# CSE 322
# Winter Quarter 2001
# Assignment 4
# Due Friday, February 2, 2001

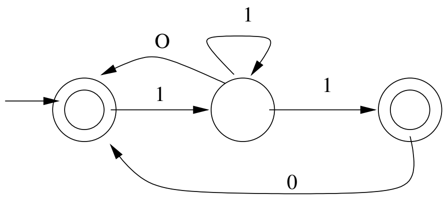
All solutions should be neatly written or type set. All major steps in proofs and algorithms must be justified.

1. (10 points) In this problem you will practice creating NFAs from regular expressions and removing $\varepsilon$-transitions Consider the regular expression $\alpha = (0 \cup 11)^*0$.

   (a) Use the standard construction (see examples 1.30 and 1.31 in the book) to construct an NFA that accepts the language $L(\alpha)$.

   (b) Take the result of part (a) and construct an NFA with no $\varepsilon$-transitions. To do this, first compute $E(q) = \{p : q \xrightarrow{\varepsilon} p\}$ for all $q$. Use this computation to construct the transition function of the new NFA.

2. (10 points) In this problem you will practice the process of converting a finite automaton into an equivalent regular expression. Consider the following NFA. Show each of the steps in the state elimination method for




   converting the NFA into a regular expression. For each intermediate GNFA, the regular expressions on each transition may be simplified to keep the regular expression as small as possible.

3. (15 points) For this problem you will examine two approaches for showing that the regular languages are closed under reversal. Recall that for a string $w$, $w^R$ denotes its reversal. For example, $(0111)^R = 1110$. We can also define the reversal of a language by
$$L^R = \{w^R : w \in L\}.$$

   (a) Given an NFA $M = (Q, \Sigma, \delta, q_0, F)$ without $\varepsilon$ transitions, construct an NFA $M'$ such that $L(M') = L(M)^R$. Write the behavioral lemma that relates the behavior of $M$ and $M'$.

   (b) Show by induction on the length of regular expressions that for every regular expression $\alpha$ there is a regular expression $\alpha'$ such that $L(\alpha') = L(\alpha)^R$.