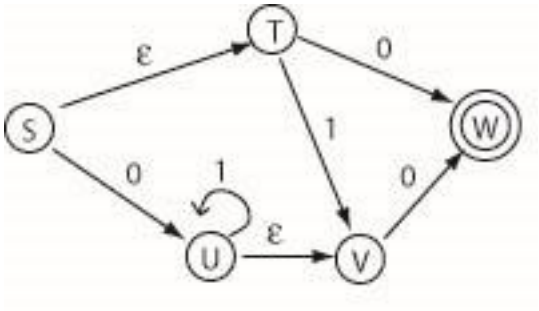
CS 383
Exam 1 Solution
March 7, 2007

Note: Problems #1 and #5 are worth 20 points each, the other four problems are worth 15 points each.

1. Which of the following are regular languages? You do not need to justify your answers. Be sure that I can tell what your answer is; either write "Yes" or "No" next to each, or say something like "a, b, and c are regular, the others are not."
    a) Strings of a's, b's, and c's that have at most 3 a's and at most 2 b's, but any number of c's (with letters in any order).
    b) Strings where the number of a's and the number of b's have the same parity: either both numbers are even or both numbers are odd.
    c) Strings that start and end with the same letter.
    d) Strings of odd length, whose middle letter is "o". Two such strings are "bob" and "stops".
    e) Strings of even length whose first half is all 0's and whose second half is any combination of 0's and 1's.

2. Give an ε-NFA that accepts strings denoted by the regular expression $(0^*11)^*1$.

3. Convert the following ε-NFA to a DFA.



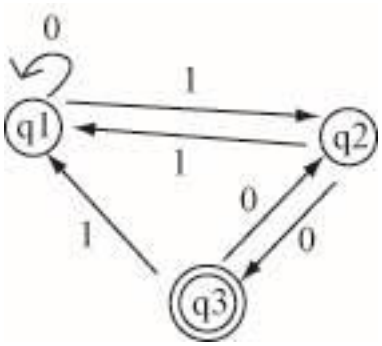
4. Use the pumping lemma to show that the set of strings of 0's and 1's with more 1's than 0's is not regular.

5. Suppose a regular language is accepted by a DFA with p states.
    a) Show that if the language includes a string of length p or more then the language contains infinitely many strings.[Hint: This isn't very deep. Think of a FAMOUS LEMMA.]

    b) Show that if the language has no string of length between p and 2p then the language is finite.

Note that parts (a) and (b) together give an algorithm for determining if a regular language is finite or infinite.

5. Consider the following automaton:



Find the regular expressions r^k_{ij} for k = 0 and k=1.

Note that $r^1_{ij}=r^0_{ij}+r^0_{i1}(r^0_{11})^*r^0_{1j}$, and $r^0_{11}=0^*$.

	k = 0	k = 1
r^k_{11}		
r^k_{12}		
r^k_{13}		
r^k_{21}		
r^k_{22}		
r^k_{23}		
r^k_{31}		
r^k_{32}		
r^k_{33}		