CSCI-3080 Discrete Structure

OLA 6: Chapter 9 -- Finite-Sate Machine & Turing Machines

NP & P Problems, Encoding Scheme

Name: Tyler Kramer

Student ID: M01578315

Due Date: 27 April 2023

1. Please draw the state graph for the following finate state machine, and compute the output sequence for the given input sequence.

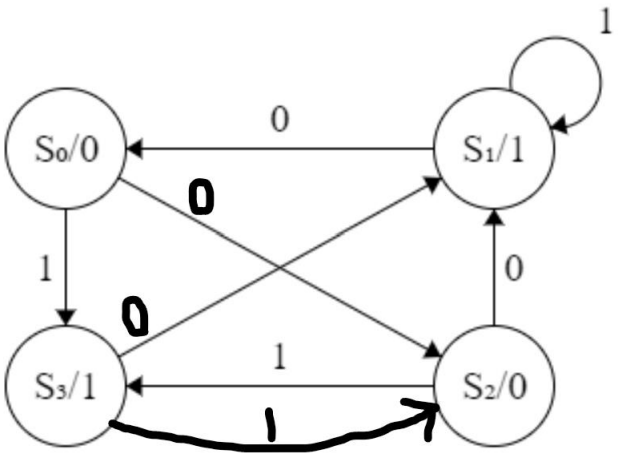
(For the output, please ignore the first bit.)

(a)

Input:0011

0011

Present state	Next state		Output
	Present input		
	0	1	
s_0	s_2	s_3	0
s_1	s_0	s_1	1
s_2	s_1	s_3	0
s_3	s_1	s_2	1



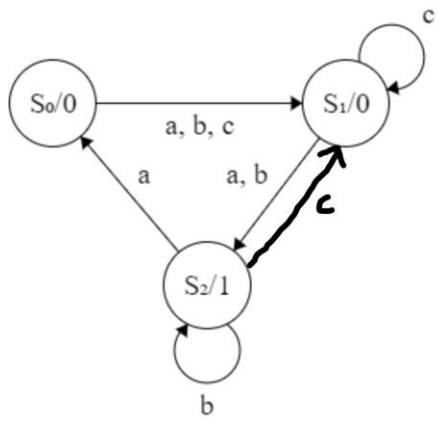
Time	t_0	t_1	t_2	t_3	t_4
Input	0	0	1	1	—
State	S_0	S_2	S_1	S_1	S_1
Output	0	0	1	1	1

Output: 0111

(b)
Input:acbbca

acbbca

Present state	Next state			Output
	Present input			
	a	*b*	*c*	
s_0	s_1	s_1	s_1	0
s_1	s_2	s_2	s_1	0
s_2	s_0	s_2	s_1	1

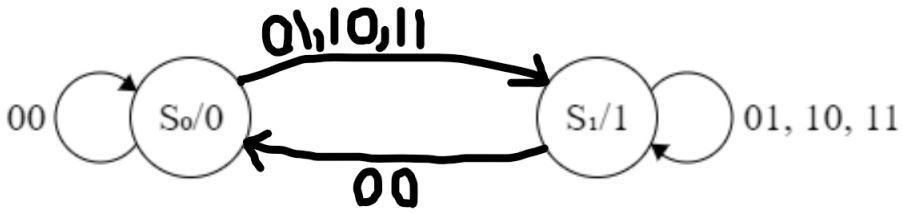


Time	t_0	t_1	t_2	t_3	t_4	t_5	t_6
Input	a	c	b	b	c	a	—
State	S_0	S_1	S_1	S_2	S_2	S_1	S_2
Output	0	0	0	1	1	0	1

Output: 001101

2.

(a) Please construct a finite-state machine that will compute the bitwise OR of two binary input string.



(b) Write the output for the input sequence consisting of the strings 11011 and 10010 (read left to right)

(For the output, please ignore the first bit.)

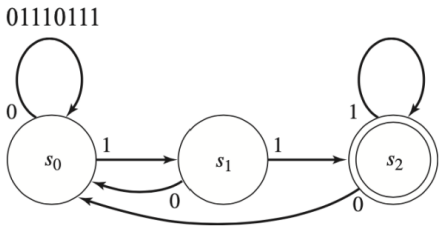
Time	t_0	t_1	t_2	t_3	t_4	t_5
Input	11	10	00	11	10	—
State	S_0	S_1	S_1	S_0	S_1	S_1
Output	0	1	1	0	1	1

Output: 11011

3. Determine whether the given machine recognizes the given input string.

(a)

Input:01110111

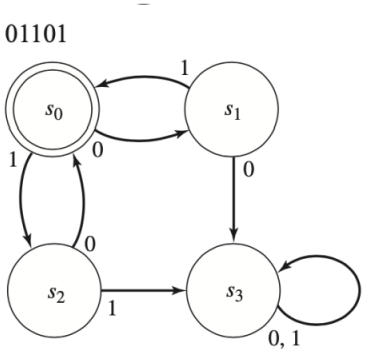


S_0 (start) → S_0 → S_1 → S_2 → S_2 → S_0 → S_1 → S_2 → S_2

Yes, the machine recognizes the input 01110111 because it ends on S_2, the final state.

(b)

Input:01101

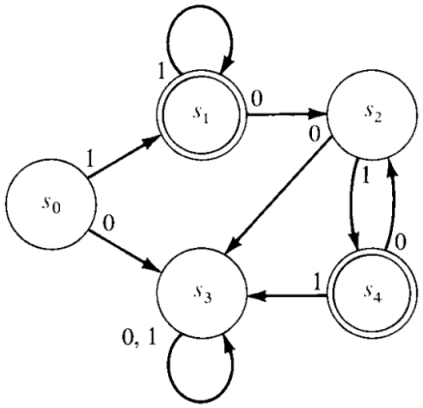


S_0 (start) → S_1 → S_0 → S_2 → S_0 → S_2

No, the machine does not recognize the input 01101 because it ends on S_2, not S_0.

4. Please give a regular expression for the set recognized by the following finite-state machine.

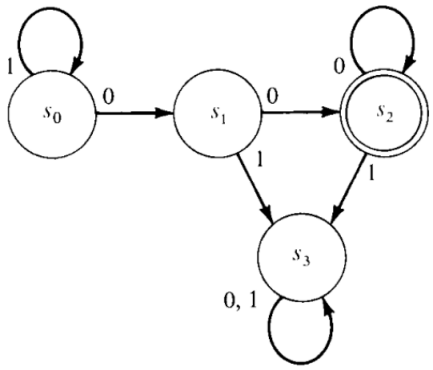
(a)



11*(01)*

both answers should be the same
1(1*) v 1(1*)01(01)*

(b)



1*(00)0*

5. Consider the Turing Machine

(0, 1, 1, 0, R)
(0, 0, 0, 1, R)
(1, 1, 1, 1, R)
(1, b, 1, 2, L)
(2, 1, 1, 2, L)
(2, 0, 0, 2, L)

(a). What is its behavior when started on the tape

···	*b*	1	0	1	0	*b*	···

(0, 1, 1, 0, R): 1010

(0, 0, 0, 1, R): 1010

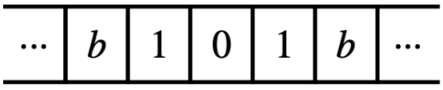
(1, 1, 1, 1, R): 1010

(1, 0…) (no rule)

Nothing on the tape changes. It stops when it reaches the final 0 in the tape.

Halts with Final Tape: 1010

(b). What is its behavior when started on the tape



(0, 1, 1, 0, R): 101

(0, 0, 0, 1, R): 101

(1, 1, 1, 1, R): 101

(1, b, 1, 2, L): 1011

(2, 1, 1, 2, L): 1011

(2, 0, 0, 2, L): 1011

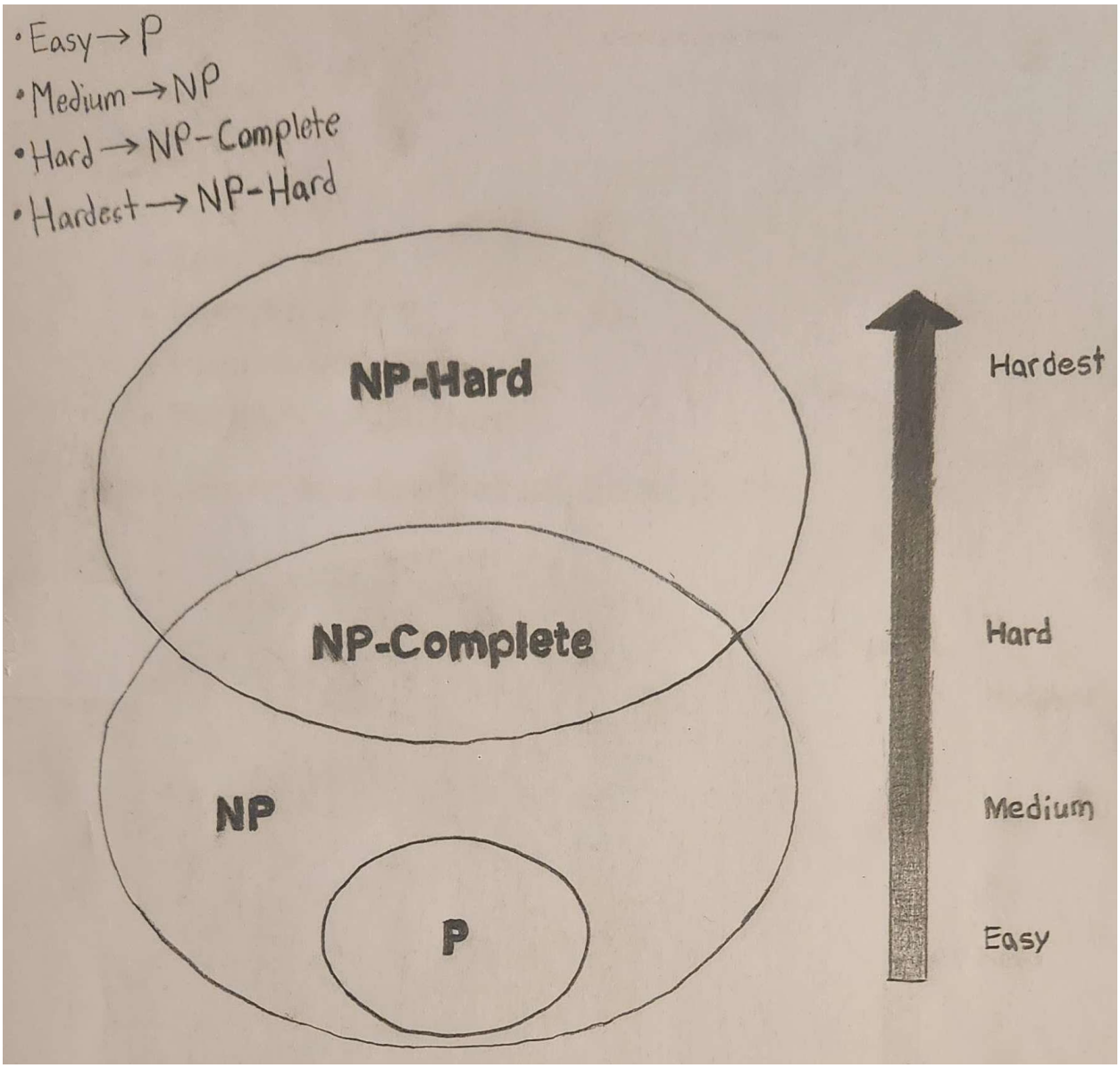
(2, 1, 1, 2, L): 1011

(2, b…) (no rule)

There is a 1 added at the end of the tape. It reads all the way to the first blank on the right, replaces it with a 1, and then makes its way to the left until it reaches a blank and stops.

Halts with Final Tape: 1011

6. Please draw the relationship diagram for P, NP, NP-Complete and NP-Hard problems.



7. The following hamming code word was received. Use it to answer questions (1) - (5).

0000110

(1) What position number is generated to determine if an error has ocurred in transmission?

1	2	3	4	5	6	7
p_3	p_2	m_1	p_1	m_2	m_3	m_4
0	0	0	0	1	1	0

c_1 (4, 5, 6, 7): 0

c_2 (2, 3, 6, 7): 1

c_3 (1, 3, 5, 7): 1

011

(2)Did an error occur?

Yes, there is an error at position 3. It needs to be a 1 instead of a 0.

(3) What was the transmitted code word?

0010110

(4) What was the transmitted message?

1110

(5) If the message was binary, what was the decimal value of the message?

1110: $1 * 2^3 + 1 * 2^2 + 1 * 2^1 + 0 * 2^0 = 2^3 + 2^2 + 2^1 = 8 + 4 + 2 = \mathbf{14}$