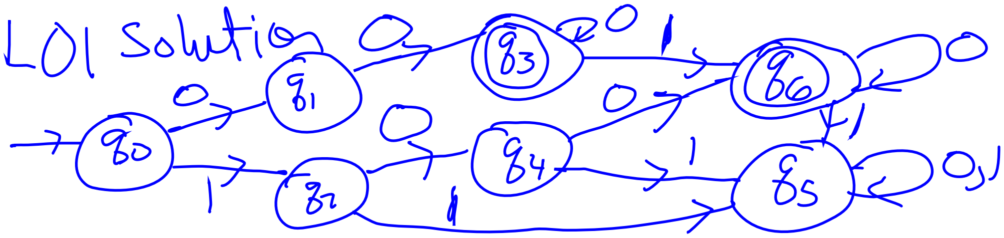
CECS 329, Learning Outcome Assessment 5, March 2nd, Spring 2023, Dr. Ebert

NO NOTES, BOOKS, ELECTRONIC DEVICES, OR INTERPERSONAL COMMUNICATION ALLOWED. Submit solutions to at most 2 LO problems on separate sheets of paper.

LO1 Solution



Problems

LO1. Do the following.

(a) Provide the state diagram for a DFA that accepts all binary words that have at *least* two 0s and at *most* one 1.

(b) Show the computation of M on input i) $w = 0100$ and ii) $w = 00110$.

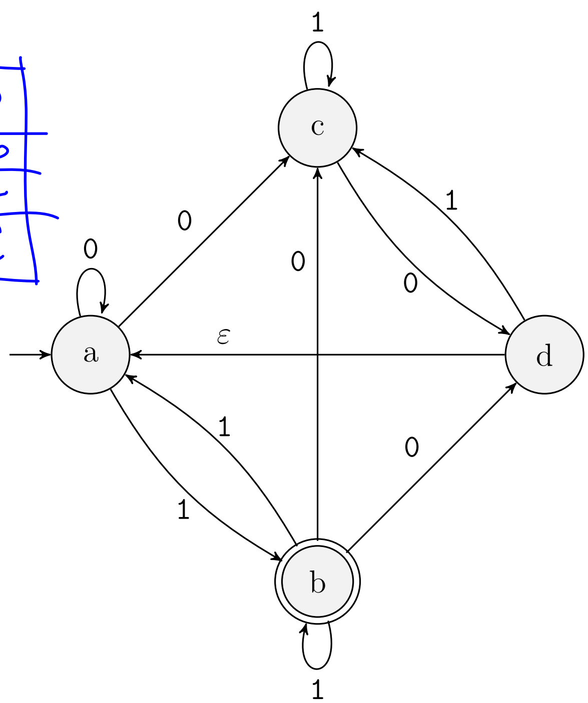
0 1 0 0
q_0 q_2 q_4 q_6 $\boxed{q_6}$ accept

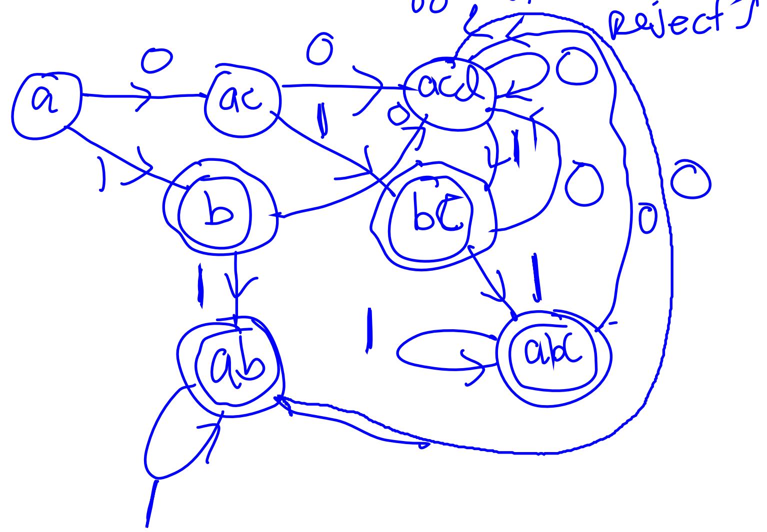
0 0 1 1 0
q_0 q_1 q_3 q_6 q_5 $\boxed{q_5}$ reject

LO2. Do the following for the NFA N whose state diagram is shown below.

LO2 a)

	0	1
a	ac	b
b	acd	ab
c	ad	c
d	∅	c





(a) Provide a table that represents N's δ transition function.

(b) Use the table from part a to convert N to an equivalent DFA M using the method of subset states. Draw M's state diagram.

(c) Show the computation of M on input $w = 11001$.

1 1 0 0 1
a b ab acd acd $\boxed{bc}$

accept since b is accepting

LO3. Provide a regular expression that represents the set of binary words w that have at most one 0 and at least three 1's. Hint: there are more than two cases to consider.

$1111^*01^* \cup 1^*01111^* \cup 111^*011^* \cup 11^*0111^* \cup 1111^*$

LO4. Do the following.

(a) Provide a context free grammar $G = (V, \Sigma, R, S)$ for which $L(G)$ is the set of words from $\{a,b\}^*$ that are palindromes of odd length (i.e. words that read the same forwards as backwards). For example, aabaa is an odd-length palindrome, but abbab is not.

(b) Use G to provide a leftmost derivation of babab.

$S \rightarrow aSa \mid bSb \mid a \mid b$

$S \rightarrow bSb \rightarrow baSab \rightarrow babab$

LO5. Let GTE(x, y) be defined as

$\overline{\text{Sgn}}(y \dot{-} x)$

$$\text{GTE}(x, y) = \begin{cases} 1 & \text{if } x \geq y \\ 0 & \text{otherwise} \end{cases}$$

$2 = ((0+1)+1)$

Provide a *recursive* definition for GTE(x, y). In addition to the basic functions, the only other functions you may use in your definition are binary addition, subtraction, multiplication, $x - 1$, Sgn, and $\overline{\text{Sgn}}$. Hint: credit will not be awarded if your recursive case does not depend on the value of GTE(x, y). For example, $f(x, y) = x + y + 0 \cdot \text{GTE}(x, y)$ is a function of x and y that does not depend on GTE(x, y) even though GTE(x, y) appears in its definition.

Recursion on x: $\text{GTE}(0, y) = \overline{\text{Sgn}}(y)$

Recursive Case: $\text{GTE}(x+1, y) = \text{Sgn}(\text{GTE}(x, y) + \text{Sgn}(x + 2 \dot{-} y))$

Base case:

Recursion on y: $\text{GTE}(x, 0) = 0 + 1$

Recursive Case: $\text{GTE}(x, y+1) = (\text{GTE}(x, y)) \cdot \text{Sgn}(x \dot{-} y))$