Introduction to Natural Language Processing
Phase 2: Question Answering
The plan for the next two weeks

**Week 8: Question Answering I & II**

**Homework 6 DUE. Wednesday 11:59 PM May 21st.**

**May 20th: Question Answering I, cont**

**Working with NLU representations for Question Answering II**

- Baseline QA system. String operations, sentence ranking
- Types of Questions in baseline QA: Who, What, When, Where
- Identifying likely phrases and sentences
- Ranking possibly responses
- Chunking and Parsing: How to search trees
- Sample Code Stubs for baseline system
- Maximizing Recall at the expense of Precision

**May 22nd:**

**Question Answering II: Using Syntax**

**Homework 7 ASSIGNED. DUE Wednesday 11:59 PM May 28th.**

**Natural Language Generation:**

- Introduction to Natural Language Generation
  
  **Guest Lecture Dr. Irene Langkilde-Geary**
  
  - Working with NLU representations.
  - Syntactic Structure and Coordination
  - Prepositional Phrase Attachments
  - Dependency vs. Constituent Structures I
  - Answering Questions from NLU/parsing representations

- **Tuesday (Reid)**
  - Baseline
  - How to use syntax

- **Today**
  - More on how to use syntax
  - Special Guest: Statistical natural language generation
Next week: Simple use of VN WN APIs.

Week 9: Question Answering III: Lexicons & Lexical Semantics

Homework 7 DUE. Wednesday 11:59 PM May 28th.

May 27th: Using VerbNet and WordNet
- Word Sense Disambiguation
- Words go in Herds
- Verbnet and Wordnet API, how it works
- Review NLTK Lexical resources (Read Chapter 2)
- Lexical Meaning: Wordnet and Verbnet
- Wordnet (READ ch. 2.5)
- Synonyms and Synsets.
- Verbs and their dependents, VerbNet semantic role types

May 29th: Review of all techniques for QA, types of questions, methods
- Verbnet and Wordnet API, how it works
- Constituent and Dependency Trees, finding subjects etc
- Increasing Precision of Answers
The plan for the next two weeks

Week 10: Question Answering Competition

Homework 8 DUE. Tuesday 11:59 PM June 3rd (accepted late only until Wednesday 10:00 AM 4th)

June 3rd: No Class

- Work on your QA system, due this DAY at 9 PM.

June 5th: Question Answering Competition Results

- STUDENT PRESENTATIONS. TEN MINUTES. SHOW YOUR SYSTEM.
- OUR ANALYSIS. What's hot and what's not.

FINAL Thurs: June 12: Bring a pink scantron. Some material from midterm as well as since then.
Baseline System

- To get started do something simple

**First Steps**
- Look for lexical overlap between the question and each sentence
- Rank each sentence by number of words in common
- Return the one with the highest overlap
Baseline System

Next Steps

- Classify questions into types
- Build simple parsers for each question type:
  - Who, what, when, where, etc.
  - E.g., identify type of expected answer
- Take word order into account
- Stem/lemmatize words
- Look for named entities of the proper type near keywords
- Rephrase question
QA II:
How can we use syntax?
What is syntax good for?

- Increasing Precision

- Some kinds of questions hard to answer from the string because of long distance syntactic dependencies.

  “The people rebelled and created a riot”

- Who created a riot?

- What did the people create?
A fox observed the crow and tried to discover how to get the cheese.
Looking at Stanford’s outputs

Your query

A fox observed the crow and tried to discover how to get the cheese.

Tagging

A/DT fox/NN observed/VBD the/DT crow/NN and/CC tried/VB

Parse

(ROOT
  (S
    (NP (DT A) (NN fox))
    (VP
      (VP (VBD observed)
        (NP (DT the) (NN crow)))
      (CC and)
      (VP (VBD tried)
        (S
          (VP (TO to)
            (VP (VB discover)
              (SBAR
                (WHADVP (WRB how))
                (S
                  (VP (TO to)
                    (VP (VB get)
                      (NP (DT the) (NN cheese))))))))))
  (.. .)))

Typed dependencies

det(fox-2, A-1)
nsubj(observed-3, fox-2)
root(ROOT-0, observed-3)
det(crow-5, the-4)
dobj(observed-3, crow-5)
cd( observed-3, and-6)
conj( observed-3, tried-7)
aux(discover-9, to-8)
xcomp(tried-7, discover-9)
advmod(get-12, how-10)
aux(get-12, to-11)
ccomp(discover-9, get-12)
det(cheese-14, the-13)
dobj(get-12, cheese-14)
Using Demo to examine parser output


Your query

*A fox observed the crow and tried to discover how to get the cheese.*

Tagging

A/DT fox/NN observed/VBD the/DT crow/NN and/CC tried/VBD

Parse

(ROOT
  (S
    (NP (DT A) (NN fox))
    (VP
      (VP (VBD observed)
        (NP (DT the) (NN crow)))
      (CC and)
      (VP (VBD tried)
        (S
          (VP (TO to)
            (VP (VB discover)
              (SBAR
                (WHADVP (WRB how))
                (S
                  (VP (TO to)
                    (VP (VB get)
                      (NP (DT the) (NN cheese)))))))))

- Who tried to discover how to get the cheese?

- How do we figure out the subject of “tried to discover”?

- S = NP VP

- VP = VP CC VP
Fox observed and tried to discover

Who tried to discover how to get the cheese?

How do we figure out the subject of “tried to discover”

NSUBJ (observed, fox)

Where is the NSUBJ for “tried”

CONJ (observed, tried)
And now for something completely different. NOT.
Story: Fox observed and set his wits

http://nlp.stanford.edu:8080/parser/index.jsp
Story: Fox observed and set his wits

(NP (DT a) (NN piece))
(PP (IN of))
(NP (NN cheese))
(PP (IN in))
(NP (PRP$ her) (NN beak)))
(SBAR)
(WHADVP (WRB when))
(S)
(NP (DT a) (NNP Fox))
(VP (VP (VBD observed))
(NP (PRP her)))
(CC and)
(VP (VBD set))
(NP (PRP$ his) (NNS wits))
(S)
(VP (TO to))
(VP (VB work))
Fox observed and set his wits
Eagle Knocked and Spilled.

Stanford Parser

Please enter a sentence to be parsed:

Heated with his exertions, the man was about to slake his thirst with a draught from the horn, when the Eagle knocked it out of his hand, and spilled its contents upon the ground.

Language: English

Sample Sentence

Your query

Heated with his exertions, the man was about to slake his thirst with a draught from the horn, when the Eagle knocked it out of his hand, and spilled its contents upon the ground.
and spilled

(SBAR
  (WHADVP (WRB when))
(S
  (NP (DT the) (NNP Eagle))
  (VP
    (VP (VBD knocked)
      (NP (PRP it))
      (PRT (RP out))
      (PP (IN of)
        (NP (PRP$ his) (NN hand))))
    (, ,)
    (CC and)
    (VP (VBD spilled)
      (NP (PRP$ its) (NNS contents))
      (PP (IN upon)
        (NP (DT the) (NN ground))))))))))))

(. .)))
The Dependency Tree

det(Eagle-23, the-22)
nsubj(knocked-24, Eagle-23)
rcmod(horn-19, knocked-24)
dobj(knocked-24, it-25)
prt(knocked-24, out-26)
prep(knocked-24, of-27)
poss(hand-29, his-28)
pobj(of-27, hand-29)
cc(knocked-24, and-31)
conj(knocked-24, spilled-32)
poss(contents-34, its-33)
dobj(spilled-32, contents-34)
prep(spilled-32, upon-35)
det(ground-37, the-36)
A young man long ago crashed the motorbike of the young man on the front yard of a narrator and broke the neck of the young man. The narrator stayed with the young man and didn't aid him because the young man had broken the neck of the young man. The young man died on the spot of the yard of the narrator. The narrator later went back to the spot of the yard of the narrator and decided to talk to the young man because it wanted the young man to know the narrator regretting that it had not aided him. The narrator saw some bright flash in a group of trees that was above the narrator. The narrator thought for the brother of the narrator to use the flashlight of the brother of the narrator. The narrator entered the house of the narrator and heard that the asleep family of the narrator was asleep. The narrator began to wonder that the flash was an orb.
Who broke the neck of the young man?
Who broke the neck of the young man?
SCH. A summit meeting named G20 summit started on eventful today. G20 summit happened annually. A world and many leader came and talked about it running a government. A people protested because it disagreed about a view. The people protested peacefully on a street. The people rebelled and created riot. The people burned a police car and threw a thing at a police. The police alleviated the people of riot. The police fired a tear gas at the people and fired a bullet at the people, and the people smashed a window.

- Who created a riot?
- Who fired a bullet at the people?
And now for something completely different. Kind of.
SCH. A summit meeting named G20 summit started on eventful today. G20 summit happened annually. A world and many leader came and talked about it running a government. A people protested because it disagreed about a view. The people protested peacefully on a street. The people rebelled and created riot. The people burned a police car and threw a thing at a police. The police alleviated the people of riot. The police fired a tear gas at the people and fired a bullet at the people, and the people smashed a window.

- What did the people create?
The people rebelled and created a riot.

**Tagging**
The/DT people/NNS rebelled/VBD and/CC

**Parse**

```
(ROOT
  (S
    (NP (DT The) (NNS people))
    (VP (VBD rebelled))
    (CC and)
    (VP (VBD created)
      (NP (NN riot))))

Typed dependencies**

- det(people-2, The-1)
- nsubj(rebelled-3, people-2)
- root(ROOT-0, rebelled-3)
- cc(rebelled-3, and-4)
- conj(rebelled-3, created-5)
- dobj(created-5, riot-6)
```
Adverbials: When did the young man die?

Your query

A few years ago, a young man died out on my front lawn when he crashed his motorbike.

Tagging

A/DT few/JJ years/NNS ago/RB ,/, a/DT young/JJ man/NN died/VBD out/F

Parse

(ROOT
  (S
    (ADVP
      (NP (DT A) (JJ few) (NNS years))
      (RB ago))
    (NP (DT a) (JJ young) (NN man))
    (VP (VBD died)
      (PRT (RP out))
      (PP (IN on)
        (NP (PRP$ my) (JJ front) (NN lawn)))))
  (S
    (WHADVP (WRB when))
    (S
      (NP (PRP he))
      (VP (VBD crashed)
        (NP (PRP$ his) (NN motorbike)))))))

- “years” can answer a when question
- When adverbials can answer a when question