

LING/C SC/PSYC 438/538

Lecture 2

Prof. Sandiway Fong

Administrivia

Hope you have Perl and Python3 installed on your computer?

- That was Homework 2
- Please try to have it ready by next class!

Today's Lecture

Chapter 1 of JM Reading:

- That was Homework 1. A brief quiz today. See end of lecture.

Introduction

- Sentence analysis

Language and Computers

- We want computers to be smart about language
 - *there's plenty of training data around*
 - make the machines learn by themselves
 - pass the **Turing Test**, but not be too smart?

HAL 9000 in *2001: A Space Odyssey*



Language and Computers

Github openai / whisper

- Whisper was trained on **680,000 hours** of audio and corresponding transcripts gathered from the internet.

```
(base) ~$ pip install -U openai-whisper
```

```
Collecting openai-whisper
```

```
  Downloading openai_whisper-20250625.tar.gz (803 kB)
```

```
  Installing build dependencies ... done
```

```
  Getting requirements to build wheel ... done
```

```
Successfully built openai-whisper
```

```
Installing collected packages: mpmath, sympy, setuptools, networkx, more-itertools, MarkupSafe, llvmlite, tiktoken, numba, jinja2, torch, openai-whisper
```

```
Successfully installed MarkupSafe-3.0.2 jinja2-3.1.6 llvmlite-0.44.0 more-itertools-10.7.0 mpmath-1.3.0 networkx-3.5 numba-0.61.2 openai-whisper-20250625 setuptools-80.9.0 sympy-1.14.0 tiktoken-0.11.0 torch-2.8.0
```

```
(base) ~$ which whisper
```

```
/Library/Frameworks/Python.framework/Versions/3.13/bin/whisper
```

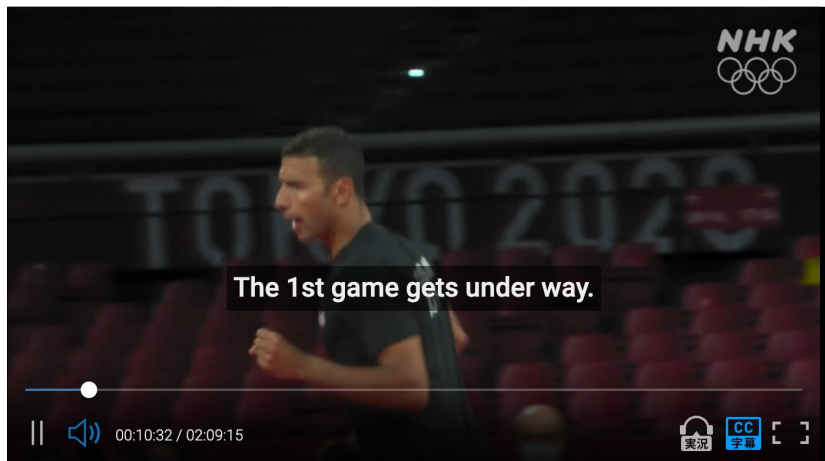
```
(base) Desktop$ whisper hal9000.mp3 --model medium
```

Language and Computers

Detected language: English

[00:00.000 --> 00:11.680] Rotate the pod please, Hal.
[00:11.680 --> 00:12.680] Rotate the pod please, Hal.
[00:12.680 --> 00:17.680] I don't think he can hear us.
[00:17.680 --> 00:20.680] Rotate the pod please, Hal.
[00:20.680 --> 00:25.680] Yeah, I'm sure we're okay.
[00:25.680 --> 00:28.680] Well, what do you think?
[00:29.360 --> 00:31.360] I've got a bad feeling about him.
[00:31.360 --> 00:32.360] You do?
[00:32.360 --> 00:33.360] Yeah, definitely.

Assistive Technology: point-by-point subtitles

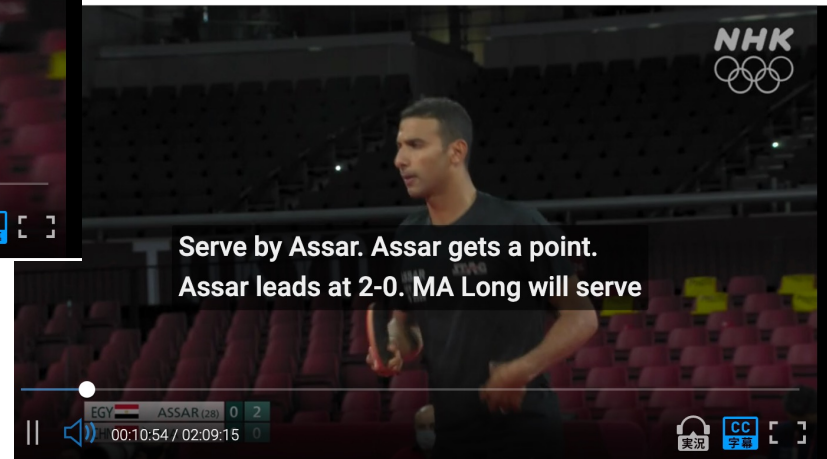


(2021)

"robot play-by-play broadcast" subtitles automatically generated by computers using data provided by the organizer of the event.



← subtitle



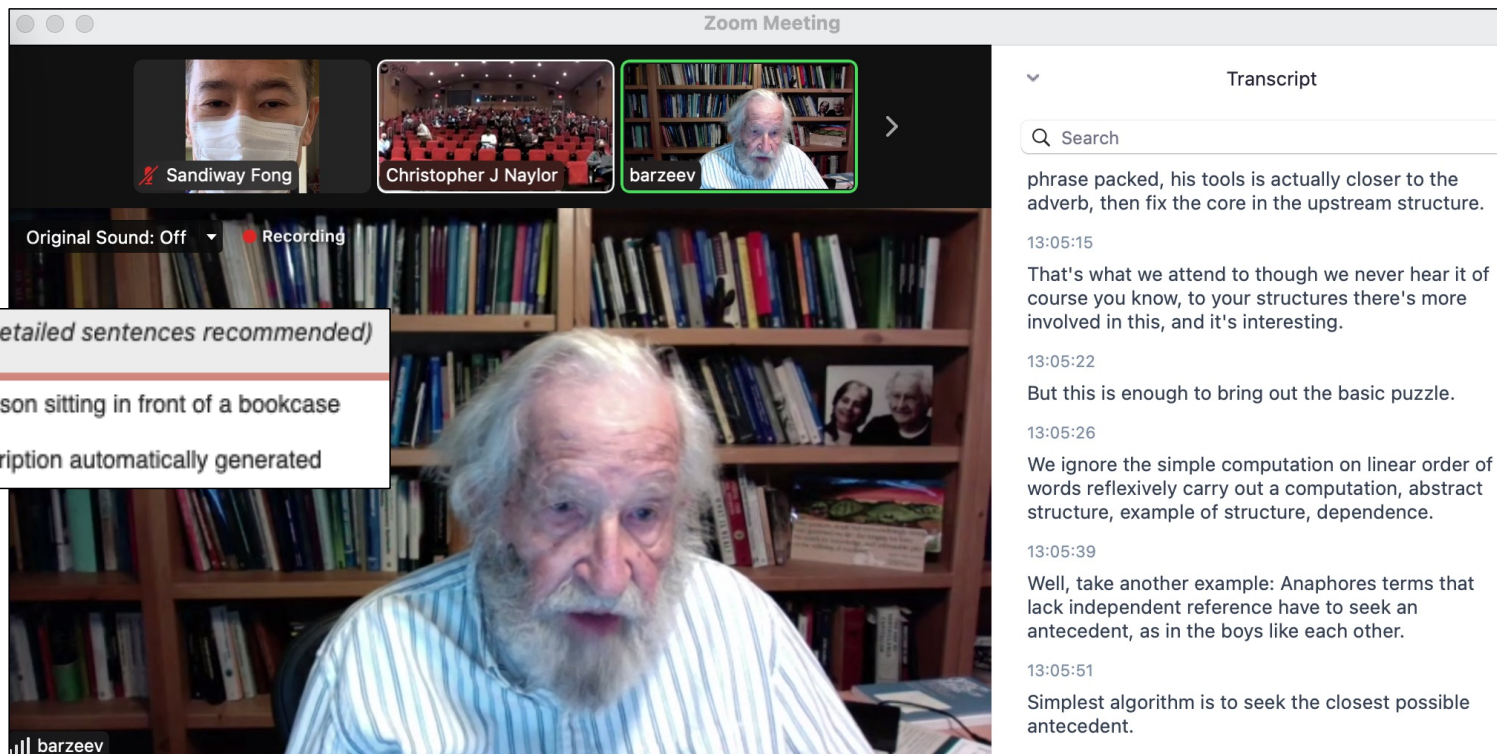
Assistive Technology: Zoom transcript

Alt Text

(1-2 detailed sentences recommended)

A person sitting in front of a bookcase

Description automatically generated



The screenshot shows a Zoom meeting window. At the top, the title bar says "Zoom Meeting". Below it, there are three video thumbnails: "Sandiway Fong" (a man wearing a face mask), "Christopher J Naylor" (a large group of people in a lecture hall), and "barzeev" (an older man with a white beard, wearing a blue and white striped shirt, sitting in front of a bookshelf). Below the thumbnails, there are controls for "Original Sound: Off" and "Recording". The main video feed shows the "barzeev" participant. On the right side of the window, there is a "Transcript" panel. It has a search bar and a list of transcript entries with timestamps. The first entry is partially visible: "phrase packed, his tools is actually closer to the adverb, then fix the core in the upstream structure." The second entry is at 13:05:15: "That's what we attend to though we never hear it of course you know, to your structures there's more involved in this, and it's interesting." The third entry is at 13:05:22: "But this is enough to bring out the basic puzzle." The fourth entry is at 13:05:26: "We ignore the simple computation on linear order of words reflexively carry out a computation, abstract structure, example of structure, dependence." The fifth entry is at 13:05:39: "Well, take another example: Anaphores terms that lack independent reference have to seek an antecedent, as in the boys like each other." The sixth entry is at 13:05:51: "Simplest algorithm is to seek the closest possible antecedent."

Zoom Meeting

Sandiway Fong

Christopher J Naylor

barzeev

Original Sound: Off

Recording

Transcript

Search

phrase packed, his tools is actually closer to the adverb, then fix the core in the upstream structure.

13:05:15

That's what we attend to though we never hear it of course you know, to your structures there's more involved in this, and it's interesting.

13:05:22

But this is enough to bring out the basic puzzle.

13:05:26

We ignore the simple computation on linear order of words reflexively carry out a computation, abstract structure, example of structure, dependence.

13:05:39

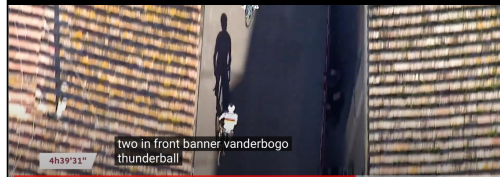
Well, take another example: Anaphores terms that lack independent reference have to seek an antecedent, as in the boys like each other.

13:05:51

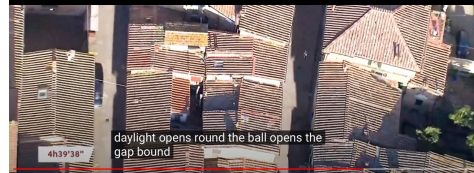
Simplest algorithm is to seek the closest possible antecedent.

Harder task: names (CC)

- banner vanderbogo



- round the ball



- matthew vanderbald



- vanderbolt



Mathieu van der Poel

Language and Computers

- (Un)fortunately, we're not quite there yet...
 - *still a gap between what computers can do and what we want them to be able to do*

Often quoted (**but never verified**):

"The spirit is strong, but the flesh is weak" was translated into
[Russian and then back to English, the result was](#)
["The vodka is good, but the meat is rotten."](#)

but with Google translate or babelfish, it's not difficult to find (funny) examples...

Language and Computers

- and how can we tell if the translation is right anyway?



<http://fun.drno.de/pics/english/only-in-china/TranslateServerError.jpg>

Summarization

We can exploit the recursive nature of language ...

Biden apologizes to Obama for marriage controversy

From **Jessica Yellin**, CNN Chief White House Correspondent
updated 10:20 PM EDT, Thu May 10, 2012

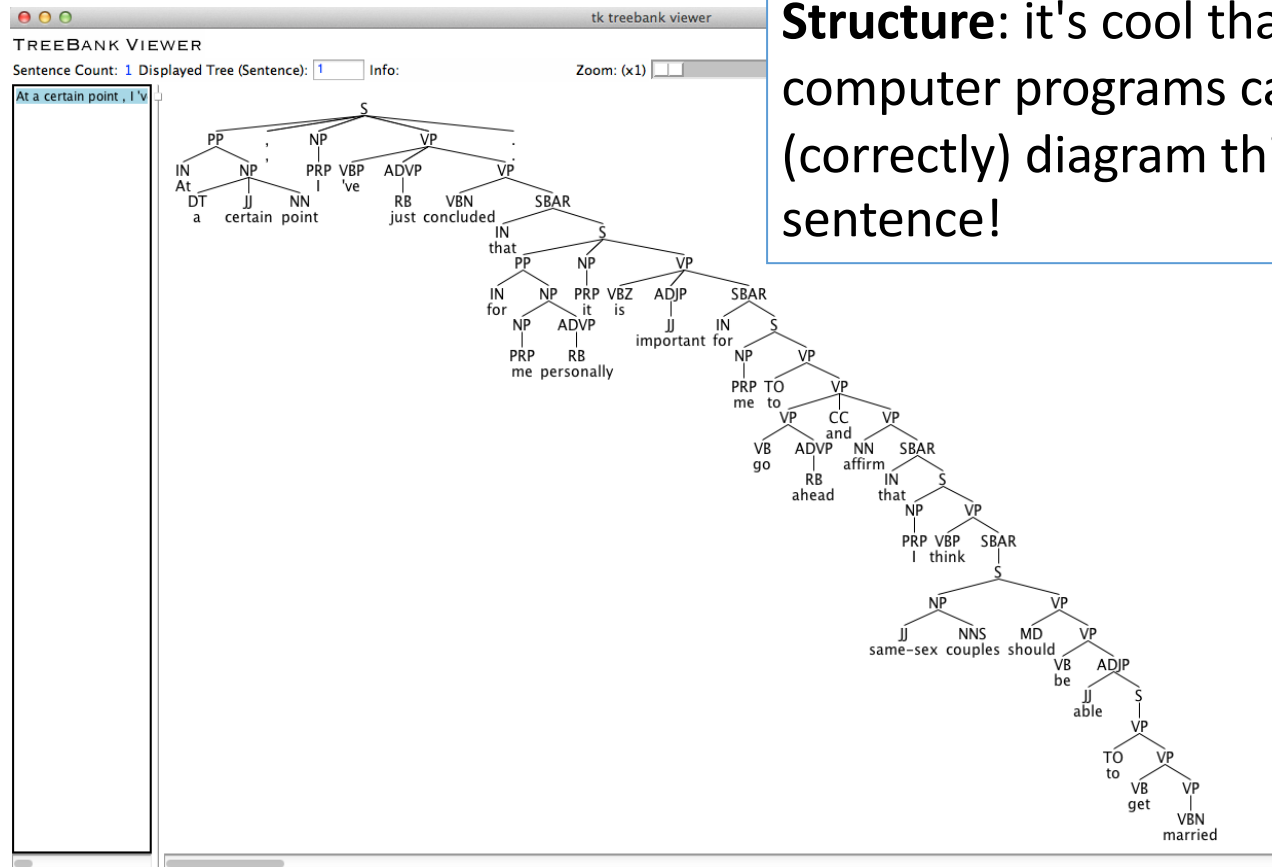


Summarization

- Obama: *"At a certain point, I've just concluded that for me personally it is important for me to go ahead and affirm that I think same-sex couples should be able to get married."*

Is this sentence complicated? Why?

Summarization



Structure: it's cool that computer programs can (correctly) diagram this long sentence!

Summarization



Executive
Summarization

Summarization

- Obama: "~~At a certain point, I've just concluded that for me personally it is important for me to go ahead and affirm that~~ **I think same-sex couples should be able to get married.**"

Summarizers prior to the AI revolution couldn't do this ...

At a certain point, I've just concluded that for me personally it is important for me to go ahead and affirm that I think same-sex couples should be able to get married.

The sentence can be summarized as:

"I believe same-sex couples should be allowed to marry."

Syntactic Structure

A Sports Shooter Shoots Shooters Shooting Sports

Jul 12, 2015 · Michael Zhang

[Share](#) [Like](#) 1.2k

[15 Comments](#)



Syntactic Structure

Natural language parsers (produce syntax diagrams)

- Let's get some idea of what these (popular) systems produce.

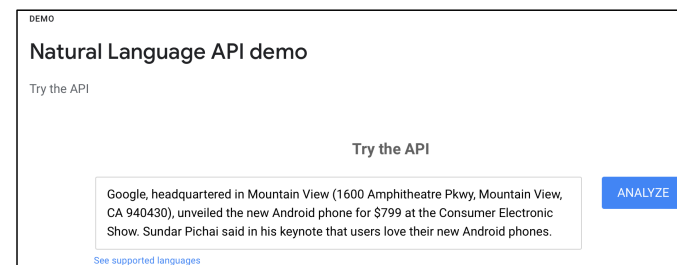
Sadly, all once had an easily accessible working demo page:

1. Stanford Parser
2. Berkeley Parser
3. Google Natural Language

(deprecated? Try <https://corenlp.run>)

(deprecated? B. Neural Parser: <https://parser.kitaev.io>)

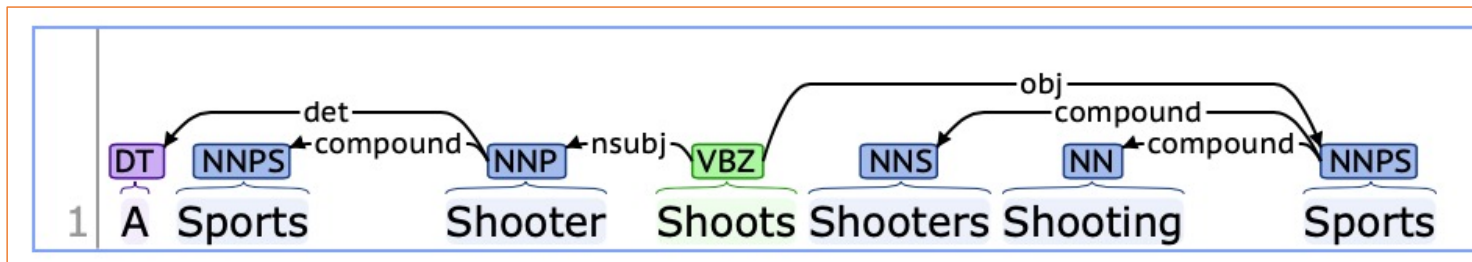
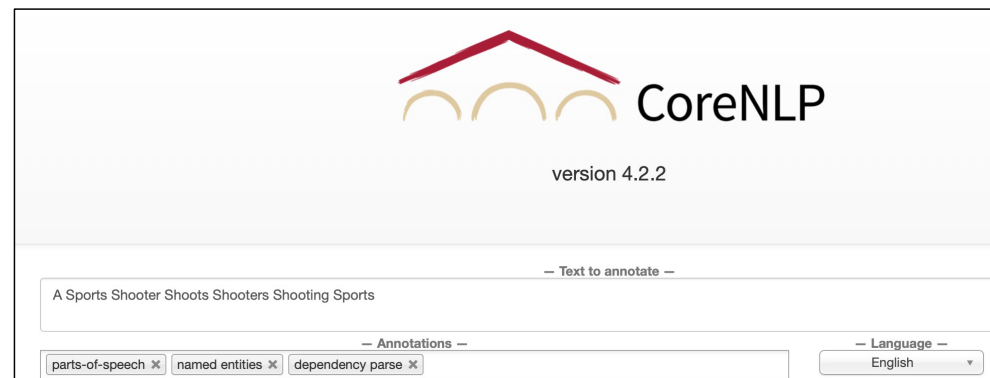
(<https://cloud.google.com/natural-language>)



Syntactic Structure

- Natural language parsers
 - Stanford CoreNLP
 - Java-based
 - Demo!

(<https://corenlp.run>)



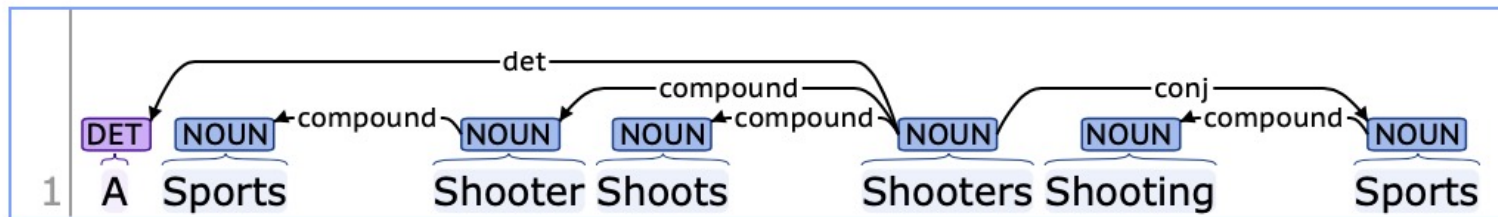
Syntactic Structure

- Natural language parsers
 - (Stanford) Stanza
 - Python-based (CoreNLP)
 - Demo!

<http://stanza.run>

— Text to annotate —			
A Sports Shooter Shoots Shooters Shooting Sports			
— Annotations —			
parts-of-speech ✕	named entities ✕	lemmas ✕	dependency parse ✕

Universal Dependencies:



Syntactic Structure

- Stanford parser (*no longer online*) <http://nlp.stanford.edu:8080/parser/index.jsp>

Stanford Parser

Please enter a sentence to be parsed:

A Sports Shooter Shoots Shooters Shooting Sports

- **Part of Speech Tagging:**

Tagging

A/DT Sports/NNPS Shooter/NNP Shoots/NNP Shooters/NNP Shooting/NNP Sports/NNP

DT = determiner;

NNP = Proper Noun; NNPS = Plural Proper Noun;

VBZ = Verb 3rd Person Singular Present; VBG = Verb Gerund Form

Syntactic Structure

- Constituency-based structure (*indicated by bracketing*):

Parse

```
(ROOT
  (FRAG
    (NP (DT A) (NNPS Sports))
    (NP (NNP Shooter) (NNP Shoots) (NNP Shooters) (NNP Shooting) (NNP Sports))))
```

Constituents:

FRAG = Fragment (of a sentence)

S = Sentence, NP = Noun Phrase, VP = Verb Phrase

Parts of Speech:

DT Determiner, NNP Proper Noun, NNPS Plural Proper Noun.

Syntactic Structure

Your query

A sports shooter shoots shooters shooting sports

Tagging

A/DT sports/NNS shooter/NN shoots/VBZ shooters/NNS shooting/VBG sports/NNS

Parse

```
(ROOT
  (S
    (NP (DT A) (NNS sports) (NN shooter))
    (VP (VBZ shoots)
      (NP
        (NP (NNS shooters))
        (VP (VBG shooting)
          (NP (NNS sports)))))))
```

FRAG = Fragment (of a sentence)
 S = Sentence
 NP = Noun Phrase
 VP = Verb Phrase

Input: Choose File no file selected

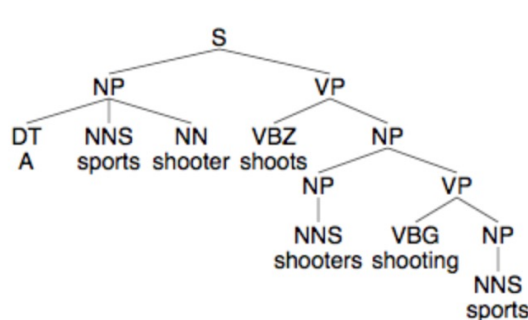
(VP (VBZ shoots) (NP (NP (NNS shooters))

WebSocket Status: 9... CONNECTED DISCONNECTED

Help: (Typing pid↵ into the input box displays the process I

Four formats are accepted (however, they may not be mi

1: [expand](#) 2: [expand](#) 3: [expand](#) 4: [expand](#)

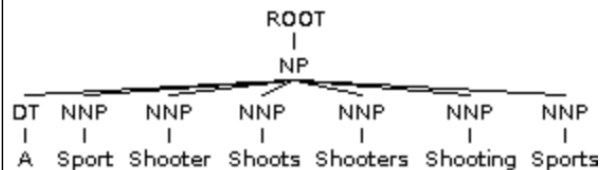


Syntactic Structure

- Berkeley Parser (downloadable, *but no longer available online*)

<http://tomato.banatao.berkeley.edu:8080/parser/parser.html>

```
(ROOT  
  (NP (DT A) (NNP Sport) (NNP Shooter) (NNP Shoots) (NNP Shooters) (NNP Shooting) (NNP Sports)))
```



A Sport Shooter Shoots Shooters Shooting Sports

Parse!

Syntactic Structure

Berkeley Parser

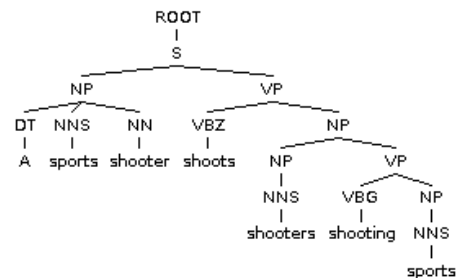
<http://tomato.banatao.berkeley.edu:8080/parser/parser.html>

This newer one is available

Berkeley Neural Parser

<https://parser.kitaev.io>

```
(ROOT
 (S
  (NP (DT A) (NNS sports) (NN shooter))
  (VP (VBZ shoots)
    (NP
     (NP (NNS shooters))
     (VP (VBG shooting)
      (NP (NNS sports)))))))
```



A sports shooter shoots shooters shooting sports

Parse!

FRAG = Fragment (of a sentence)

S = Sentence

NP = Noun Phrase

VP = Verb Phrase

Syntactic Structure

Word to Word
Dependency

A Sports Shooter Shoots Shooters Shooting Sports

RESET

<https://cloud.google.com/natural-language>

[See supported languages](#)

Entities
Sentiment
Syntax ?
Categorization

☒ Dependency

☒ Parse label

☒ Part of speech

☒ Lemma

☒ Morphology

det	nn	nsubj	root	nn	nn	dobj
A	Sports	Shooter	Shoots	Shooters	Shooting	Sports
DET	NOUN	NOUN	shoot VERB	NOUN	NOUN	NOUN
	number=SINGULAR	number=SINGULAR	mood=INDICATIVE	number=SINGULAR	number=SINGULAR	number=SINGULAR

nn: noun compound modifier

A noun compound modifier of an NP is any noun that serves to modify the head noun. (Note that in the current system for dependency extraction, all nouns modify the rightmost noun of the NP – there is no intelligent noun compound analysis. This is likely to be fixed once the Penn Treebank represents the branching structure of NPs.)

“Oil price futures”

nn(futures, oil)
 nn(futures, price)

Natural Language API demo

Try the API

A Sports Shooter Shoots Shooters Shooting Sports

[See supported languages](#)

Entities
Sentiment
Moderation

A (Sports)₁ (Shooter)₁ Shoots (Shooters)₂ Shooting (Sports)₄

Syntactic Structure: Word Dependency Relations

<https://universaldependencies.org/u/dep/index.html>

Universal Dependency Relations


The following table lists the 37 universal syntactic relations used in UD v2. It is a revised version of the relations originally described in [Universal Stanford Dependencies: A cross-linguistic typology](#) (de Marneffe *et al.* 2014).

The upper part of the table follows the main organizing principles of the UD taxonomy such that *rows* correspond to functional categories in relation to the head (core arguments of clausal predicates, non-core dependents of clausal predicates, and dependents of nominals) while *columns* correspond to structural categories of the dependent (nominals, clauses, modifier words, function words). The lower part of the table lists relations that are not dependency relations in the narrow sense.

	Nominals	Clauses	Modifier words	Function Words
Core arguments	nsubj obj iobj	csubj ccomp xcomp		
Non-core dependents	obl vocative expl dislocated	advcl	advmod * discourse	aux cop mark
Nominal dependents	nmod appos nummod	acl	amod	det clf case
Coordination	MWE	Loose	Special	Other
conj cc	fixed flat compound	list parataxis	orphan goeswith reparandum	punct root dep

* The [advmod](#) relation is used for modifiers not only of predicates but also of other modifier words.

Syntactic Structure: ChatGPT

ChatGPT ▾ 

Sentence:
A Sports Shooter Shoots Shooters Shooting Sports

1. Identify each chunk

- **Sports Shooter** → Person A: a photographer who covers sports.
- **Shoots** → action: takes a photo of.
- **Shooters** → Person B: other people with cameras.
- **Shooting Sports** → Person B's action: taking photos of people engaged in sports that involve shooting (e.g., rifle, archery, skeet).

Syntactic Structure: ChatGPT

2. Logical structure

SCSS

Copy Edit

Person **A** (Sports Shooter)
↓ (takes pictures of)
Person **B** (Shooters)
↓ (taking pictures of)
Event (Shooting Sports)

3. Full plain-English translation

A sports photographer takes pictures of other photographers who are photographing shooting sports.

Homework 3

Computer Programs are unambiguous

- A sentence is **ambiguous** if multiple, alternative linguistic structures can be built for it.

1. Is *Caesar's murder* **ambiguous**? Explain.
2. What's funny about this? Can you identify a structural difference?

Mark: Who's the cook in this cafeteria?

Gary: It's a man with one eye called Bernie.

Mark: What's the other eye called?

Homework 3

3. What's funny about this?
- Can you point to a relevant structural difference?



Homework 3

- Email to sandiway@arizona.edu
- Due by **Sunday** midnight (*no late homeworks, please*)
 - Will be reviewed in class on **Tuesday**
- Email SUBJECT: 438/538 Homework 3: **YOUR NAME**
- Either Plain Text or PDF accepted (*no Word files please!*)