



Statistical Natural Language Processing

Lecture 2: NLP Challenges

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Outline

- 1 Linguistic Knowledge
- 2 Challenges

Outline

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- 1 Linguistic Knowledge

- 2 Challenges

Linguistic Knowledge

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- Phonetics and Phonology
- Morphology
- Syntax
- Semantics
- Pragmatics
- Discourse

Phonetics and Phonology

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- The study of linguistic sounds and their relations to words

b	b	l	l	sh	ʃ	a	æ	oh	oʊ ^r
p	p	r	ɹ	zh	ʒ	ah	aɪ ^r	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

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

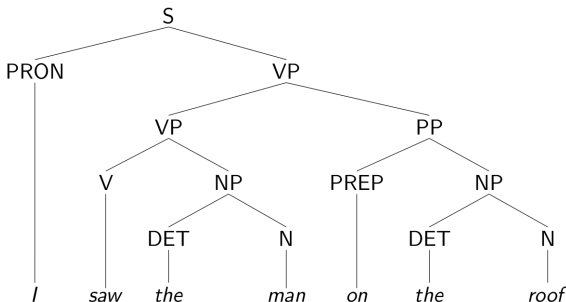
unbelievable
un+believ+able

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

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- 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) *dog & animal*

Meronymy (part of) *arm & body*

Synonymy *fall & autumn*

Antonymy *tall & short*

Pragmatics

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

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Challenges

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■ 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

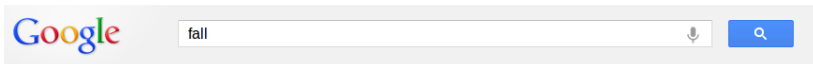
■ One word/sentence can have different meanings

- *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

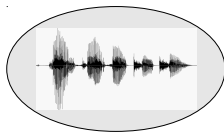
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- Moving down?
- The third season of the year?
 - What about *autumn*?

Phonetics and Phonology

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Computers can recognize speech

Computers can wreck a nice peach

Morphology

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Unionize

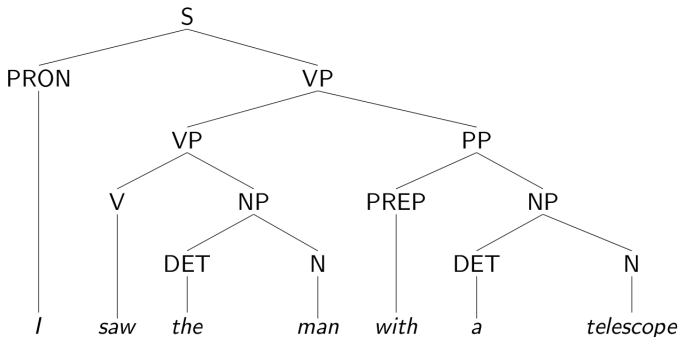
Union + ize

Un + ion + ize

Syntax

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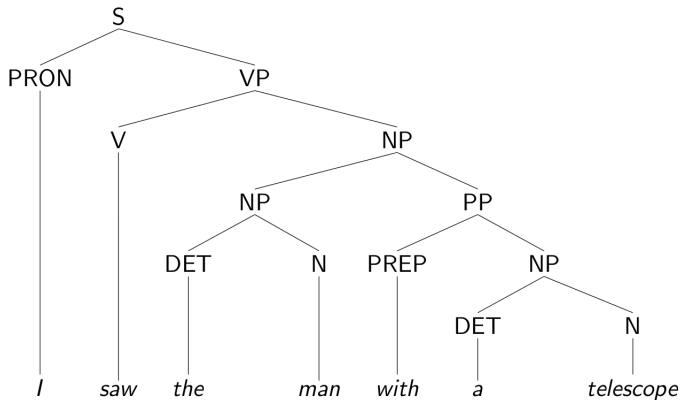
I saw the man with a telescope.



Syntax

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I saw the man with a telescope.



Semantics

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The astronomer loves the **star**.

Movie Star (Celebrity)

Sky Star

Semantics

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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

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Can you give me the salt?

Would you please give me the salt?

Do you have the ability to give me the salt?

Discourse

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

Alice

Your Mother

Ambiguity

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I made her duck.



Ambiguity

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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

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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)

...

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Question?