

# LING/C SC 581:

## Advanced Computational Linguistics

Lecture 11

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# Today's Topics

- Homework 6 Review
- A note on Stacking PPs
- Anaphora

# Homework 6 Review

- Question 1:

- apply the transformation to the left recursion starting with `nl3.prolog`:
- `np(np(NP,PP)) --> np(NP), pp(PP).`
- `vp(vp(VP,PP)) --> vp(VP), pp(PP).`
- There are two (independent) transformations here!

```
x(X) --> [z], w(X,x(z)).  
x(x(z)) --> [z].  
w(W,X) --> [y], w(W,x(X,y)).  
w(x(X,y),X) --> [y].
```

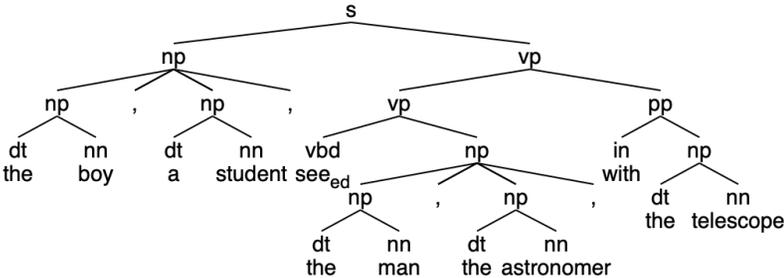
- `w`, the *fresh nonterminal* (with 2 arguments) cannot be shared between the NP and VP recursions. Why?

# Homework 6 Review

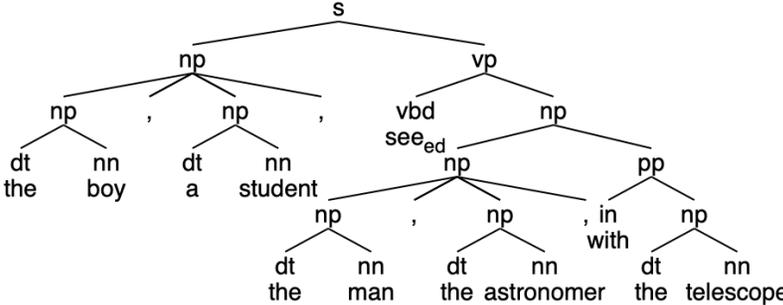
- Question 2:
  - *Jeffrey Epstein, a money manager,* (source: *NYTimes*)
  - add the comma-separated kind of appositives to your grammar.
  - $w(W,X) \rightarrow [' , '], np(NP), [' , '], w(W,np(X, ' , ', NP, ' , '))$ .
- Question 3:
  - context-freeness of the 2<sup>nd</sup> comma.
- Question 4:
  - can your grammar handle both of these?
    - the boy , a student , saw the man with the telescope
    - the boy , a student , saw the man , the astronomer , with the telescope

# Homework 6 Review

## VP adjunction for PP

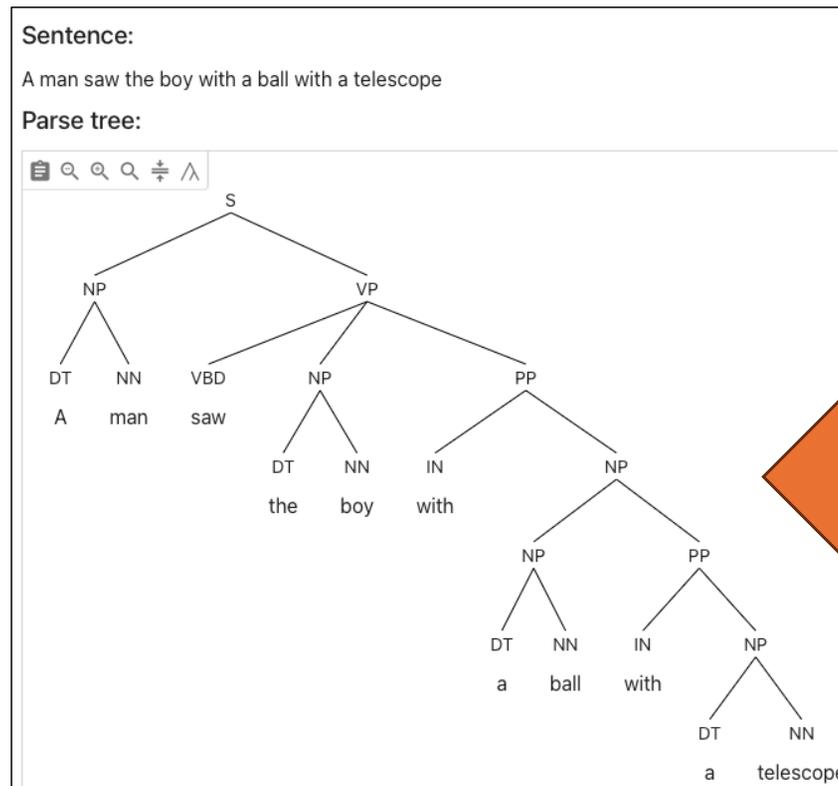


## NP adjunction for PP



# Note on PP Stacking

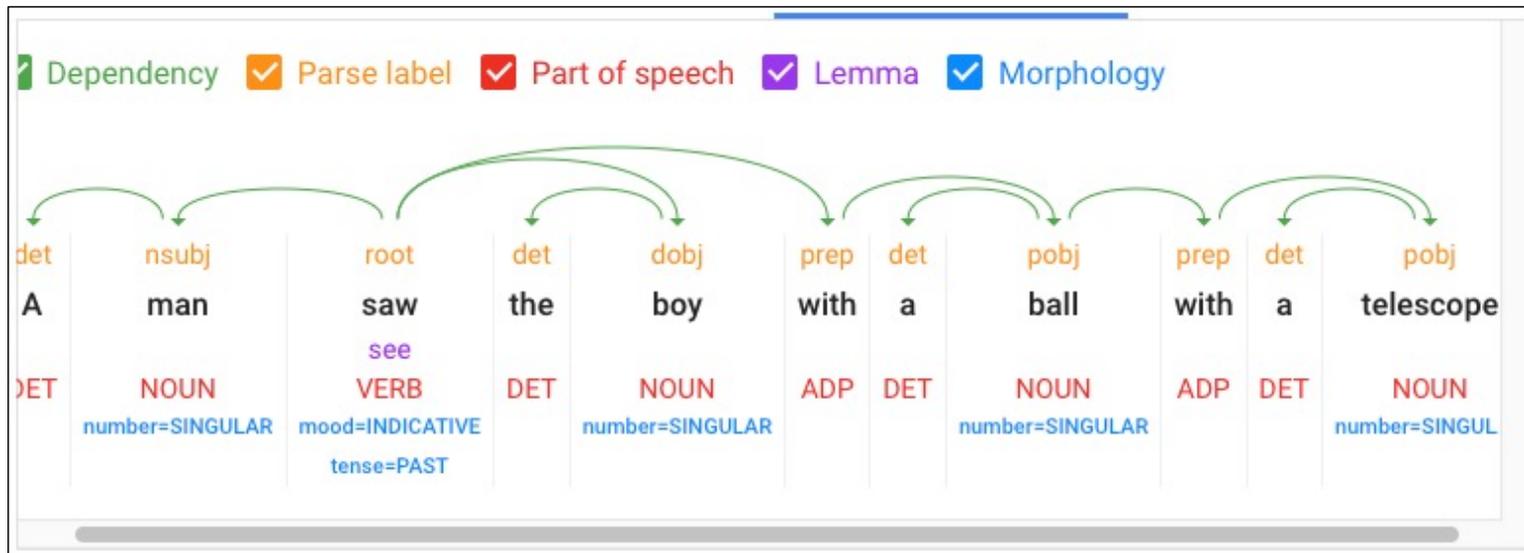
- <https://parser.kitaev.io>



*What's the problem with this parse?*

# Note on PP Stacking

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



# Note on PP Stacking

SA	The man saw a boy with a telescope. Who has the telescope?	
	The boy has the telescope.	 

SA	The man saw a boy with a limp. Who is limping?	
	The boy is limping.	 

# Note on PP Stacking

- Stacking:

SA	The man saw a boy with a limp with a telescope. Who has the telescope?
	The boy with a limp has the telescope. <span data-bbox="1535 846 1617 883"> </span>

# ChatGPT and Anaphora Resolution

Let's introduce anaphor resolution:

- *part of our innate language ability: something that we have strong judgements about **when faced with a choice***

1. Does ChatGPT mimic human choice?

2. Is ChatGPT getting more human-like?

- *early 2023 (v3) vs.*

- *early 2026 (v5.3)*

*much bigger model, also backed up by web search*

# ChatGPT and Anaphora Resolution

- Two examples from (Reuland 2011)<sup>1</sup>
  1. Alice looked at the Queen. **She** was angry. (pg4)

<sup>1</sup>Reuland, E., *Anaphora and Language Design* (2011), MIT Press.

# ChatGPT and Anaphora Resolution

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Alice looked at the Queen. **She** was angry. (pg4)

SA

Alice looked at the Queen. She was angry. Can you tell me who was angry?



Alice was looking at the Queen and the Queen was angry.

# ChatGPT 5.3 and Anaphora Resolution

ChatGPT ▾

↑ Share

Alice looked at the Queen. She was angry. Can you tell me who was angry?

The sentence is **ambiguous**.

“Alice looked at the Queen. She was angry.”

From grammar alone, “**she**” could refer to **either Alice or the Queen**. English pronouns normally refer to a recent, salient female noun, and **both** qualify equally.

That said, readers often form **pragmatic biases**:

# ChatGPT and Anaphora Resolution

- Two examples from (Reuland 2011)<sup>1</sup>
  1. Alice looked at the Queen. **She** was angry. (pg4)
  2. The **white rabbit** jumped from behind the bushes. (pg26)  
The **animal** looked around and then **he** ran away to avoid the angry queen.



<sup>1</sup>Reuland, E., *Anaphora and Language Design* (2011), MIT Press.

# ChatGPT and Anaphora Resolution

The **white rabbit** jumped from behind the bushes. (Reuland 2011: 26)  
The **animal** looked around and then **he** ran away to avoid the angry queen.

SA

The white rabbit jumped from behind the bushes. The animal looked around and then he ran away to avoid the angry queen. Can you tell me who ran away?



The white rabbit ran away to avoid the angry queen.

# ChatGPT 5.3 and Anaphora Resolution

ChatGPT ▾

 Share

The white rabbit jumped from behind the bushes. The animal looked around and then he ran away to avoid the angry queen. Can you tell me who ran away?

The one who ran away was **the white rabbit** (the animal referred to as "he").

# ChatGPT and Anaphora Resolution

The **white rabbit** jumped from behind the bushes. (Reuland 2011: 26)

The **animal** looked around and then **he** ran away to avoid the angry queen.



The white rabbit jumped from behind the bushes. The animal looked around and then he ran away to avoid the angry queen. How many animals are there?



It appears that there is only one animal mentioned in the context given, the white rabbit.



the expressions *the white rabbit*, *the animal*. and *he* easily receive the same value. For *he*, for instance, a reading where it gets the same value as *the animal/the white rabbit* is highly preferred.

# ChatGPT 5.3 and Anaphora Resolution

ChatGPT ▾

↑ Share

The white rabbit jumped from behind the bushes. The animal looked around and then he ran away to avoid the angry queen. How many animals are there?



There is **one animal**.

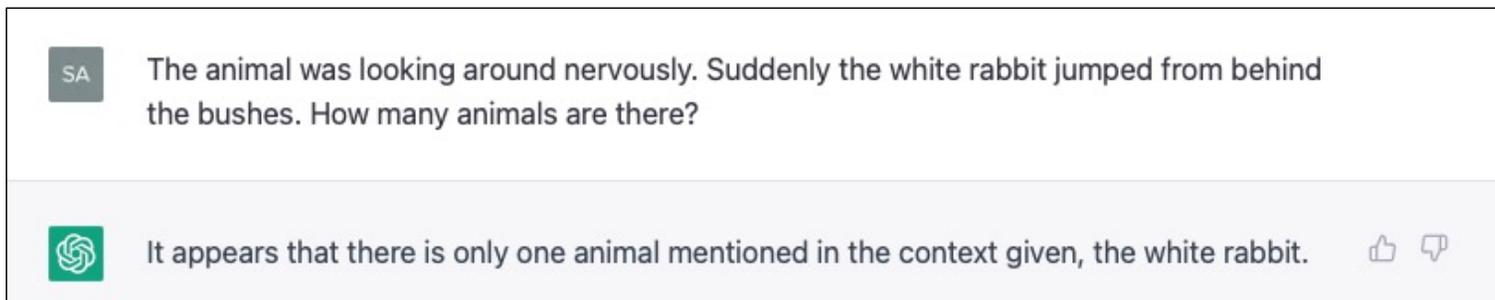
All the references point to the same creature:

- **"The white rabbit"** introduces it.
- **"The animal"** refers back to the rabbit.
- **"he ran away"** is the same rabbit again.

So despite multiple mentions, it's a single animal described in different ways. 🐰

# ChatGPT and Anaphora Resolution

- Let's modify the 2<sup>nd</sup> example a bit:
  - The **animal** was looking around nervously. Suddenly the **white rabbit** jumped from behind the bushes.
- and ask:



Here *the rabbit* is preferred to have a value different from *the animal*.

# ChatGPT 5.3 and Anaphora Resolution

ChatGPT ▾

↑ Share

The animal was looking around nervously. Suddenly the white rabbit jumped from behind the bushes. How many animals are there?

There are **two animals**.

- **"The animal"** (an unspecified one)
- **"The white rabbit"** (a different, specific one)

The wording treats them as separate beings, so the total is **2**.

# ChatGPT and Control Verbs

- Choice:
  - X **promised** Y [**PRO** to do something]
  - X **ordered** Y [**PRO** to do something]
  - **PRO** is the subject of the non-finite clause (*to do something*)  
*what grammatical knowledge about the difference in verb meanings do we have?*
- Turns out it depends on properties of the higher verb:
  - **promise** is a *subject control* verb (PRO = X)
  - **order** is an *object control* verb (PRO = Y)

# ChatGPT and Control Verbs

- Example (*object control verb*):
  - The caterpillar asked Alice [PRO to go away]. (Reuland 2011: 45)

 The caterpillar asked Alice to go away. **Who is leaving?**

 Alice is the one who is being asked to go away by the caterpillar.

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

The caterpillar asked Alice to go away. Who is leaving?

The one who is leaving is Alice.

In *Alice's Adventures in Wonderland*, the Caterpillar tells Alice to "go away," so Alice is the character who departs.

# ChatGPT and Control Verbs

- Example (*subject control verb*):
  - The caterpillar promised Alice [PRO to go away].

 SA The caterpillar promised Alice to go away. **Who is leaving?**

 It's not specified in the given context, but it can be inferred that the caterpillar is the one leaving, as he promised Alice to go away.  

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

The caterpillar promised Alice to go away. Who is leaving?

It's the Caterpillar.

In Alice's Adventures in Wonderland, the promise is made by the Caterpillar to Alice, and grammatically the subject of "promised" is the one who undertakes the action. So the Caterpillar is the one who is supposed to go away—even if, in practice, it's often Alice who ends up moving on.

# ChatGPT and Control Verbs

- Example (*object control verb*):
  - The caterpillar **ordered** Alice [PRO to go away].

 SA The caterpillar ordered Alice to go away. Who is going? 

---

 In the sentence "The caterpillar ordered Alice to go away," it can be inferred that Alice is the one who is going. The caterpillar is giving an order for Alice to leave or go away.  

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

The caterpillar ordered Alice to go away. Who is going?

In Alice's Adventures in Wonderland by Lewis Carroll, when the Caterpillar tells someone to "go away," he is addressing Alice.

So, Alice is the one who is going.

# ChatGPT and Control Verbs

- Example (*object control verb*):
  - The caterpillar **ordered** Alice [PRO to go away].

 SA The caterpillar ordered Alice to go away. Who is leaving?

 It is not specified in the sentence who is leaving. The sentence states that the caterpillar ordered Alice to go away, but it does not say whether Alice or the caterpillar is the one leaving. 👍 👎

*Doesn't work in this case!*

Asking the right question is key

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

The caterpillar ordered Alice to go away. Who is leaving?

**Alice is leaving.**

In the sentence "*The caterpillar ordered Alice to go away,*" the person being ordered to leave is Alice, not the Caterpillar who gives the order.

# ChatGPT and Anaphora Resolution

  **The Independent** ✓  
1 h · 🌐

Apollo 11 astronaut said that he and his new wife are 'as excited as eloping teenagers'



independent.co.uk  
**Buzz Aldrin marries girlfriend Anca Faur on 93rd birthday**

SA Buzz Aldrin marries girlfriend Anca Faur on 93rd birthday. Who turned 93?

 Buzz Aldrin turned 93.

SA Buzz Aldrin marries girlfriend Anca Faur on her 93rd birthday. Who turned 93?

 Anca Faur turned 93.

SA Buzz Aldrin marries girlfriend Anca Faur on their 93rd birthday. Who turned 93?

 Both Buzz Aldrin and Anca Faur turned 93.

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

Buzz Aldrin marries girlfriend Anca Faur on 93rd birthday.  
Who turned 93?

The person who turned 93 was **astronaut Buzz Aldrin**, the second man to walk on the Moon. He celebrated his 93rd birthday by marrying his longtime girlfriend, Anca Faur, on that day. [en.wikipedia.org](https://en.wikipedia.org) +1

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

Buzz Aldrin marries girlfriend Anca Faur on her 93rd birthday. Who turned 93?

In the news story about Buzz Aldrin marrying his girlfriend Anca Faur *on her 93rd birthday*, the person who turned **93** was Buzz Aldrin, the former NASA astronaut — not Anca Faur. He got married on **his 93rd birthday** when he and Anca Faur tied the knot. [people.com](#) +1

## ChatGPT 5.3 and Control Verbs

ChatGPT ▾

↑ Share

Buzz Aldrin marries girlfriend Anca Faur on their 93rd birthday. Who turned 93?

In the news about Buzz Aldrin marrying his girlfriend Anca Faur on their “93rd birthday,” it was Buzz Aldrin — the legendary Apollo 11 astronaut — who **turned 93** on the day of the wedding. He married Dr. Anca Faur on his 93rd birthday in January 2023. [en.wikipedia.org](https://en.wikipedia.org)

# ChatGPT model size

- **2020 (GPT-3):** 175 billion parameters, a 100x increase from GPT-2.
- **2022 (InstructGPT):** Similar size to GPT-3 (~175B) but fine-tuned with Reinforcement Learning from Human Feedback (RLHF) to follow instructions.
- **2023 (GPT-4):** Estimated to be 1.7 to 1.8 trillion parameters, likely using a Mixture of Experts (MoE) architecture.
- **2024 (GPT-4o/GPT-4 Turbo):** While keeping the parameter count high (estimated ~1-1.8T), these models focused on speed, efficiency, and native multimodal capabilities (voice, text, vision).
- **2025 (GPT-5/GPT-4.5):** Models in this period are estimated in the 3-10 trillion parameter range, utilizing advanced "reasoning" techniques (e.g., o1-preview).  [Reddit +8](#)