CSE 105: Automata and Computability Theory **Fall 2015**

Homework #1

Due: Thursday, October 8th, 2015, 11:59 PM

Your solutions should be submitted using Bundle on ieng6, and should include, as a collaboration disclosure, a plain text file `collab.txt` listing (one name per line) all students you collaborated with on the solution of any of the assigned problems. (If you did not collaborate with anybody, you can submit an emtpy file.) As a reminder, by course policy, even if you form a study group and discuss the problems with other students, you are still responsible for writing your solutions individually. All starter files used in this assignment are available both from the course webpage, and on ieng6 in the directory *$PUBLIC/HW1/*.

Problem 1 (DFAs) Sign up for an account on Automata Tutor, at `http://automatatutor.com`. If you are a UCSD student, use your official UCSD e-mail for your account, so that we know whom to assign credit to. If you are an extension student, use the same e-mail address you gave us for GradeSource. Enroll in CSE 105's Automata Tutor section, which has Course ID "`77UCSDCSE`" and password "`RL4M2DOO`". You may practice designing DFAs using the practice problem sets on Automata Tutor, before attempting the homework assignment.

a–h. Complete the 8 problems that constitute CSE 105's HW1 on Automata Tutor.

Notice that you have only a limited number of chances to submit/revise your solution. So, you should try to get it right each time before submitting, rather than proceeding by trials and errors.

Problem 2 (Proofs.) This problem is just a refresher of standard mathematical notation and simple proofs by induction, which are both essential tools in the study of automata and computability theory. Your solution will be graded both for correctness and clarity.

Prove, by induction on n, that

$$\sum_{k=1}^{n} k \cdot 2^{k-1} = 1 + (n-1) \cdot 2^n.$$

Submit your solution as a pdf file `HW12.pdf` using Bundle. Your solution should be typeset. If using LaTex to typeset your proof, start from the `HW12.tex` template file on the course webpage.

Problem 3 (Haskell.) This is a very simple programming exercise, meant to familiarize yourself with the Haskell programming language and the ghc compiler. To start with, read the instructions on the course webpage on using Haskell.

The task is to write (and compile) a haskell program that computes the function $f(n) = \sum_{k=1}^{n} k2^{k-1}$ from problem 2. You should define your function by induction, following the scheme in the starter file `HW13.hs` provided on the course webpage. Test your code using ghc, and submit your modified file `HW13.hs` using Bundle.

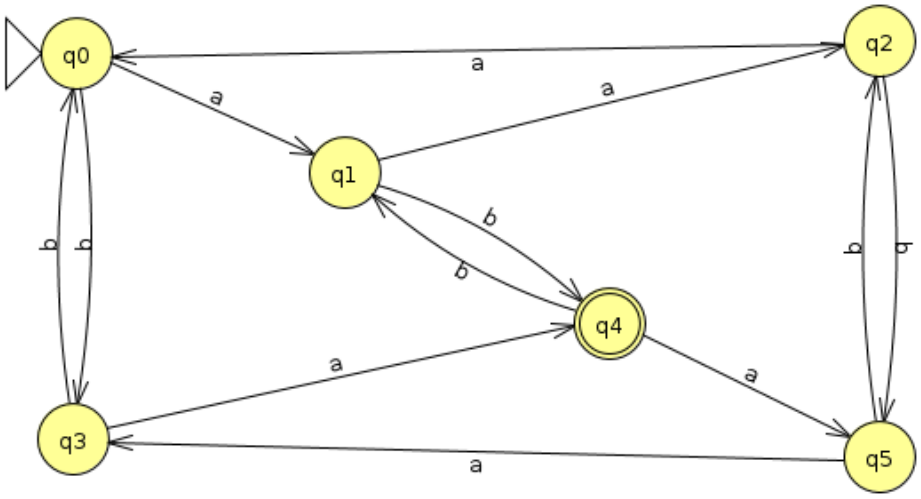
Problem 4 (Drawing automata in JFLAP.) The aim of this problem is just to make sure you can run JFLAP on your computer. Download JFLAP from the webpage `http://www.jflap.com` and start it on your computer following the instructions on the JFLAP webpage. You can also follow the tutorial on that webpage to familiarize yourself with the program. Then use JFLAP to draw the DFA $M = (Q, \Sigma, \delta, s, F)$ where

- $Q = \{1, 2, 3, 4\}$,
- $\Sigma = \{a, b\}$,
- $s = 1$,
- $F = \{1, 4\}$, and
- $\delta: Q \times \Sigma \to Q$ is given by

δ	a	b
1	2	3
2	3	2
3	1	4
4	4	3

Save the automaton into a file `HW14.jff` and submit it using Bundle.

Problem 5 (Mathematical definition of DFA.) Convert the following diagram into the mathematical definition of a DFA $(Q, \Sigma, \delta, s, F)$, and give 3 strings that are accepted, and 3 strings that are rejected. Code up your answers in Haskell completing the starter file `HW15.hs`, and submit the modified file using Bundle.



You can check your answers by loading your solutions in ghci, and running the 'test' function.