

# Where am I?

- **HUL242: Fundamentals of Language Sciences**
- **Semantics (Lecture-2)**
- **Saturday, April 12<sup>th</sup>**

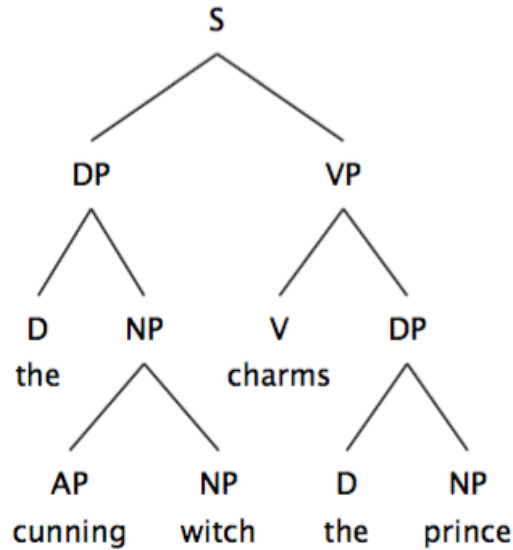
# Semantics?

- Semantics is **the study of linguistic meaning**.
- Humans have the ability not only to *produce* an infinite number of sentences but also to **understand** them.
- Like syntax, there is a finite set of linguistic rules involved in semantics. In this course, we will uncover some of them.

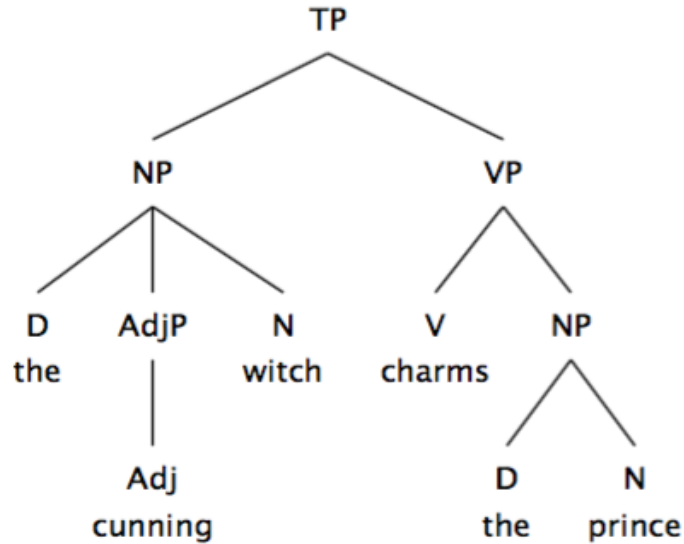
# A note about the reading

- The reading contains the structure as in (1). But our phrase structure rules only generate structures like the one given in (2).

1.



2.



- How are they different?
  - Labels: DP vs. NP (also, S vs. TP, AP vs. AdjP)
  - (1) is binary but (2) is not
- For now, note the difference, but don't worry about it. We will stick with the structures like (2).

# What semanticists do not do

- Semantics is **the study of linguistic meaning**.
- **What kind** of linguistic meaning?
- When we hear the term meaning, we mostly think of ‘word meanings’. You all would be familiar with looking up words in dictionaries

The OED defines ***chair*** as follows:

*A seat for one person (always implying more or less of comfort and ease); now the common name for the movable four-legged seat with a rest for the back, which constitutes, in many forms of rudeness or elegance, an ordinary article of household furniture, and is also used in gardens or wherever it is usual to sit.*

- That’s *quite* complicated. Is it adequate?

# What semanticists do not do

- Is it adequate?
- Not really!
- Do chairs need four legs? Do they have to be movable? Can chairs be for more than one person?

# Rocking chair for two people



taken from google

OED definition of Chair: A seat for one person

# Chairs without legs/Unmovable chairs



Taken from google

OED definition of Chair: movable four-legged seat

# What semanticists don't do

- Such definitions are unreliable
- Meanings of even simple words like *chair* are hard to get at.
- A word's meaning is not just what the dictionary says
- So, **semantics is not about writing down super precise dictionary-type meanings.**
- So how can we get at meanings?

# Meaning in linguistics: Sense and Reference

- **Two components of linguistic meaning: Gottlob Frege (1892)**

- A mental component/representation = **Sense**
- The relationship of a mental representation to the (outside) world: **Reference**

- Which of the following animals are cats?



- A particular entity in the world to which some expression refers is called its **referent**.
- The collection of all the referents of an expression is its **reference**.

# Debate: Sense and Reference

## Huge debate on 'sense' and 'reference'

- Expressions can have a sense but no referents:
  - Unicorn
  - King/Queen of India
  - The first man on Mars
- It is also possible for multiple distinct expressions with different senses to pick out the same referent.
  - The 46<sup>th</sup> president of the United States and Joe Biden
  - The 14<sup>th</sup> Prime Minister of India and Narendra Modi
  - Morning star and Evening star
- Without going into the debate, we will use sense and reference in restricted way
  - **A mental component of meaning (Sense)**
  - **Its relation to the outside world (Reference)**

# Meaning in linguistics

## **Semantic Theory:**

1. The meaning of sentential components
2. The semantic relations between sentences

# Semantic theory: The meaning of sentential components

The meaning of a complex expression is due to:

- a) The meanings of its parts (*lexical* semantics).
- b) How those parts are put together by the syntax! (*compositional* semantics)

**The principle of Compositionality**

# Semantic theory: The meaning of sentential components

- The words you use in a sentence contribute to the meaning of that sentence!

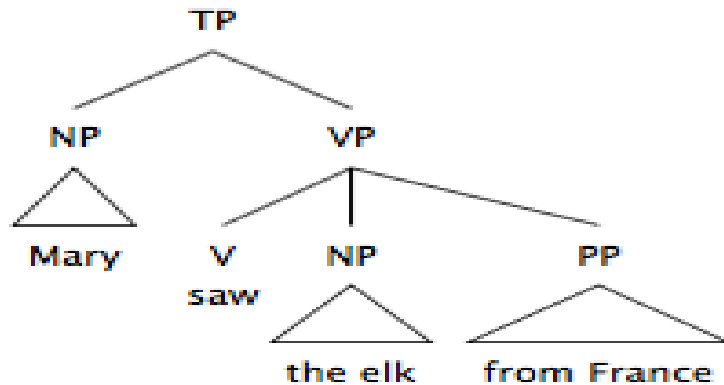
1. John will **win** the race.

2. John will **lose** the race.

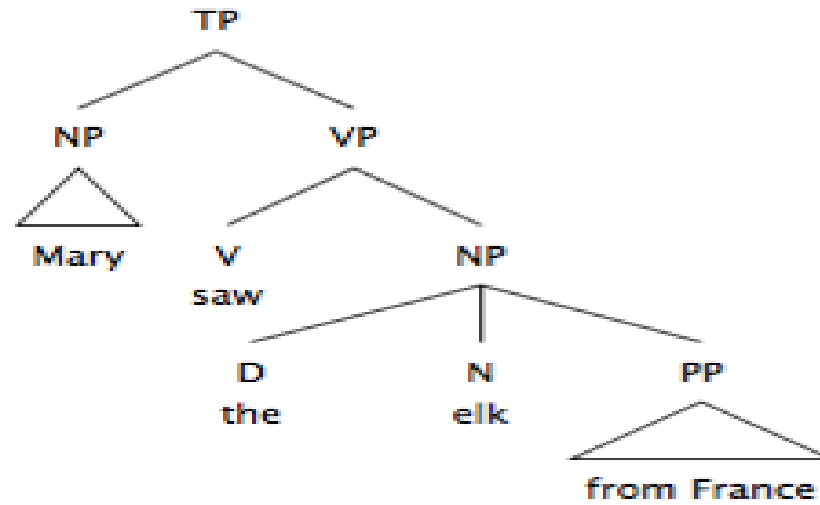
# Semantic theory: The meaning of sentential components

- The way you put words together gives you meanings:

**Mary saw the elk from France.**



Mary is in France

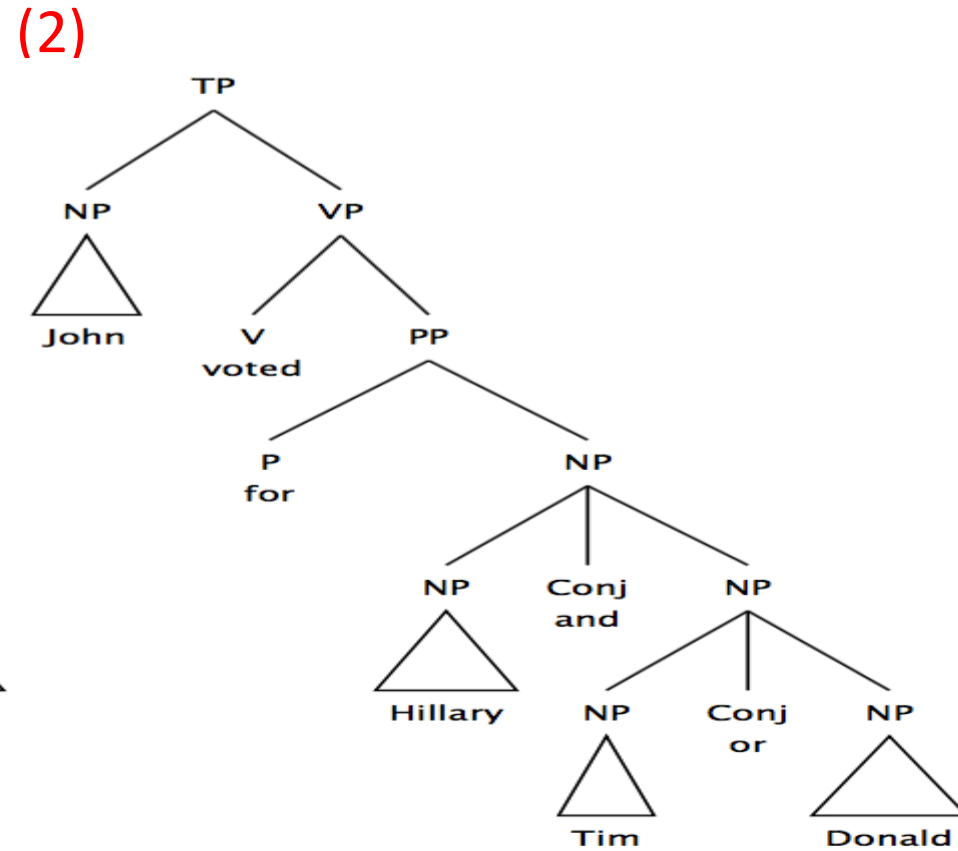
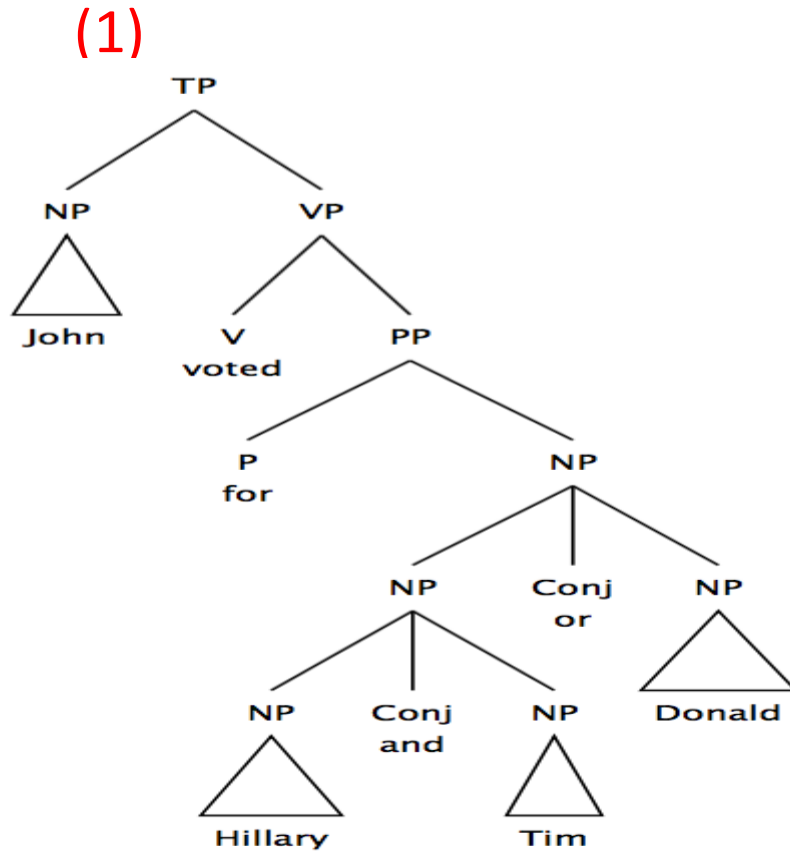


The elk is from France

- The same words but putting them in different ways gives you different meanings.

# Semantic theory: The meaning of sentential components

- One of these sentences has the meaning John voted for Hillary. Which one?



- The one on the right i.e. (2)

# Semantic theory: The relationship between sentences

- Consider the following sentences:
  1. John ate bread in the morning.
  2. John ate bread.
  3. John ate bread in the morning in the kitchen.
- What kind of relationship do you notice about these sentences?
  - If someone tells you (1), you *know* that (2) is true, but you *don't* know that (3) is true!
  - If someone tells you (3), you *know* that both (1) and (2) are true!
  - If someone tells you (2), you *don't* know that (1) and (3) are true!
- So (1) is *more **specific** than* (2), but not more specific than (3). (3) is more specific than both (1) and (2)!

# Entailment

- When we say one sentence  $S1$  **entails** another sentence  $S2$ , we mean:
  - Whenever  $S1$  is true,  $S2$  **must** also be true.
  - This is often written as  $S1 \models S2$ .
  - If  $S1$  doesn't entail  $S2$ , we write  $S1 \not\models S2$ .

# Back to the previous three examples

1. John ate bread in the morning.
2. John ate bread.
3. John ate bread in the morning in the kitchen.

Does (1) entail (2)?

**Yes.** If (1) is true, (2) must also be true.  $(1) \models (2)$ .

Does (2) entail (1)?

**NO.** If (2) is true, (1) might not be true.  $(2) \not\models (1)$ .

Does (1) entail (3)?

**No.** If (1) is true, (3) might not be true.  $(1) \not\models (3)$

Does (3) entail (1)?

**Yes.** If (3) is true, (1) must also be true.  $(3) \models (1)$

# Synonymy as mutual entailment

- Consider the following pair of sentences.

1. John ate bread in the morning in the kitchen.
2. John ate bread in the kitchen in the morning.

Does (1) entail (2)?     **yes**

Does (2) entail (1)?     **yes**

- When  $S1 \models S2$ , and  $S2 \models S1$ , we say that  $S1$  and  $S2$  are **synonymous**.

In symbols:  $S1 \models S2$

# Independence

Consider the following pair of sentences.

1. John ate bread in the morning in the kitchen.
2. Mary ate a banana in the morning in the kitchen.

Does (1) entail (2)?    **No**

Does (2) entail (1)?    **No**

- When  $S1 \not\models S2$ , and  $S2 \not\models S1$ , we say that  $S1$  and  $S2$  are (logically) **independent**.

# Summary of relationship between sentences

- **Entailment**

- $S1$  **entails** another sentence  $S2$ , we mean:
  - Whenever  $S1$  is true,  $S2$  must also be true.

- **Synonymous**

- $S1$  and  $S2$  are synonymous, we mean:
  - $S1$  entails  $S2$ , and  $S2$  entails  $S1$

- (logically) **Independent**

- $S1$  and  $S2$  are logically independent, we mean:
  - $S1$  does not entail  $S2$ , and  $S2$  does not entail  $S1$

# Quantified determiners and entailment

# Quantified determiners

- Words like *a/an, every, no, most, few, some*. . .
- Very interesting expressions in a language!
- In the next few slides, we'll see why these expressions are interesting looking at the entailment patterns in English.
- They behave differently from each other depending on how **specific** their noun and VP are.

# The determiner 'a' and Entailment

Consider the following sentence:

1. A linguist ate berries.

○ Making the noun less and more specific:

2. A human ate berries.

$(1) \models (2)$

3. A semanticist ate berries.

$(1) \not\models (3)$

○ Making the VP less and more specific:

4. A linguist ate fruit.

$(1) \models (4)$

5. A linguist ate blackberries.

$(1) \not\models (5)$

# The determiner 'a' and Entailment

- If Determiner is 'a', making N or VP less specific gives an entailment:
  - *a linguist ate berries*  $\models$  *a human ate berries*
  - *a linguist ate berries*  $\models$  *a linguist ate fruit*

# The determiner ‘every’ and Entailment

Consider the following example:

- 1. Every linguist ate berries.
- Making the noun less and more specific:
  - 2. Every **human** ate berries. (1)  $\not\models$  (2)
  - 3. Every **semanticist** ate berries. (1)  $\models$  (3)
- Making the VP less and more specific:
  - 4. Every linguist ate **fruit**. (1)  $\models$  (4)
  - 5. Every linguist ate **blackberries**. (1)  $\not\models$  (5)

Purple means different from the pattern observed with the quantifier ‘a’.

# The determiner 'every' and Entailment

- If Determiner is **every**, making N more specific gives an entailment, and making VP less specific gives an entailment:
  - *every linguist ate berries*  $\models$  *every semanticist ate berries*
  - *every linguist ate berries*  $\models$  *every linguist ate fruit*

# The determiner ‘no’ and Entailment

Consider the following example:

- 1. No linguist ate berries.
- Making the noun less and more specific:
  - 2. No human ate berries.  $(1) \not\models (2)$
  - 3. No semanticist ate berries.  $(1) \models (3)$
- Making the VP less and more specific:
  - 4. No linguist ate fruit.  $(1) \not\models (4)$
  - 5. No linguist ate blackberries.  $(1) \models (5)$

Purple means different from the pattern observed with the quantifier ‘a’.

# The determiner 'no' and Entailment

- If Determiner is **no**, making N or VP more specific gives an entailment:
  - *no linguist ate berries*  $\models$  *no semanticist ate berries*
  - *no linguist ate berries*  $\models$  *no linguist ate blueberries*

# Summing up

- Linguists use the following shorthand for these patterns:
  - *a* is **upward-entailing** for both N and VP.
  - *every* is **downward-entailing** for N and **upward-entailing** for VP.
  - *no* is **downward-entailing** for both N and VP.
- To think: why?

# Semantic theory: The meaning of sentential components

- We will be investigating the following sorts of sentences in this course:
  - 1) Prof. Deepak teaches Linguistics. T
  - 2) A professor teaches Linguistics. T
  - 3) Every professor teaches Linguistics. F
  - 4) No professor teaches Linguistics. F
  - 5) Most professors teach Linguistics. F
- What is the meaning of a sentence?
  - Whether a sentence makes a True or False claim in a given situation/scenario/world

# Meaning below the sentence level

Some questions:

- What do names mean?     *Deepak, Siddharth, Joynal, Tanvi . . .*
- What do nouns mean?     *linguist, semanticist, professor. . .*
- What do verb phrases mean?     *teach, eat, sleep....*
- What do determiners mean?     *a, every, no, . . .*

# Names

- The meaning of a **name** is just **an individual!**

[[Deepak]]	=		DEEPAK
[[Joynal]]	=		JOYNAL
[[Siddharth]]	=		SIDDHARTH
[[Tanvi]]	=		TANVI

**Notation:** We write  $[[X]]$  for meaning of X

# Nouns

- The meaning of **nouns** is **sets of individuals**

$\llbracket \text{Professor} \rrbracket = \{ \textit{DEEPAK} \}$

$\llbracket \text{TA} \rrbracket = \{ \textit{JOYNAL}, \textit{TANVI}, \textit{SIDDHARTH} \}$

$\llbracket \text{man} \rrbracket = \{ \textit{DEEPAK}, \textit{JOYNAL}, \textit{SIDDHARTH} \}$

$\llbracket \text{woman} \rrbracket = \{ \textit{TANVI} \}$

$\llbracket \text{Martian} \rrbracket = \{ \}$

# Verb phrases

- The meanings of verb phrases are also **sets of individuals!**

$\llbracket \text{teach linguistics} \rrbracket = \{DEEPAK, JOYNAL, TANVI, SIDDHARTH\}$

$\llbracket \text{teach lecture classes} \rrbracket = \{DEEPAK\}$

$\llbracket \text{teach tut classes} \rrbracket = \{JOYNAL, TANVI, SIDDHARTH\}$

$\llbracket \text{speaks Farsi} \rrbracket = \{ \}$

# Sentence meaning

- Sentences express a *proposition* which has a “**truth value**”.
- The meaning of a sentence is its truth value i.e., **true (T) or false (F)**.
- This is called **truth-conditional semantics**. It takes speakers’ knowledge of truth conditions as basic.
- That is, if you know the meaning of a sentence, you know its **truth conditions** i.e., the condition(s) in which the sentence will be true (and the condition(s) in which the sentence will be false).

1. Deepak teaches Linguistics.      T
2. Deepak speaks Farsi.              F

Question: How do we calculate the truth value of the above sentences?

# Compositional interpretation of a sentence

- The meaning of a **simple sentence** (a sentence where the subject NP is a ‘name’) is a claim about **set membership**.
- If the meaning of NP (an individual) is a member of the meaning of VP (a set of individuals), then S is TRUE, otherwise, it is FALSE.
- A general rule for interpretation of a simple sentence (where the subject NP is a ‘name’):

$$\llbracket \text{NP VP} \rrbracket = \llbracket \text{NP} \rrbracket \in \llbracket \text{VP} \rrbracket$$

**Notation:** We write  $\llbracket X \rrbracket$  for meaning of X

We write  $\in$  for ‘member of’

# Compositional interpretation of a sentence

Deepak teaches Linguistics.

- This sentence makes a **true** claim. You can, indeed, find a set of people who teach linguistics, and Deepak is one of them.

$$\begin{aligned}\llbracket \text{NP VP} \rrbracket &= \llbracket \text{NP} \rrbracket \in \llbracket \text{VP} \rrbracket \\ &= \text{DEEPAK} \in \{ \text{DEEPAK}, \text{JOYNAL}, \text{TANVI}, \text{SIDDHARTH} \} \\ &= \text{True}\end{aligned}$$

Deepak speaks Farsi.

- This sentence makes a **false** claim. You cannot find Deepak inside the set of people who speak Farsi. (In the given situation, the set denoting the meaning of ‘speak Farsi’ is null.

$$\begin{aligned}\llbracket \text{NP VP} \rrbracket &= \llbracket \text{NP} \rrbracket \in \llbracket \text{VP} \rrbracket \\ &= \text{DEEPAK} \in \{ \} \\ &= \text{False}\end{aligned}$$

## Next class

We will discuss how to drive the meaning of different kinds of sentences.

Reading: Chapter 7, **section 7.3** (Fromkin et. al)