Natural Language Understanding and Computational Semantics

DS-GA/LING-GA 1012

Homework 4: Due April 17th

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Question 1 (35 pts) Find the predicate logic denotations for sentences 1–7. You will be using symbols for conjunction ($\wedge$), disjunction ($\vee$), existential quantification ($\exists$), universal quantification ($\forall$), implication ($\rightarrow$), and negation ($\neg$). You can ignore inflection on the verb.

1. [[Something barks]]
$\exists$ x Barks(x)

2. [[Something that is a dog barks]]
Dog(x) $\wedge$ Barks(x)

3. [[Some dog barks]]
$\exists$ x[Dog(x) $\wedge$ Barks(x)]

4. [[Some dog barks or growls]]
$\exists$ x[Dog(x) $\wedge$ [Barks(x) $\vee$ Growls(x)]]

5. [[Some dog does not bark]]
$\exists$x[dog(x) $\wedge$ $\neg$Barks(x)]

6. [[No dog barks]]
$\forall$x[dog(x) $\rightarrow$ $\neg$Barks(x)] (my answer is this one, but I also think the second one has the same meaning. I'm confused lol)
$\neg\exists$x[dog(x) $\wedge$ Barks(x)]

7. [[Every dog barks]]
$\forall$x[dog(x) $\rightarrow$ Barks(x)]

Question 2 (30 pts) Derive the meaning of "John or Mary talks" from the meaning of its parts, i.e. provide denotations for 1–6 using lambda predicate logic. For each denotation, give its type.

1. [[John]]
John
Real-world individual
Type e

2. [[or]] Hint: A disjunction of individuals is not well-formed. In other words, the meaning of "or" is cannot be $\lambda x.\lambda y.\ x \vee y$ where x and y are individuals. Find a more complex meaning of "or" that avoids this problem.
$\lambda x.\lambda y.\ (x \vee y) \wedge \neg(x \wedge y)$
type t

3. [[Mary]]
Mary
Real-world individual
Type e

4. [[talks]]
$\lambda xe.\ talks(x)$
Type <e,t>

5. [[John or Mary]]
$(\lambda y.\lambda z.\ (y \vee z) \wedge \neg(y \wedge z))\ (John,Mary)$
$=(John \vee Mary) \wedge \neg(John \wedge Mary)$
Type t

6. [[John or Mary talks]]
$\lambda xe.\ talks(x)[\ (\lambda y.\lambda z.\ (y \vee z) \wedge \neg(y \wedge z))]$
$=talks((John \vee Mary) \wedge \neg(John \wedge Mary))$
Type t

Question 3 (20 pts) Provide Neo-Davidsonian event semantic denotations for the following sentences. Make sure you use thematic functions agent and theme.

1. [[Susan ate]]
$\exists e.ate(e) \wedge agent(e,Susan)$

2. [[Susan ate the apple]]
$\exists e.ate(e) \wedge agent(e,Susan) \wedge theme(e,apple)$

3. [[The apple was eaten by Susan]]
$\exists e.eaten(e) \wedge agent(e,Susan) \wedge theme(e,apple)$

4. [[The apple was eaten]]
$\exists e.eaten(e) \wedge theme(e,apple)$

Question 4 (15 pts) Consider the sentence “Every dog loves some cat.” This sentence is ambiguous. Give the predicate logic denotations for each of the two meanings of the sentence. Explain in one sentence the difference between these two meanings.

$\forall x[dog(x) \rightarrow \exists y[cat(y) \wedge loves(x,y)]]$

It means every dog has cats they love but different dogs might love different cats.

$\exists y[cat(y) \wedge \forall x[dog(x) \rightarrow loves(x,y)]]$
It means there are some cats that every dog loves.