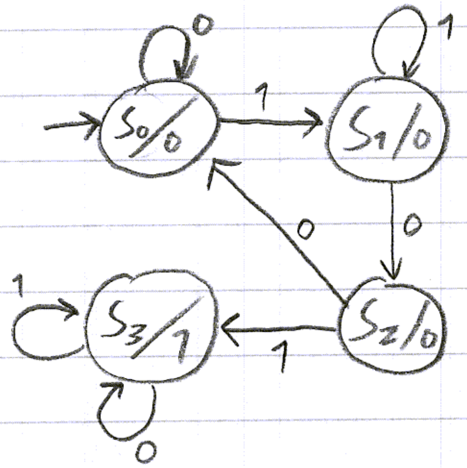
Robert Dick   EECS 303   Final   6 Dec. 2006

1.2)



1.1)

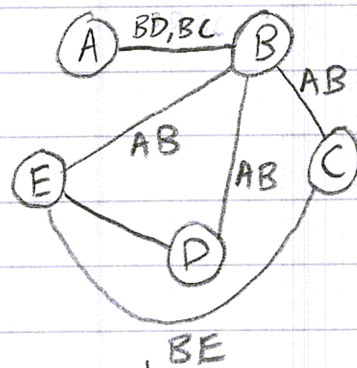
	NS(i)		
CS	0	1	Z
S_0	S_0	S_1	0
S_1	S_2	S_1	0
S_2	S_0	S_3	0
S_3	S_3	S_3	1

1.3) $(0+1)^*101(0+1)^*$

2)

B	BD BC			
C	X	AB		
D	~~AC~~ X	AB	X	
E	~~DE AC~~ X	AB	BE	1
	A	B	C	D

→



	α BDE	DE	β AB	γ BC	CE	A	B	C
~~A~~			1			1		
~~B~~	1		1	1			1	
C				1	1			1
~~D~~	1	1						
~~E~~	1	1			1			
~~BDE→AB~~	0		1					
~~AB→BD,BC~~	1		0	1				
~~CE→BE~~	1				0			

Prime compat.

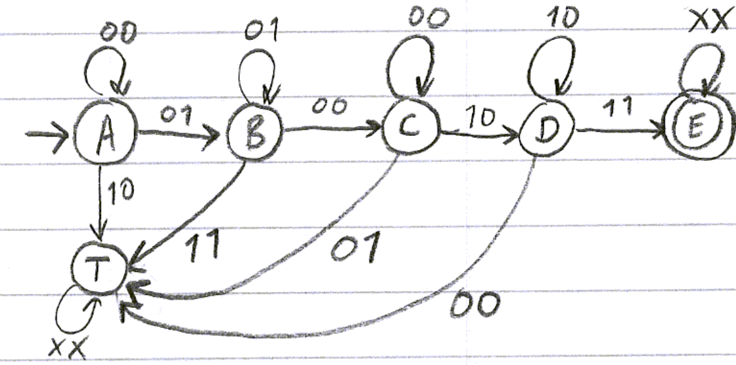
BDE → AB
DE
AB → BD, BC
BC → AB
CE → BE
A
B
C

Best case is 3, even if implications neglected.

2)

	NS(i)		
CS	0	1	z
β	α	γ	0
α	α	β	0
γ	γ	β	1

3.1)



Four adj. to T. Need 4 state variables before state splitting. However, using multiple T states permits 3 variables.

p \ qr				
	A	B	C	T_2
p	X	T_1	D	E

	NS($\alpha\beta$)				
CS	00	01	10	11	Z
A(000)	A(000)	B(001)	T_2(010)	X	0
B(001)	C(011)	B(001)	X	T_1(101)	0
C(011)	C(011)	D(111)	T_2(010)	X	0
D(111)	T_1(101)	D(111)	X	E(110)	0
E(110)	E(110)	" →			1
T_1(101)	T_1(101)	" →			0
T_2(010)	T_2(010)	" →			0

3.2) Without a clock signal, f^+ and f cannot be distinguished.

3.3) Kernel extraction could introduce dynamic hazards, resulting in incorrect transitions. Using it would therefore be dangerous.

4) Only sum of odd and even is odd.

$$s_0 = a_0 \oplus b_0$$

$$s_1 = a_1 \oplus b_1 \oplus (a_0 b_0)$$

$$s_2 = a_1 b_1 + a_1 (a_0 b_0) + b_1 (a_0 b_0)$$

$$s_0 = \bar{a}_0 b_0 + a_0 \bar{b}_0 \,, \quad s_2 = a_1 b_1 + a_1 a_0 b_0 + b_1 a_0 b_0$$

$$s_1 = (\bar{a}_1 b_1 + a_1 \bar{b}_1) \oplus (a_0 b_0)$$

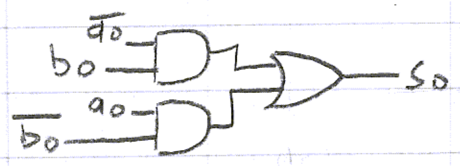
$$s_1 = \overline{\bar{a}_1 b_1 + a_1 \bar{b}_1} \cdot a_0 b_0 + (\bar{a}_1 b_1 + a_1 \bar{b}_1)\, \overline{a_0 b_0}$$

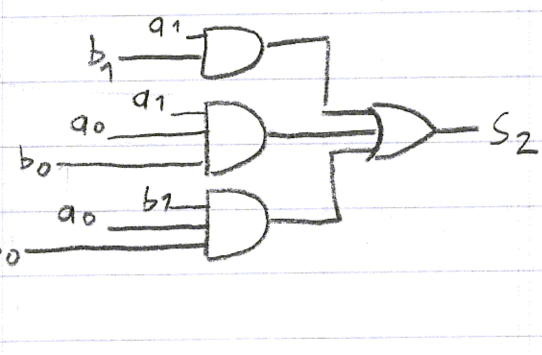
$$s_1 = \overline{\bar{a}_1 b_1} \cdot \overline{a_1 \bar{b}_1} \cdot a_0 b_0 + (\bar{a}_1 b_1 + a_1 \bar{b}_1)(\bar{a}_0 + \bar{b}_0)$$

$$s_1 = (a_1 + \bar{b}_1)(\bar{a}_1 + b_1) a_0 b_0 + \bar{a}_0 \bar{a}_1 b_1 + \bar{a}_0 a_1 \bar{b}_1 + \bar{a}_1 \bar{b}_0 b_1 + a_1 \bar{b}_0 \bar{b}_1$$

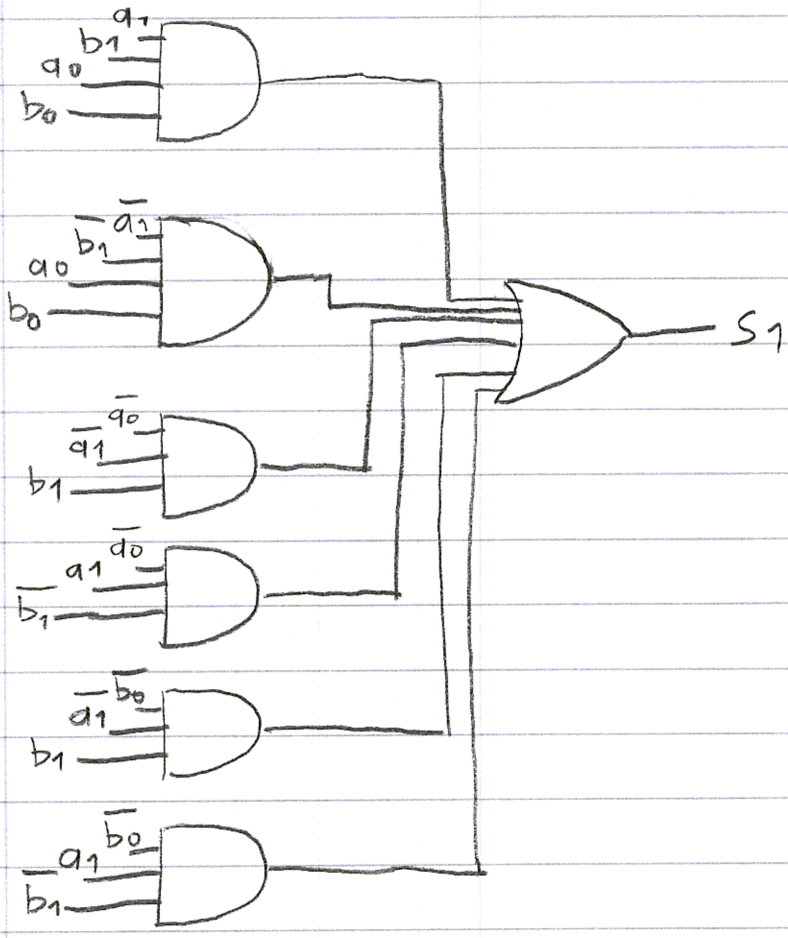
$$s_1 = (\cancel{a_1 \bar{a}_1} + a_1 b_1 + \bar{b}_1 \bar{a}_1 + \cancel{\bar{b}_1 b_1}) a_0 b_0 + \bar{a}_0 \bar{a}_1 b_1 + \bar{a}_0 a_1 \bar{b}_1 + \bar{a}_1 \bar{b}_0 b_1 + a_1 \bar{b}_0 \bar{b}_1$$

$$s_1 = a_1 b_1 a_0 b_0 + \bar{a}_1 \bar{b}_1 a_0 b_0 + \bar{a}_0 \bar{a}_1 b_1 + \bar{a}_0 a_1 \bar{b}_1 + \bar{b}_0 \bar{a}_1 b_1 + \bar{b}_0 a_1 \bar{b}_1$$





4)

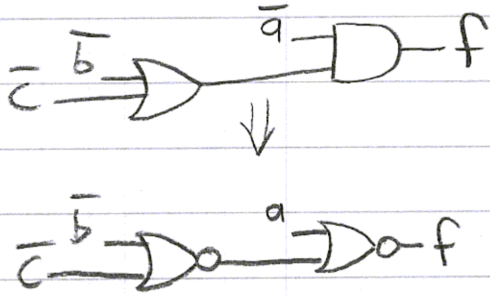


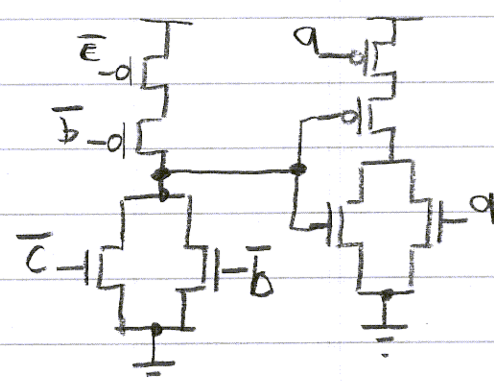
5.1)

a \ bc				
	1	1	0	1
a	0	0	0	0

$\cancel{f_1 = \bar{a}\bar{b} + \bar{a}\bar{c}}$

$f_2 = (\bar{a})(\bar{b} + \bar{c})$





5.2) 8

6) Which states can be reached from A in M_1 and M_2?

M_1 : A, D, E, C → A, C, D, E

M_2 : A, B, D, E, F, C → A, B, C, D, E, F

Minimize

M_1

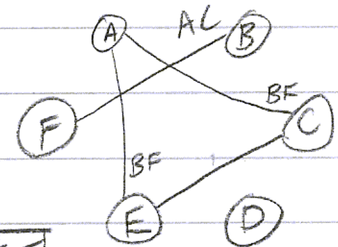
	A	C	D
C	~~AD~~ X		
D	X	~~AC AE~~	
E	~~AD~~	CE	X

Merge CE

	NS (i)		
CS	0	1	Z
A	D	CE	0
D	CE	A	1
CE	A	CE	0

↓

CS	0	1	Z
α	β	γ	0
β	γ	α	1
γ	α	γ	0



	A	B	C	D	E
B	X				
C	BF	X			
D	~~BE~~	X	~~EF~~		
E	BF	X	1	~~EF~~	
F	X	AC	X	X	X

ACE → BF

CE

BF → AC

A

D

B

F

6)

	ACE	CE	BF	A	D	B	F
~~A~~	1			1			
~~B~~			1			1	
~~C~~	1	1					
D					1		
~~E~~	1	1					
~~F~~			1				1
ACE→BF	0		1				
~~BF→AC~~	1		0				

Best case would require 3 states, even w.o. implications.

	NS(i)		
CS	0	1	Z
ACE	BF	D	0
BF	D	ACE	1
D	ACE	D	0

↓

CS	0	1	Z
α	β	γ	0
β	γ	α	1
γ	α	γ	0

$\boxed{\text{Equiv.}}$