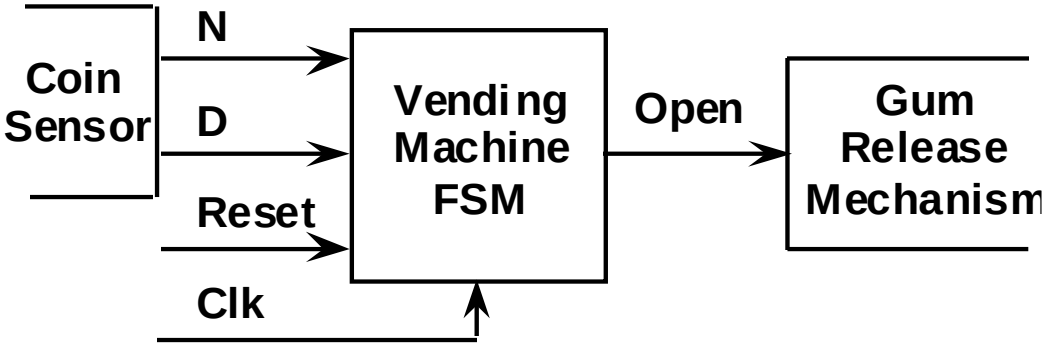
BIM203 Logic Design

Sequential Circuit Design Example

Example: Vending Machine

Specification

- deliver package of gum after 15 cents deposited
- single coin slot for dimes (10 cents), nickels (5 cents)
- no change



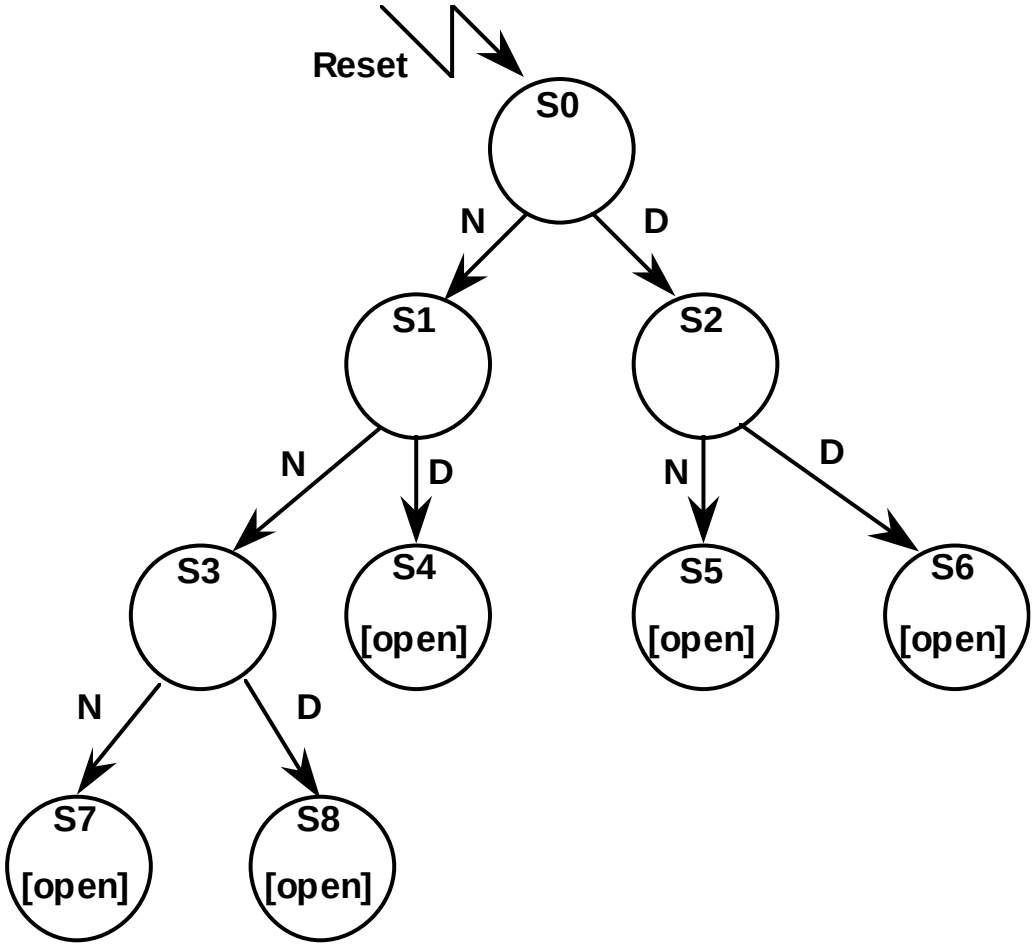
Example: Vending Machine

Inputs: N, D, reset

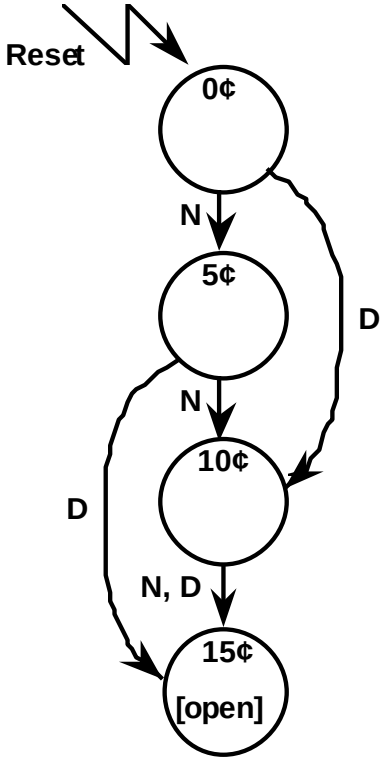
Output: open

Coin Possibilities

- three nickels
- nickel, dime
- dime, nickel
- two dimes
- two nickels, dime



Example: Vending Machine



reuse states whenever possible

Present State	Inputs D	Inputs N	Next State	Output Open
0¢	0	0	0¢	0
	0	1	5¢	0
	1	0	10¢	0
	1	1	X	X
5¢	0	0	5¢	0
	0	1	10¢	0
	1	0	15¢	0
	1	1	X	X
10¢	0	0	10¢	0
	0	1	15¢	0
	1	0	15¢	0
	1	1	X	X
15¢	X	X	15¢	1

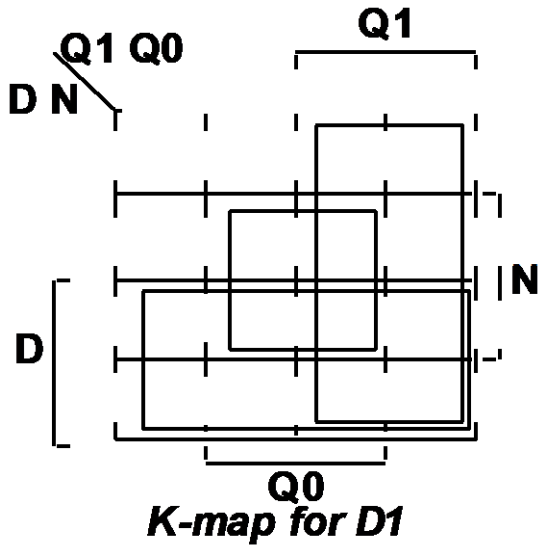
Symbolic State Table

Example: Vending Machine

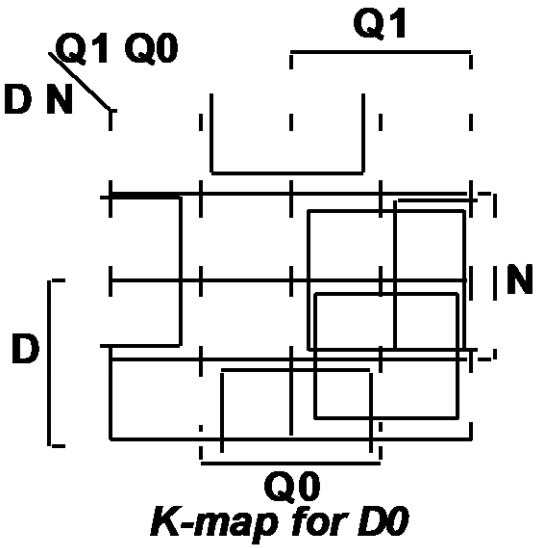
State Encoding

Present State Q_1	Q_0	Inputs D	N	Next State D_1	D_0	Output Open
0	0	0	0	0	0	0
		0	1	0	1	0
		1	0	1	0	0
		1	1	X	X	X
0	1	0	0	0	1	0
		0	1	1	0	0
		1	0	1	1	0
		1	1	X	X	X
1	0	0	0	1	0	0
		0	1	1	1	0
		1	0	1	1	0
		1	1	X	X	X
1	1	0	0	1	1	1
		0	1	1	1	1
		1	0	1	1	1
		1	1	X	X	X

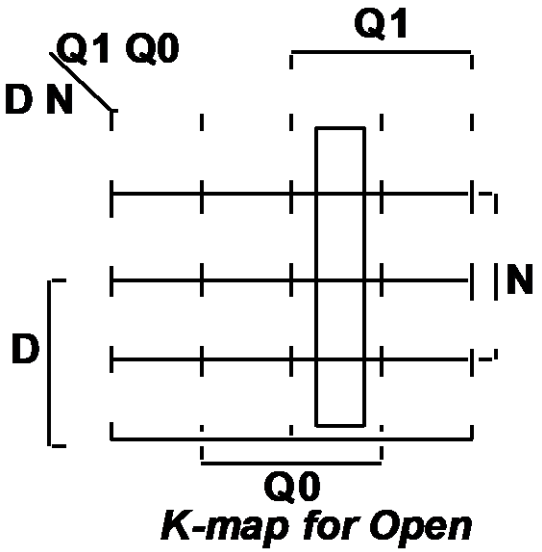
Example: Vending Machine



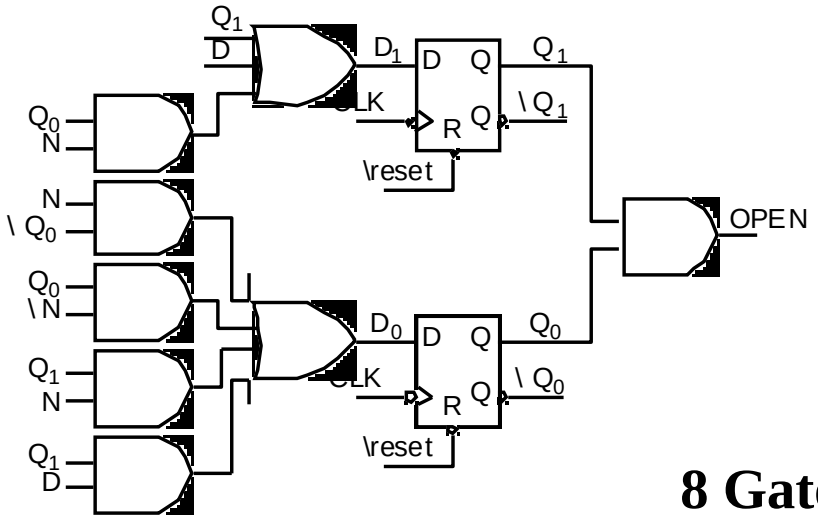
K-map for D1



K-map for D0



K-map for Open



D type *FFs for implementation*

D1 = Q1 + D + Q0 N

D0 = N $\overline{Q0}$ + Q0 $\overline{N}$ + Q1 N + Q1 D

OPEN = Q1 Q0

8 Gates

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