Natural Language

Practical Classes

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P10

Semantics

Image generated by ChatGPT

- **Summary**:
  - Symbolic representation of language
  - Compositional Semantics
- **Operational objectives**:
  - Practice language representation via First Order Logic
  - Practice the semantic compositionally approach
- **This class needs**: paper, a pen/pencil
- **Class material**: these guidelines

On the edge of disaster

You had barely awake when you receive a message from Morcela:

Youngster,

Refine your semantic skills. Now.

You gulp, check the magnificent slides about Semantics, and start working.

Hands on

1. Fill in the table by associating each of the semantic relations in column 1 with the terms given below, considering their relation with the word "cat" (if possible):

   - animal
   - whisker
   - domestic cat
   - leopard

Semantic Relation	**Word or Phrase**
Hyponym of cat:	
Meronym of cat:	
Hypernym of cat:	
Synonym of cat:	
None of the above:	

Tabela 1: Fill in the appropriate terms related to "cat"

2. Consider constant $Pedro$ and the predicates:

   $sister\_of(x, y)$: if y is a sister of x
   $equal(x, y)$: if x is equal to y

   Represent in FOL the following sentences:

   (a) *Peter has (at least) one sister.*

   (b) *Peter has no sister.*

   (c) *Peter has at most one sister.*

   (d) *Peter has exactly one sister.*

3. Consider constants $Dustin$ and $Dart$ and the predicates:

   $friend(x, y)$: if x is a friend of y
   $likes(x, y)$: if x likes y
   $different(x, y)$: if x is different from y

   Represent in First Order Logic (FOL) the following sentences:

   (a) *If Dart is a friend of Dustin, all Dustin friends like Dart*

   (b) *There are at least two friends of Dustin that don't like Dart.*

4. (*from Eisenstein book*) Consider the G2 grammar in the following figure. Find the meaning representation of the phrase "likes a dog" by completing the missing parts. Assume that the semantics of "a dog" is:

   λQ. $\exists$x DOG(x) $\wedge$ Q(x).

S	$\rightarrow$ NP VP	NP.sem@VP.sem
VP	$\rightarrow$ V_t NP	V_t.sem@NP.sem
VP	$\rightarrow$ V_i	V_i.sem
NP	$\rightarrow$ DET NN	DET.sem@NN.sem
NP	$\rightarrow$ NNP	$\lambda P.P(\text{NNP.sem})$
DET	$\rightarrow$ *a*	$\lambda P.\lambda Q.\exists x P(x) \wedge Q(x)$
DET	$\rightarrow$ *every*	$\lambda P.\lambda Q.\forall x(P(x) \Rightarrow Q(x))$
V_t	$\rightarrow$ *likes*	$\lambda P.\lambda x.P(\lambda y.\text{LIKES}(x,y))$
V_i	$\rightarrow$ *sleeps*	$\lambda x.\text{SLEEPS}(x)$
NN	$\rightarrow$ *dog*	DOG
NNP	$\rightarrow$ *Alex*	ALEX
NNP	$\rightarrow$ *Brit*	BRIT

Strange Days[1]

When you were already fed up with semantics, you receive a call from Inspector Morcela, more nervous than you ever imagined possible. The NLP freak planted a bomb at the station and is going to destroy extremely important records. You receive the new quiz that the NLP freak sent to Morcela:

> *Dear Morcela,*
> *The meaning of the sequence "4 3 3 4 2" is the code you need, but you will never be able to solve this.*
> *Muahahahahahahahahahahah!*

A $\rightarrow$ B C D {(B.sem + C.sem – D.sem)$\times$10}(A is the initial symbol)
B $\rightarrow$ E F {E.sem $\times$ F.sem}
C $\rightarrow$ F E {F.sem + E.sem}
D $\rightarrow$ 1 {1} | 2 {2} // the semantics of 1 is 1 and the semantics of 2 is 2
E $\rightarrow$ 4 {4} | 6 {6} | 8 {8}
F $\rightarrow$ 3 {3} | 5 {5} | 7 {7} | 9 {9}

You have just solved the previous challenge and your heart rate is almost normal, when inspector Morcela calls you again, even more hysterical: another bomb and another terrifying message (see below). This time, instead of a code you have to find out which are the wires you should cut. The bomb has a red, a blue, a violet, a green, another blue, a pink and a yellow wire. OMG!

> *Dear Morcela,*
> *In the improbable case you have found the previous code, here goes a more complicated challenge, with lambda calculus. The meaning of the sequence "every red cut" tells you what you need to do. Which wires should you cut? This time is over! You are done!*
> *Muahahahahahahahahahahah!*

S $\rightarrow$ NP VP {NP.sem@VP.sem}
NP $\rightarrow$ DET ADJ {DET.sem@ADJ.sem}
DET $\rightarrow$ every {λP. λQ. $\forall$x (P(x) $\rightarrow$ Q(x))}
ADJ $\rightarrow$ red {BLUE}
VP $\rightarrow$ Vi {Vi.sem}
Vi $\rightarrow$ cut {λx. CUT(x)}

Can you help Morcela again?

[1] Remember: one of the best movies ever!