CS 421 — Lambda Calculus Activity

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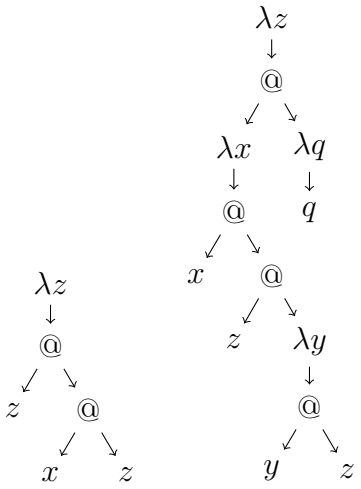
Plant some Trees

Write out lambda calculus trees for the following expressions.

- $\lambda x.\lambda y.xy$
- $\lambda x.\lambda y.xy\lambda z.yz$
- $\lambda x.(\lambda y.xy)(\lambda z.yz)$

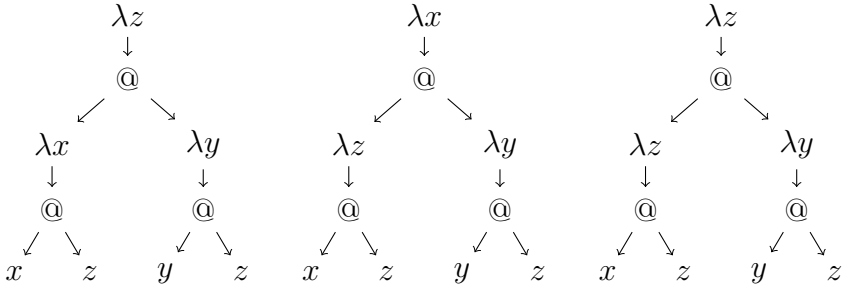
Chop down some Trees!

Write out the equivalent lambda calculus espression for the following trees.



Find the Free Variables!

Where are the free variables? To which lambdas are bound variables bound?



$\lambda z.(\lambda x.xz)(\lambda y.yz)$ $\lambda x.(\lambda z.xz)(\lambda y.yz)$ $\lambda z.(\lambda z.xz)(\lambda y.yz)$

Do some Reductions!

It is essential that you can do lambda calculus reductions. Try these out and compare with a neighbor. If a varaiable would be α-captured, rename the offending λ.

1. $(\lambda x.x)\ y$

2. $(\lambda x.x\ z)\ (\lambda y.y)$

3. $(\lambda x.x\ (\lambda x.y))\ (\lambda z.z)$

4. $(\lambda x.(\lambda y.x))\ y\ (\lambda z.z)$

5. $(\lambda x.x\ x)\ (\lambda x.x\ x)$

Boolean Lambda Terms

In lambda calculus, we can represent a boolean as a function that takes two parameters. A true function returns the first parameter, and a false function returns the second parameter.

6. Write the definitions of $True$ and $False$ as lambda calculus terms.

7. Write the definitions of and, or, not, and if.

If you get bored, try writing the lambda calculus terms for function and apply.