Harvard University
Computer Science 121
Midterm — October 11, 2011 — All problems count equally, except the noncredit challenge problem

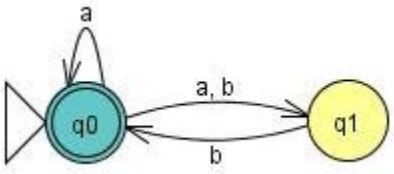
The alphabet $\Sigma = \{a, b\}$ unless otherwise specified.

PROBLEM 1

Draw the state diagram for a DFA accepting all strings containing the substring *babba*.

PROBLEM 2

Convert the NFA below to a corresponding DFA using subset construction. Show your work.



PROBLEM 3

Explain briefly in each case why the set is uncountable, countably infinite, finite but nonempty, or empty.
(A) The set of even integers (including negative integers).
(B) The class of nonregular languages.
(C) The set of regular languages that are recognized by DFAs with three states.

PROBLEM 4

Let n be the number of states of a DFA M.
(A) Show that M accepts a string of length $\geq n$ if and only if it accepts infinitely many strings.
(B) Is it true that M accepts a string of length $= n$ iff it accepts infinitely many strings? Explain.

PROBLEM 5

Write a regular expression for the set of strings with no consecutive b's.

PROBLEM 6

(A) Write the rules for a context-free grammar that generates all properly balanced strings of parentheses ( ) and brackets [ ], such as ([[ ] ( )]) and ( ) [ ] but not ( ] .
(B) Prove that the language of part (A) is not regular.

PROBLEM 7 (0 points)

Noncredit challenge problem! Don't attempt until you have finished all the other problems.
Explain why the class of co-finite languages is closed under concatenation.

THE END