Where am I?

- HUL242: **Fundamentals of Language Sciences**
- **Semantics (Lecture-2)**
- Thursday, April 17th

Semantics?

- How syntactic form is associated with meaning
- To discover a small finite set of rules that underlie our semantic competence.
- Using these rules to explain people's intuitions about meaning, entailment, synonym and logically independent relationships etc.

Entailment

- When we say one sentence S_1 **entails** another sentence S_2, we mean:
  - Whenever S_1 is true, S_2 **must** also be true.
  - This is often written as $S1 \vDash S2$.
  - If S_1 doesn't entail S_2, we write $S_1 \nvDash S_2$.

Quantifiers and Entailment

- *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.

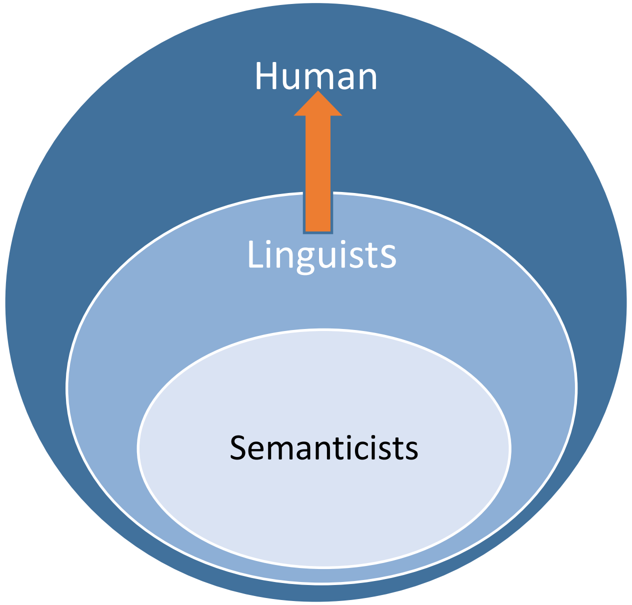
	Noun	VP
a		
every		
no		

- Note: Based on the subset and superset relation

The determiner ‘a’: NP

(1). A linguist ate berries.

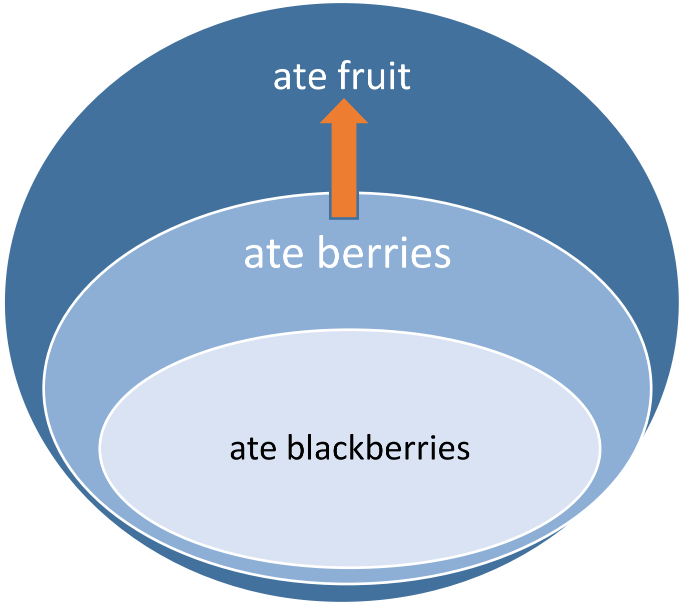
- Make the noun less specific (2) and more specific (3):
  - (2). A human ate berries. $(1) \vDash (2)$
  - (3). A semanticist ate berries. $(1) \nvDash (3)$



- We say *a* is upward-entailing on the noun:
  - you can replace the N with something more general, and the new sentence will be entailed by the first sentence
- Upward-entailing = subset to superset relation

The determiner 'a': VP

(1). A linguist ate berries.



- Make the VP less specific (4) and more specific (5):

  (4). A linguist <u>ate fruit</u>. (1) ⊨ (4)
  (5). A linguist <u>ate blackberries</u>. (1) ⊭ (5)

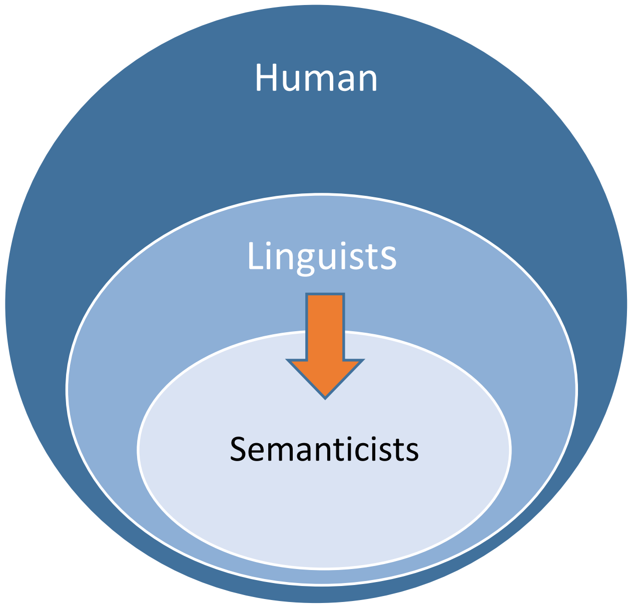
- We say 'a' is upward-entailing on its VP:

- you can replace the VP with something more general, and the new sentence will be entailed by the first sentence

- So, 'a' is upward-entailing **on both its N and VP**.

The determiner ‘every’: NP

(1). Every linguist ate berries.



- Make the noun less specific (2) and more specific (3):

  (2). Every <u>human</u> ate berries. (1) $\nvDash$ (2)

  (3). Every <u>semanticist</u> ate berries. (1) $\vDash$ (3)

- Every is downward-entailing **on its Noun**:
- You can replace the N with something more specific, and the new sentence is entailed by the first sentence

- Downward-entailing = superset to subset relation

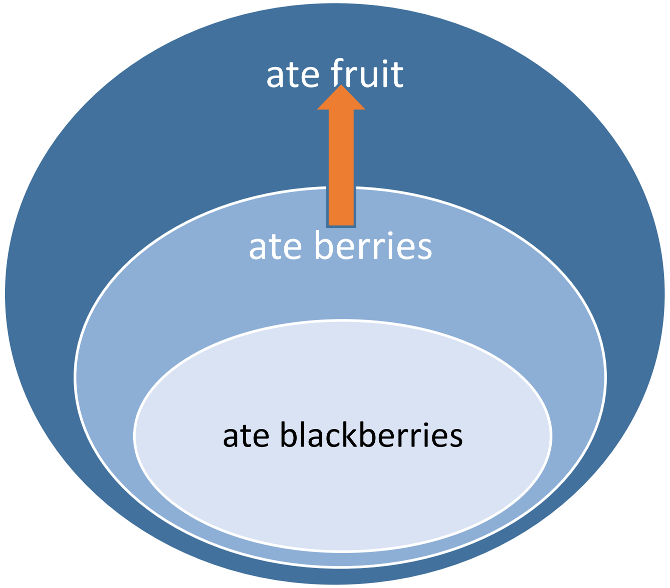
The determiner ‘every’: VP

(1). Every linguist ate berries.

➢ Making the VP less specific (4) and more specific (5):

(4). Every linguist <u>ate fruit</u>. (1) ⊨ (4)

(5). Every linguist <u>ate blackberries</u>. (1) ⊭ (5)

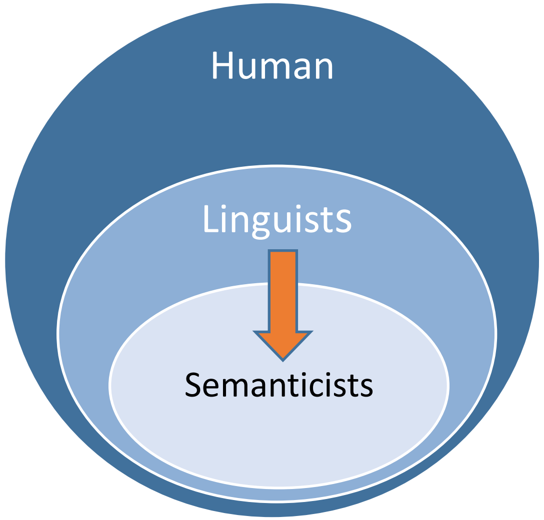


- Every is upward-entailing on its VP
  - ➢ you can replace the VP with something more general, and the new sentence will be entailed by the first sentence

- Every is downward-entailing **on its N** and upward-entailing **on its VP**

The determiner 'No': NP

(1). No linguist ate berries.

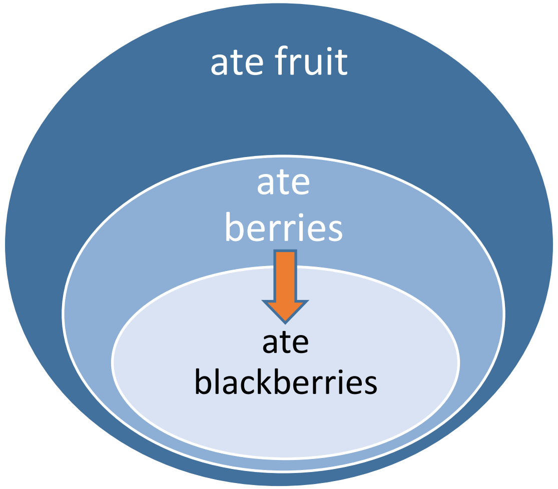


- ➢ Make the noun less specific (2) and more specific (3):
  - (2). No <u>human</u> ate berries. (1) $\nvDash$ (2)
  - (3). No <u>semanticist</u> ate berries. (1) $\vDash$ (3)

- o No is downward-entailing to its N
- ➢ You can replace the N with something more specific, and the new sentence is entailed by the first sentence.

The determiner ‘No’: VP

(1). No linguist ate berries.



- Making the VP less specific (4) and more specific (5):
  - (4). No linguist <u>ate fruit</u>. (1) $\nvDash$ (4)
  - (5). No linguist <u>ate blackberries</u>. (1) $\vDash$ (5)

- No is also downward-entailing to its VP
- You can replace the N with something more specific, and the new sentence is entailed by the first sentence.

- So, ‘no’ is downward-entailing **on both its N and VP**.

Summary

	Noun	VP
a	↑	↑
every	↓	↑
no	↓	↓

- ↑, the up arrow, stands for upward entailing (*from subset to superset*).
- ↓, the down arrow, stands for downward-entailing (*form superset to subset*).

More determiners: In tutorial

- Fill in the chart for the quantifiers *not every, at least three, exactly five*. Give sentence pair (and the entailment relation to them!) to justify your answer.

	Noun	Verb phrase
at least three		
not every		
exactly five		

- Use ↑ to show upward-entailing and ↓ to show downward-entailing

More determiners: In tutorial

- Fill in the chart for the quantifiers *not every, at least three, exactly five*. Give sentence pair (and the entailment relation to them!) to justify your answer.

	Noun	Verb phrase
at least three	↑	↑
not every	↑	↓
exactly five	x	x

Meaning of ‘names’, ‘nouns’ and ‘VPs’

- The meanings of names? **Individuals.**

  ⟦Deepak⟧ = DEEPAK

  = d

- The meanings of nouns? **Set of Individuals.**

  ⟦TA⟧ = $\{JOYNAL, TANVI, SIDDHARTH\}$

  = {j, t, s}

- The meanings of VP? **Set of Individuals.**

  ⟦teach linguistics⟧ = $\{DEEPAK, JOYNAL, TANVI, SIDDHARTH\}$

  = {d, j, t, s}

Sentence meaning

- Sentences express a proposition that has a "**truth value**".

- The meaning of a sentence is its truth value i.e., **true or false.**

- 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**.

- We calculate the truth value of the above sentences via compositional interpretation.

Compositional interpretation of a sentence

- The meaning of simple sentences (where the subject NP is a ‘name’) is a claim about **set membership**.

- The meaning of [NP VP] is the following **truth condition**:
  - 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:

$$[\![\text{NP VP}]\!] = [\![\text{NP}]\!] \in [\![\text{VP}]\!]$$

Notation: We write $[\![X]\!]$ for meaning of X

We write $\in$ for ‘member of’

Working with sets

Union

The **union** of two sets A and B, written as $A \cup B$, means the set containing all the elements that are at least in A or in B.

A = {DEEPAK, SIDDHARTH}

B = {DEEPAK, JOYNAL, TANVI}

$A \cup B$ = { DEEPAK, SIDDHARTH} $\cup$ {DEEPAK, JOYNAL, TANVI}

= { DEEPAK, SIDDHARTH, JOYNAL, TANVI}

Note: No need to mention the same member twice.

Union: Practise

A = {a, b, c, d}

B = {1, 2, 3}

$A \cup B$ =?

$A \cup B$ = {a, b, c, d, 1,2,3}

....

C = {2, 4, 6, 8}

D = {1, 3, 5, 7}

$C \cup D$ =?

$C \cup D$ = {1, 2, 3, 4, 5, 6, 7, 8}

Intersection

The **intersection** of A and B, written '$A \cap B$', means the set consisting only of things that are in **both** A and B.

A = {DEEPAK, SIDDHARTH}

B = {DEEPAK, JOYNAL, TANVI}

$A \cap B$ = {DEEPAK, SIDDHARTH} ∩ {DEEPAK, JOYNAL, TANVI}

= {DEEPAK}

Intersection: Practise

$A = \{ 2, 3, 4, 5, 6\}$

$B = \{4, 6\}$

$A \cap B = ?$

$A \cap B = \{4, 6\}$

....

$A = \{ 2, 3\}$

$B = \{4\}$

$A \cap B = ?$

$A \cap B = \{ \}$

Set subtraction

Subtracting B from A, written '$A - B$', means removing every member of B from A.

A = {DEEPAK, JOYNAL, SIDDHARTH, TANVI}

B = {DEEPAK, SIDDHARTH}

$A - B$ = {DEEPAK, JOYNAL, SIDDHARTH, TANVI} - {DEEPAK, SIDDHARTH}

= {JOYNAL, TANVI}

Set subtraction: Practise

$A = \{2, 3, 4\}$
$B = \{4\}$
$A - B = ?$
$A - B = \{2, 3\}$

....

$A = \{2, 3, 4\}$
$B = \{5, 6\}$
$A - B = ?$
$A - B = \{2, 3, 4\}$

Subsets and Supersets

If every element of A is also in B, we say that A is a **subset** of B, and we say that B is a **superset of** A.

We represent it as $A \subseteq B$ (A is a subset of B)

$B \supseteq A$ (B is a superset of A)

A = {DEEPAK, JOYNAL}

B = {DEEPAK, JOYNAL, SIDDHARTH, TANVI}

- A is a subset and B is a superset

Subsets and Superset: Practise

A = {DEEPAK, JOYNAL, SIDDHARTH, TANVI}

B = {DEEPAK, JOYNAL}

$A \subseteq B$ =?

No

What about this?

$\{\ \} \subseteq$ {DEEPAK, JOYNAL} = ?

Yes

Note: An **empty set** is a member of **every set.**

Sentence meaning: compositional interpretation

Simple Sentences

- The meaning of simple sentences (where the subject NP is a 'name') is a claim about **set membership**.

- A general rule for interpretation: $[\![\text{NP VP}]\!] = [\![\text{NP}]\!] \in [\![\text{VP}]\!]$

- What is the meaning of 'Hillary ran for president.'

(Situation: presidential election in the USA for 2017-2021)

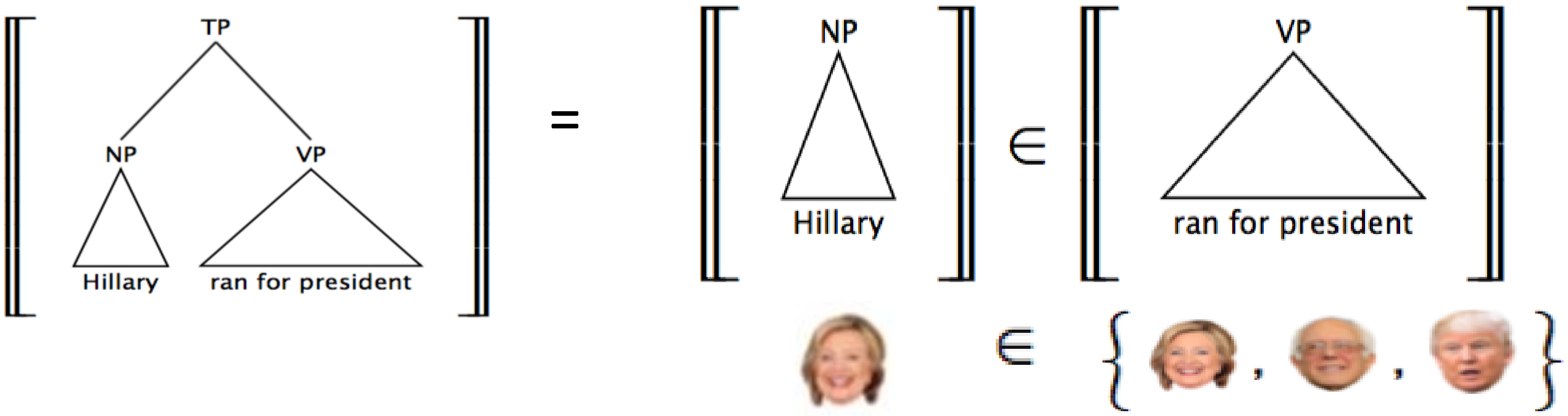
$$[\![\text{Hillary ran for president}]\!] = [\![\text{Hillary}]\!] \in [\![\text{ran for president}]\!]$$

 $\in$ $\{$  $\}$

➢ This sentence makes a **true** claim. You can find Hillary inside the set of people who ran for president.

Cautionary note

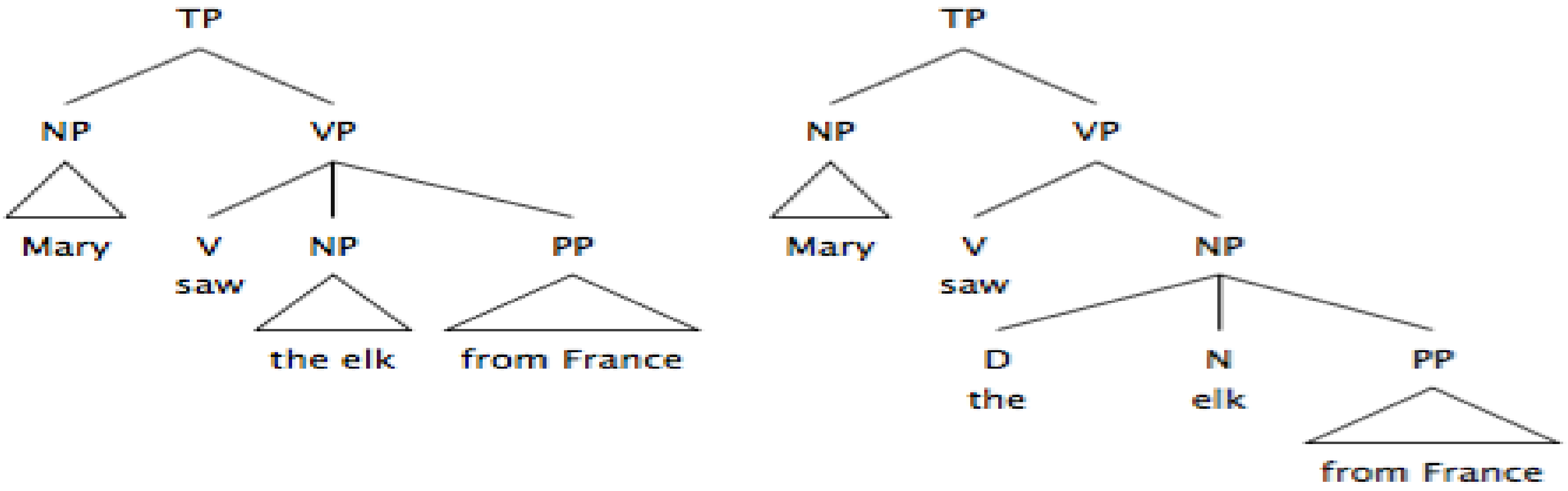
- We interpret the structure of the sentence



- Why?

Cautionary note

- **Mary saw the elk from France.** Mary is in France or The elk is from France



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

- **Note: we will use sentences (not structures) for the sake of simplicity.**

Simple sentences with VP conjunction

1. Deepak teaches Linguistics and likes semantics.

2. Deepak teaches Linguistics and speaks Farsi.

VP conjunction

$$[\![\text{VP1 and VP2}]\!] = [\![\text{V1}]\!] \cap [\![\text{V2}]\!]$$

Situation/world

$U = \{DEEPAK, JOYNAL, TANVI, SIDDHARTH, ISHAN, SUMITASH\}$

$[\![\text{teach linguistics}]\!] = \{DEEPAK, JYONAL, TANVI, SIDDHARTH\}$

$[\![\text{teach lecture classes}]\!] = \{DEEPAK\}$

$[\![\text{teach tut classes}]\!] = \{JOYNAL, TANVI, SIDDHARTH\}$

$[\![\text{like semantics}]\!] = \{DEEPAK\}$

$[\![\text{speaks Farsi}]\!] = \{\ \}$

Simple sentences with VP conjunction

Deepak teaches Linguistics and likes semantics.

⟦Deepak teaches Linguistics and likes semantics⟧

⟦Deepak⟧ $\in$ ⟦teaches Linguistics and likes semantics⟧

⟦Deepak⟧ $\in$ ⟦ teaches Linguistics⟧ $\cap$ ⟦ likes semantics⟧

DEEPAK $\in$ $\{DEEPAK, JOYNAL, TANVI, SIDDHARTH\}$ $\cap$ {DEEPAK}

DEEPAK $\in$ {DEEPAK}

The sentence makes a **true** claim.

Simple sentences with VP conjunction

Deepak teaches Linguistics and speaks Farsi.

$[\![$ Deepak teaches Linguistics and speaks Farsi$]\!]$

$[\![$Deepak$]\!] \in [\![$teaches Linguistics and speaks Farsi$]\!]$

$[\![$Deepak$]\!] \in [\![$ teaches Linguistics$]\!] \cap [\![$ speaks Farsi$]\!]$

$\text{DEEPAK} \in \{DEEPAK, JOYNAL, TANVI, SIDDHARTH\} \cap \{\,\}$

$\text{DEEPAK} \in \{\,\}$

The sentence makes a **False** claim.

Semantics of negation

- We saw how to interpret sentences like (1). How about (2)?

  1. Deepak [teaches linguistics].
  2. Deepak [**doesn’t** teach linguistics].

- The meaning of a sentence is its compositional interpretation.
- Because of this **compositionality**, ‘doesn’t teach linguistics’ should have something to do with ‘teach linguistics’.
- How do we get this?

Semantics of negation

$\text{U} \ = \{DEEPAK, JOYNAL, TANVI, SIDDHARTH, ISHAN, SUMITASH\}$

(U stands for the universe of individuals. In the present scenario, that's just six people.)

$[\![\text{teach linguistics}]\!] \ = \{DEEPAK, JOYNAL, TANVI, SIDDHARTH\}$

$[\![\text{doesn't teach linguistics}]\!] \ = \ ?$

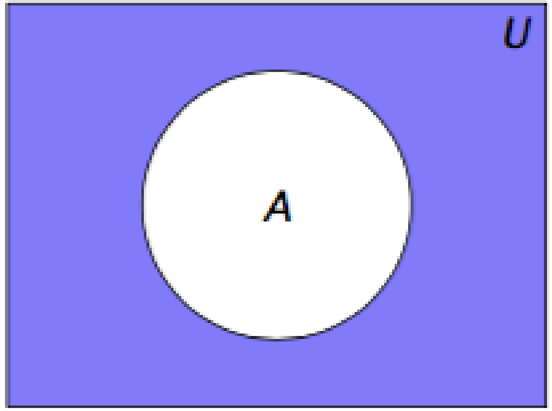
- We get 'doesn't teach linguistics' after subtracting the people who 'teach linguistics' from the set of all the people in the given universe (U).

- The rule for interpretation of negated VP:

$$[\![\text{ not VP }]\!] \ = \text{U} - [\![\text{ VP }]\!]$$

Complementation: Van diagram

- In the diagram below, the circle is the set A, the rectangle is the universe U, and the shaded blue area is $U - A$.



- This rule of subtraction i.e., $U - A$ is called **complementation** and the result of this subtraction is called **complement** (of A).

Semantics of negation

Deepak [**doesn’t** teach linguistics].

$[\![\text{NP}]\!] \in [\![\text{not VP}]\!]$

$[\![\text{NP}]\!] \in \text{U} - [\![\text{VP}]\!]$

$[\![\text{NP}]\!] \in \text{U} - [\![\text{teach linguistics}]\!]$

$$\text{DEEPAK} \in \{DEEPAK, JOYNAL, TANVI, SIDDHARTH, ISHAN, SUMITASH\} - \{DEEPAK, JOYNAL, TANVI, SIDDHARTH\}$$

$$\text{DEEPAK} \in \{ISHAN, SUMITASH\}$$

The sentence makes a **False** claim.

Semantics of negation

Deepak doesn't speak Farsi.

$[\![\text{NP}]\!] \in [\![\text{not VP}]\!]$

$[\![\text{NP}]\!] \in \text{U} - [\![\text{VP}]\!]$

$[\![\text{NP}]\!] \in \text{U} - [\![\text{speak Farsi}]\!]$

$\text{DEEPAK} \in \{DEEPAK, JOYNAL, TANVI, SIDDHARTH, ISHAN, SUMITASH\} - \{\ \}$

$\text{DEEPAK} \in \{DEEPAK, JOYNAL, TANVI, SIDDHARTH, ISHAN, SUMITASH\}$

The sentence makes a **True** claim.

Interim Summary

- A simple sentence with a simple VP:
  Deepak teaches linguistics.
  $[\![\text{NP VP}]\!] = [\![\text{NP}]\!] \in [\![\text{VP}]\!]$

- A simple sentence with VP conjunction:
  Deepak teaches linguistics and likes semantics.
  $[\![\text{NP VP1 and VP2}]\!] = [\![\text{NP}]\!] \in [\![\text{V1}]\!] \cap [\![\text{V2}]\!]$

- A simple sentence with negated VP
  Deepak doesn't speak Farsi.
  $[\![\text{NP not VP}]\!] = [\![\text{NP}]\!] \in U - [\![\text{VP}]\!]$

Next class

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

Reading:
Chapter 7, **section 7.4** (Fromkin et. al)
Chapter 8, ONLY **section 8.3: Relative scope** (Fromkin et. al)