Homework assignment 4

Due date: November 3rd, 2016

It is possible to collect up to 110 points in this homework.

1. Construct a nondeterministic finite automaton (NFA) that recognizes the language described by the following regular expression:
   
   (a) \((0 \cup 1)^* 1\) \(\cup\) \(\epsilon\)
   
   (b) \((10^+ 1) \cup (01^+ 0) \cup \emptyset\)

2. Construct a regular expression for the language \(L\) defined by the following deterministic finite automaton (DFA):

   \[\text{Diagram of DFA}\]

3. Prove that the following languages are nonregular:
   
   (a) \(L = \{w \# x \mid x \text{ is a substring of } w\}\), where \(\Sigma = \{0, 1, \#\}\);
   
   (b) \(L = \{1^{n^2 + 1} \mid n \geq 0\}\), where \(\Sigma = \{1\}\).

4. Is the following language regular or not, where \(\Sigma = \{a, b\}\)? (Prove your answer.)
   
   (a) \(L = \{(aba)^n \mid n \geq 0\}\);
   
   (b) \(L = \{a^n b^m a^{\ell} \mid n, m, \ell \geq 0\}\);
   
   (c) \(L = \{a^n b^m a^n \mid n, m \geq 0\}\).