CMPT 383 Comparative Programming Languages

Homework 5

This homework is due by 11:59pm PT on Wednesday Mar 16, 2022. No late submission is accepted. Please save your answers in a single file called `h5_firstname_lastname.pdf` and submit it to Canvas. You may also write on paper and scan it (or take a picture) into a PDF. Please make sure the text is readable.

Requirements of this homework:

- Use normal order strategy for beta reductions.

1. (20 points) Reduce the following λ-term to normal form

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

2. (20 points) Given Church numerals and $times = \lambda m.\lambda n.\lambda s.\lambda z.\ m\ (n\ s)\ z$, show your steps to check

$$times\ 1\ 2 \rightarrow^* 2$$

3. (20 points) Given the following definition of Y combinator:

$$Y = \lambda f.\ (\lambda x.\ f\ (x\ x))\ (\lambda x.\ f\ (x\ x))$$

Check $Y\ g = g\ (Y\ g)$ by showing that Yg and $g\ (Y\ g)$ reduce to the same λ-term.

4. (20 points) Given the following definitions:

$$\begin{array}{rcl} S & = & \lambda f.\lambda g.\lambda x.\ f\ x\ (g\ x) \\ K & = & \lambda x.\lambda y.\ x \end{array}$$

Reduce $S\ K\ K$ to normal form.

5. (20 points) Define a λ-term called *or* such that *or* is a binary logical or function for Church booleans. Also, show your steps to check

$$or\ false\ true \rightarrow^* true$$