Additional Practice Problems

1. True or False. If the question is currently open, write "O" or "Open."

   (i) ________ Every subset of a regular language is regular.

   (ii) ________ There exists some proposition which is true but which has no proof.

   (iii) ________ The set of all binary numerals for prime numbers is a regular language.

   (iv) ________ For any deterministic finite automaton, there is always a unique minimal non-deterministic finite automaton equivalent to it.

   (v) ________ It can always be decided, in polynomial time, whether two given regular expressions are equivalent.

   (vi) ________ The halting problem is decidable.

   (vii) ________ The complement, over the binary alphabet, of every regular binary language is regular.

   (viii) ________ The union of any two regular languages is regular.

   (ix) ________ The Kleene closure of any regular language is regular.

   (x) If w is a string, let w^R denote the reverse of w. For example, if $w = said$ then $w^R = dias$. If L is a language $L^R = \{w^R : w \in L\}$.
   ________ If L is regular, then L^R is regular.

   (xi) A string w is called a *palindrome* if $w^R = w$. For example, *bob* is a palindrome.
   ________ The set of all palindromes over the binary alphabet is a regular language.

   (xii) We say a binary string w is *balanced* if w has the same number of 1's as 0's.
   ________ The set of balanced binary strings is a regular language.

   (xiii) ________ The intersection of any two regular languages is regular.

   (xiv) ________ The language of all regular expressions over the binary alphabet is a regular language.

   (xv) ________ There is no computer program that decides whether two given C++ programs are equivalent.

   (xvi) ________ If anyone ever proves that $\mathcal{P} = \mathcal{NP}$, then all one-way encoding systems will be insecure.

   (xvii) ________ The set of all binary numerals for prime numbers is a $\mathcal{P}$–TIME language.

2. Draw the state diagram for a minimal DFA that accepts the language described by the regular expression a^*b^*

3. Give a regular grammar for the language accepted by the NFA shown in Figure 1.

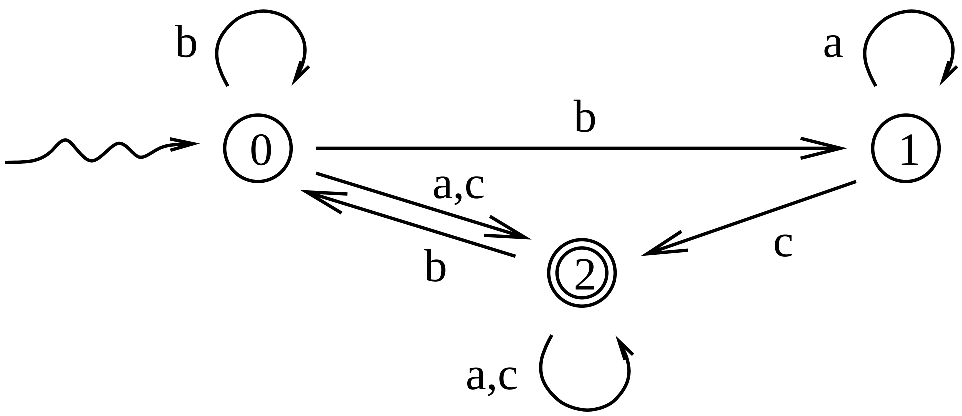

Figure 1: The NFA for Problems 3 and 4.

4. Construct a minimal DFA equivalent equivalent to the NFA shown in Figure 1.

5. Let L be the language of all binary numerals for positive integers equivalent to 2 modulo 3. Thus, for example, the binary numerals for 2, 5, 8, 11, 14, 17 ... are in L. We allow a binary numeral to have leading zeros; thus (for example) $001110 \in L$, since it is a binary numeral for 14. Draw a minimal DFA which accepts L.

6. Give a grammar (not a regular grammar) for the language $L = \{a^n b^n : n \geq 0\}$

7. Name a class of machines that accepts the class of regular languages.

8. Give a regular grammar for the language accepted by the NFA shown below, and draw a state diagram for a minimal equivalent DFA.