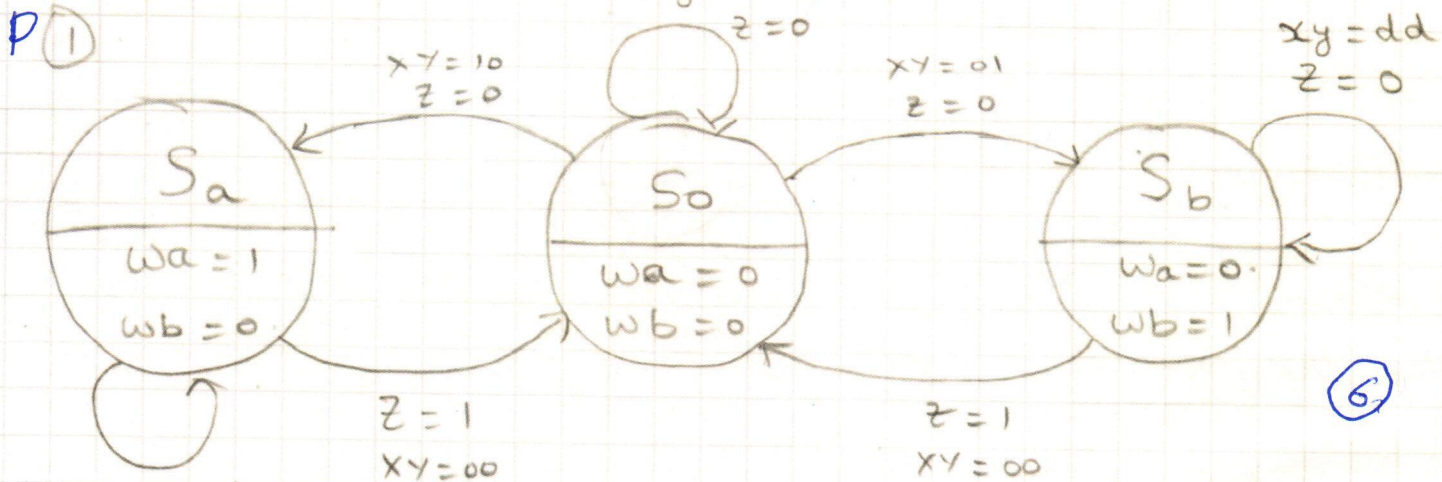


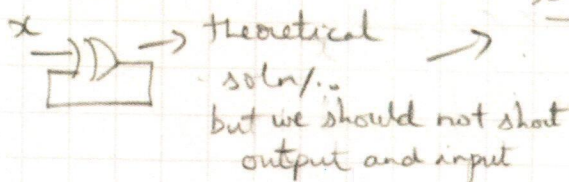
# ASSIGNMENT 4 Solutions



where  $dd$  is any value except  $00$ .

P2

A	$a^+$	$x = 0$	$x = 1$	$a^+ = A \oplus x$
0	0	0	1	
1	1	1	0	



P3

ab	$a^+ b^+$	
	$s = 0$	$s = 1$
00	00	10
01	00	01
11	00	10
10	00	11

ab	$a^+ b^+$	
	$s = 0$	$s = 1$
00	00	11
01	00	01
11	00	01
10	00	11

2

cycle present

Race:  $00 \xrightarrow{s \rightarrow 1} 11$

note:  $01 \xrightarrow{s \rightarrow 0} 00$   
has no problem

3 cases - goes to either 11, 01 or 10  
eventually the system ends up in 01.

This race is non-critical

P④ no hazards for C ; need to check for a, b.

Choose c first to restrict

$$(ab + \bar{a}c)(c + \bar{b}) + ab$$

Can reuse this level

$c=0 / \quad \backslash c=1$ $\leftarrow ab\bar{b} + ab$ $b=0 / \quad \backslash b=1$ $0 \quad a$	$(ab + \bar{a}) + ab$ $b=0 / \quad \backslash b=1$ $\bar{a} \quad a + \bar{a}$ <p style="text-align: right;">static 1 hazard for b=c=1</p>
---	--

$ab\bar{b} + ab$ $a=0 / \quad \backslash a=1$ $0 \quad b\bar{b} + b$	$(ab + \bar{a}) + ab$ $a=0 / \quad \backslash a=1$ $1 \quad b$
--	--

② dynamic hazard for a=1, c=0

Static 1 hazard for b=c=1 ; can be masked by or'ing with bc

dynamic hazard for a=1; c=0 → need to mask the static hazard  $b\bar{b}$  in  $(ab + \bar{a}c)(c + \bar{b})$  for a=1 and c=0

and it with  $(\bar{a} + c)$

Expression without hazards.

$$(ab + \bar{a}c)(c + \bar{b})(\bar{a} + c) + ab + bc$$

②

\*continued

Recheck to make sure no new hazards were introduced.

$$(ab + \bar{a}c)(c + \bar{b})(\bar{a} + c) + ab + bc$$

$$c=0/$$

$$\backslash c=1$$

Reuse

←

$$ab\bar{b}\bar{a} + ab$$

$$(ab + \bar{a})b + ab + b$$

$$b=0/$$

$$\backslash b=1$$

$$b=0/$$

$$\backslash b=1$$

$$0$$

$$a$$

$$\bar{a}$$

$$1$$

$$ab\bar{b}\bar{a} + ab$$

$$(ab + \bar{a})b + ab + b$$

$$a=0/$$

$$\backslash a=1$$

$$a=0/$$

$$\backslash a=1$$

$$0$$

$$b$$

$$b$$

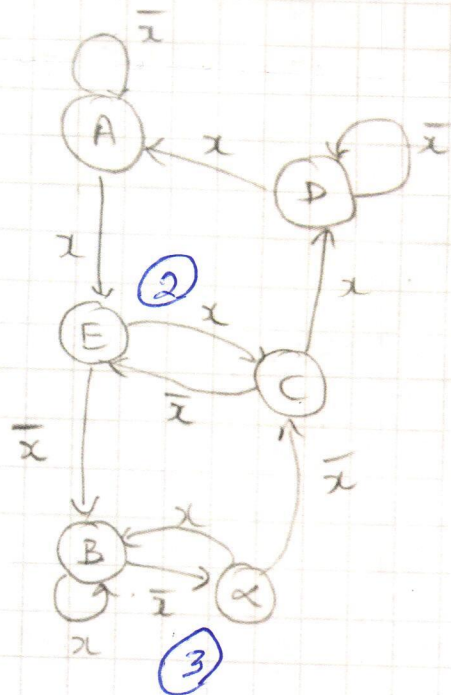
$$b$$

No hazards !!

Final answer

$$(ab + \bar{a}c)(c + \bar{b})(\bar{a} + c) + ab + bc$$

5

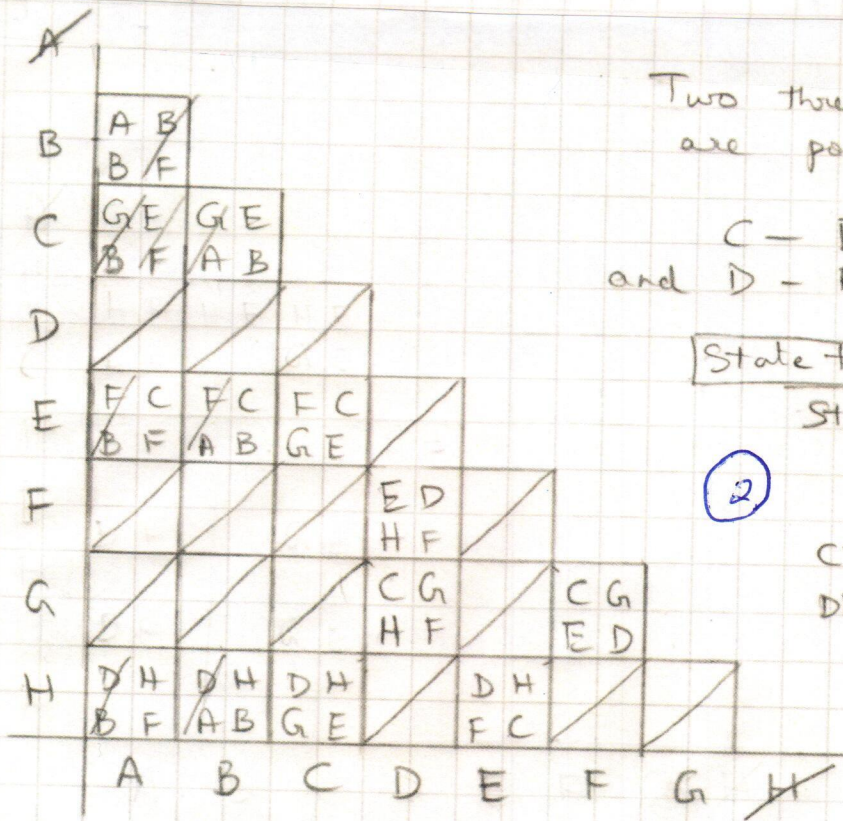


A	D
E	C
B	alpha

1

- A = 000
- D = 001
- E = 010
- C = 011
- B = 110
- alpha = 111

6



Two three way merges are possible.

- C - E - H (2)
- and D - F - G (2)

State	x=0	x=1	output
A	B	DFG	0
B	A	B	0
CEH	DFG	CEH	0
DFG	CEH	DFG	1

2