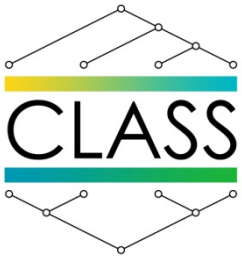

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MEANING REPRESENTATIONS & SEMANTIC ANALYSIS

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Semantic analysis

- A sequence of characters (i.e. **a text**) has no meaning by itself.

Donald Trump is the president of USA

Δοναλδ Τρυμπ ισ τηε πρεσιδεντ οφ ΥΣΑ

Semantic analysis

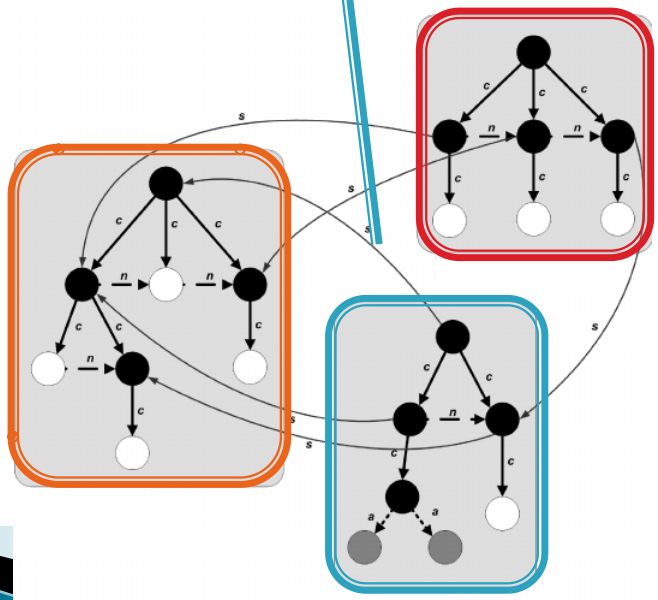
- **Linguistic representations** must be linked with our non-linguistic **knowledge of the world.**

Donald Trump is the president of USA

Semantic analysis

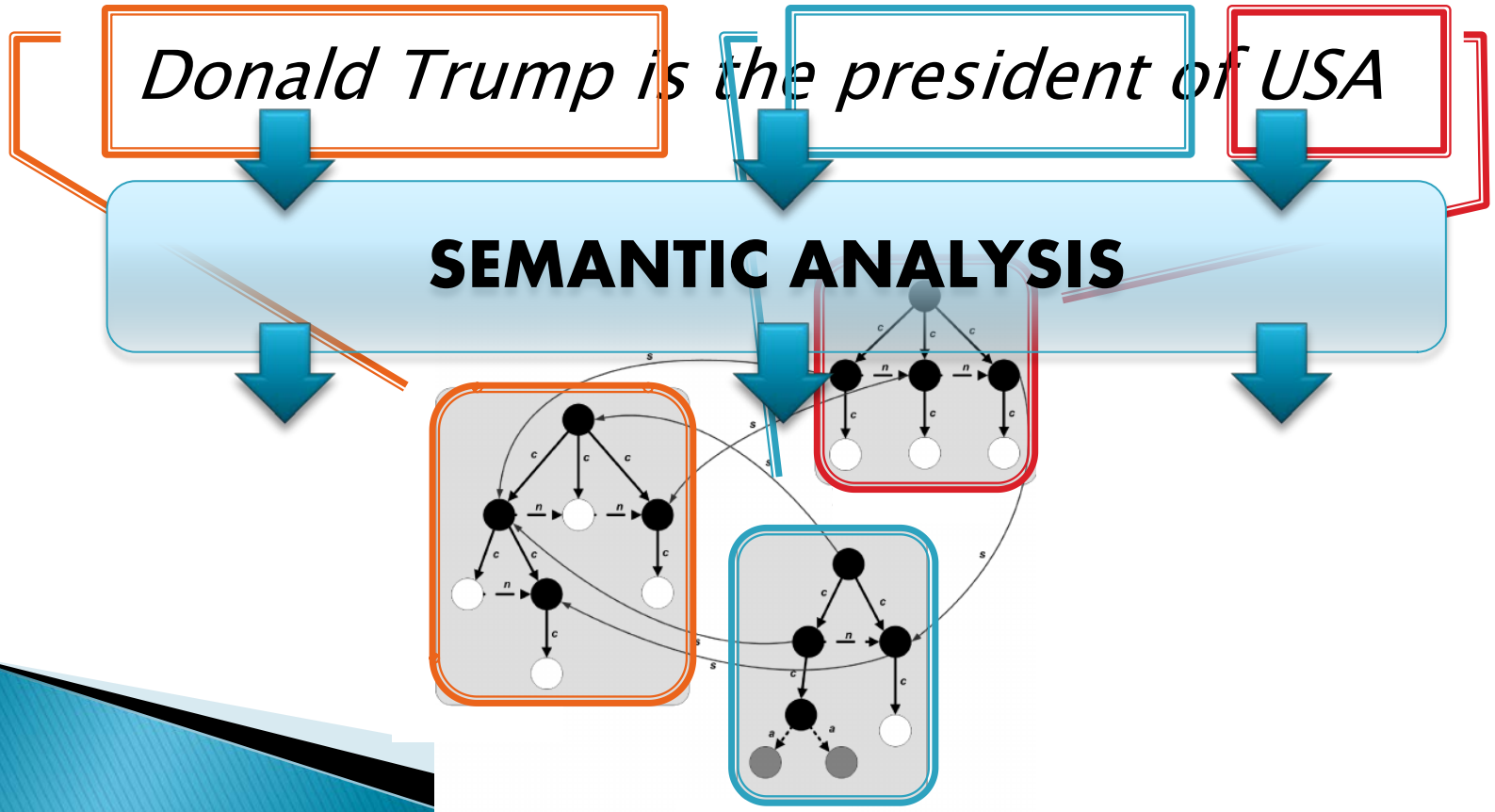
- This knowledge (**meaning**) can be captured with formal structures (**meaning representations**).

Donald Trump is the president of USA



Semantic analysis

- The process whereby such representations are created is called **semantic analysis.**



Meaning representations

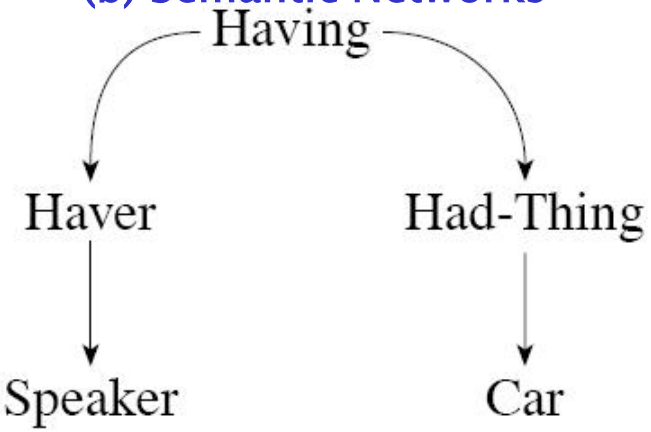
- Different **meaning representation languages** (i.e. different types of formal representations) available:

e.g. *"I have a car"*

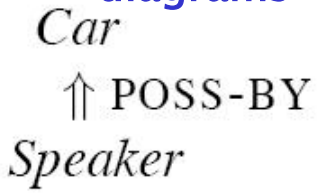
(a) First-Order Logic predicates

$$\exists e, y\ Having(e) \wedge Haver(e, Speaker) \wedge HadThing(e, y) \wedge Car(y)$$

(b) Semantic Networks

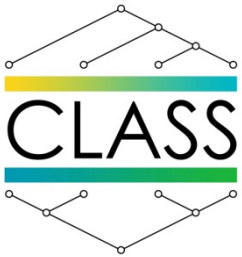


(c) Conceptual dependency diagrams



(d) Frames

```
Having
 Haver:   Speaker
 HadThing:   Car
```



Meaning representations

- Or any other representation fulfilling/allowing:
  a) Verifiability
  b) Unambiguous representations
  c) Canonical form
  d) Inference mechanisms
  e) Use of variables
  f) Expressiveness

Syntax-driven semantic analysis

- How to combine the meaning of separate words into the meaning of a whole sentence?
  - **(Frege's) Principle of compositionality**: *the meaning of a complex expression is determined by the meanings of its constituent expressions and the rules used to combine them*.

  - The **syntactic structure of a sentence** is used to guide the process of semantic analysis.

Syntax-driven semantic analysis

Example (1/2): the grammar

S: Sentence
NP: Noun Phrase
PN: Proper Noun
VP: Verbal Phrase
TV: Transitive Verb

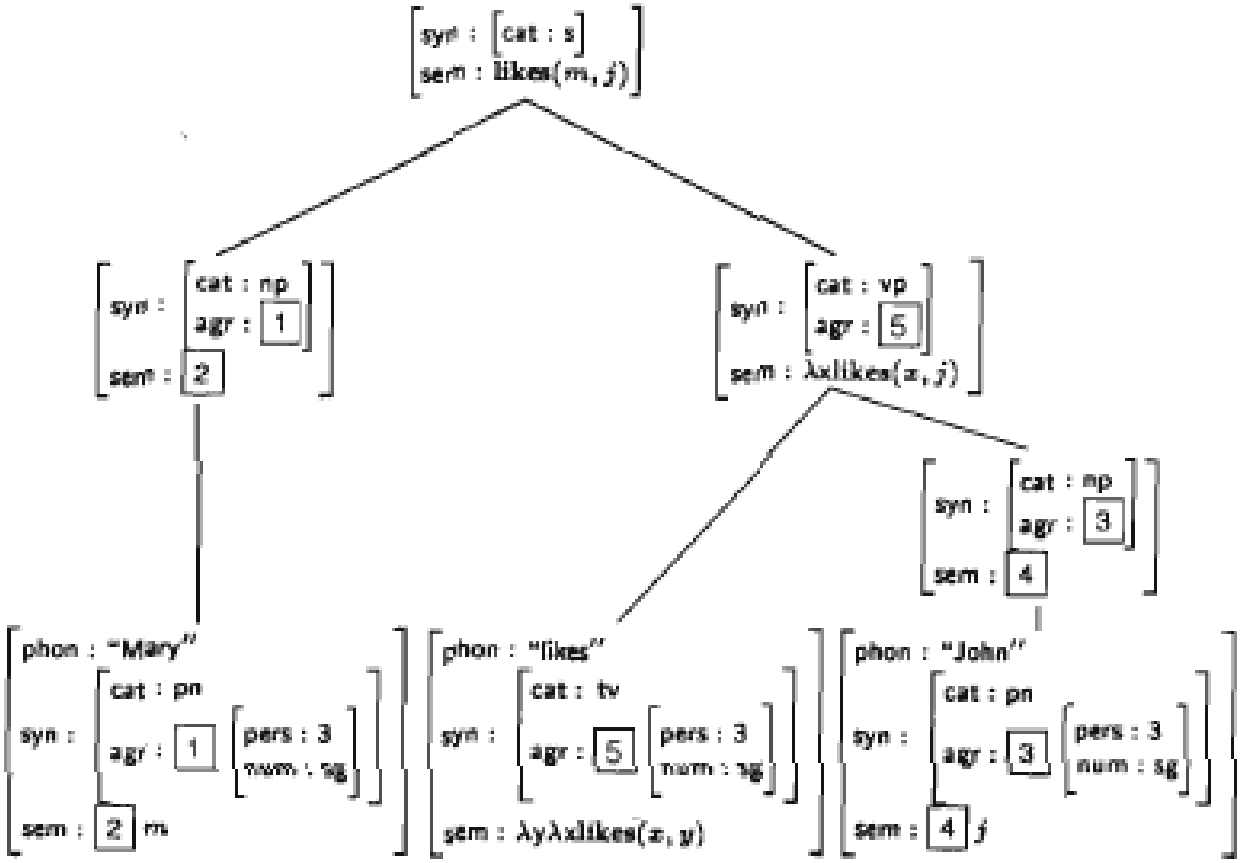
$$S \rightarrow NP\ VP \left\{ \begin{array}{lcl} \langle S.syn.cat \rangle & \doteq & s \\ \langle NP.syn.cat \rangle & \doteq & np \\ \langle VP.syn.cat \rangle & \doteq & vp \\ \langle NP.syn.agr \rangle & \doteq & \langle VP.syn.agr \rangle \\ & & \\ \langle VP.sem \rangle & \doteq & Pred \\ \langle NP.sem \rangle & \doteq & Arg \\ \langle S.sem \rangle & \doteq & Pred(Arg) \end{array} \right.$$

$$NP \rightarrow PN \left\{ \begin{array}{lcl} \langle NP.syn.cat \rangle & \doteq & np \\ \langle PN.syn.cat \rangle & \doteq & pn \\ \langle NP.syn.agr \rangle & \doteq & \langle PN.syn.agr \rangle \\ & & \\ \langle NP.sem \rangle & \doteq & \langle PN.sem \rangle \end{array} \right.$$

$$VP \rightarrow TV\ NP \left\{ \begin{array}{lcl} \langle VP.syn.cat \rangle & \doteq & vp \\ \langle TV.syn.cat \rangle & \doteq & tv \\ \langle NP.syn.cat \rangle & \doteq & np \\ \langle VP.syn.agr \rangle & \doteq & \langle TV.syn.agr \rangle \\ & & \\ \langle V.sem \rangle & \doteq & Pred \\ \langle NP.sem \rangle & \doteq & Arg \\ \langle VP.sem \rangle & \doteq & Pred(Arg) \end{array} \right.$$

Syntax-driven semantic analysis

Example (2/2): analysis of “Mary likes John”



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