Compositionality

CS 112: Problem Set

Posted:Tues, October 31, 2006 Due Date: Fri, November 10, 2006 IN CLASS

1 Handling Coordination

1. We have looked at how to compose expressions through function application in the λ -calculus. From a nonempty set BasType of basic types, the set T or types is the smallest set such that:

- (a) $BasTyp \subseteq T$
- (b) If $\sigma, \tau \in T$, then $\sigma \to \tau \in T$.

We will take BasTyp, following Montague, to be

 $BasTyp = \{Ind, Bool\} \text{ or } \{e, t\}$

where e is the type of individuals and t is the type of propositions.

In this exercise, you are to give (a) the type and (b) appropriate semantics (λ -expression) for the following linguistic expressions. We covered some of these in class. You are to also show (c) the type derivation using these types.

- 1. and: as used in "Every girl runs and plays."
- 2. and: as used in "John and Mary visited Bill."
- 3. and: as used in "An old and useless car."
- 4. after: as used in "It rained after John left."

As an example, the types, semantics, and derivation for the following sentence are shown below.

(1) John loves Mary. a. john: e, loves: $e \to (e \to t)$, mary: e. b. $j, \lambda y \lambda x[loves(x, y)], m.$ c. S:t. love(j, m)John: e. j VP: $e \to t$. $\lambda x[love(x, m)]$ John V: $e \to (e \to t)$ NP: e. mlove. $\lambda x \lambda y[love(y, x)]$ Mary As extra credit, consider what analysis you might give to other uses of *after* and other temporal prepositions. For example, notice that the type of such expressions will have to be different to account for the cases below. What would the type, semantics, and derivation be for *after* in each of these sentences?

- (2) a. Mary left after John.
 - b. Mary smoked after eating.

2 Type Shifting

Now let's look at the way expressions of one type really can show up as functioning as another type. For example, notice that a proper name can be combined by coordination with a quantified noun phrase.

(3) Mary and some guy visited us.

In this case, *Mary* can be type raised to be of the same type as the expression some guy so that coordination (as you were defining it in problem (1)) can put the two expressions together. So this shows that NPs can be of type e or $(e \to t) \to t$.

This relationship is sometimes captured by writing a type-shifting rule which explicitly changes one type to another:

(4) The rule $e \implies (e \rightarrow t) \rightarrow t$ applies in a context where it is needed, such as coordination with a generalized quantifier.

With this, the expression associated with *Mary* must reflect that new type, i.e., $\lambda P[P(m)]$.

But what happens when it looks like an NP has type $e \to t$, that is, the type of a simple predicate? Notice in (5a) what the desired interpretation in (5b) is.

(5) a. Mary is a professor.b. professor(m)

You need to give the type shifting rule that is working above in (4) and the context in which it applies. Are there other cases of treating NPs as predicates?

3 Relative Clauses

The relative clause construction is a pervasive strategy for adding information to an NP much like an adjective does. For example, notice the two sentences below.

- (6) a. A well-liked book won the Booker Prize.
 - b. A book which everyone likes won the Booker Prize.

Notice how similar the modification being performed by the relative clause in (6b) is to that performed by the pre-nominal adjective in (6a).

There are two things you need to do. First, what is the desired semantics for the sentence in (6b)? If you think of it as similar to adjectives, then this will give you a clue. Secondly, how do you construct this meaning compositionally? In other words, what is the type be for the "relative pronoun" *which*? And how does this allow you to combine the information in the relative clause to make it seem like a big adjective?