Natural Language Processing

Lecture 2: Linguistics Knowledge and NLP Challenges

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Outline

- **Linguistic Knowledge**
- Challenges

Linguistic

- Phonetics and Phonology

- Morphology

- Syntax

- Semantics

- Pragmatics

- Discourse

Phonetics and Phonology

- The study of linguistic sounds and their relations to words

b	b	l	l	sh	ʃ	a	æ	oh	ɔːʳ
p	p	r	ɹ	zh	ʒ	ah	ɑːʳ	oa	o
d	d	m	m	th	θ	ay	e	u	ʊ
t	t	n	n	h	h	e	ɛ	uh	ʌ
f	f	s	s	w	w	ee	i	oo	u
v	v	z	z	y	j	i	ɪ	oi	ɔj
g	g	ch	tʃ	ng	ŋ	iy	aj	ow	aw
k	k	j	dʒ			o	ɑ		

Morphology

- The study of internal structures of words and how they can be modified
- Parsing complex words into their components
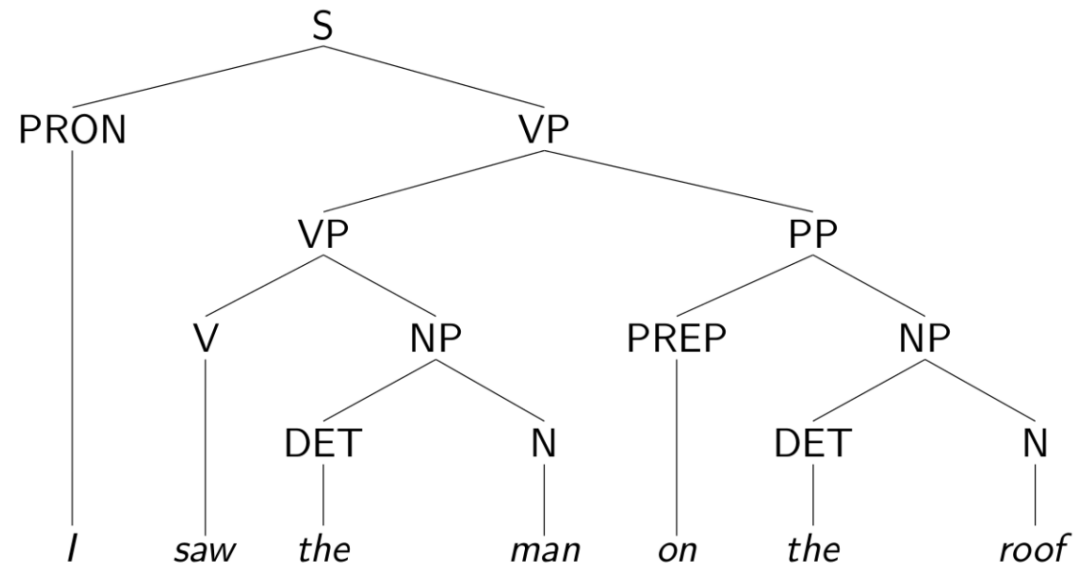
unbelievable

un+believ+able

prefix: un

root: believe

sufix: able

Syntax

- The study of the structural relationships between words in a sentence

I saw the man on the roof.

Semantics

- The study of the meaning of words, and how these combine to form the meanings of sentences

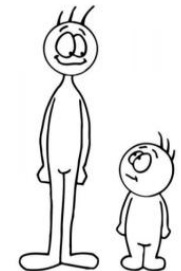- Realizing lexical relations among words

Hyponymy (is a)

Synonymy

Meronymy (part of)

Antonymy

Pragmatics

- The study of how language is used to accomplish goals, and the influence of context on the meaning

- Understanding the aspects of a language which depends on situation and world knowledge
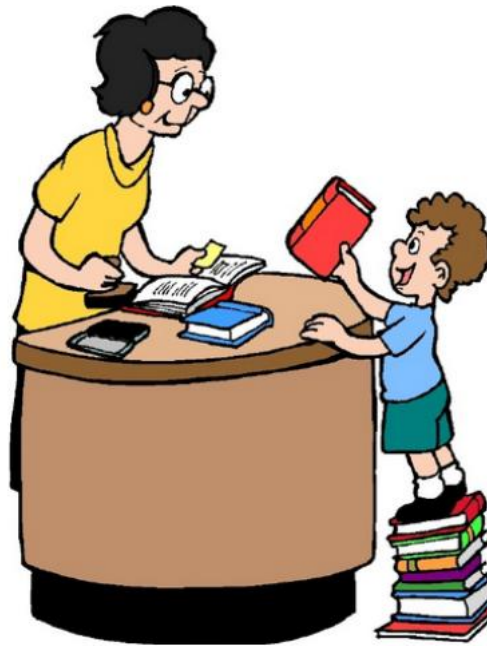
Do you know what time it is?

Discourse

- The study of linguistic units larger than a single utterance

John reads a book. *He* borrowed *it* from *his* friend.

Outline

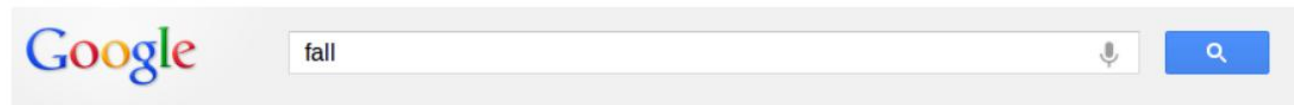- Linguistic Knowledge
- **Challenges**

Challenges

- Different words/sentences express the same meaning
  - The third season of the year
    - Fall
    - Autumn
  - Book delivery time
    - When will my book arrive?
    - When will I receive my book?

Paraphrasing

- One word/sentence can have different meanings
  - Fall
    - The third season of the year
    - Moving down towards the ground or towards a lower position
  - The door is open.
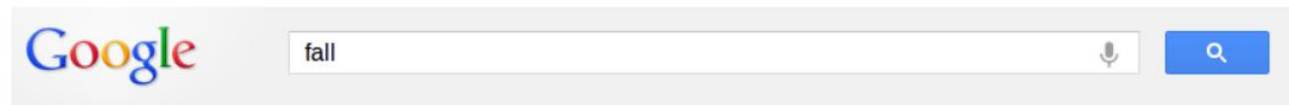   - Expressing a fact
    - A request to close the door
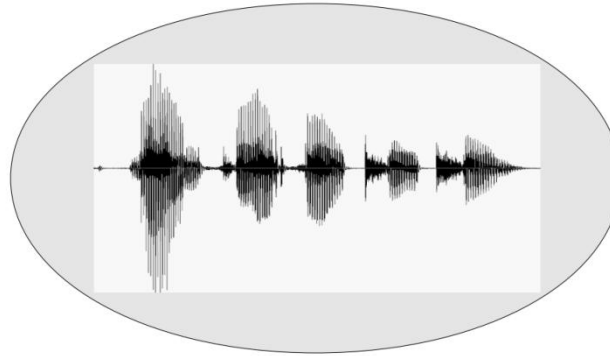
Ambiguity

Challenges

Challenges

What about *autumn*?

Phonetics and Phonology

Computers can recognize speech

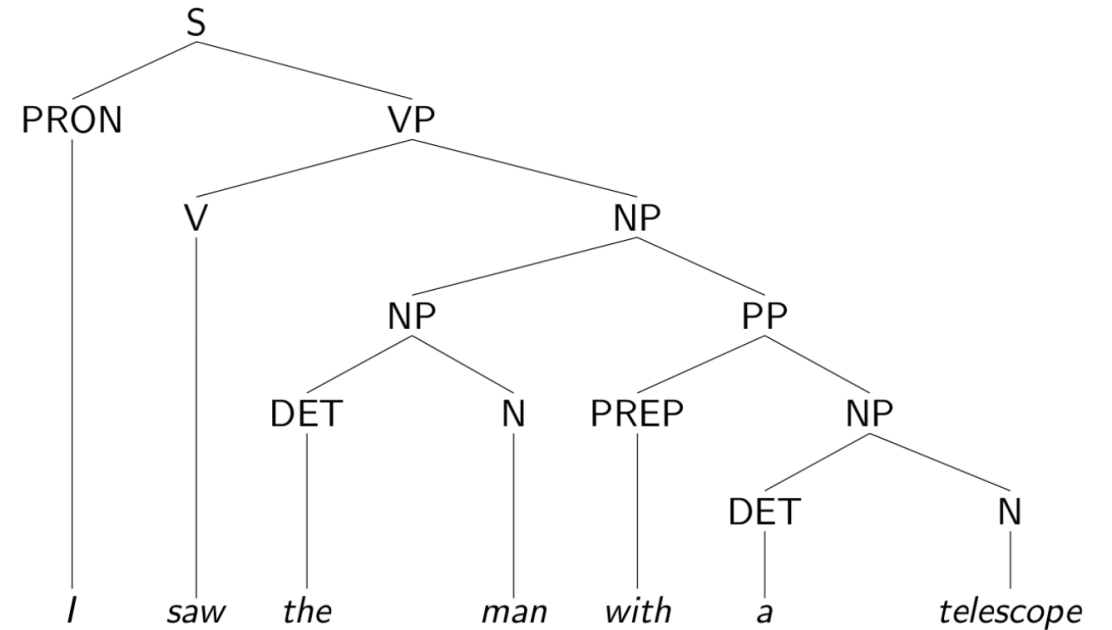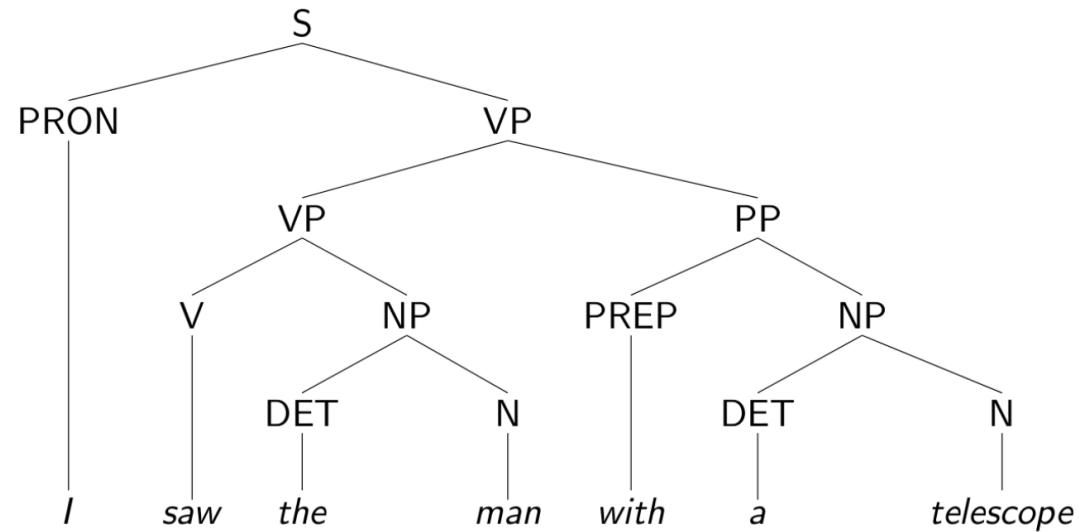Computers can wreck a nice peach

Morphology

Unionize

Union + ize
Un + ion + ize

Syntax

I saw the man with a telescope.

Semantics

The astronomer loves the star.

Movie Star (Celebrity)

Sky Star

Semantics

Every man loves a woman.

$\forall x : (man(x) \rightarrow \exists y : (woman(y) \ \& \ love(x, y)))$

$\exists y : (woman(y) \ \& \ \forall x : (man(x) \rightarrow love(x, y)))$

Pragmatics

Can you give me the salt?

Would you please give me the salt?

Do you have the ability to give me the salt?

Discourse

Alice understands that you like your mother, but she ...

Alice
Your Mother

Ambiguity

I made her duck.

Ambiguity

I made her duck.

- I cooked duck for her (to eat)

- I cooked duck belonging to her

- I created a toy duck which she owns

- I created a vehicle which she owns

- I caused her to quickly lower her head or body

- I waved my magic wand and turned her into a duck

Ambiguity

I made her duck.

- duck - morphologically and syntactically ambiguous
  - noun
  - verb

- duck - semantically ambiguous
  - waterfowl
  - vehicle moving on the water

- her - syntactically ambiguous
  - possessive
  - dative

- make - semantically ambiguous
  - cook
  - create

- make - syntactically ambiguous
  - Takes a direct object and a verb (5)
  - Transitive - takes a direct object (2)
  - Di-transitive - takes two objects (6)