Guideline

Due Date: Thursday, 2023-09-21, by 23:59.

Upload your answers as a singular PDF to Brightspace.

If you're writing by hand, please ensure your handwriting is legible.

Multiple submissions are possible before the due time; the last submission will be graded.

Exercise 1 (points = 20)

Consider the lambda term (λa.aλb.ab)λa.a

1. Draw a parse tree
2. Reduces it to a normal form

A term is said to be in "normal form" if no beta reductions are possible. This means you've simplified the term as much as you can, and there are no more beta reductions to perform.

Exercise 2 (points = 20)

Consider the lambda term (λx.λw.xwz)y x

1. Draw a parse tree
2. Reduces it to a normal form

Exercise 3 (points = 35)

In the following, we write TRUE as an alias for λx.λy.x, and FALSE as an alias for λx.λy.y.

Now, simplify the following lambda terms to their normal form using beta reduction. You don't need to show intermediate results.

1. TRUE TRUE TRUE
2. TRUE TRUE FALSE
3. TRUE FALSE TRUE
4. TRUE FALSE FALSE
5. FALSE TRUE TRUE
6. FALSE FALSE TRUE
7. FALSE TRUE FALSE

Hint: To complete this exercise, you you can either mechanically use beta reductions, or you can attempt to deduce the meanings of TRUE and FALSE.

Exercise 4 (points = 25)

Simplify the following lambda terms to their normal form using beta reduction. You don't need to show intermediate results.

1. (λx. λy. x y) a b
2. (λx. x (λy. y x)) (λz. z)
3. (λx. λy. x (λz. y z)) a b
4. (λx. λy. λz. x z (y z)) a b c
5. (λx. x (λy. y)) (λx. x)