Intro to Natural Language Processing

Mausam

(Based on slides by Rada Mihalcea, Chris Manning, Luke Zettlemoyer, Mari Ostendorf, Regina Barzilay)

Natural?

- Natural Language?
  - Refers to the language spoken by people, e.g. English, Japanese, Swahili, as opposed to artificial languages, like C++, Java, etc.
- Natural Language Processing
  - Applications that deal with natural language in a way or another
- Computational Linguistics
  - Doing linguistics on computers
  - More on the linguistic side than NLP, but closely related

What is NLP?

Computer processing of human language

NL Understanding and Info Extraction

NL Generation

Machine Translation, Paraphrasing, Summarization

NLP is AI Complete

Turing Test

young woman: Men are all alike.
eliza: In what way?
young woman: They're always bugging us about something specific or other.
eliza: Can you think of a specific example?
young woman: Well, my boyfriend made me come here.
eliza: Your boyfriend made you come here?

ELIZA (Weizenbaum, 1966): first computer dialogue system based on keyword matching

http://www.stanford.edu/group/SHR/4-2/text/dialogues.html
http://www.youtube.com/watch?v=WnzlbyTZsQY

Why Natural Language Processing?

- HUGE amounts of data
  - Web: ~1 trillion URLs
  - Intranet
- Applications for processing large amounts of texts

  require NLP expertise

- Classify text into categories
- Index and search large texts
- Automatic translation
- Speech understanding
  - Understand phone conversations
- Information extraction
  - Extract useful information from text
- Automatic summarization
  - Condense 1 book into 1 page
- Question answering
- Knowledge acquisition
- Text generations / dialogues

Some Applications

- Yahoo, Google, Microsoft
  - Information Retrieval
- Monster.com, HotJobs.com (Job finders)
  - Information Extraction + Information Retrieval
- Systran powers Babelfish
  - Machine Translation
- Ask Jeeves
  - Question Answering
- Myspace, Facebook, Blogspot
  - Processing of User-Generated Content
- Tools for “business intelligence”
- All “Big Guys” have (several) strong NLP research labs:
  - IBM, Microsoft, AT&T, Xerox, Sun, etc.
- Academia: research in an university environment

Web Search … n.0

find all web pages containing the word Liebermann

read the last 3 months of the NY Times and provide a summary of the campaign so far

Syntax

"the dog ate my homework" - Who did what?

1. Identify the part of speech (POS)

   Dog = noun ; ate = verb ; homework = noun

   English POS tagging: 95%

2. Identify collocations

   mother in law, hot dog

   Compositional versus non-compositional collocates

Syntax

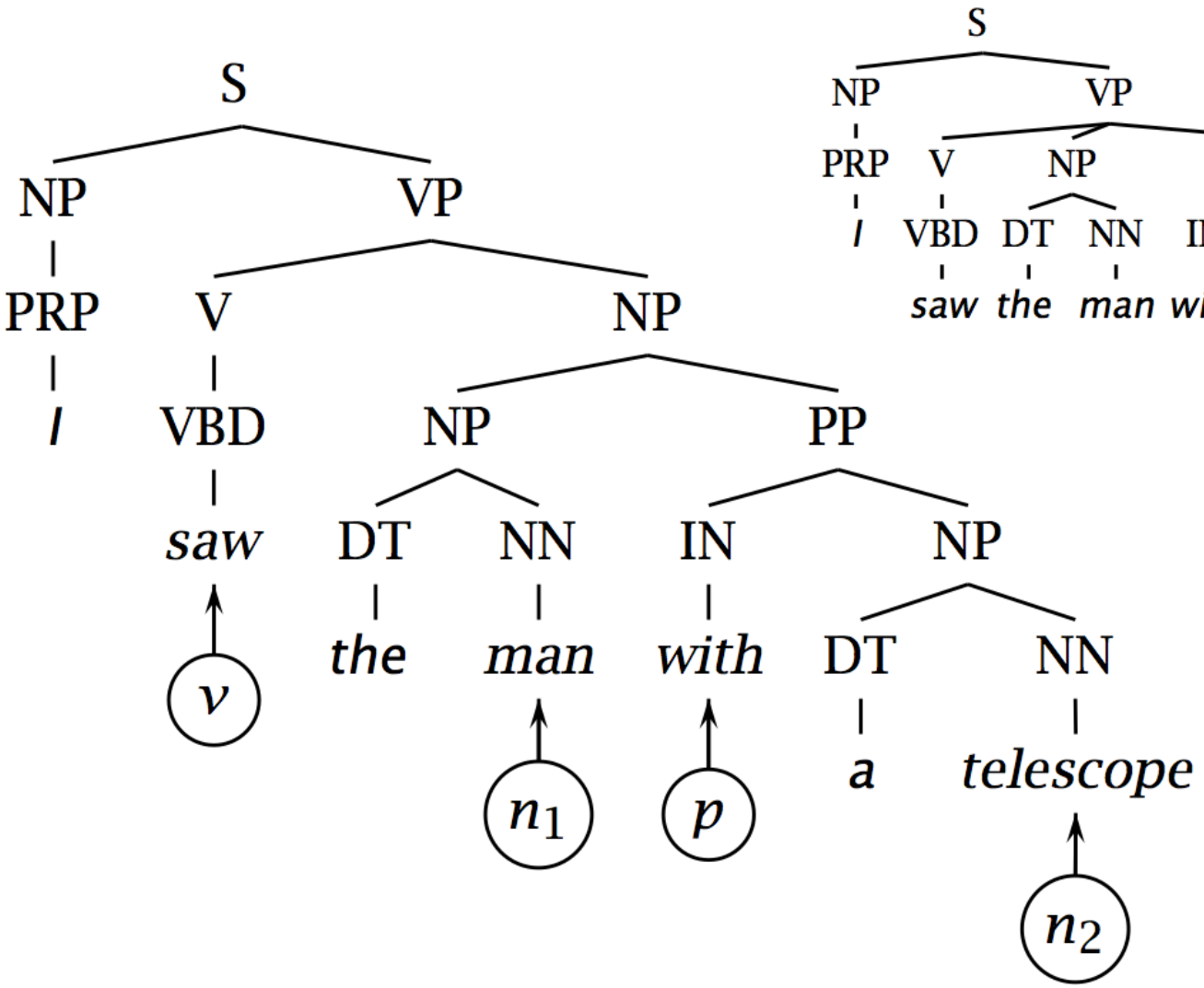
- Anaphora Resolution:

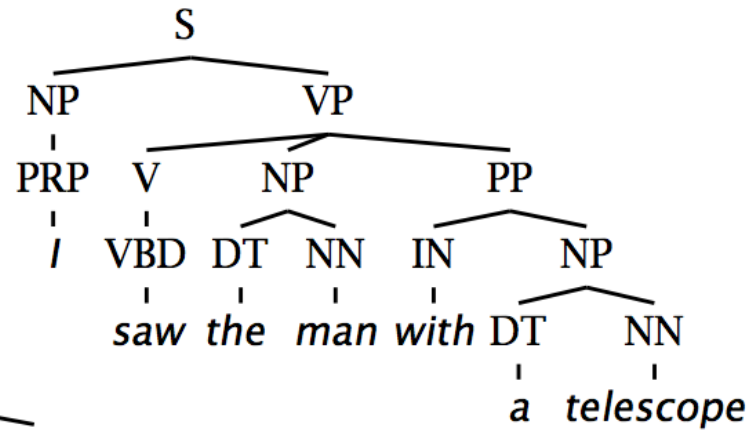
"The dog entered my room. It scared me"

- Preposition Attachment

"I saw the man in the park with a telescope"

Syntactic Parsing





Syntax vs. Semantics

(1) Colorless green ideas sleep furiously.

(2) Furiously sleep ideas green colorless.

"…(1), though nonsensical, is grammatical, while (2) is not." (Chomsky 1957)

Issues in Semantics

- Understand language! How?
- *“plant” = industrial plant*
- *“plant” = living organism*
- Words are ambiguous
- Importance of semantics?
  - Machine Translation: wrong translations
  - Information Retrieval: wrong information
  - Anaphora Resolution: wrong referents

Ambiguity

I made her duck.

- Possible interpretations of the text out of context:
  - I cooked waterfowl for her.
  - I cooked the waterfowl that is on the plate in front of her.
  - I created a toy (or decorative) waterfowl for her.
  - I caused her to quickly lower her head.

Why Semantics?

- The sea is at the home for billions factories and animals

- The sea is home to million of plants and animals
- English → French [commercial MT system]
- Le mer est a la maison de billion des usines et des animaux
- French → English

English -- Russian

- ***The spirit is willing but the flesh is weak. (English)***
- ***The vodka is good but the meat is rotten. (Russian)***

Why are these funny?

- Ban on Nude Dancing on Governor's Desk
- Iraqi Head Seeks Arms
- Juvenile Court to Try Shooting Defendant
- Teacher Strikes Idle Kids
- Stolen Painting Found by Tree
- Local High School Dropouts Cut in Half
- Red Tape Holds Up New Bridges
- Clinton Wins on Budget, but More Lies Ahead
- Hospitals Are Sued by 7 Foot Doctors
- Kids Make Nutritious Snacks

Information Retrieval

- General model:
  - A huge collection of texts
  - A query
- Task: find documents that are relevant to the given query
- How? Create an index, like the index in a book

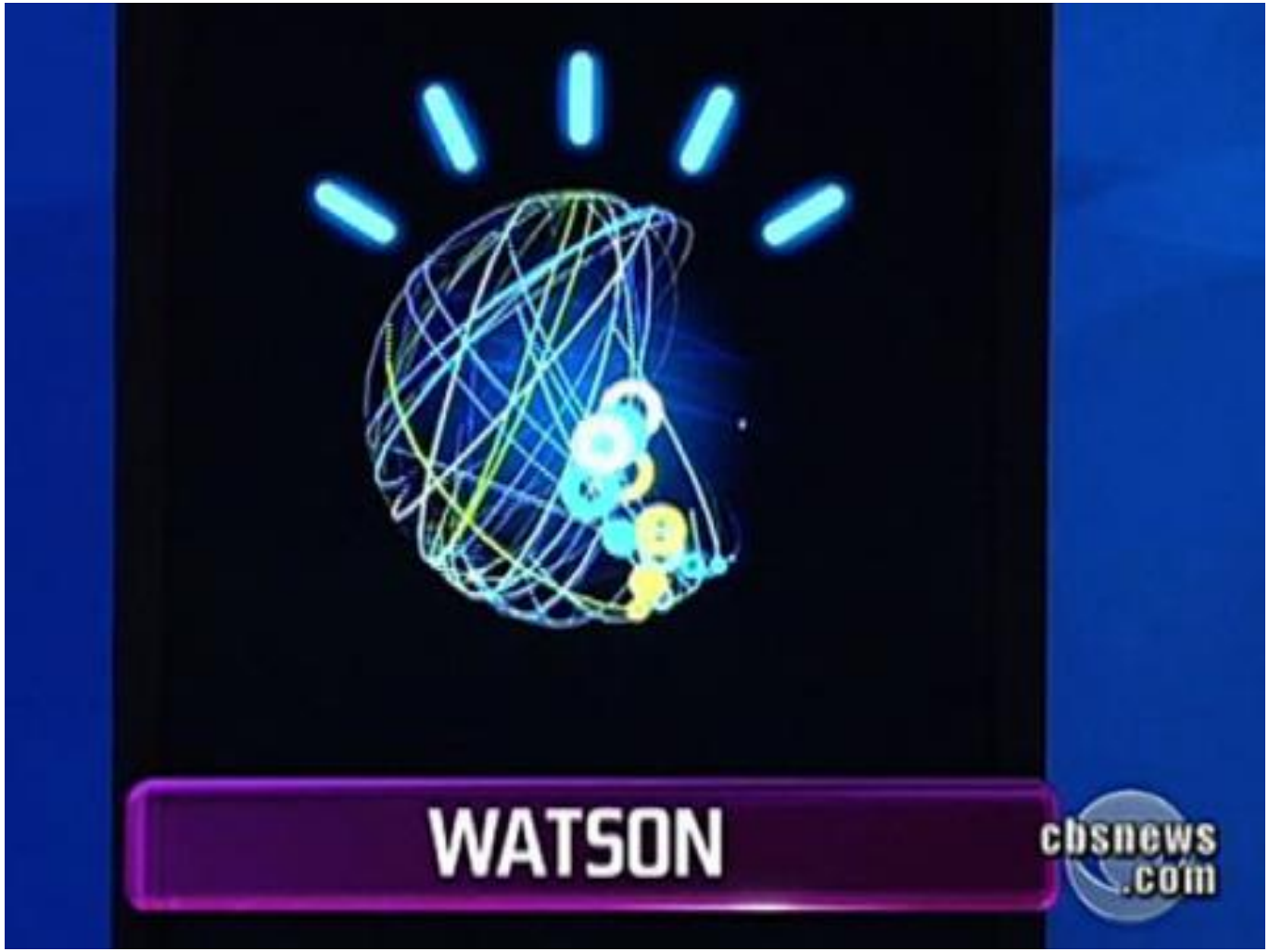
- Retrieve specific information: Question Answering
- “What is the height of mount Everest?”
- 11,000 feet

Information Extraction

- “There was a group of about 8-9 people close to the entrance on Highway 75”
- Who? “8-9 people”
- Where? “highway 75”

- Extract information
- Detect new patterns:
  - Detect hacking / hidden information / etc.
- Gov./mil. puts lots of money put into IE research

Watson



http://www.youtube.com/watch?v=WFR3lOm_xhE

Watson

And Ken Jennings pledges obeisance to the new Computer Overlords..

http://www.youtube.com/watch?v=Y2wQQ-xSE4s