Introduction to Natural Language Processing
More QA
Using Lexical Semantics
HW6 Summary
CMPS143  2015 Spring
## HW6 Results

<table>
<thead>
<tr>
<th>Team</th>
<th>Recall Train</th>
<th>Recall Dev (Easy)</th>
<th>Precision Train</th>
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<th>F-measure Train</th>
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<td>Centaurs</td>
<td>0.5172</td>
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<td>0.2387</td>
<td>0.3072</td>
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<td>0.5763</td>
<td>0.6301</td>
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<td>-</td>
<td>Unable to fix for the heldout data.</td>
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</tbody>
</table>

Dev: HW7 - Easy Question. (student-easy.txt)
Code

- Try to make your code clear by clear names, and comments.
- Separate different logic by functions.
- Make them more robust on unseen heldout, for example,

  - KeyError:
    
    ```python
    if key in dict:
        d = dict[key]
    ```

  - Index Out of Range Error:
    
    ```python
    if len(list) > k:
        a = list[k]
    ```
Evaluation - File Order

Your code needs to analyse the questions in the order of fables-01, fables-02, ... blogs-01, blogs-02... even the unseen files, so here is an example code of doing it:

```python
# TODO: this function is just for reference, you may need to check about the real requirement.
def get_sorted_question_ids(questions):
    sorted_question_ids = []
    orders = ["fables", "blogs"] # This order is very important.
    for ord in orders:
        for i in range(1, 10): # This upper bound is the maximum number of files...
            file_name = "{}-0{}1".format(ord, i)
            for j in range(1, len(questions)): # This is not the actual upperbound.
                qid = "{}-{}1".format(file_name, j)
                if qid not in questions: # At the end of the questions in each file_name
                    break
                sorted_question_ids.append(qid)
    return sorted_question_ids
```
Evaluation - Question Order

```
perl score-answers.pl train_my_answers.txt train_answers.answer
```

You need to
- make sure the order of question is correct;
- make sure when no answer return, you still write “Answer:”
- there is no new line between QuestionID and Answer, for example:
  ```
  QuestionID: fables-01-1
  Answer: XXXXXX
  ```
Here are the rubric for the homework 7:

1. **Summary**: a brief summary of what your team have improved, in your own words.
2. **Submission**: You must submit the program, and with consistent version in the team.
3. **Code**: clear code without exception.
4. **Evaluation**: your output file must be in the correct format so that the perl script can run it.

Each of this point will take 5 units., which sum up as 20 units.
Rubric

More specifically:

1. **Summary:** Please use your own words in one or two sentences to summary what your team has improved for the parser. Paste it in the "Assignment Submission" window in eCommons.

2. **Submission:** Please submit only one version of code of your team. We are going to check the difference of the code, if they are not the same, you are going to lose 5 units.

3. **Code:** Please make sure that your code is robust enough to run on the unseen heldout data. For example, test whether the key is None before using it to get the value from a dict.

4. **Evaluation:** Please check whether the evaluation perl script can run on your output file, or you are going to lose 5 units. Note that you need to output the “Answer:” even though there is no result.

It will be great if you can meet these requirements. Thanks! :)
Summary

You are all doing good on HW6, wish you have great improvement on HW7! :)

Natural Language and Dialogue Systems
http://nlds.soe.ucsc.edu
## HW6: Last year

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<tr>
<th></th>
<th>Recall</th>
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Homework 6: grades released.

- Who are these dragons people and what are they doing that is working so well?

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- Dev: HW7 - Easy Question. (student-easy.txt)
Two weeks until final presentations

- Homework 7: Worth 20 points. Due Friday.
  - Grading will be stricter.
  - Increase precision using syntax w/out losing recall

- HW8: Last Phase. Worth 25 points
  - Continue testing techniques so far
  - Add in lexical semantics: noun and verb synsets, etc.

- **Final Slot: Presentations and Competition**: see who can get the best accuracy on the test set.
  - Presentation a team presentation worth 10 points
Homework 7: last year, note scoring

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</table>
Using 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/VBD

Parse

(ROOT
   (S
      (NP (DT A) (NN fox))
      (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)
cc(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)
comp(discover-9, get-12)
det(cheese-14, the-13)
dobj(get-12, cheese-14)
Get the Manual and Use it

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/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)))))))))
    (.))))

- 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)
Next Week: Project & Final

- Tuesday: special section in class to answer project questions or final questions
- Final: should not be any harder/longer than the midterm
  - Covering parsing
  - Syntactic structures and dependency representations
  - Wordnet & Verbnet
  - Questions related to the project
HW8: Today and Thursday

- HW8: New test/dev set released
- New Stories in HW7 and HW8
- More data all the time
- New easy, medium questions released, SAME Type
- New Hard Questions: using subset of lexical relations in Wordnet and Verbnet
- Verbnet subset: we will give you a Verbnet file that has only the entries from NLTK
- Will provide Word Sense Disambiguation information for verbs as well as nouns
What is Word Sense Disambiguation?
Word Sense Disambiguation

- An area of NLP which focuses on automatically finding the word senses for words in text or dialogue.
- Not yet a solved problem.
- Classic Example:
  - I took the money to the bank.
  - I went fishing at the bank.
- “Words go in Herds”: Money would rarely co-occur with fishing.
- Many methods, current research.
- We will disambiguate your words for you.
Word Sense Disambiguation

Classic Example:

- I took the money to the bank.
- I went fishing at the bank.
- But also “a bank of switches”

WordNet Search - 3.1
- WordNet home page - Glossary - Help

Word to search for: bank

Display Options: (Select option to change)

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations
Display options for sense: "an example sentence"

Noun

- S: (n) bank "they pulled the canoe up on the bank"; "he sat on the bank of the river and watched the currents"
- S: (n) depository financial institution, bank, banking concern, banking company "he cashed a check at the bank"; "that bank holds the mortgage on my home"
- S: (n) bank "a huge bank of earth"
- S: (n) bank "he operated a bank of switches"
Word Sense: A Sense Key

WordNet Search - 3.1
- WordNet home page - Glossary - Help

Word to search for: bank

Display Options: (Select option to change)
Change

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations
Display options for sense: "an example sentence"
Display options for word: word (sense key)

Noun

- S: (n) bank (bank%1:17:01::) "they pulled the canoe up on the bank"; "he sat on the bank of the river and watched the currents"
- S: (n) depository financial institution (depository_financial_institution%1:14:00::), bank (bank%1:14:00::), banking concern (banking_concern%1:14:00::), banking company (banking_company%1:14:00::) "he cashed a check at the bank"; "that bank holds the mortgage on my home"
- S: (n) bank (bank%1:17:00::) "a huge bank of earth"
What were we doing with words when we annotated
A Lion watched a fat Bull feeding in a meadow, and his mouth watered when he thought of the royal feast he would make, but he did not dare to attack him, for he was afraid of his sharp horns.

There once was a fat bull. The bull was grazing in a meadow. A lion watched the bull and salivated because the lion wanted to eat the bull. The lion didn't attack the bull because the lion feared sharp every horn of the bull.
The Wily Lion: Scheherezade

A Lion watched a fat Bull

feeding

in a meadow,

and his mouth watered

when he thought of the royal feast he would make,

but he did not dare to attack him,

for he was afraid of his sharp horns.

presently compelled him to do something:

the lion is watching the bull

the bull is eating

in the meadow

the lion salivates

because the lion believes that the bull is tasty

the bull is tasty

the lion doesn't dare himself to attack the bull

because the lion fears the horn of the bull

the lion decides to pursue the bull
Used the Sch menus to pick word senses
The Word Senses of “feed”

Verb

- [34] S: (v) range#7 (range%2:34:00::) (let eat) "range the animals in the prairie"
- [35] S: (v) crop#4 (crop%2:35:10::), graze#3 (graze%2:35:10::), pasture#1 (pasture%2:35:10::) (let feed in a field or pasture or meadow)
  - direct hypernym / inherited hypernym / sister term
  - derivationally related form
  - sentence frame
- [35] S: (v) graze#2 (graze%2:35:02::) (break the skin (of a body part) by scraping) "She was grazed by the stray bullet"
- [35] S: (v) crop#4 (crop%2:35:10::), graze#3 (graze%2:35:10::), pasture#1 (pasture%2:35:10::) (let feed in a field or pasture or meadow)
- [35] S: (v) graze#4 (graze%2:35:00::), crease#3 (crease%2:35:02::), rake#6 (rake%2:35:02::) (scrape gently) "graze the skin"
- [34] S: (v) browse#4 (browse%2:34:00::), graze#5 (graze%2:34:02::) (eat...
Using Synonyms, Hyponyms, Hypernyms

- Where was the bull feeding?
- Where was the bull cropping?
- Where was the bull pasturing?
- Where was the bull eating?
It’s very easy to navigate between concepts. For example, given a concept like *motorcar*, we can look at the concepts that are more specific; the (immediate) **hyponyms**.
The WordNet Hierarchy in NLTK

• Hypernyms and hyponyms are called **lexical relations** because they relate one synset to another. These two relations navigate up and down the "is-a" hierarchy.
It’s very easy to navigate between concepts. For example, given a concept like *motorcar*, we can look at the concepts that are more specific; the (immediate) **hyponyms**.

- Motorcare has only one sense
The WordNet Hierarchy in NLTK

- We can also navigate up the hierarchy by visiting hypernyms. Some words have multiple paths, because they can be classified in more than one way. There are two paths between `car.n.01` and `entity.n.01` because `wheeled_vehicle.n.01` can be classified as both a vehicle and a container.
  
  - **direct hypernym / inherited hypernym / sister term**
    - *S:* (n) motor vehicle#1, automotive vehicle#1
      - *S:* (n) self-propelled vehicle#1
      - *S:* (n) wheeled vehicle#1
        - *S:* (n) vehicle#1
          - *S:* (n) conveyance#3, transport#1
            - *S:* (n) instrumentality#3, instrumentation#1
              - *S:* (n) artifact#1, artefact#1
                - *S:* (n) whole#2, unit#6
                  - *S:* (n) object#1, physical object#1
                    - *S:* (n) physical entity#1
                      - *S:* (n) entity#1

  - *S:* (n) container#1
    - *S:* (n) instrumentality#3, instrumentation#1
      - *S:* (n) artifact#1, artefact#1
        - *S:* (n) whole#2, unit#6
          - *S:* (n) object#1, physical object#1
            - *S:* (n) physical entity#1
              - *S:* (n) entity#1
A Lion watched a fat Bull feeding in a meadow, and his mouth watered...

There once was a fat bull. The bull was grazing in a meadow.

Verb

- [35] S: (v) crop#5 (crop%2:35:01::), browse#2 (browse%2:35:01::), graze#1 (graze%2:35:01::), range#6 (range%2:35:02::), pasture#2 (pasture%2:35:00::)
  (feed as in a meadow or pasture) "the herd was grazing"
  • verb group
    - [34] S: (v) range#7 (range%2:34:00::) (let eat) "range the animals in the prairie"
    - [35] S: (v) crop#4 (crop%2:35:10::), graze#3 (graze%2:35:10::), pasture#1 (pasture%2:35:10::) (let feed in a field or pasture or meadow)
  • direct hypernym / inherited hypernym / sister term
    - [34] S: (v) feed#6 (feed%2:34:00::), eat#3 (eat%2:34:02::) (take in food; used of animals only) "This dog doesn't eat certain kinds of meat"; "What do whales eat?"
How will we do Word Sense Disambiguation?
Eagle and the Serpent

- In revenge the Serpent spat some of his poison into the man's drinking-horn. 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.

- The serpent spat some poison in the drinking vessel. The countryman decided to sip from the drinking vessel. The eagle spilled the drinking vessel.
Some highly ambiguous Words: Horn

Noun

- (7){03542265} <noun.artifact>[06] S: (n) horn#1 (horn%1:06:06::) (a noisemaker (as at parties or games) that makes a loud noise when you blow through it)
- (3){01328058} <noun.animal>[05] S: (n) horn#2 (horn%1:05:01::) (one of the bony outgrowths on the heads of certain ungulates)
- (1){07280214} <noun.communication>[10] S: (n) horn#3 (horn%1:10:02::) (a noise made by the driver of an automobile to give warning)
- (1){03542111} <noun.artifact>[06] S: (n) horn#4 (horn%1:06:04::), saddle horn#1 (saddle_horn%1:06:00::) (a high pommel of a Western saddle (usually metal covered with leather))
- (1){03115320} <noun.artifact>[06] S: (n) cornet#1 (cornet%1:06:00::), horn#5 (horn%1:06:01::), trumpet#1 (trumpet%1:06:00::), trumpet#3 (trumpet%1:06:01::) (a brass musical instrument with a brilliant tone; has a narrow tube and a flared bell and is played by means of valves)
- (1){01328494} <noun.animal>[05] S: (n) horn#6 (horn%1:05:02::) (any hard protuberance from the head of an organism that is similar to or suggestive of a horn)
- {14782206} <noun.substance>[27] S: (n) horn#7 (horn%1:27:00::) (the material (mostly keratin) that covers the horns of ungulates and forms hooves and claws and nails)
- {03542421} <noun.artifact>[06] S: (n) horn#8 (horn%1:06:07::) (a device...
Word to search for: drinking vessel

Display Options: (Select option to change) Change

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations
Display options for sense: (frequency) {offset} <lexical filename> [lexical file number] (gloss) "an example sentence"
Display options for word: word#sense number (sense key)

Noun

- {03246199} <noun.artifact>[06] S: (n) drinking vessel#1
  (drinking_vessel%1:06:00::) (a vessel intended for drinking)
  - direct hyponym / full hyponym
    - {03699033} <noun.artifact>[06] S: (n) loving cup#1
      (loving_cup%1:06:01::) (a large drinking vessel (usually with two handles) that people drink out of in turn at a banquet)
    - {03802912} <noun.artifact>[06] S: (n) mug#4 (mug%1:06:00::)
      (with handle and usually cylindrical)
    - {04337327} <noun.artifact>[06] S: (n) stoup#1 (stoup%1:06:02::)
      (an archaic drinking vessel)
    - {04396517} <noun.artifact>[06] S: (n) tankard#1
      (tankard%1:06:00::) (large drinking vessel with one handle)
Use the Sch files to produce a CSV

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Use the Sch files to produce a CSV

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VerbNet: A Verb Lexicon

- VerbNet, a hierarchical verb lexicon linked to WordNet. It can be accessed with nltk.corpus.verbnet.
- VerbNet is the largest on-line verb lexicon currently available for English.
- It is a hierarchical domain-independent, broad-coverage verb lexicon with mappings to other lexical resources such as WordNet and FrameNet.
- **NLTK only has a subset of VerbNet.**
- We are only giving you Verb WSDs when they are in NLTK verbnet
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<td>2421374</td>
<td>free</td>
<td>set(['fables-03.vgl'])</td>
<td></td>
</tr>
<tr>
<td>bring.v.01</td>
<td>2077656</td>
<td>bring</td>
<td>set(['blogs-03.vgl'])</td>
<td></td>
</tr>
</tbody>
</table>
Verb CSV has Verb Lemmas

- Word, Synset ID, Synset offset, Lemmas
- Lemmas are the Word roots for the synonyms
- Make a DICT from the CSV

```
burn,burn.v.03,377002,"[Lemma('burn.v.03.burn'), Lemma('burn.v.03.combust')]"
flea,flea.v.01,2421374,"[Lemma('flea.v.01.flea'), Lemma('flea.v.01.liberate')]
ase'], Lemma('flea.v.01.unloose'), Lemma('flea.v.01.unloosen'), Lemma('flea.v
graze,graze.v.02,1608508,"[Lemma('graze.v.02.graze')]"
devour,devour.v.02,1820798,"[Lemma('devour.v.02.devour')]"
rebel,rebels.v.01,2583139,"[Lemma('rebels.v.01.rebel'), Lemma('rebels.v.01.arise')]
ise'), Lemma('rebels.v.01.rise_up')]"
put,put.v.01,1494310,"[Lemma('put.v.01.put'), Lemma('put.v.01.set'), Lemma('put
```
A Lion watched a fat Bull **feeding** in a meadow, and his mouth watered...

There once was a fat bull. The bull was **grazing** in a meadow.

There once was a fat bull. The bull was pasturing in a meadow.
There was a protest that happened along the street where I work and at first it looked peaceful until a bunch of people started rebelling and creating a riot. Police cars were burned and things were thrown at cops.
Eagle and the Serpent

- In revenge the Serpent spat some of his poison into the man's drinking-horn. 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.

- The serpent spat some poison in the drinking vessel. The countryman decided to sip from the drinking vessel. The eagle spilled the drinking vessel.
### Verbs CSV file

<table>
<thead>
<tr>
<th>synset_id</th>
<th>synset_offset</th>
<th>story_verb</th>
<th>stories</th>
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<td>set(['fables-04.vgl'])</td>
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<td>spare.v.02</td>
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<td>tie.v.01</td>
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<td>meet.v.05</td>
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Wordnet demo
# 'Rodent' is a hypernym of 'mouse',
# so we look at hyponyms of 'rodent' to find 'mouse'

# Question: Where did the rodent run into?
# Answer: the face of the lion
# Sch: The lion awaked because a mouse ran into the face of the lion.
rodent_synsets = wn.synsets("rodent")
print("'Rodent' synsets: %s" % rodent_synsets)

print("'Rodent' hyponyms")
for rodent_synset in rodent_synsets:
    rodent_hypo = rodent_synset.hyponyms()
    print("%s: %s" % (rodent_synset, rodent_hypo))
'Rodent' synsets: [Synset('rodent.n.01')]

'Rodent' hyponyms

Synset('rodent.n.01'): [Synset('abrocome.n.01'), Synset('agouti.n.01'), Synset('beaver.n.07'), Synset('capybara.n.01'), Synset('cavy.n.01'), Synset('chinchilla.n.03'), Synset('cotton_rat.n.01'), Synset('coypu.n.01'), Synset('dormouse.n.01'), Synset('gerbil.n.01'), Synset('hamster.n.01'), Synset('jerboa.n.01'), Synset('jumping_mouse.n.01'), Synset('lemming.n.01'), Synset('mara.n.02'), Synset('marmot.n.01'), Synset('mole_rat.n.01'), Synset('mole_rat.n.02'), Synset('mountain_bea ver.n.01'), Synset('mountain_chinchilla.n.01'), Synset('mountain_paca.n.01'), Synset('mouse.n.01'), Synset('murine.n.01'), Synset('muskat.n.02'), Synset('new_world_mouse.n.01'), Synset('paca.n.01'), Synset('porcupine.n.01'), Synset('prairie_dog.n.01'), Synset('rat.n.01'), Synset('round-tailed_muskat.n.01'), Synset('s and_rat.n.01'), Synset('squirrel.n.01'), Synset('viscacha.n.01'), Synset('water_rat.n.03'), Synset('wood_rat.n.01')]

abrocome

is hypo_synset in Wordnet_nouns/verbs.dict?

agouti

is hypo_synset in Wordnet_nouns/verbs.dict?

beaver

is hypo_synset in Wordnet_nouns/verbs.dict?
# 'Know' is a hyponym of 'recognize' (know.v.09),
# so we look at hypernyms of 'know' to find 'recognize'
#
# Question: What did the mouse know?
# Answer: the voice of the lion
# Sch: The mouse recognized the voice of the lion.
know_synsets = wn.synsets("know")
print("\n'Know' synsets: %s" % know_synsets)

print("'Know' hypernyms")
for know_synset in know_synsets:
    know_hyper = know_synset.hypernyms()
    print("%s: %s" % (know_synset, know_hyper))