Homework 2: CFGs and Inductive Definitions using Judgments
Programming Languages Concepts (CSCI 3030)

Submit a single PDF file of your solution set on D2L.
All questions must be in order.
All assignments not adhering to this will not be graded.

0. Write a context-free language for the following:

   Strings of characters 0 and 1 such that there are always two more 0's than 1's.

1. Give a derivation of 01001 using your solution to problem 0.

2. Consider the judgment $l_1 \,\mathsf{QS}\, l_2$ which can be read as:

   The list l_2 is the sorted version of the list l_1 using quick sort

   It's defined by the following rules:

$$\frac{}{[]\,\mathsf{QS}\,[]}\ \mathrm{E} \qquad\qquad \frac{[s \in xs \mid s \leq x]\,\mathsf{QS}\,sms \qquad [b \in xs \mid b > x]\,\mathsf{QS}\,bgs}{(x : xs)\,\mathsf{QS}\,(sms +\!\!+ [x] +\!\!+ bgs)}\ \mathrm{D}$$

   (a) Derive the judgment $[5, 1, 4]\,\mathsf{QS}\,[1, 5, 4]$.

   (b) Show that the judgment $[7, 3, 9]\,\mathsf{QS}\,[3, 9, 7]$ fails to hold.