LING4400: Problem Set 1

Due via Carmen dropbox at 11:59 PM 9/12.

1. [9 pts.] List all the unique possible functions (that is, tables) of type $\langle e, t \rangle$ in a world with two e's: (**Laos, Togo**), and three t's (**False, True, Maybe**). Hint: there are 9.

2. [3 pts.] How many unique possible functions (that is, tables) of type $\langle e, \langle e, t \rangle \rangle$ are there in a world with three e's: (**A, B, C**), and two t's (**False, True**)? In a sentence, explain why.

3. Assuming variables x and y and constant A are of type e, constants P and Q are of type $\langle e, t \rangle$ and constant R is of type $\langle e, \langle e, t \rangle \rangle$, draw derivation trees that identify the type of each of the following:

   (a) [2 pts.] $\lambda_{x:e}\ x$

   (b) [2 pts.] $\lambda_{x:e}\ P\ x$

   (c) [2 pts.] $P\ x$

   (d) [2 pts.] $R\ x$

   (e) [2 pts.] $(\lambda_{x:e}\ P\ x)\ y$

   (f) [2 pts.] $R\ A\ A$

   (g) [2 pts.] $\lambda_{x:e}\ R\ x\ A$

   (h) [2 pts.] $\lambda_{y:e}\ \lambda_{x:e}\ R\ y\ x$

   (i) [2 pts.] $\lambda_{x:e}\ And\ (P\ x)\ (Q\ x)$

4. [3 pts.] Beta reduce the following expression:

$$(\lambda_{x:e}\ \lambda_{y:e}\ And\ (Coastal\ y)\ (Capital\ x))\ Laos$$

5. [3 pts.] What is the interpretation of the following expression in a world model M with truth value tables for the function constants as shown in the lecture notes on propositional logic:

$$[\![And\ (If\ True\ False)\ True]\!]^M$$

6. [3 pts. extra credit] Write a lambda calculus expression for a function using conjunction (And) and negation (Not) as defined in the lecture notes on propositional logic that takes three truth values as input and outputs True if the output of a conjunction of the first two is equal to the third, and False otherwise.