Meaning 5.1: Semantics 4 — Quantifiers

May 20, 2020

Recap

Model architecture: based on set theory.

Basic units: elements/individuals, ordered pairs, sets

TRUTH CONDITIONS

Operations/relationships: membership $\in$, intersection $\cap$, union $\cup$, subset $\subseteq$, superset $\supseteq$

COMPOSITIONALITY

Denotations we've covered so far

The following linguistic units are represented by these objects in our model:

(i) names, definite NPs (DPs) — elements/individuals $a, b, c, \ldots$

$[\![\text{Ted}]\!] = t$

(ii) nouns, adjectives, intransitive verbs — sets of individuals $A, B, C, \ldots$

$[\![\text{dance}]\!] = \{x\colon x \text{ dances}\}$

(iii) transitive verbs — sets of ordered pairs $\mathcal{A}, \mathcal{B}, \mathcal{C}, \ldots$

$[\![\text{like}]\!] = \{\langle x, y\rangle\colon y \text{ likes } x\}$

Compositions

(i) simple predication $S \to DP\ VP$; $VP \to V$ or $VP = is + AdjP$

S is true iff $[\![DP]\!] \in [\![VP]\!]$

$[\![\text{Ted dances}]\!]$ is true iff $t = [\![\text{Ted}]\!] \in [\![\text{dance}]\!] = \{x\colon x \text{ dances}\}$

(ii) transitive VP $S \to DP_1\ VP$; $VP \to V\ DP_2$

S is true iff $\langle [\![DP_2]\!], [\![DP_1]\!] \rangle \in [\![VP]\!]$

$[\![\text{Ted likes the shawarma}]\!]$ is true iff

$\langle s, t \rangle = \langle [\![\text{the shawarma}]\!], [\![\text{Ted}]\!] \rangle \in [\![\text{like}]\!] = \{\langle x, y \rangle\colon y \text{ likes } x\}$

(iii) definite descriptors $DP \to D\ NP$

$[\![D\ NP]\!]$ = contextually salient individual d s.t. $d \in [\![NP]\!]$

$[\![\text{the shawarma}]\!]$ = contextually salient shawarma s in set $[\![\text{shawarma}]\!]$

Quantifiers

Consider the following sentences which exhibit quantification over objects in our model:

(i) **All** students like to learn.

(ii) **Some** students like to code.

(iii) **No** student likes to debug code.

What are the truth conditions for these sentences? How do we model the bolded words?

Domain Restriction

First note that we usually understand quantifier phrases with respect to a specific domain or context.

All students know articulatory phonetics.

We understand that here, the domain for all students is not the entire world, but specific to our class.

This is called **domain restriction**.

Simple predication won't work

Quantifier DPs are not interpreted as individuals or sets of individuals; rather, they talk about a relationship between sets.

Our simple predication rule that $\mathrm{S} = 1$ iff $[\![\mathrm{DP}]\!] \in [\![\mathrm{VP}]\!]$ does not apply here because the DP here is a set of elements/individuals, not a particular individual.

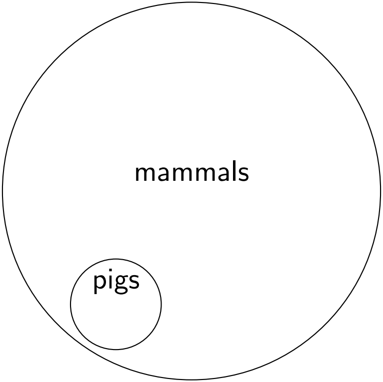
We need to talk about the relationship between $[\![\mathrm{N}]\!]$ set in the DP and the $[\![\mathrm{VP}]\!]$ set.

All with no domain restriction — the subset relation $\subseteq$

All N VP is true iff $[\![N]\!] \subseteq [\![VP]\!]$, such that $[\![N]\!]$ consists of the contextually salient individuals that have that property.

All pigs are mammals. (no domain restriction here)

$\{x\text{: } x \text{ is a pig}\} \subseteq \{x\text{: } x \text{ is a mammal}\}$

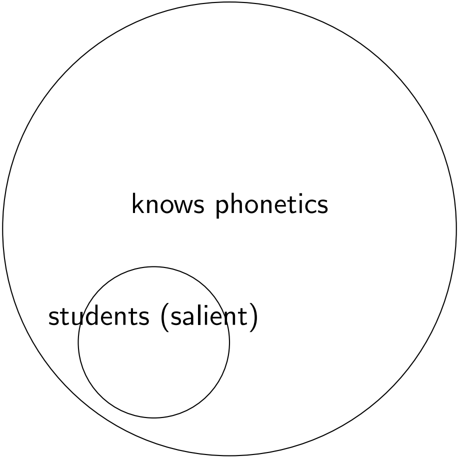


All with domain restriction — the subset relation $\subseteq$

All students know articulatory phonetics.

(domain restriction here if understood as student of UChicago)

$\{x$: x is a contextually salient student$\} \subseteq \{x$: x knows articulatory phonetics$\}$

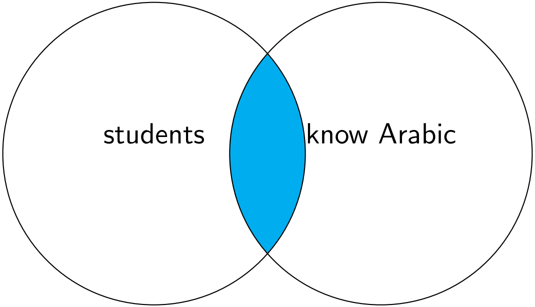


Some — non-empty intersection ∩

Some N VP is true iff $(\llbracket N \rrbracket \cap \llbracket VP \rrbracket) \neq \varnothing$

Some students know Arabic. (note potential for domain restriction)

$\Big(\{x\text{: } x \text{ is a student [in contextually restricted domain]}\} \cap$
$\{x\text{: } x \text{ knows Arabic}\}\Big) \neq \varnothing$

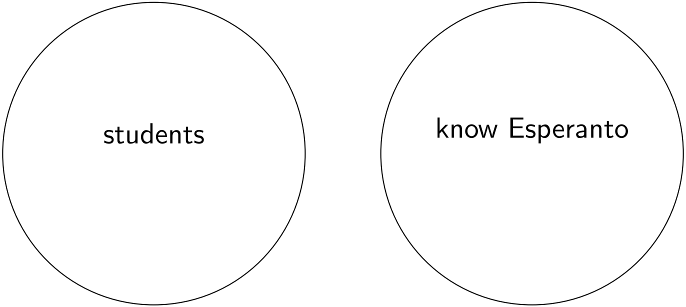


No — empty ∅ intersection ∩

No N VP is true iff $([\![N]\!] \cap [\![VP]\!]) = \varnothing$

No student knows Esperanto. (note potential for domain restriction)

$\Big(\{x\text{: } x \text{ is a student [in contextually restricted domain]}\} \cap$
$\{x\text{: } x \text{ knows Esperanto}\}\Big) = \varnothing$



Entailment relations in terms of set theory

Set theory also helps us understand **entailment** relationship between sentences.

(i) A student is listening to funk music.

(ii) A student is listening to music.

Whenever (i) is true, (ii) will also be true.

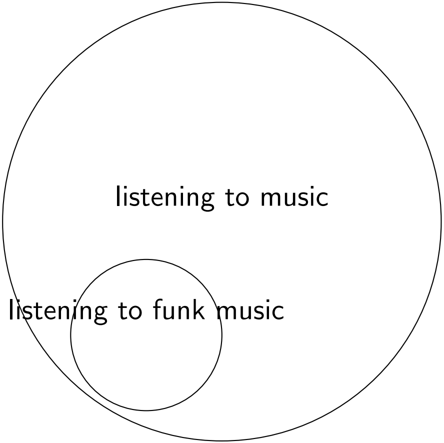
In other words, (i) **entails** (ii).

Entailment relations in terms of set theory

Instances of ‘listening to funk music’ is a subset of ‘listening to music’

If we want to model these, then it would mean

$[\![\text{listening to funk music}]\!] \subseteq [\![\text{listening to music}]\!]$



End of this video's material.