CSE 232 Homework 3

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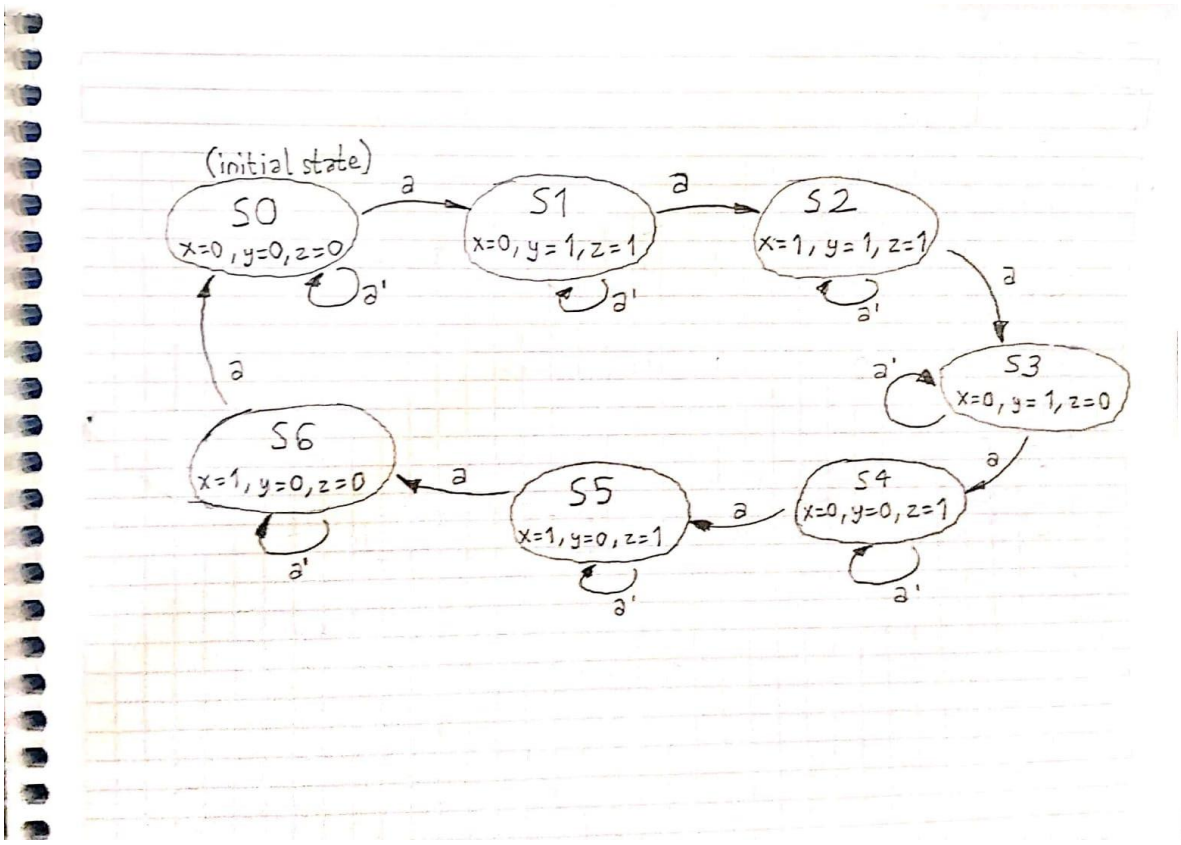
Step 1: Create FSM



Step 2: Obtain Architecture

- 7 states (3-bit register will be used)
- a is input
- x, y, z are outputs

Step 3: Encode the states

State	S2	S1	S0
S0	0	0	0
S1	0	0	1
S2	0	1	0
S3	0	1	1
S4	1	0	0
S5	1	0	1
S6	1	1	0

Step 4: Generate State Table

Inputs				Outputs					
s2	**s1**	**s0**	**a**	**n2**	**n1**	**n0**	**x**	**y**	**z**
0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	1	0	0	0
0	0	1	0	0	0	1	0	1	1
0	0	1	1	0	1	0	0	1	1
0	1	0	0	0	1	0	1	1	1
0	1	0	1	0	1	1	1	1	1
0	1	1	0	0	1	1	0	1	0
0	1	1	1	1	0	0	0	1	0
1	0	0	0	1	0	0	0	0	1
1	0	0	1	1	0	1	0	0	1
1	0	1	0	1	0	1	1	0	1
1	0	1	1	1	1	0	1	0	1
1	1	0	0	1	1	0	1	0	0
1	1	0	1	0	0	0	1	0	0

Step 5: Obtain Boolean expressions and draw controller

N2

n2 = s2’.s1.s0.a + s2.s1’.s0’.a’ + s2.s1’.s0’.a + s2.s1’.s0.a’ + s2.s1’.s0.a + s2.s1.s0’.a’

= s2’.s1.s0.a + s2.s1’.s0’. (a’+a) + s2.s1’.s0.(a’+a) + s2.s1.s0’.a’

= s2’.s1.s0.a + s2.s1’.(s0’+s0) + s2.s1.s0’.a’

n2 = s2’.s1.s0.a + s2.s1’ + s2.s1.s0’.a’

Karnaugh-Map

s2 s1 \ s0 a	**00**	**01**	**11**	**10**
00				
01			**1**	
11	**1**			
10	**1**	**1**	**1**	**1**

We obtained same equation from Karnaugh-Map.

N1

n1 = s2’.s1’.s0.a + s2’.s1.s0’.a’ + s2’.s1.s0’.a + s2’.s1.s0.a’ + s2.s1’.s0.a + s2.s1.s0’.a’

= s2’.s1.(s0’ + s0.a’) + s0.a.s1’.(s2’+s2) + s2.s1.s0’.a’

n1 = s2’.s1.s0’ + s2’.s1.s0.a’ + s1’.s0.a + s2.s1.s0’.a’

Karnaugh-Map

s2 s1 \ s0 a	00	01	11	10
00			**1**	
01	**1**	**1**		**1**
11				
10		**1**		**1**

We obtained same equation from Karnaugh-Map.

N0

n0 = s2'.s1'.s0'.a + s2'.s1'.s0.a' + s2'.s1.s0'.a + s2'.s1.s0.a' + s2.s1'.s0'.a + s2.s1'.s0.a'

= s2'.s0'.a.(s1'+s1) + s2'.s0.a'.(s1'+s1) + s2.s1' (s0'.a + s0.a')

= s2'.s0'.a + s2'.s0.a' + s2.s1'. (s0 XOR a)

= s2'. (s0 XOR a) + s2.s1'. (s0 XOR a)

n0 = s0 XOR a (s2' + s2.s1')

Karnaugh-Map

s2 s1 \ s0 a	00	01	11	10
00		**1**		**1**
01		**1**		**1**
11				
10		**1**		**1**

We obtained same equation from Karnaugh-Map.

X

x = s2'.s1.s0'.a' + s2'.s1.s0'.a +s2.s1'.s0.a' + s2.s1'.s0.a + s2.s1.s0'.a' + s2.s1.s0'.a

= s2'.s1.s0'.(a'+a) + s2.s1'.s0.(a'+a) + s2.s1.s0'.(a'+a)

= s1.s0'.(s2'+s2) + s2.s1'.s0

x = s1.s0' + s2.s1'.s0

Karnaugh-Map

s2 s1 \ s0 a	00	01	11	10
00				
01	**1**	**1**		
11	**1**	**1**		
10			**1**	**1**

We obtained same equation from Karnaugh-Map.

Y

y = s2’.s1’.s0.a’ + s2’.s1’.s0.a + s2’.s1.s0’.a’ + s2’.s1.s0’.a + s2’.s1.s0.a’ + s2’.s1.s0.a

= s2’.s1’.s0.(a’+a) + s2’.s1.s0’.(a’+a) + s2’.s1.s0.(a’+a)

= s2’. (s1’.s0 + s1.s0’ + s1.s0)

= s2’. (s1. (s0+s0’) + s1’.s0)

= s2’. (s1 + s1’.s0)

y = s2’.s1 + s2’.s1’.s0

Karnaugh-Map

s2 s1 \ s0 a	00	01	11	10
00			1	1
01	1	1	1	1
11				
10				

y = s2’.s0 + s2’.s1

We obtained a simpler equation from Karnaugh-Map and used this equation in controller design.

Z

z = s2’.s1’.s0.a’ + s2’.s1’.s0.a + s2’.s1.s0’.a’ + s2’.s1.s0’.a + s2.s1’.s0’.a’ + s2.s1’.s0’.a + s2.s1’.s0.a’ + s2.s1’.s0.a

= s2’.s1’.s0.(a’+a) + s2’.s1.s0’.(a’+a) + s2.s1’.s0’.(a’+a) + s2.s1’.s0.(a’+a)

= s2.s1’.(s0’+s0) + s2’.(s1’.s0 + s1.s0’)

z = s2.s1’ + s2’.(s1 XOR s0)

Karnaugh-Map

s2 s1 \ s0 a	00	01	11	10
00			1	1
01	1	1		
11				
10	1	1	1	1

We obtained same equation from Karnaugh-Map.

Controller Design