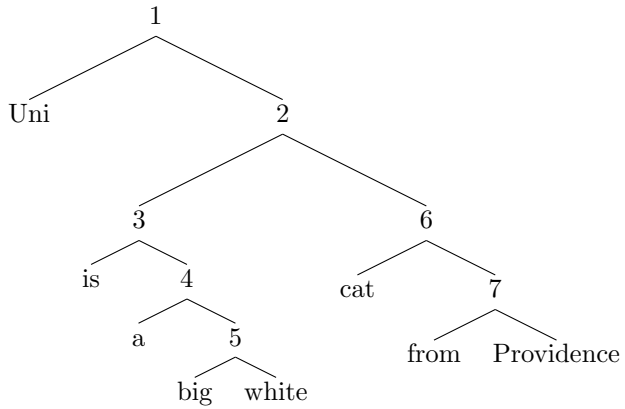
Homework for Tuesday September 23, 2014

1 Type theory and lambdas

- What are the types of the following expressions?
  1. devour
  2. fond
  3. part of New Brunswick
  4. show Porky
  5. white cat from Providence
- Evaluate the following claims.
  - ▷ If the expressions are equal, show how to derive the latter from the former by applications of α-, β-, or η- equivalence.
  - ▷ If not, say why not.
  1. $(\lambda x.\lambda y.licks'(x)(y))(\mathrm{u})(\mathrm{p}) = licks'(\mathrm{u})(\mathrm{p})$
  2. $(\lambda x.f(x)(y))(y) = f(y)(y)$
  3. $(\lambda x.\lambda y.f(x)(y))(y) = \lambda z.f(y)(z)$
  4. $\lambda x.kiss'(x) = \lambda y.\lambda x.kiss'(y)(x)$
  5. $\lambda x.kiss'(x) = \lambda x.\lambda y.kiss'(y)(x)$
- Simplify the following expressions as much as possible.
  - ▷ Show (and justify) each step in your calculation (you might have to do more than one β-reduction!).
  - ▷ Exploit α-equivalences as needed to avoid variable capture.
  - ▷ Be careful. Some of these are tricky.
  1. $(\lambda x.kiss'(x)(y))(y)$
  2. $(\lambda P.\lambda x.P(x))(run')$
  3. $(\lambda R.R(a)(b))(\lambda y.\lambda x.kiss'(y)(x))$
  4. $(\lambda f.f(x))(\lambda y.\lambda x.g(x)(y))$
  5. $(\lambda \mathcal{P}.\mathcal{P}(\lambda p.p))(\lambda k.k(meows'(x)))$
- Any function f has a type that we can write as $\langle \sigma, \tau \rangle$ (for some type σ and some type τ). Can a function ever apply to itself? Why or why not?

2 Composition inside DP

- Calculate ⟦Uni is a big white cat from Providence⟧, labeling each node in the tree with its type and denotation (as in the Sept 19 handout).
  - ▷ Assume the available combination operations are **Functional Application** (**FA**) and **Predicate Modification** (**PM**).
  - ▷ Assume whatever semantics you like for is and a (so long as it works!).
  - ▷ Indicate which composition operation (**FA** or **PM**) you used to interpret each binary-branching node.
- Give *another* derivation, this time with a different syntactic structure (there are a few possible parses). Did you get the same result as before?
- Now, suppose that you only have **FA** in your toolbox.
  - ▷ Devise a silent morpheme $\mathsf{mod}_\emptyset$ which allows you to give a meaning for ⟦Uni is a big white cat from Providence⟧ anyway.
  - ▷ Show the derivation (again labeling each node).
  - ▷ Did you get the same result as before?
- Both the grammar with **FA** and **PM** and the grammar with **FA** and $\mathsf{mod}_\emptyset$ can glue this sentence together in a way you might not have expected. For example, the tree below is interpretable using **FA** and **PM**.



- ▷ Assign an interpretation to the tree (using any set of assumptions, so long as it's clear what they are). Give a type and meaning to each numbered node.
- ▷ Does the interpretation differ from the previous examples?
- ▷ Do you find this structure plausible?