

### Semantics Worksheet 3

NOTE: ignore minor differences in notation from the textbook (e.g. use of [] vs. ()).

1. From p. 382 of the textbook: (Re-)Read the section on Quantifier Scope Ambiguity on pp. 381-2.  
Devise a new model based on m2 so that (27a) comes out false in your model.

Devise a new model such that (27b) comes out true.

2. What sets are denoted by:

(i)  $\lambda y [(like(y))(jo) \ \& \ \sim((like(y))(ethel))]$ .

(ii)  $\lambda z [give(z)(the-cake))(z)]$ .

(iii)  $\lambda x [x = jo]$

(iv)  $\lambda z [student(z) \ \& \ like(jo))(z)]$ .

3. Lambda convert ( $\beta$ -reduce):

(i)  $\lambda y [(like(y))(jo) \ \& \ \sim((like(y))(ethel))] \ (the-dog)$

(ii)  $\lambda z [(give(z)(the-cat))(z)] \ (bertie)$

(iii)  $\lambda x [\sim(x = jo)] \ (bertie)$

(iv)  $\lambda y [(like(the-cat))(y) \ \vee \ \sim(like(the-dog))(y)] \ (bertie)$

(iv)  $\lambda x [\lambda y [crazy(x) \ \& \ (like(x))(y)](jo) \ \vee \ \sim(crazy(x))] \ (bertie)$

4. Why are the following wrong? And what should they be?:

(i)  $\lambda x [(kick(x))(x)] \ (jo)$

>>  $(kick(x))(jo)$

(ii)  $\lambda x [\lambda x [howl(x)] \ (the-cat)] \ (the-dog)$

>>  $\lambda x [howl(the-dog)] \ (the-cat)$

(iii)  $\lambda y [(like(jo))(x)] \ (bertie)$

>>  $(like(jo))(bertie)$

(iv)  $\lambda z [crazy(z)] \ (ethel) \ \vee \ drunk(z)$

>>  $crazy(ethel) \ \vee \ drunk(ethel)$

5. Given the variables below, what are the types of the lambda expressions that follow? (Where a is a type, the set of variables of type a can be symbolized as  $\text{Var}_a$ ).

$P, Q \in \text{Var}_{\langle e, t \rangle}$

$p, q \in \text{Var}_t$

$R \in \text{Var}_{\langle e, \langle e, t \rangle \rangle}$

$x, y, z \in \text{Var}_e$

$A \in \text{Var}_{\langle \langle e, t \rangle, \langle e, t \rangle \rangle}$

- i.  $\lambda R [(R(jo'))(bertie')]$ .
- ii.  $\lambda P [\lambda A [A(P)]]$ .
- iii.  $\lambda Q [Q(ethel')]$ .
- iv.  $\lambda x [\lambda y [\lambda z [(give'(x)(y))(z)]]]$ .
- v.  $\lambda p [p \leftrightarrow \text{rain}']$ .
- vi.  $\lambda p [\lambda q [p \leftrightarrow q]]$ .

6. It has been suggested that we should see the semantics of questions (interrogative sentences) as defined in terms of the set of possible answers the question determines in context. For example, a 'yes-no question' such as 'Does Cyril like Bertie' determines the set of possible answers, {True, False}, while a 'wh-question' like 'Who likes Cyril?' might in context determine a set of possible answers which is a set of propositions such as {Olive likes Cyril, Angus likes Cyril}. Re-read section 10.1 and discuss this suggestion with respect to that section of the chapter. Are we closer to allowing the interrogation of databases using natural language questions?

7. For further work: try exercises 5 and 6 on p 405 of the textbook.