1   Interpreting type theory

Compute the truth conditions of the following expressions. You may abbreviate intermediate results appropriately, as long as you show the most important interpretation steps. student and work are constants of type $\langle e, t \rangle$, and $\mathbf{p}^*$ and $\mathbf{j}^*$ are constant of type e. *Don't β-reduce anything for now.*

1. $(\lambda F \lambda G \neg \exists x (F(x) \wedge G(x)))(\text{student})(\text{work})$
   "No student works."

2. $(\lambda F (F(\mathbf{j}^*) \vee F(\mathbf{p}^*)))(\text{work})$
   "Either John or Peter works."

Then β-reduce the term (b) into a formula of first-order predicate logic (FOL) and compute its truth conditions as a FOL formula. Compare the two interpretations.

2   Semantics construction

Construct semantic representations for each of the following sentences using type theory. First give a representation for each word. Then combine them compositionally into a representation for the whole sentence. Give the type of each term in your derivation. Use lambda abstraction as necessary, and β-reduce your results (including intermediate representations) as far as possible.

1. Every successful student works hard.

2. John says that Peter is a criminal.

   Assume that "that" translates into $\lambda p.p$ (identity function). You might treat "is a" as a single word (as on slide 15) if you cannot find an appropriate translation of "is." Hint: the translation of "is" is quite similar to the translation of transitive verbs.

3. Some students don't drink and drive.

   (negation takes scope over conjunction)

   Treat "don't" as a single word, and translate it into an appropriate λ-term involving a negation.

3 Determiners

In the lecture, we have presented lambda terms for a couple of determiners ("some," "every," "no," . . .). Give corresponding lambda terms for "exactly one" and "at least two."

4 Adjectives

In the lecture, we have presented a meaning postulate for intersective adjectives. Give (a) appropriate meaning postulates for the subsective adjective "good" and the privative adjective "former," and (b) corresponding lambda terms that encode the meaning postulates as explicit lambda terms for the two adjectives.

5 And

1. What type would you have to assign the semantic representation of "and" in each of the following sentences so the representation for the whole sentence gets type t?

   (a) John sleeps and Mary works.
   (b) John works hard and is successful.
   (c) All students and some professors work hard.
   (d) John works quickly and thoroughly.

2. Represent the semantics of "and" in each sentence as a λ-term.

To be turned in by Tuesday, May 13