

Solutions to Assignment 2

Question 1

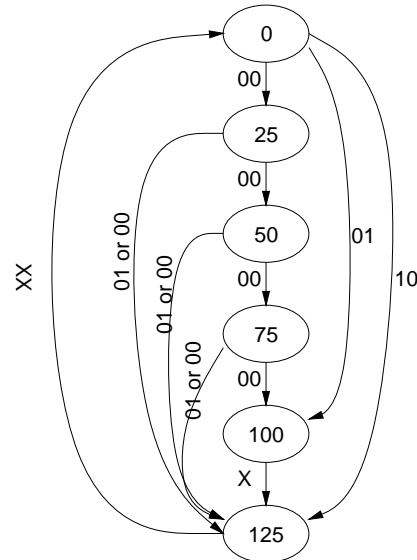
(a)

- The controller inputs are the coin detector outputs (labelled d and e). The controller output is the widget release signal (labelled r).
- The six states correspond to the possible sum of money deposited: 0, 25, 50, 75, 100, and 125 (or more) which are encoded using three state variables (a , b , and c) as 101, 100, 011, 010, 001, and 000 respectively.
- The tabular description of the state transitions is:

current state	input conditions		next state		
	abc	d	e	$a'b'c'$	
0	101	0	0	100	20
	101	0	1	001	100
	101	1	0	000	125
25	100	0	0	011	50
	100	0	1	000	125
	100	1	0	000	125
50	011	0	0	010	75
	011	0	1	000	125
	011	1	0	000	125
75	010	0	0	001	100
	010	0	1	000	125
	010	1	0	000	125
100	001	X	X	000	125
125	000	X	X	101	0

where X is a "don't care" condition.

- The state transition diagram is:



- The release, r , is only turned on when the count of money reaches 125 cents (or more). The tabular description of the outputs is:

state	r
0	0
25	0
50	0
75	0
100	0
125	1

- The next-state equations (not simplified) are:

$$a' = \bar{a}\bar{b}\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}$$

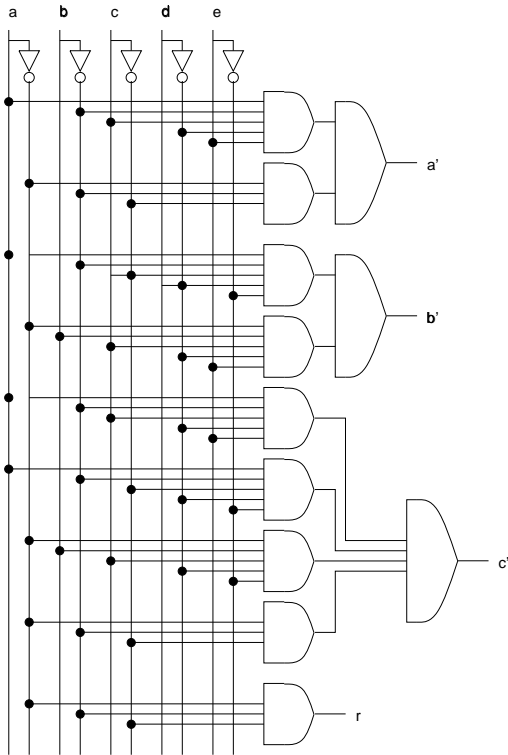
$$b' = \bar{a}\bar{b}\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}\bar{d}\bar{e}$$

$$c' = \bar{a}\bar{b}\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}$$

The output equation is:

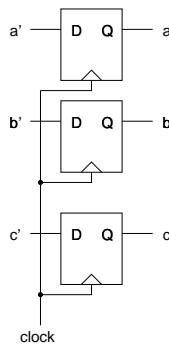
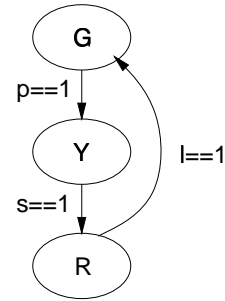
$$r = \bar{a}\bar{b}\bar{c}$$

- Schematic diagrams of the controller implemented directly from the sum-of-products expressions are given below:



current state	input conditions			next state
	p	s	l	
G (00)	0	X	X	G (00)
G (00)	1	X	X	Y (01)
Y (01)	X	0	X	Y (01)
Y (01)	X	1	X	R (10)
R (10)	X	X	0	R (10)
R (10)	X	X	1	G (00)

4. The state transition is shown below:



5. The outputs for each state are:

state	g	y	r	w	n
G (00)	1	0	0	0	1
Y (01)	0	1	0	0	1
R (10)	0	0	1	1	0

(b)

1. The controller inputs are the pushbutton p, and the short and long timer signals s and l. The outputs are the lights r, y, g, w, n.
2. The set of states correspond to the possible traffic light conditions: G (green), Y (yellow) and R (red) which are encoded as 00, 01 and 10 respectively.
3. A tabular description of the state transition diagram is as follows:

6. The sum-of-products boolean expressions for each output signal and for the signal giving the next state are:

$$a' = \bar{a}bs + a\bar{b}\bar{l}$$

$$b' = \bar{a}\bar{b}p + \bar{a}b\bar{s}$$

$$g = \bar{a}\bar{b}$$

$$y = \bar{a}b$$

$$r = a\bar{b}$$

$$w = a\bar{b}$$

$$n = \bar{a}b + \bar{a}\bar{b}$$

7. a schematic diagram for the controller is:

