

## CS 381 Assignment 3, Due Friday September 14

**Problem 1.** Describe (informally, in English) the following set:

$$\{0^n 10^{2n} 1 | n \geq 1\}^* \{\epsilon + 0^* 1\} \cap 01 \{0^n 10^{2n} 1 | n \geq 1\}^* \{\epsilon + 0^* 1\}.$$

How does this set differ from the set in last week's homework. The set in last week's homework was:

$$\{0^n 10^{n+1} 1 | n \geq 1\}^* \cap 01 \{0^n 10^{n+1} 1 | n \geq 1\}^* 0^* 1.$$

**Problem 2.** Think of a good example of a set that can be accepted by a finite automata and provide an English description of the set. Be creative and come up with a set not used in class but also keep in simple. Create the transition diagram for a (non)deterministic finite automata accepting your set.

**Problem 3.**

- Write a regular expression for all strings of 0's and 1's having an even number of 0's. Does every string denoted by your expression have an even number of 0's? Is every string with an even number of 0's included in your regular expression?
- Write a regular expression for all strings of 0's and 1's in which all 0's occur before any 1's.
- Write a regular expression for all strings of 0's and 1's that are of odd length.

**Problem 4.**

- Write a regular expression for all strings of 0's and 1's in which the total number of zeros to the right of each 1 is even.
- Write a regular expression for all strings of 0's and 1's in which at least one copy of the substring 01 occurs before any copy of the substring 10 occurs in the string. If there is no occurrence of the substring 10 then there need not be any copy of the substring 01.
- Write a regular expression for all strings of 0's and 1's in which there is an even number of 0's between any two 1's.

**Problem 5.**

- Write a regular expression for all strings of 0's and 1's such that at every point in the string, the number of 1's minus the number of 0's is zero, one or two.
- Write a regular expression for all strings of 0's and 1's with an even number of 0's and an odd number of 1's.
- Write a regular expression for all strings of 0's and 1's such that every odd numbered 0 is immediately followed by a 0, i.e., the 0's occur in pairs.

The following problem is a problem to think about and discuss with your classmates. This is not a homework problem.

**Extra Problem.** Let  $M$  be a finite automaton. Let  $S$  be the set obtained by taking the first half of each even length string in  $L(M)$ . Prove that  $S$  is the set accepted by some other finite automaton. Formally,

$$S = \{x \mid \exists y \text{ s.t. } |x| = |y| \text{ and } xy \in L(M)\}.$$