LING3804: Problem Set 5

Due via Carmen dropbox at 11:59 PM 4/6.

1. [10 pts.] Assuming the functions defined in the lecture notes on logic, as well as the following predicates:

   - Prof is of type $(\mathtt{e}) \rightarrow \mathtt{t}$,
   - Adult is of type $(\mathtt{e}) \rightarrow \mathtt{t}$,
   - True is of type $\mathtt{t}$,

   draw a tree for the following lambda calculus expression, showing type labels on all branches:

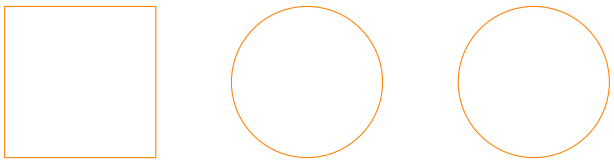
   $$\text{Some } (\lambda_{x:\mathtt{e}} \text{ Prof } x \ \wedge \ \text{True}) \ (\lambda_{x:\mathtt{e}} \ \neg \ \text{Adult } x).$$

2. [10 pts.] Beta reduce the following expression: $(\lambda_{x:\mathtt{e}} \text{ Prof } x \ \wedge \ \neg \ \text{Adult } x) \ \text{Person43}$. Show each step in the reduction.

3. [10 pts.] Use the entailments in the lecture notes on logic to obtain an *upper* bound on cardinality for Adult given the theory Adult Kim $\wedge$ $\neg$ Adult Pat. Show each step in the entailment and identify the inference used.

4. [10 pts.] Given this theory of Shape entities (where Circle and Square have their usual meanings):

$$\begin{aligned}&\text{Shape Shape1} \wedge \text{Square Shape1} \wedge \neg \text{Circle Shape1} \wedge\\ &\text{Shape Shape2} \wedge \text{Circle Shape2} \wedge \neg \text{Square Shape2} \wedge\\ &\text{Shape Shape3} \wedge \text{Circle Shape3} \wedge \neg \text{Square Shape3}\end{aligned}$$



prove the following lambda calculus expression using the entailments provided in the lecture notes on logic (first prove upper and lower bounds, then show this satisfies the definition of the quantifier):

$$\text{Some } (\lambda_{x:\text{e}} \text{ Shape } x) \ (\lambda_{x:\text{e}} \text{ Circle } x)$$