Computer Science 456/656 Spring 2013

Practice for the First Examination, Thursday September 12, 2013

The entire practice examination is 230 points.

1. True or False. [5 points each]

   (a) _____ Every subset of a regular language is regular.

   (b) _____ Let L be the language over $\Sigma = \{a, b\}$ consisting of all strings of the form $a^m b^n$, where $m, n \geq 0$. Then L is a regular language.

   (c) _____ The complement of every regular language is regular.

   (d) _____ The intersection of any two regular languages is regular.

   (e) _____ The language consisting of all base 7 numerals for positive integers n such that $n \ \% \ 3 = 2$ is regular.

   (f) _____ Let L be the language over $\Sigma = \{a, b, c\}$ consisting of all strings of the form $a^m b^n c^m$, where $m, n \geq 0$. Then L is a regular language.

   (g) _____ Let L be the language over $\Sigma = \{a, b\}$ consisting of all strings of the form $a^m b^n$, where $m \geq n \geq 0$. Then L is a regular language.

   If w is any string, we write w^{-1}, or w^R, to mean the *inverse*, or *reverse* of w. For example, $(tab)^R = bat$. We say that a string is a *palindrome* if $w^R = w$. If L is a language, write $L^R = \{w^R : w \in L\}$.

   (h) _____ The language of all binary strings which are palindromes is regular.

   (i) _____ If L is a regular language, then L^R must be regular.

   (j) _____ Every deterministic machine is a non-deterministic machine.

   (k) _____ The language consisting of all base 2 numerals for integer powers of 2 is regular.

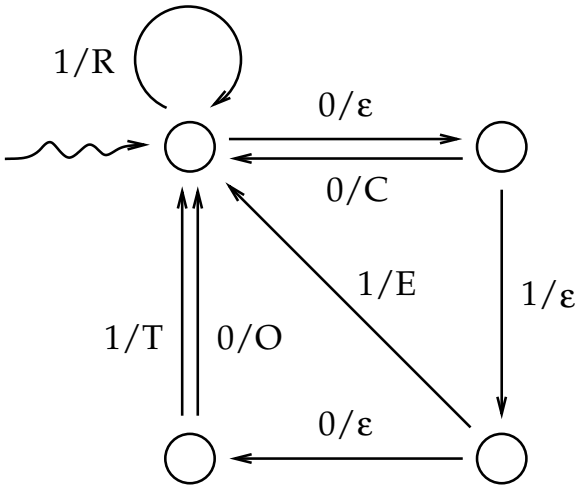
2. [5 points each blank] Fill in the blanks.

   (a) Name two classes of machines that accept the class of regular languages. _____

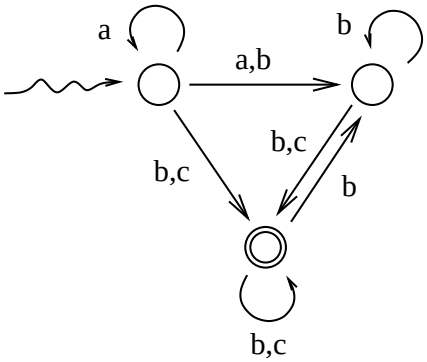
   and _____.

   (b) If a machine M is _____, there is at most one legal move M can make from any give configuration.

3. [20 points] Write the output string of the following finite state transducer, where the input string is 00010011011000101

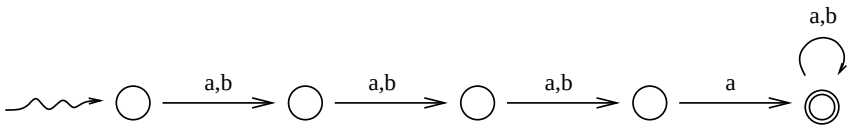


4. [25 points] Write a regular expression for the language accepted by the following NFA. If your answer is unnecessarily long by a wide margin, I might mark it wrong even if it's right.



5. [30 points] Draw a DFA with five states that accepts the language over $\Sigma = \{0, 1, 2\}$ consisting of all base 3 numerals which represent multiples of 5. We allow a numeral to have leading zeros; for example, 0012 is a member of the language.

6. [30 points] Let L be the language accepted by the DFA shown below. Draw an NFA which accepts the language L^R.



7. [25 points] State the pumping lemma for regular languages.

8. [30 points] Consider the NFA whose transition diagram is drawn below, where the input alphabet is $\{a, b, c\}$. Draw the transition diagram of an equivalent minimal DFA. Show your steps.

