Ethan Wong
CSM51A

Assignment 6

Input : n (5¢)   d (10¢)   g (gum)   c (candy)

Output : N (5¢)   D (10¢)   G (gum)   C (candy)

(This wasn't in the problem but I'll use 'O' as nothing gets outputted yet)

The different states for the machine should be based on how much money has been credited to the user. Change will be returned for values over 15 cents; all coins are multiples of 5.
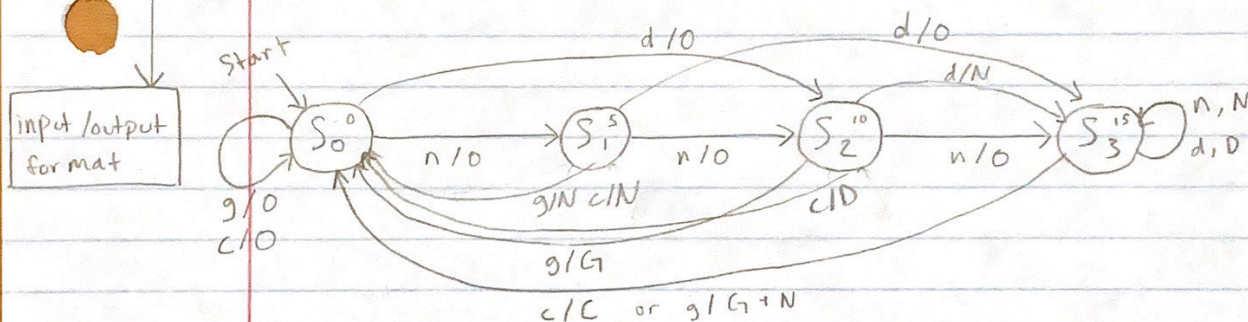
Possible States

S_0 : 0 cents credit $\rightarrow$ 0 coins

S_1 : 5 cents credit $\rightarrow$ 1 nickel

S_2 : 10 cents credit $\rightarrow$ 2 nickels, or 1 dime

S_3 : 15 cents credit $\rightarrow$ 3 nickels, or 1 dime + 1 nickel

State Diagram

Flip Flops Needed : 2 , because there are 4 total states

		0¢	5¢	10¢	15¢
		AB	AB	AB	AB

State Table . $S_0 : 00$ $S_1 : 01$ $S_2 : 11$ $S_3 : 10$

M - Nickel input   d - Dime input   g - Request Gum   c - Request Candy
N - nickel output   D - dime output   G - Dispense Gum   C - Dispense Candy

Current State	Input	Next State	Flip Flops				Outputs			
H A B	W Z	H A B	JA	KA	JB	KB	N	D	G	C
S_0 0 0	0 0	S_1 0 1	0	X	1	X	0	0	0	0
S_0 0 0	0 1	S_2 1 1	1	X	1	X	0	0	0	0
S_0 0 0	1 1	S_0 0 0	0	X	0	X	0	0	0	0
S_0 0 0	1 0	S_0 0 0	0	X	0	X	0	0	0	0
S_1 0 1	0 0	S_2 1 1	1	X	X	0	0	0	0	0
S_1 0 1	0 1	S_3 1 0	1	X	X	1	0	0	0	0
S_1 0 1	1 1	S_0 0 0	0	X	X	1	1	0	0	0
S_1 0 1	1 0	S_0 0 0	0	X	X	1	1	0	0	0
S_2 1 1	0 0	S_3 1 0	X	0	X	1	0	0	0	0
S_2 1 1	0 1	S_3 1 0	X	0	X	1	1	0	0	0
S_2 1 1	1 1	S_0 0 0	X	1	X	1	0	0	1	0
S_2 1 1	1 0	S_0 0 0	X	1	X	1	0	1	0	0
S_3 1 0	0 0	S_3 1 0	X	0	0	X	1	0	0	0
S_3 1 0	0 1	S_3 1 0	X	0	0	X	0	1	0	0
S_3 1 0	1 1	S_0 0 0	X	1	0	X	1	0	1	0
S_3 1 0	1 0	S_0 0 0	X	1	0	X	0	0	0	1

Because the inputs (inserting coins, requesting from machine)
are mutually exclusive, I will assign values to WZ (the input variable)
WZ : 00 means a nickel was inserted
       01 means a dime was inserted
       11 means the user requested gum
       10 means the user requested candy

Flip
Flop

JA

AB \ WZ	00	01	11	10
00	0	1	0	0
01	1	1	0	0
11	X	X	X	X
10	X	X	X	X

$JA = (w' \cdot z) + (B \cdot w')$

KA

AB \ WZ	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	0	0	1	1
10	0	0	1	1

$KA = W$

JB

AB \ WZ	00	01	11	10
00	1	1	0	0
01	X	X	X	X
11	X	X	X	X
10	0	0	0	0

$JB = A' \cdot w'$

KB

AB \ WZ	00	01	11	10
00	X	X	X	X
01	0	1	1	1
11	1	1	1	1
10	X	X	X	X

$KB = Z + w + A$

Outputs

N

AB \ WZ	00	01	11	10
00	0	0	0	0
01	0	0	1	1
11	0	1	0	0
10	1	0	1	0

$N = (a' \cdot b \cdot w) + (a \cdot b' \cdot w' \cdot z') +$
$(a \cdot b' \cdot w \cdot z) + (a \cdot b \cdot w' \cdot z)$

D

AB \ WZ	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	0	1
10	0	1	0	0

$D = (a \cdot b' \cdot w' \cdot z) + (a \cdot b \cdot w \cdot z')$

G

AB \ WZ	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	1	0
10	0	0	1	0

$G = a \cdot w \cdot Z$

C

AB \ WZ	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	0	0	0	0
10	0	0	0	1

$C = a \cdot b' \cdot w \cdot z'$
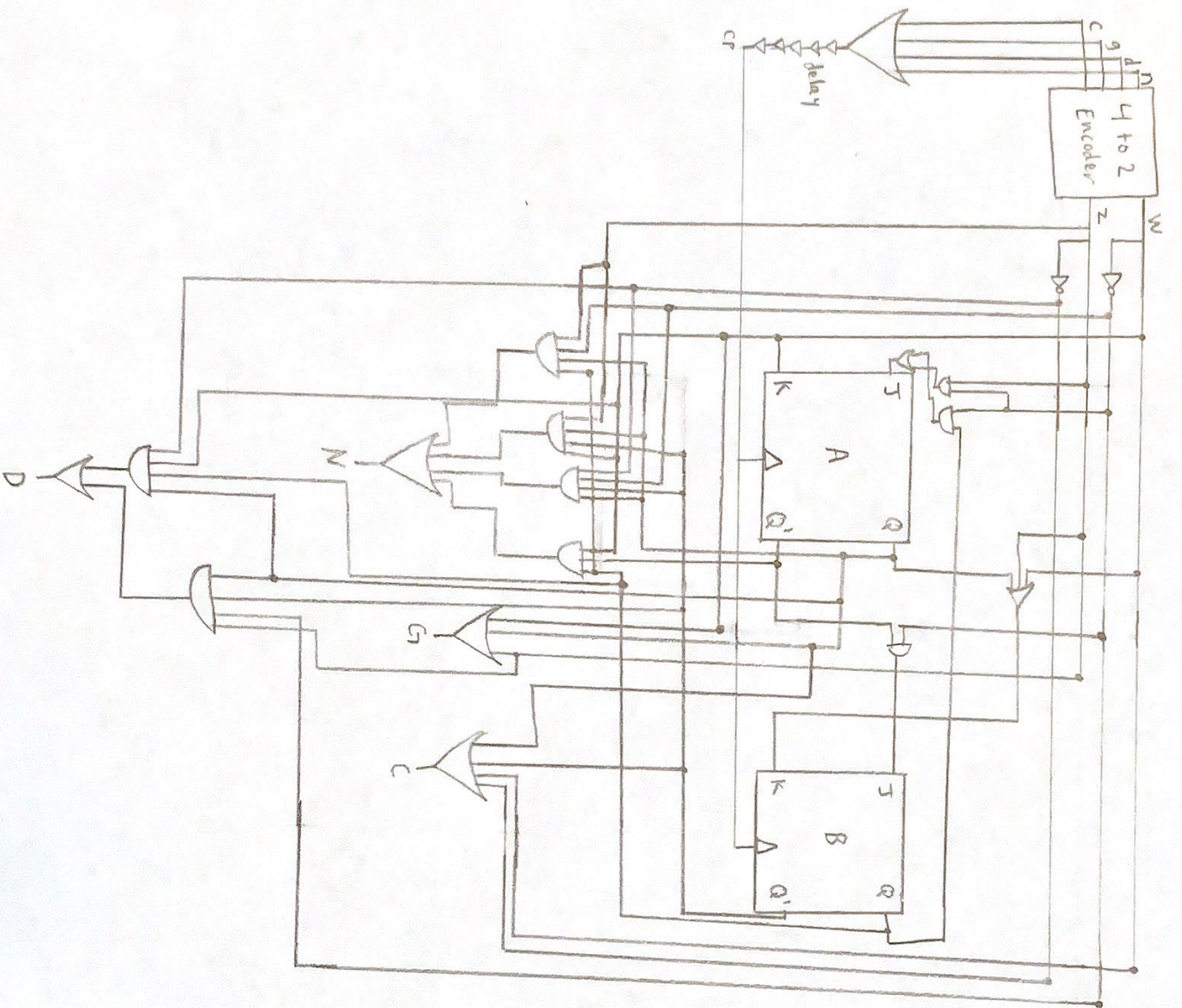
Sorry this is kind of messy, it was hard since some of the expressions were weird.