

# Quiz Guide

## CSC 28 – Discrete Structures for Computer Science

To maximize your quiz performance: attend lectures, do readings, start homework early, ask for help when you need it, review problems and solutions before the quiz. If anything in this assignment does not make sense, please ask for help.

- 1) Make sure you've studied all the material on the course webpage.
- 2) Any problem similar to the ones in the homework may be on the quiz. Study them until you completely understand. Some people find it useful to try to write their own problems and then have their classmates try to solve them.
- 3) Here are some problems from old quizzes. There is no guarantee that the problems on your quiz will be like these, but it may be useful to see what I've asked in the past.

Draw a three state finite automata over alphabet  $\{0,1\}$  that accepts a string only if it ends in 01.

Draw a three state finite automata over alphabet  $\{0,1\}$  that accepts a string only if it does not end in 01.

Draw a regular expression over alphabet  $\{0,1\}$  that generates a string only if it ends in 01.

Draw a regular expression over alphabet  $\{0,1\}$  that generates a string only if it does not end in 01.

- 4) For more practice here are some more problems. Some of their solutions are below. There is no guarantee that the problems on your quiz will be like these.

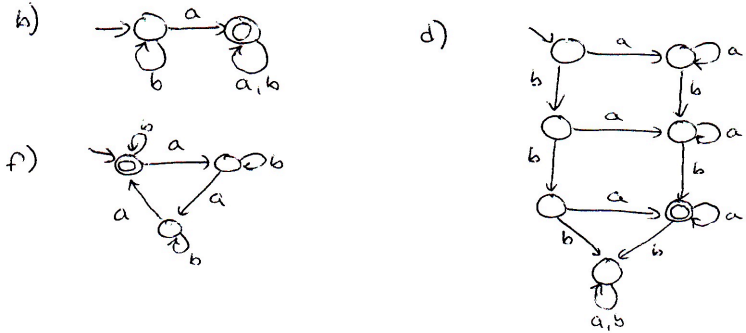
Finite automata. For each of the following sets of strings draw a finite automata that accepts every string in the set and does not accept the strings not in the set.

- a) All strings with exactly one  $a$ .
- b) All strings with at least one  $a$ .
- c) All strings with no more than three  $a$ 's.
- d) All strings with at least one  $a$  and exactly two  $b$ 's.
- e)  $\{w \in A^* \mid \text{length}(w) \bmod 3 = 0\}$
- f)  $\{w \in A^* \mid (\text{number of } a\text{'s in } w) \bmod 3 = 0\}$
- g)  $\{w \in A^* \mid \text{every letter in } w \text{ is either preceded or followed by the same letter}\}$ . For example  $aab$  and  $abaa$  are not in the set because the  $b$  is neither preceded nor followed by another  $b$ , but  $aabb$ ,  $aaa$ ,  $bbaabb$  are in the set.

Regular expressions. Give a regular expression equivalent to each of the following sets of strings.

- a)  $\{a^n b^m \mid (n + m) \text{ is even}\}$ .
- b)  $\{a^n b^m \mid n \geq 4 \text{ and } m \leq 3\}$ .
- c)  $\{vww \mid v, w \in A^* \text{ and } \text{length}(v) = 2\}$ .
- d) All strings with exactly one  $a$  over alphabet  $\{a, b, c\}$ .
- e) All strings with no more than three  $a$ 's over alphabet  $\{a, b, c\}$ .
- f) All strings ending in  $ab$ .
- g) All strings not ending in  $ab$ .
- h) All strings with an even number of  $a$ 's.
- i)  $\{w \in A^* \mid \text{length}(w) \bmod 3 = 0\}$ .
- j)  $\{w \in A^* \mid (\text{number of } a\text{'s in } w) \bmod 3 = 0\}$ .
- k)  $\{w \in A^* \mid \text{every letter in } w \text{ is either preceded or followed by the same letter}\}$ .
- l) Find all strings of length 4 or less in  $b(a + ab)^*$ .

**#4 FA Solutions)** (b) The only thing to keep track of is whether we've seen an  $a$ . So, one state means "haven't seen an  $a$ " and the other means "we've seen at least one  $a$ ". (d) Two things to keep track of: whether we've seen an  $a$ , and the number of  $b$ 's we've seen (0, 1, 2, more than 2). Since these are distinct things, our FA has two dimensions to it: the columns indicate whether we've seen an  $a$  and the rows count the  $b$ 's. (f) All integers are in one of three states when you "mod" them: 0, 1, or 2. We need one state for each of these remainders.



**#4 RE Solutions)**

- (b)  $aaaaa^*(\lambda + b + bb + bbb)$ . Exclusions are usually done by building the things that are allowed with +.
- (d)  $(b + c)^*a(b + c)^*$
- (f)  $(a + b)^*ab$
- (h)  $(b^*ab^*ab^*)^* + b^*$ . The building block is chunks with two  $a$ 's.
- (j)  $(b^*ab^*ab^*ab^*)^*$
- (l)  $b, ba, baa, bab, baaa, baab, baba$