61A Lecture 35

Wednesday, December 4

Announcements

- Homework 11 due Thursday 12/5 @ 11:59pm.
- No video of lecture on Friday 12/6.
  - Come to class and take the final survey.
  - There will be a screencast of live lecture (as always).
  - Screencasts: http://www.youtube.com/view_play_list?p=-XXv-cvA_iCIEwJhyDVdyLMCiimv6Tup
- Homework 12 due Tuesday 12/10 @ 11:59pm.
  - All you have to do is vote on your favorite recursive art.
- 29 review sessions next week! Come learn about the topics that interest you the most.
  - See http://inst.eecs.berkeley.edu/~cs61a/fa13/exams/final.html for the schedule.

Natural Language Processing

Ambiguity in Natural Language

Unlike programming languages, natural languages are ambiguous.

Syntactic ambiguity:	TEACHER STRIKES IDLE KIDS	HOSPITALS ARE SUED BY 7 FOOT DOCTORS
Semantic ambiguity:	IRAQI HEAD SEEKS ARMS	STOLEN PAINTING FOUND BY TREE

Tasks in Natural Language Processing

Research in natural language processing (NLP) focuses on tasks that involve language:

Question answering. "*Harriet Boyd Hawes was the first woman to discover and excavate a Minoan settlement on this island.*" Watson says, "What is Crete?"

Machine Translation. "Call a spade a spade!" Google Translate says, "Appeler un chat un chat."

Semantic Parsing. "When's my birthday?" Siri says, "Your birthday is May 1st."

Much attention is given to more focused language analysis problems:

Coreference Resolution: Do the phrases "Barack Obama" and "the president" co-refer?

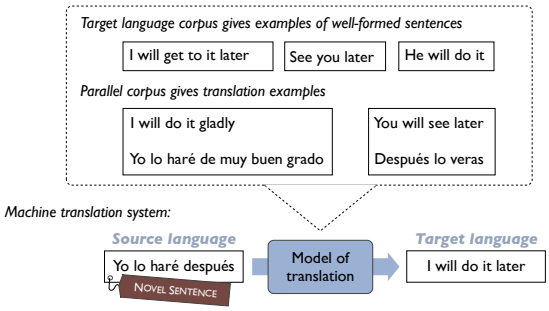
Syntactic Parsing: In "I saw the man with the telescope," who has the telescope?

Word Sense Disambiguation: Does the "bank of the Seine" have an ATM?

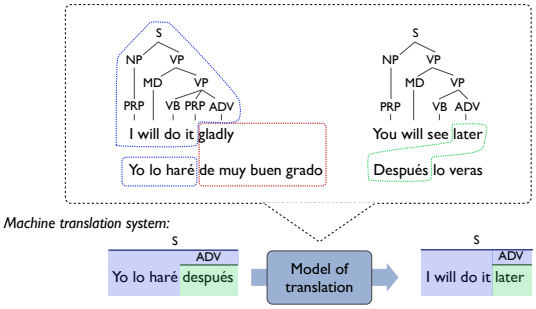
Named-Entity Recognition: What names are in "Did van Gogh paint the Bank of the Seine?"

Machine Translation

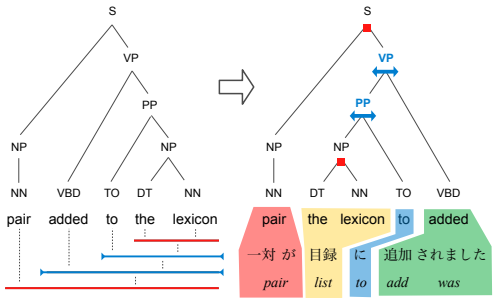
Machine Translation



Syntactic Agreement in Translation



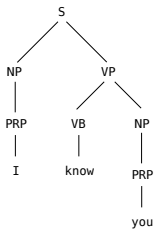
Syntactic Reordering in Translation



Context-Free Grammars

A Context-Free Grammar Models Language Generation

A grammar contains rules that hierarchically generate word sequences using syntactic tags.



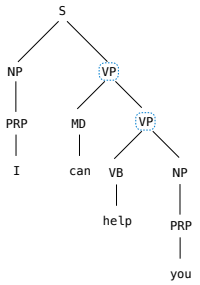
Grammar Rules

```
S -> NP VP
NP -> PRP
VP -> VB
VP -> VB NP
```

Lexicon

```
PRP -> I
PRP -> you
VB -> know
VB -> help
```

Probabilistic Context-Free Grammars



Grammar Rules

```
S -> NP VP
NP -> PRP
0.2 VP -> VB
0.7 VP -> VB NP
0.1 VP -> MD VP
```

Lexicon

```
PRP -> I
PRP -> you
VB -> know
VB -> help
MD -> can
```

Learning Probabilistic Context-Free Grammars

(Demo)

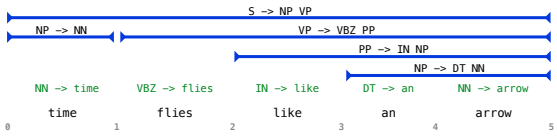
Parsing with Probabilistic Context-Free Grammars

Parsing is Maximizing Likelihood

A probabilistic context-free grammar can be used to select a parse for a sentence.

Parse by finding the tree with the highest total probability that yields the sentence.

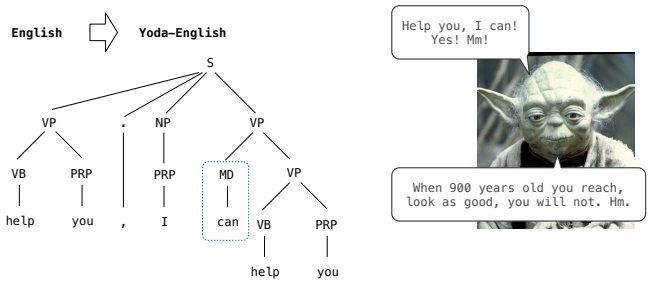
Algorithm: Try every rule over every span. Match the lexicon to each word.



(Demo)

Tree Transformations

Reordering Modal Arguments



(Demo)