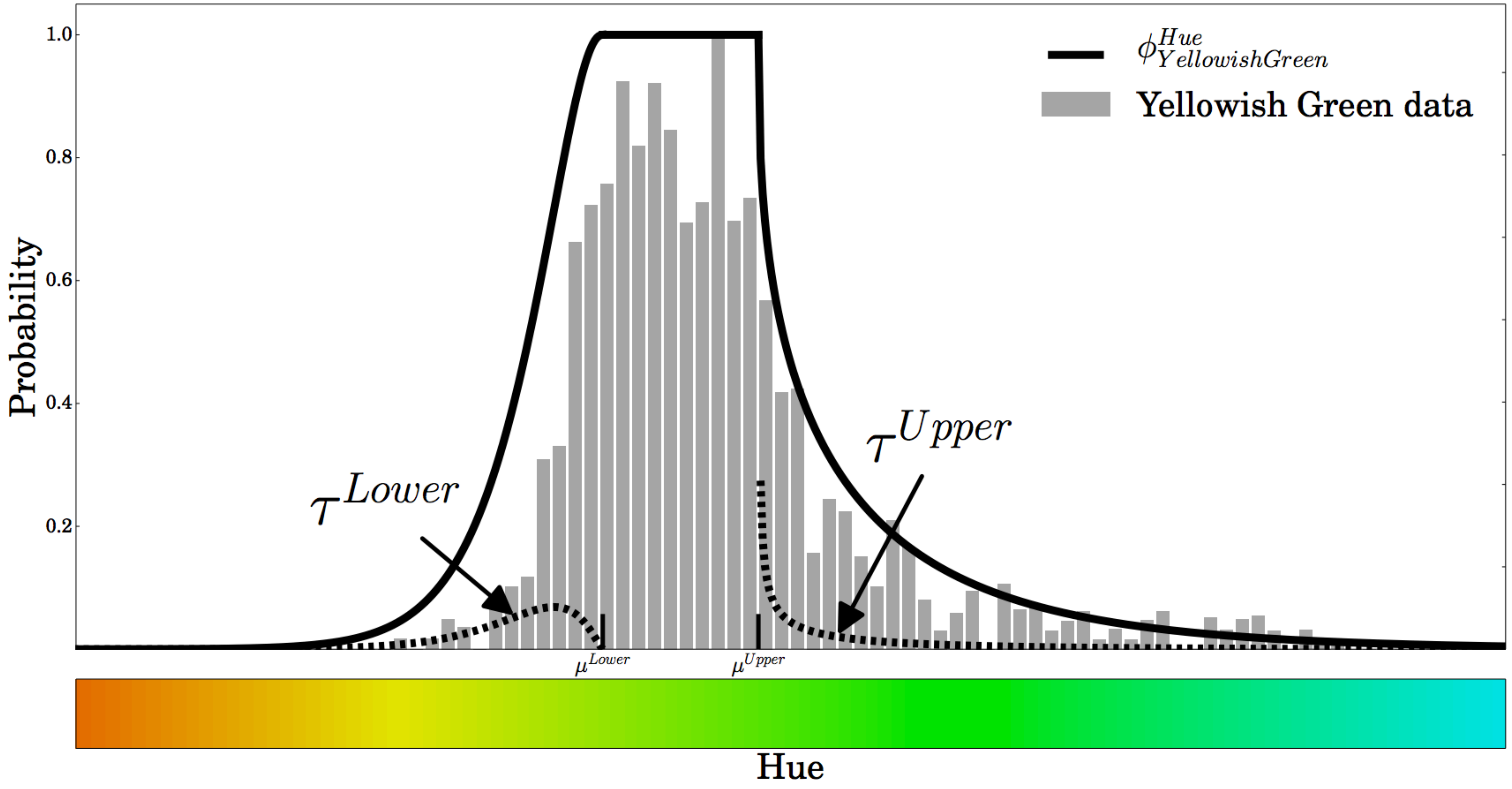
What do we need to understand language?

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



Question: What object is **right of** O2 ?

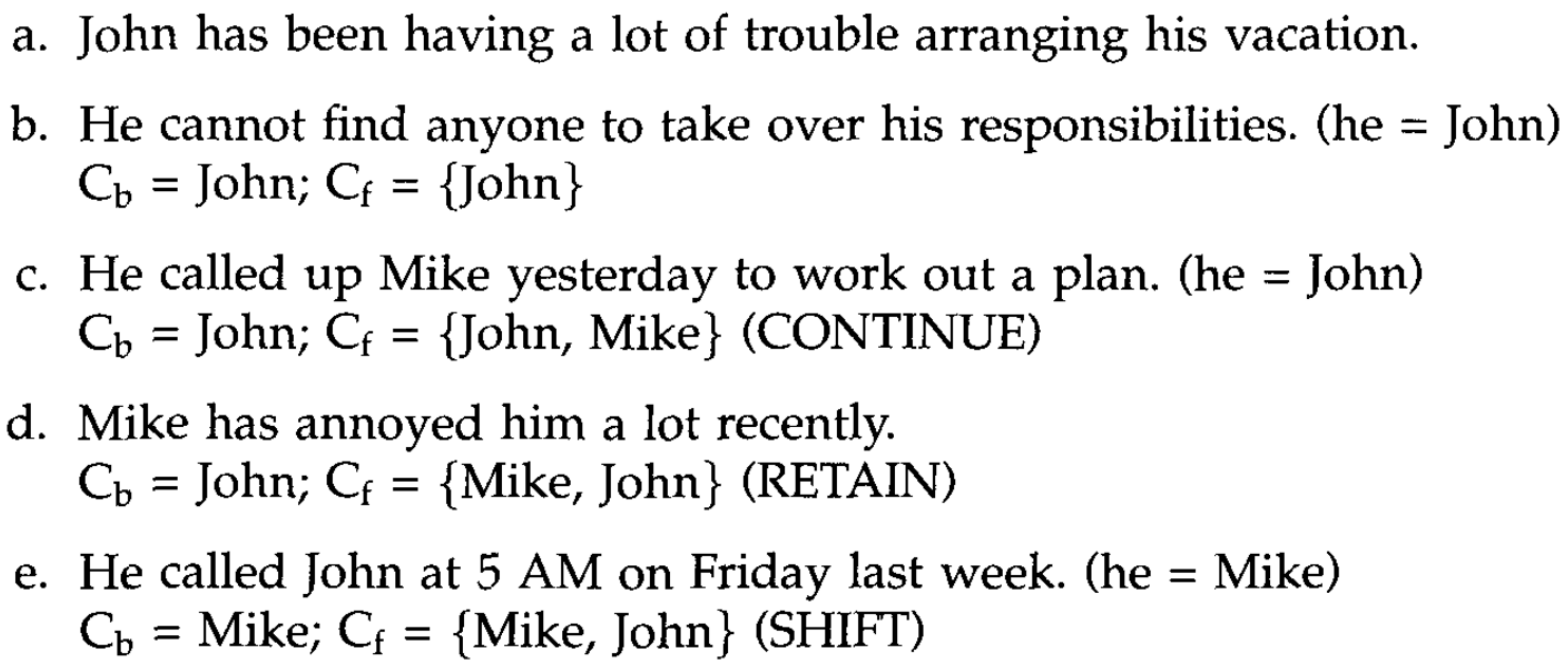
Golland et al. (2010)



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?

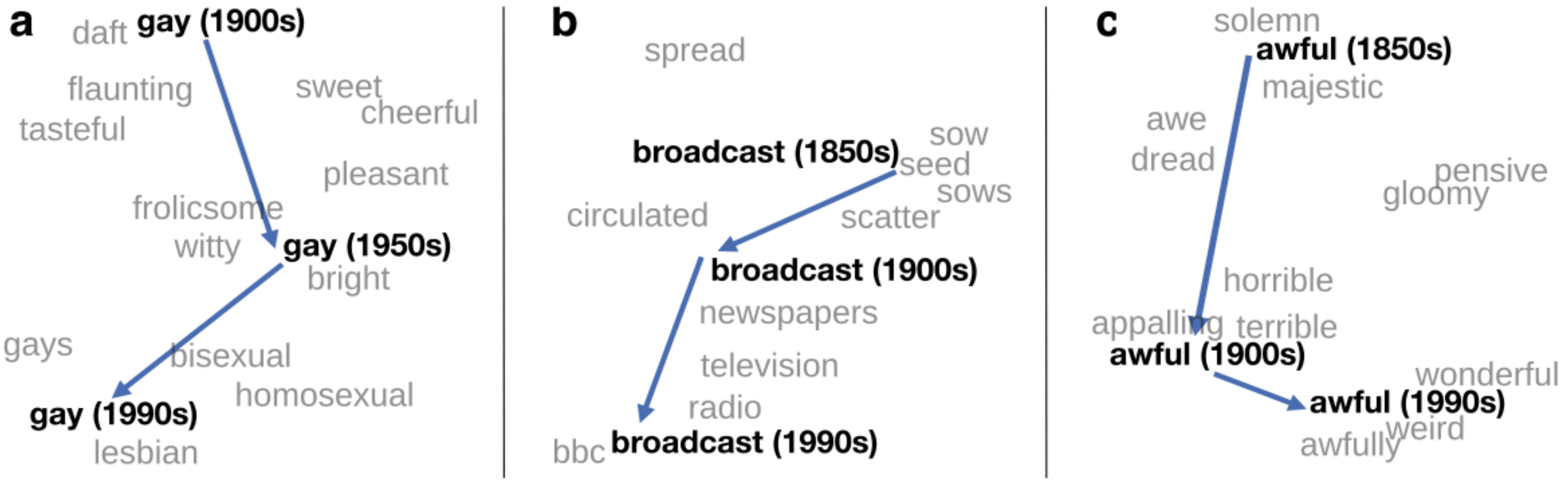
(to combine data, knowledge, linguistics, etc.)

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

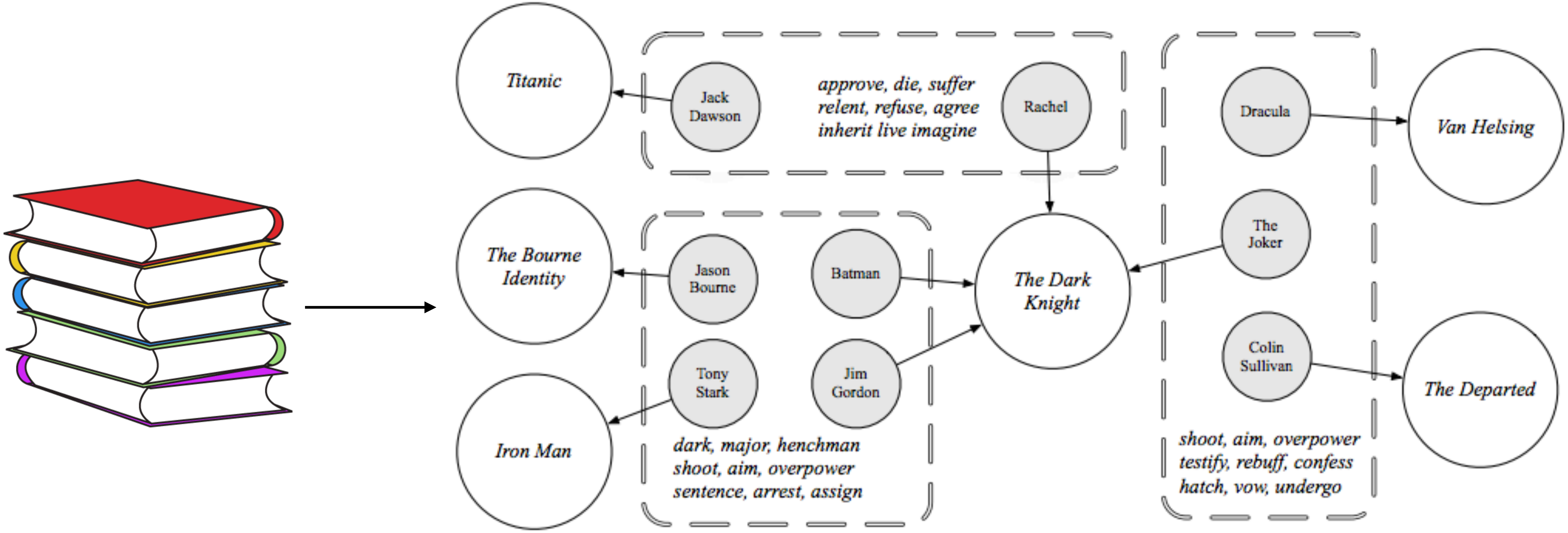
- NLP: build systems that deal with language data
- CL: use computational tools to study language



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: linear and neural, word representations (3.5 weeks)
- Text analysis: tagging and parsing (3 weeks)
- Generation, applications: language modeling, machine translation (3 weeks)
- Question answering, pre-training (2 weeks)
- Applications and miscellaneous (3.5 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 2020?

Coursework

- Five assignments, worth 50% of grade (A0, A5: 5%; all others 10%)
  - Mix of writing and implementation;
  - Assignment 0 is out NOW, due Friday (extensions granted if you get in the class late)
  - ~2 weeks per assignment after Assignment 0
  - 2 “slip days” throughout the semester to turn in assignments 24 hours late. Otherwise, you lose 15% credit per day the assignment is late

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!**

The course staff are not here to debug your code! We will help you understand the concepts from lecture and come up with debugging strategies, but we won’t read through your code to spot your bug.

Coursework

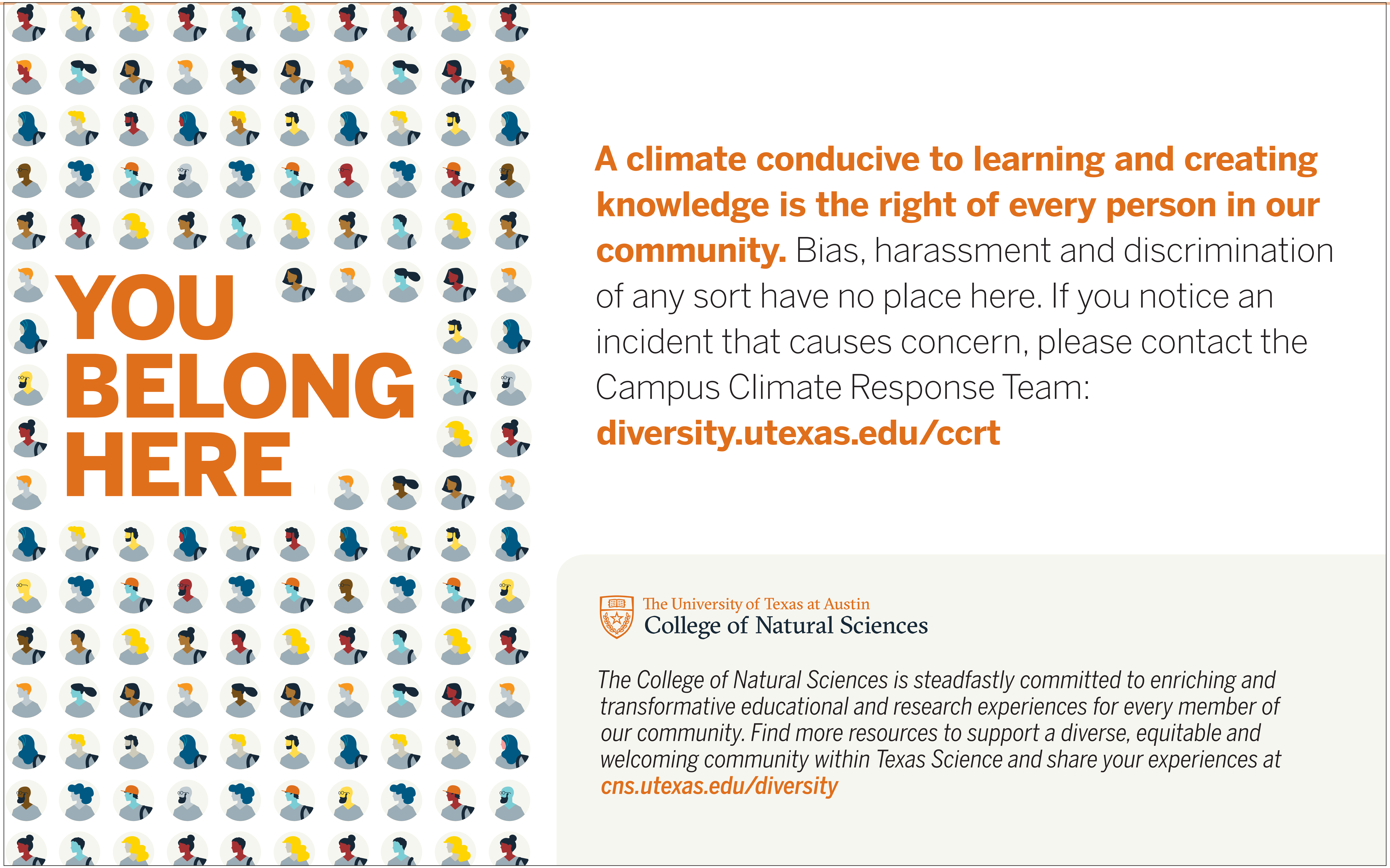
- Midterm (25% of grade), in class
  - Similar to written homework problems

- Final project (25% of grade)
  - Groups of 2 preferred, 1 is possible
  - Standard project: neural network models for question answering
  - Independent projects are possible: these must be proposed by March 24 (to get you thinking early) and will be held to a high standard!

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



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College of Natural Sciences

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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. One reason you want to take this class or one thing you want to get out of it
5. One interesting fact about yourself, or what you like to do in your spare time