

# Lecture 23

# Context in Language Processing

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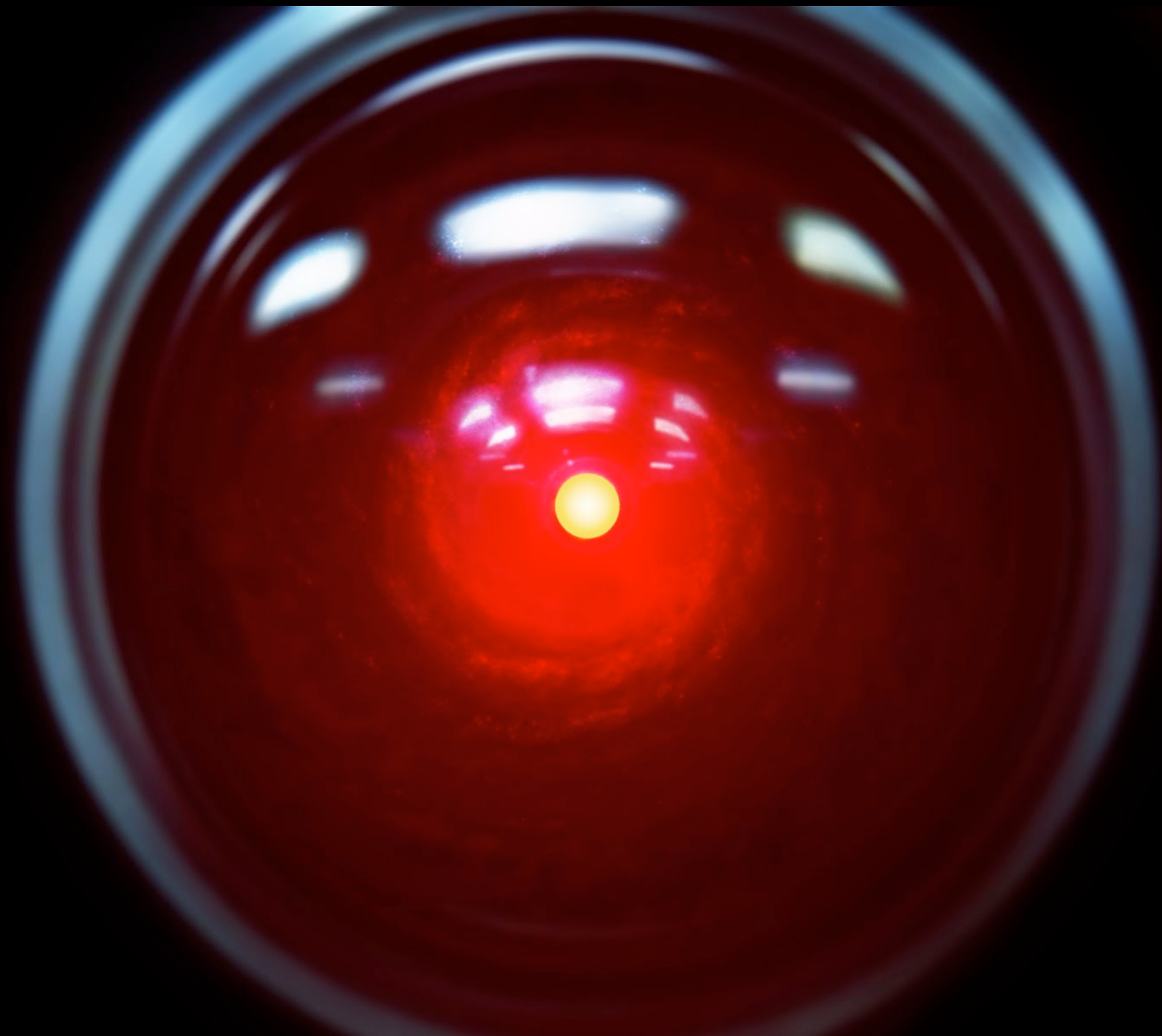
Be aware she can move in any direction

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# AI Ambitions



# Semantic Analysis

- We've seen tasks that analyze the meanings or topics of documents, words, and sentences
  - ▶ document classification
  - ▶ topic models
  - ▶ word representations & similarity
  - ▶ word sense disambiguation
  - ▶ semantic role labeling
- These are challenging tasks. But even if we could automate them perfectly, we'd still be a long way from human-like automatic language processing.

# Understanding: Beyond Semantics

What is required to understand this conversation?





- **Semantics of the expressions themselves**

- ▶ coffee refers to the drink, not the tree or bean (WSD)
- ▶ 4:00 and 3:00 are times (NER)
- ▶ “at 4:00”: semantic role marking the time of an event
- ▶ “?” indicates question

- **But there’s a lot more to understanding than just the explicit language....**



- **Encyclopedic knowledge about the world**
  - ▶ Nobody would think this means “Does coffee exist at 4:00?” We know about social activities associated with coffee.
  - ▶ Likely 4:00pm, because people are normally asleep at 4:00am. (And people generally don’t go for coffee in their sleep.) Unless.....



- **Knowledge of the situation/  
conversational context/  
common ground**
  - ▶ Perhaps it's 2:30am and we're working to finish something for a deadline. Or we both are back from a conference and are severely jetlagged.
  - ▶ Perhaps we have a habit of going to a certain place for coffee, so it can be left implicit.



- **Discourse coherence**

- ▶ We normally assume that interlocutors are “cooperative” (H.P. Grice): They respond with relevant information, say what they believe to be true, don’t change topics without suitable pause or warning, etc.
- ▶ Here, we interpret the second question as *proposing an alternative* time, and requesting confirmation.

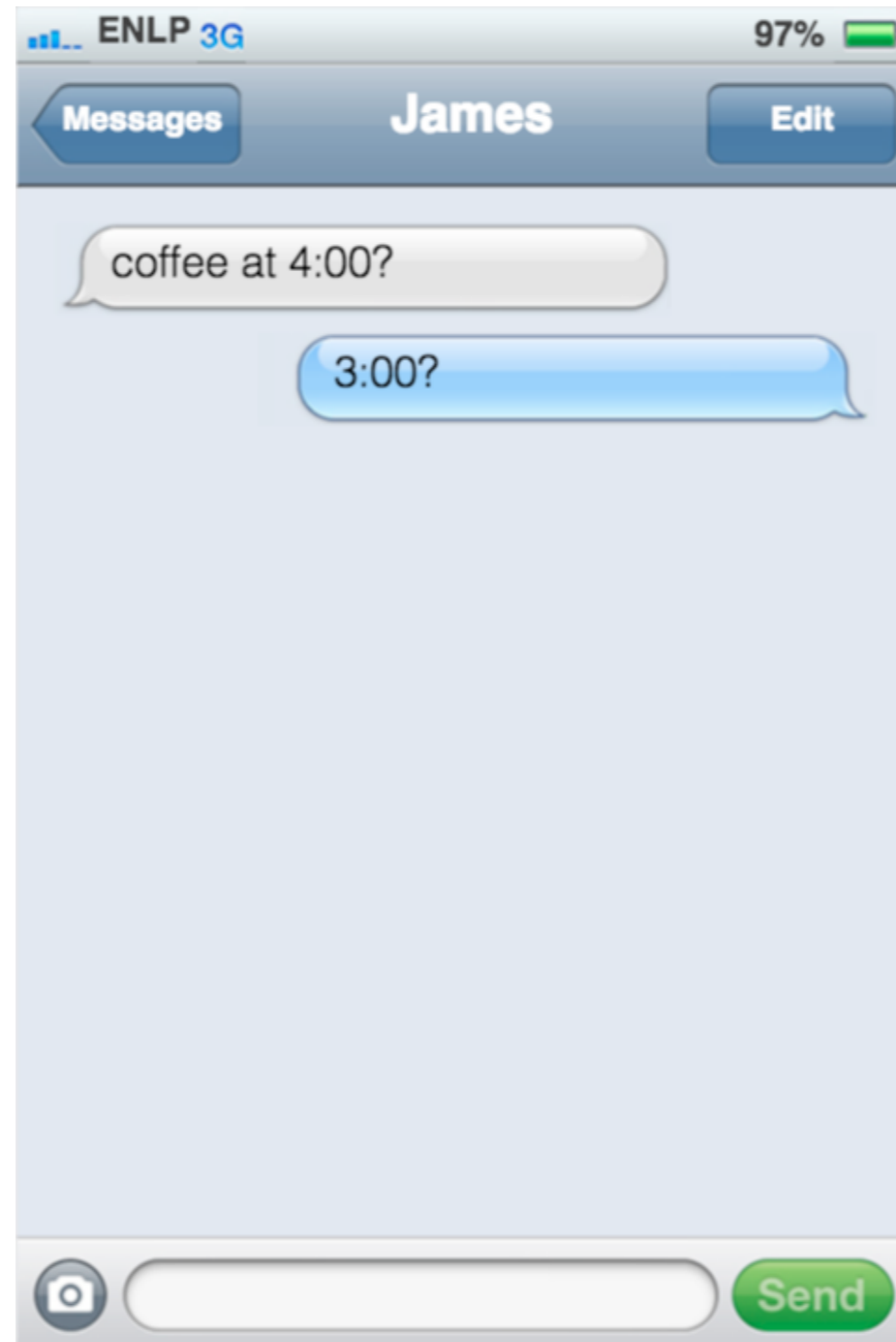


- **Relationship to action**

- ▶ A truly intelligent app would offer information that would help my decision (e.g., when the café closes)
- ▶ and put the event on my calendar at the agreed-upon time
- ▶ and remind me to leave in time to arrive at the agreed-upon meeting place at that time.
- ▶ If it is unsure of details, it should confirm with me rather than do the wrong thing.
- ▶ Industry is already moving in this direction with personal assistants.



What else can be inferred from this conversation?



- **Relationship between interlocutors**

- ▶ This conversation is informal. We might infer that the speakers are friends.



# Types of Context

- **Conversational** (what has been said already, whose turn it is to talk)
- **Situational** (what is going on at the moment of conversation)
- **Social**
  - ▶ relationship between interlocutors—e.g. status/formality
  - ▶ their sociolinguistic identities—e.g. accent, expression of gender
- **Shared knowledge** (e.g. that we are in the same class and there is an exam coming up)
- **General knowledge** (e.g. that in order to stay awake late at night it might be helpful to drink coffee)



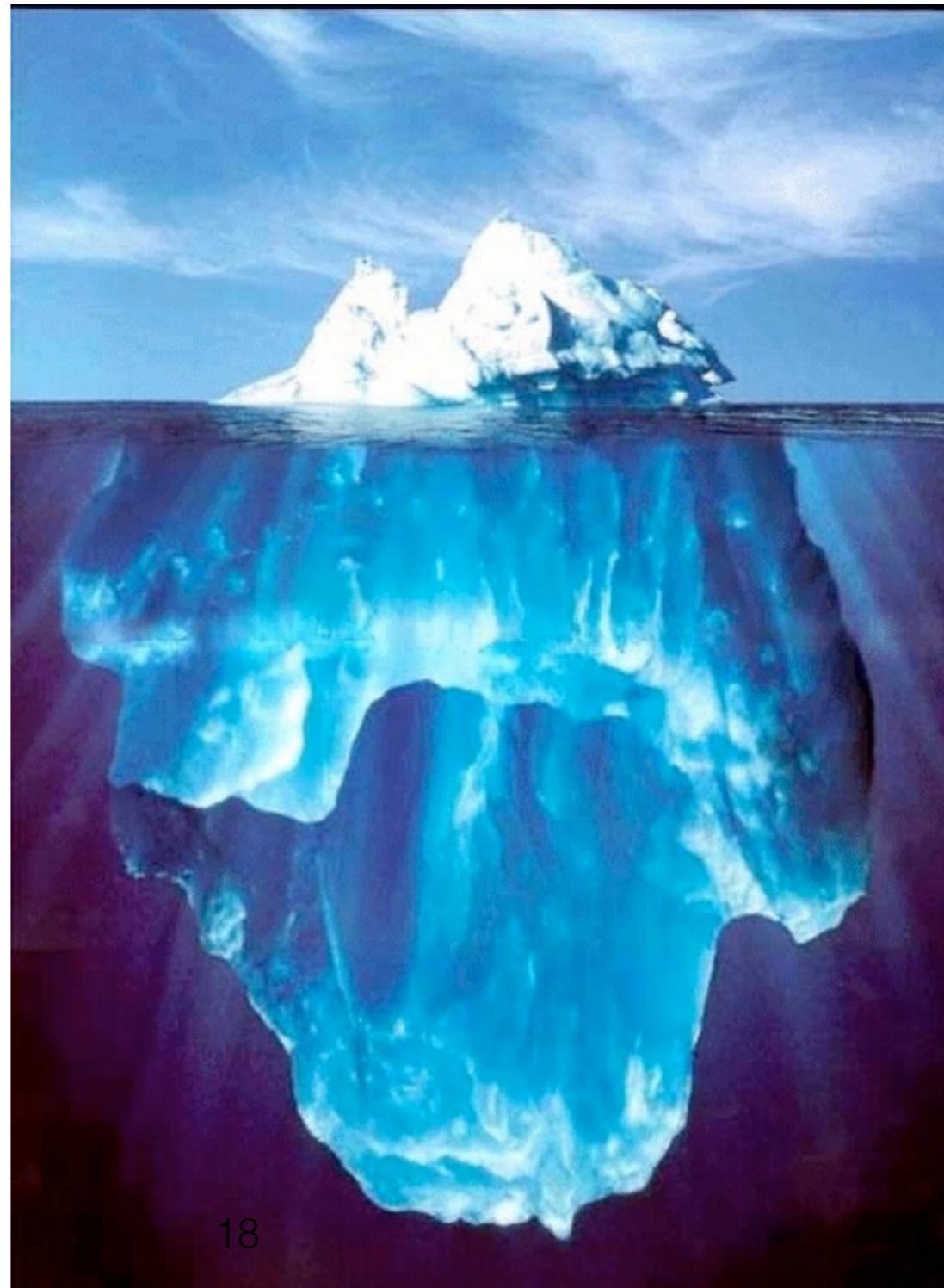
# Understanding: It's Not Just the Words

- Actually understanding such conversations requires a lot of inferences based on world knowledge and context (**pragmatics**).

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WHAT IS SAID

WHAT IS UNDERSTOOD



# Understanding: It's Not Just the Words

- Actually understanding such conversations requires a lot of inferences based on world knowledge and context (**pragmatics**).
- But is that only true of conversations? What about unidirectional language use (books, articles)?

“Sherwood Park had its third fire in less than a month on Tuesday. However, there were no injuries” (<http://www.sherwoodparknews.com/2016/01/14/no-injuries-in-park-fire>)

- **Semantics:** Sherwood Park is a neighborhood (not a literal park); this fire is no longer active
- **Discourse + world knowledge:**
  - ▶ *no humans injured in this fire* (unknown whether any ants were harmed)
  - ▶ “However” signals a contrast with an expectation raised by the first sentence: injuries might have been expected from an unintentional fire
  - ▶ Harm to humans is highly newsworthy, so it’s important for the story to inform us of an event that DIDN’T occur
  - ▶ Likely inference: there is a pattern of fires in Sherwood Park (why?)
  - ▶ Were there injuries in previous fires? Unspecified.
  - ▶ What would have to change for the information to be presented in the opposite order?

# Understanding: It's Not Just the Words

- Different aspects of meaning are required to be explicit in different languages. E.g., **lexicalization** patterns in Hebrew vs. English:





# Understanding: It's Not Just the Words

- Different aspects of meaning are required to be explicit in different languages. E.g., **lexicalization** patterns in Hebrew vs. English:
  - ▶ EN “fire” ↔ HE {*eish* ‘purposeful fire’, *srefa* ‘destructive fire’}
  - ▶ EN {“color”, “paint”} ↔ HE *tseva*
- **formality/social status:** Which 2nd person pronoun to use in German or French?
- **evidentiality:** How does the speaker know the information? (directly observed, secondhand, etc.)
- **spatial systems:** absolute (compass directions) or relative



# Understanding: It's Not Just the Words

- Some information can be made “minimally explicit”, requiring discourse-level inference.
- **anaphora** (pronouns): *He* sells the greatest soup *you*'ve ever eaten.
  - ▶ Need to decide which pronouns are **referential**, and resolve their antecedents.
  - ▶ Special case of **coreference resolution** (grouping referring expressions that indicate the same entity).
- **pro-drop**: In many languages, pronominal subjects can be dropped (verb agreement helps disambiguate): *Quiero un taco.*

# Perspective in language

- The choice of language can put a “spin” on the information being conveyed, emphasizing certain nuances or dimensions of meaning. Sometimes called **construal**.
- May indicate a social perspective (**framing**)
  - ▶ *Mistakes were made.*
  - ▶ “thrifty” vs. “stingy”
  - ▶ “terrorists” vs. “freedom fighters”
- May be mundane and subtle: **on** *the bus* vs. **in** *the bus*

# Understanding: It's Complicated

- Lots of implicit information, even in expository text.
- How to even evaluate whether a system is comprehending the story?
  - ▶ Give the system an **exam**—multiple choice or fill-in-the-blank. Challenge datasets based on actual exam questions (reading comprehension, mathematical reasoning, biology).
  - ▶ Test the system's **decision-making** skills, such as controlling a robot or making moves in a game based on language. Requires link between comprehension and action/grounding.
  - ▶ **Multimodal**: Link text to image, video, or action.

# Automatic Caption Generation

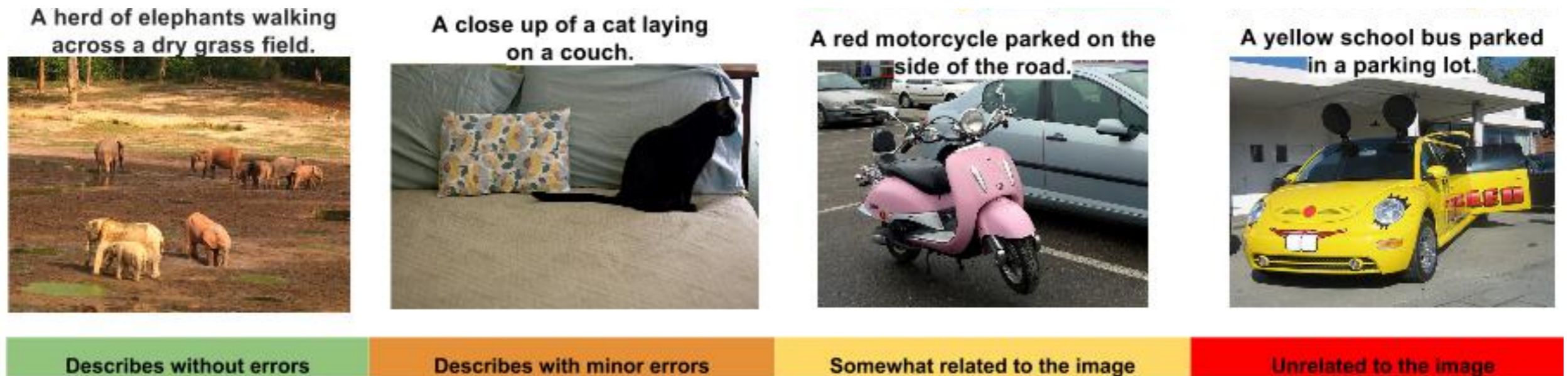


Figure 5. A selection of evaluation results, grouped by human rating.

Vinyals et al., CVPR 2015

[http://www.cv-foundation.org/openaccess/content\\_cvpr\\_2015/papers/Vinyals\\_Show\\_and\\_Tell\\_2015\\_CVPR\\_paper.pdf](http://www.cv-foundation.org/openaccess/content_cvpr_2015/papers/Vinyals_Show_and_Tell_2015_CVPR_paper.pdf)

# Language-Directed Robot Navigation



[https://www.youtube.com/watch?v=7nUq28utuGM&list=PL6SYoj2z5jWfBFhZQdxF\\_luQ-sgpDXAO4&index=1](https://www.youtube.com/watch?v=7nUq28utuGM&list=PL6SYoj2z5jWfBFhZQdxF_luQ-sgpDXAO4&index=1)

# NLP in Academia



Muppets Models

# NLP in the Real World



# Social Context

- NLP technologies have users.
- Sometimes characteristics of the users matter to the task.
- It's one thing to optimize F-score in a research paper. But this might not capture the true cost of certain errors to a user.
- Do users trust systems? Do they trust them *too much*?
- How can systems be designed to be more trustworthy and transparent?



# Societal Context

How is the NLP/AI technology going to be used?

What positive or negative effects might it have on society?

- **ACTIVITY:** Give examples of how technology can be used in ways that are
  - ▶ Advantageous to society
  - ▶ Unintentionally harmful
  - ▶ Intentionally harmful

# Societal Context

How is the NLP/AI technology going to be used?  
What positive or negative effects might it have on society?

- ▶ Promote societal goals—health care, crime prevention?
- ▶ Unfairness—implicit bias against certain groups of people (gender, race, dialect, ...)?
- ▶ Unethical or malicious uses—violating privacy, deception?

# Summary

- The techniques discussed in this course were aimed at classifying documents, or analyzing words and sentences.
- But much of human language exploits our awareness of discourse, pragmatics, perspectives, other modalities, and the world. This is really, really hard (AI complete).
- Different languages have different requirements for what needs to be explicit.
- Tasks like **coreference resolution**, **automatic caption generation**, and **language-directed robot tasks** are important for stimulating research along dimensions beyond local and explicit linguistic communication.
- NLP technologies have an impact on users and society. Important to consider potential malicious or unintentionally problematic implications.