

A photograph of a server room with rows of server racks. The racks are filled with equipment, and many lights are glowing, creating a blue and white light effect. The perspective is looking down a long aisle between the racks.

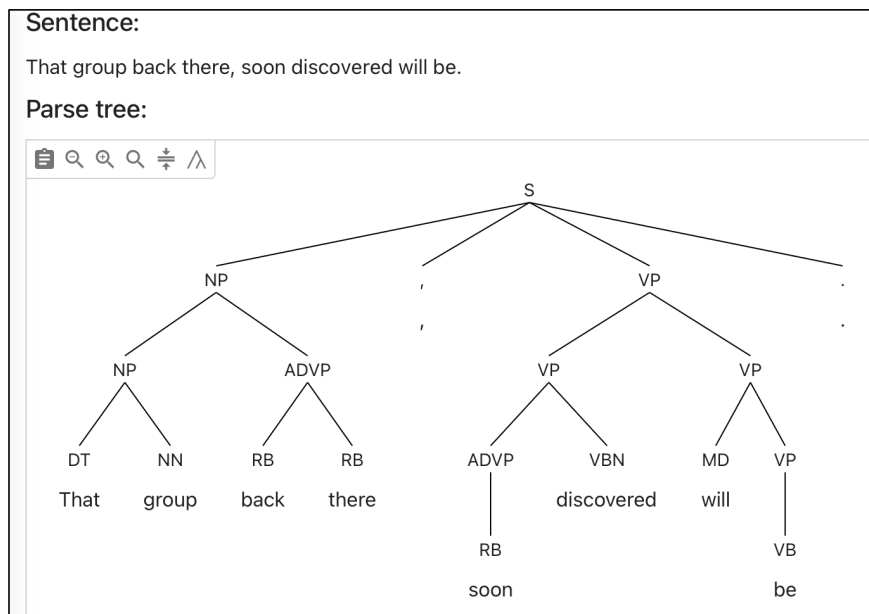
LING 388: Computers and Language

Lecture 26

Today's Topics

- Reminder:
 - Homework 10: Term Project Proposals
- Last time:
 - constituency parsing using the Berkeley neural parser etc.
 - *getting comfortable with phrase structure grammars*
- syntax and nltk
 - hands-on programming
 - writing grammar rules based on a parse

Yoda Speak

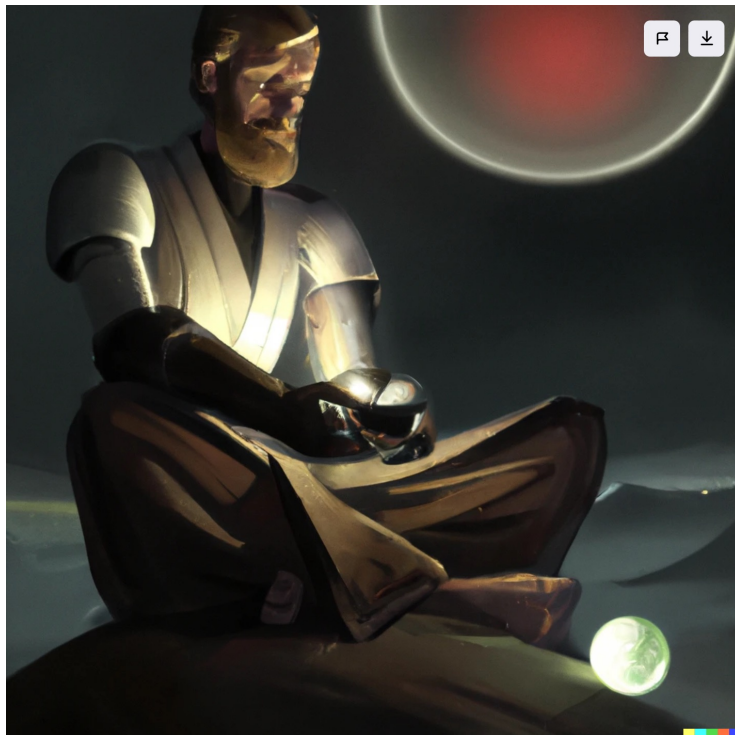


Berkeley Neural Parser

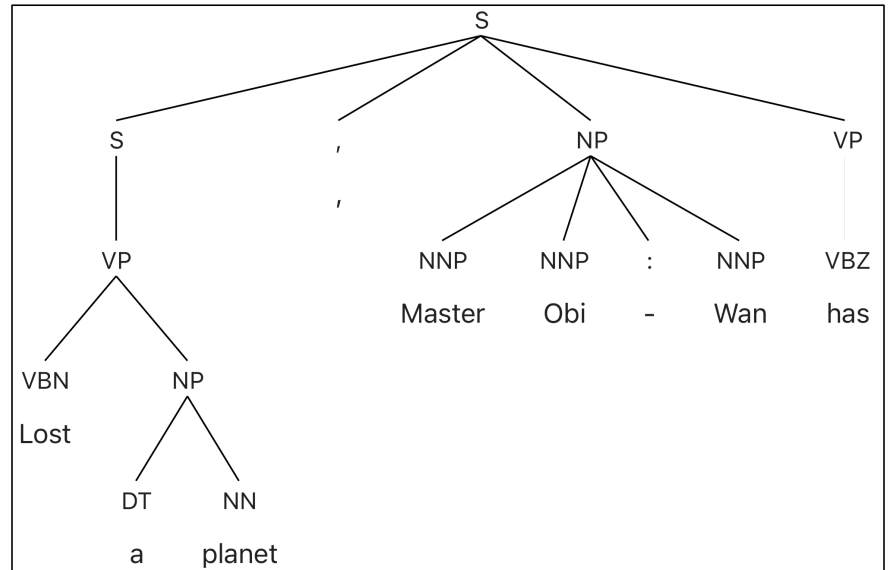
<https://parser.kitaev.io>

- Yoda speak involves displacement:
 - *still comprehensible to the native English speaker*
 - ...
 - “Lost a planet, Master Obi-Wan has.”
 - “That group back there, soon discovered will be.”

More Yoda Speak



- AI generated digital art picture from the sentence:



nltk.ChartParser()

- Using nltk:

```
$ python
```

```
>>> import nltk
```

```
>>> g = open('g.txt').read()
```

```
>>> g
```

```
"s -> y x3\ns -> x1 z\ns -> y z\ny -> x1 x2\nz -> x2 x3\nx1 -> 'w1'\nx2 -> 'w2'\nx3 -> 'w3'\n"
```

```
>>> cfg = nltk.CFG.fromstring(g)
```

```
>>> cfg
```

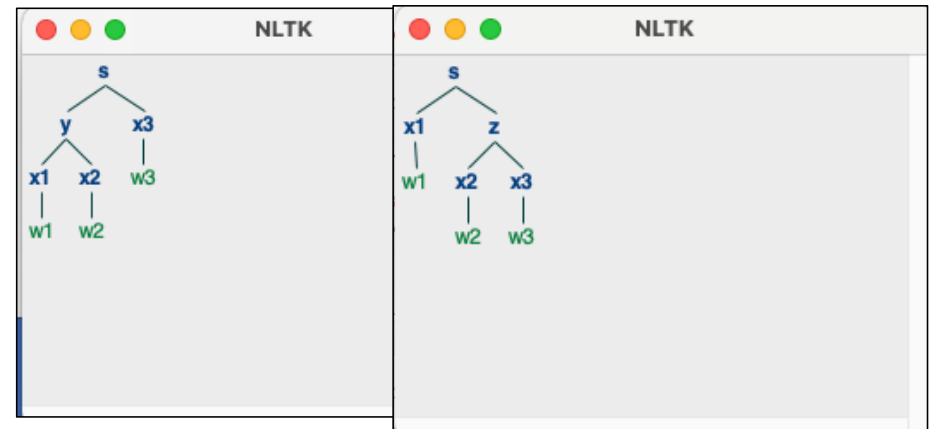
```
<Grammar with 8 productions>
```

```
>>> p = nltk.ChartParser(cfg)
```

```
>>> for tree in p.parse(['w1', 'w2', 'w3']):
```

```
...     tree.draw()
```

```
...
```

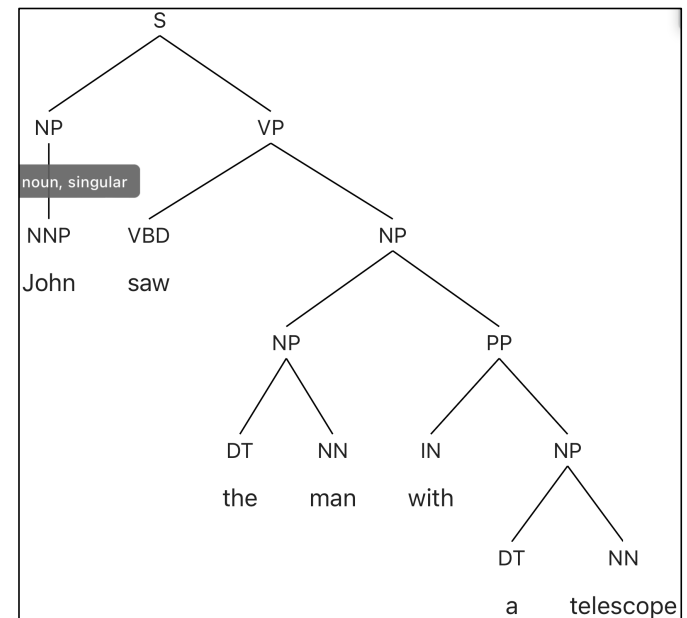
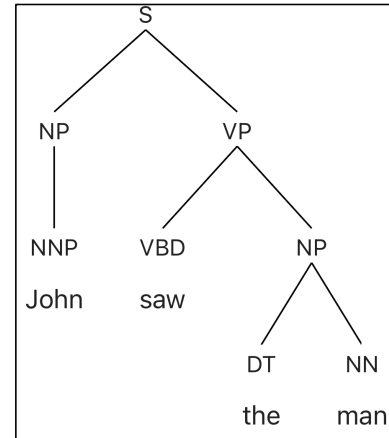


Writing a grammar

- Context-free phrase structure grammar rules should be:
 - read in from a plain text file (e.g. g.txt)
 - 1st line defines the start-symbol (S)
 - -> is the rewrite symbol (lhs -> rhs) left/right hand side
 - space between grammar symbols
 - lexical items are quoted, e.g. 'I'
 - *you cannot mix grammatical categories with lexical items on the rhs*
 - PP -> 'of' NP (disallowed)
 - *you are not permitted multi-word lexical items*
 - not ok: NP -> 'New York'
 - ok: NP -> 'New_York'

Writing a grammar

- You have to know the grammar.
- How?
 - take a syntax class, or
 - use something like the Berkeley Neural parser
 - <https://parser.kitaev.io>
 - *let's assume this*



Reference

- The part of speech (POS) tags:
 - https://www.ling.upenn.edu/courses/Fall_2003/ling001/penn_treebank_pos.html
- All the syntactic tags:
 - <https://www.ling.upenn.edu/~beatrice/gtrc/syntax/labels.htm>

Number	Tag	Description
1.	CC	Coordinating conjunction
2.	CD	Cardinal number
3.	DT	Determiner
4.	EX	Existential <i>there</i>
5.	FW	Foreign word
6.	IN	Preposition or subordinating conjunction
7.	JJ	Adjective
8.	JJR	Adjective, comparative
9.	JJS	Adjective, superlative
10.	LS	List item marker
11.	MD	Modal
12.	NN	Noun, singular or mass
13.	NNS	Noun, plural
14.	NNP	Proper noun, singular

g.txt

- Based on Berkeley Neural Parser output, we can craft a context-free grammar (CFG):

1. S → NP VP

2. NP → NNP

3. NP → DT NN

4. NP → NP PP

5. VP → VBD NP

6. VP → VP PP

7. PP → IN NP

8. NNP → 'John'

9. NNP → 'Mary'

10. VBD → 'saw'

11. DT → 'the'

12. DT → 'a'

13. NN → 'man'

14. NN → 'boy'

15. NN → 'telescope'

16. IN → 'with'

g.txt

- Let's run g.txt using nltk.ChartParser():
 1. copy grammar into a text file called g.txt
 2. `g = open('g.txt').read()`
 3. `cfg = nltk.CFG.fromstring(g)`
 4. `p = nltk.ChartParser(cfg)`
 5. `for tree in p.parse(nltk.word_tokenize(Sentence)):`
 6. `... tree.draw()`

Senses of preposition *with*

Sense diambiguation is important and humans do it reflexively.

- How many senses does *with* have?
- Source: <https://www.merriam-webster.com/dictionary/with>
 1. opposition to/separation: fight/break *with*
 2. to indicate a participant in an action, transaction, or arrangement: work/talk *with*
 3. x is identical *with* y; I'm *with* him; can pitch *with* the best of them
 4. accompaniment/addition: went there *with* her, costs \$5 *with* tax
 5. judgment/estimation: stood well *with* her classmates
 6. means/cause/agent/instrumentality: hit him *with* a rock
 7. manner: ran *with* effort
 8. possession: came *with* good news; person *with* a sharp nose
 9. close association in time: *with* the outbreak of war they went home
 10. in spite of/except for: finds that, *with* one group of omissions
 11. in the direction of: *with* the wind/grain

g2.txt

- Let's update the grammar to indicate the sense of *with*.
- Call this grammar g2.txt

- **Idea:**

- VP → VP PP
- NP → NP PP

becomes

- VP → VP PP_instrument
- NP → NP PP_possession

Next, write a rule for PP_instrument

- PP_instrument → IN_instrument NP
- IN_instrument → 'with'

Also, write a rule for PP_possession

- PP_possession → IN_possession NP
- IN_possession → 'with'

g2.txt

- Consider # parses for:
 - a man `with` a telescope saw the boy `with` a telescope