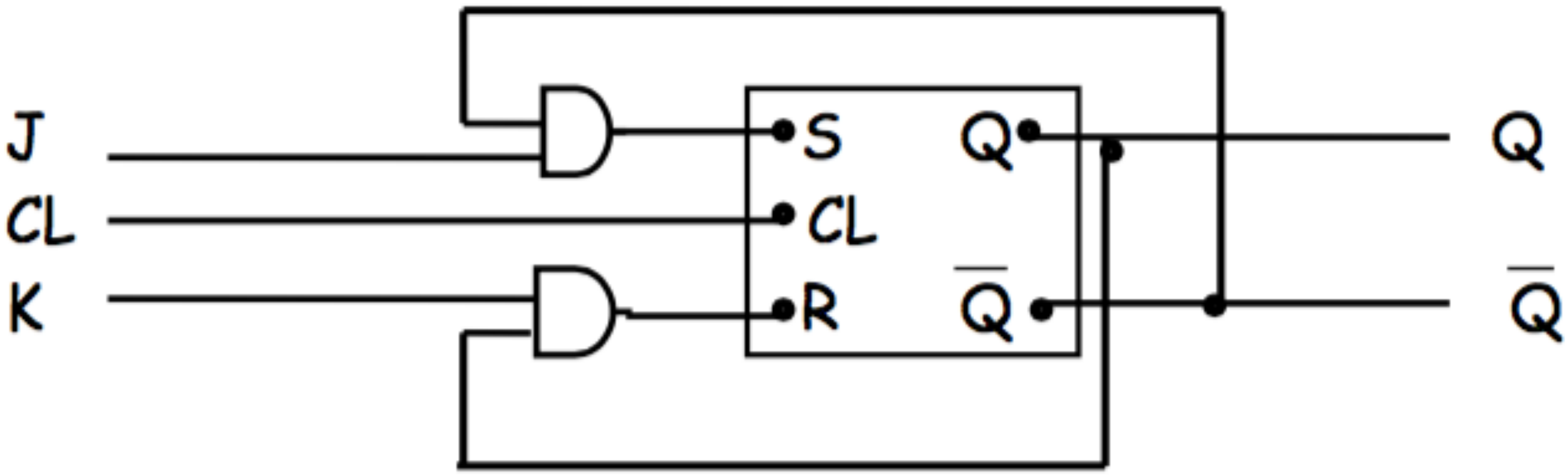
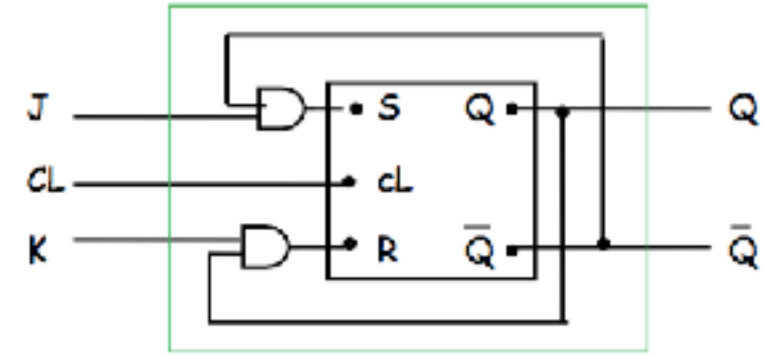
CL 22=CSCI 160

REVIEW CLASS

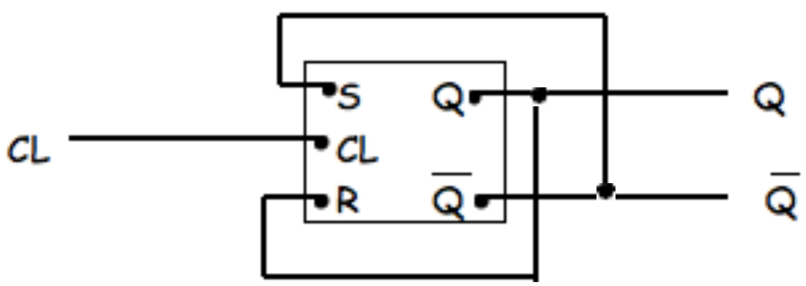
HW 21 J-K Flip-Flop - Describe its behavior

Solution





a) J = K = 1, the circuit becomes a T- Flip-Flop in which output Q oscillates 2x slower than CL.



b) Otherwise, for CL =1:

J = 0 --> S fixed at S = 0

K = 0 --> R fixed at R = 0

J	K	Q
0	0	PS
0	1	0 (= value of J)
1	0	1 (= value of J)

Put together, the answer is:

J	K	Q
0	0	PS
0	1	J
1	0	J
1	1	T flip-flop 2 x slower than CL

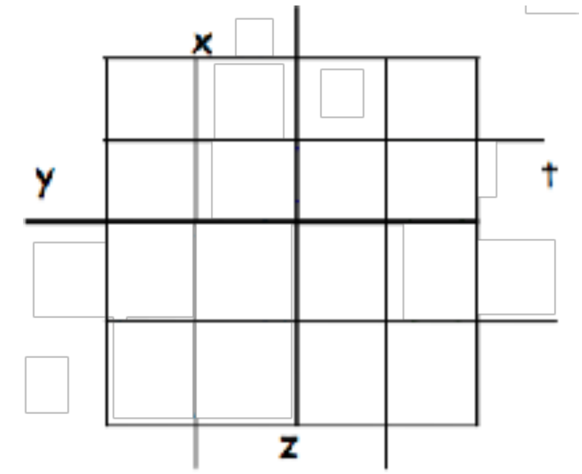
For CL = 1 (F-F enabled)

For oscillating CL

If CL = 0, then Q = PS, for all values of J and Q

REVIEW 2 - TOPICS

Always use this K-map:



and no other!

1) & 2) Minimization of functions - K-map
- Tabulation
- d's
- Circuit design

3) Adders, subtractors

4) Controlled circuits

5) Flip-Flops

For topic #5 we worked out the J-K F-F HW.

Let's review the topics in decreasing order.

4) Controlled circuits - Example

* 2 inputs (external): A, B
* 2 outputs: Y_1, Y_2, such that we have

	Y_1:	Y_2:
* at times	A	B
* at other times	B	A
* yet at other times	0	0
* yet at other times	1	1

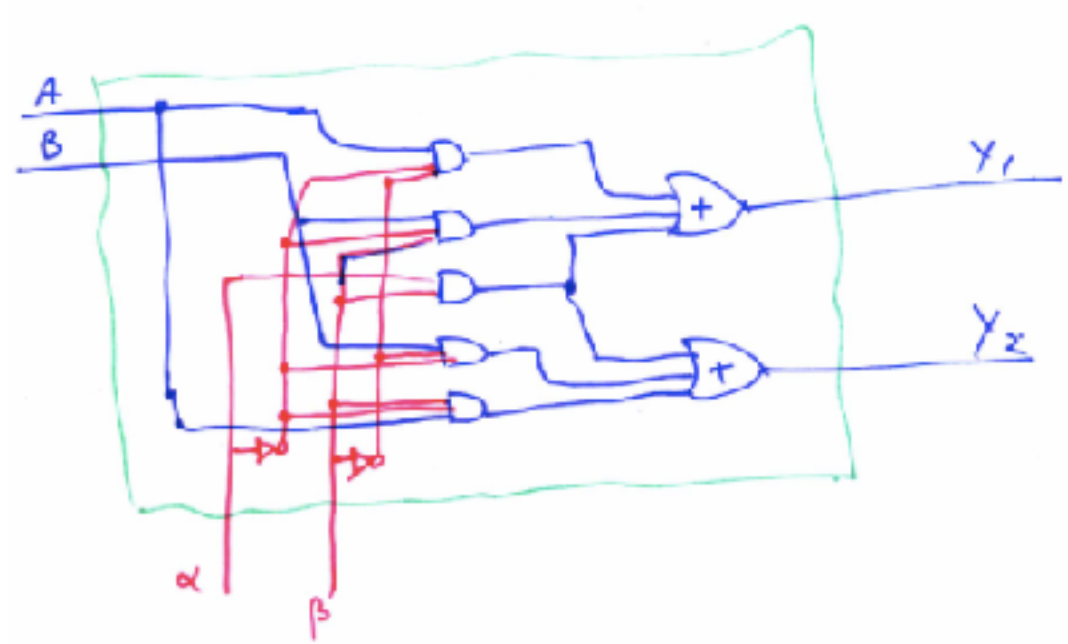
Solution

4 possible outcomes $\Longrightarrow$ 2 control lines

$$\boxed{\begin{aligned} Y_1 &= \alpha'\beta'A + \alpha'\beta B + \alpha\beta \\ Y_2 &= \alpha'\beta'B + \alpha'\beta A + \alpha\beta \end{aligned}}$$

α	β	Y1	Y2
0	0	A	B
0	1	B	A
1	0	0	0
1	1	1	1

<u>If you finished everything</u> draw diagram:



3) Adders, subtractors - Example

HW (older): Construct FS using HS's and one other gate.

Solution

FS: β_{out}

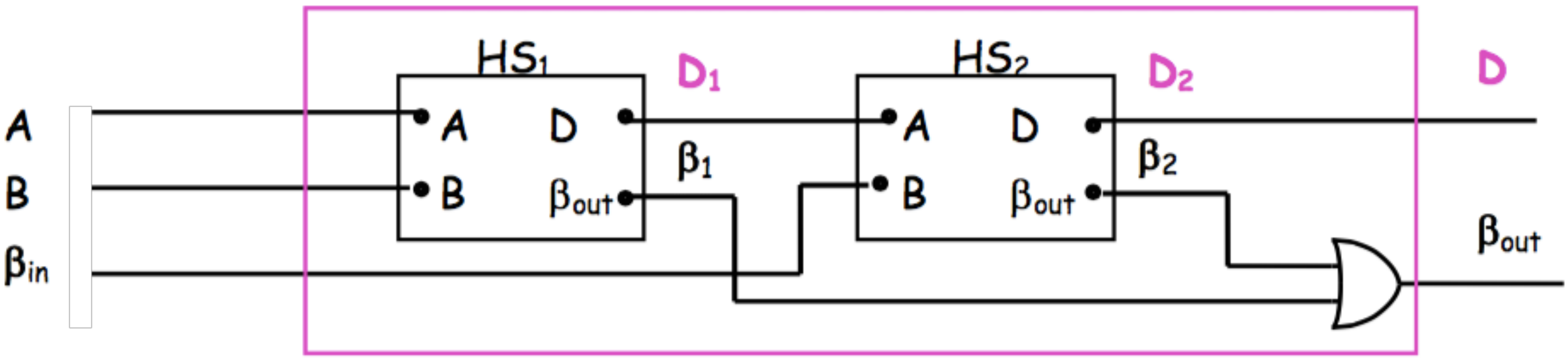
$$\begin{array}{r} A \; - \\ B \; - \\ \beta_{in} \\ \hline D \end{array}$$

HS₁: β_1

$$\begin{array}{r} A \; - \\ B \\ \hline D1 \end{array}$$

HS₂: β_2

$$\begin{array}{r} D1 \; - \\ \beta_{in} \\ \hline D2 \end{array}$$



Important to Note (solution not finished otherwise):

β_1 and β_2 may not be both = 1. Why? $\beta_1 = 1 \text{ ---> } \left\{ \begin{array}{l} A=0 \\ \text{and} \\ B=1 \end{array} \right. \text{ ---> } D_1 = 1 \text{ ---> } \beta_2 = 0$

⇨ We can use an OR gate for β_1, β_2.

Remember:

•	0	1
0	0	0
1	0	1

+	0	1
0	0	1
1	1	1

2) Minimization of functions - Design - Example

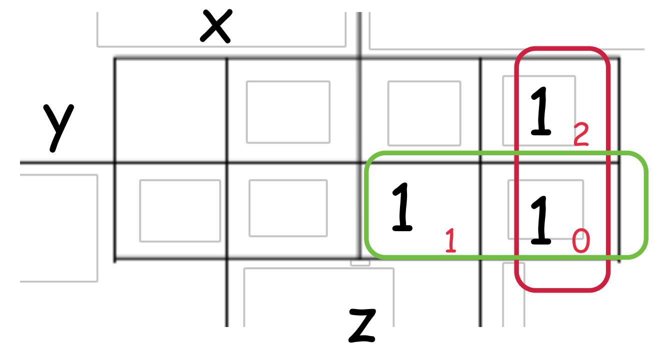
Design a circuit with 3 binary (external) inputs, x, y, z and two outputs, A, B, which satisfies both specifications (a) and (b) below. Minimize A and B.

(a) A = 1 exactly when xyz, the value of the input (in decimal), is less than 3.
(b) B = 1 exactly when xyz, the value of the input, is odd.

Solution

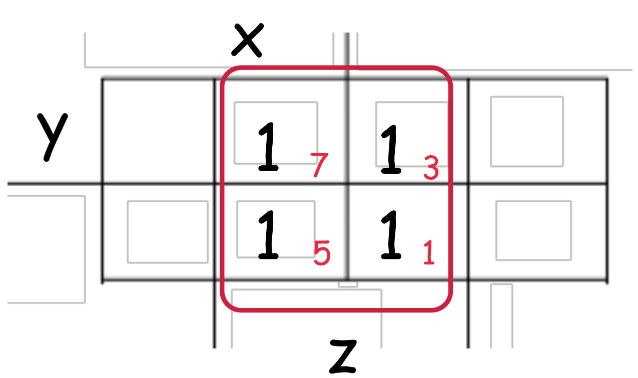
	x	y	z	A	B
0	0	0	0	1	0
1	0	0	1	1	1
2	0	1	0	1	0
3	0	1	1	0	1
4	1	0	0	0	0
5	1	0	1	0	1
6	1	1	0	0	0
7	1	1	1	0	1

(a)



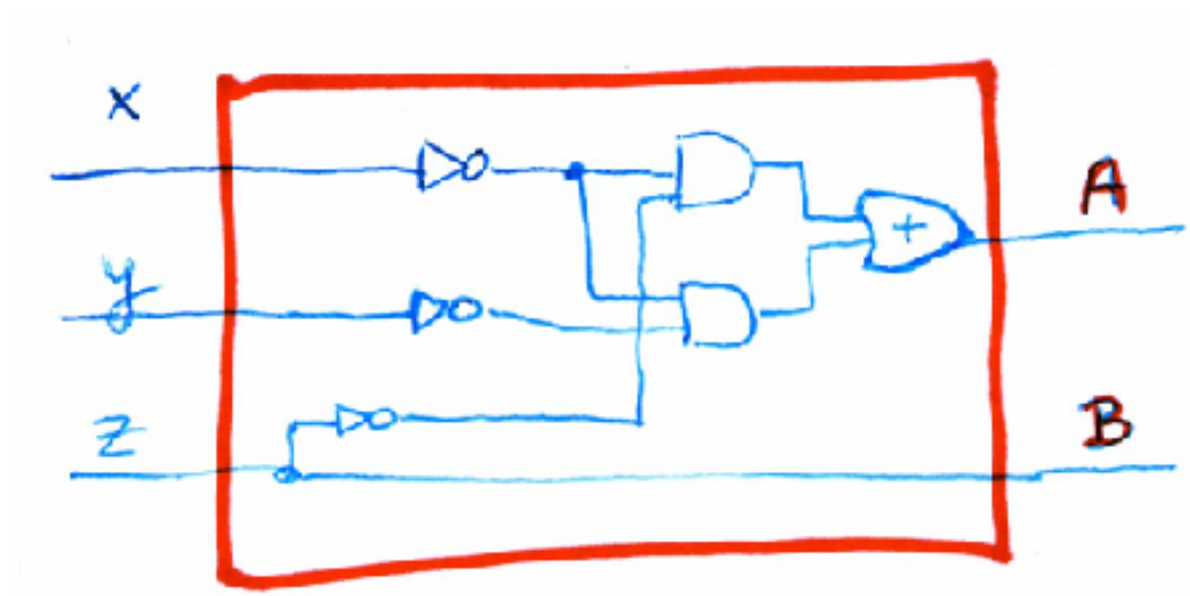
$$\boxed{A = x'y' + x'z'}$$

(b)



$$\boxed{B = z}$$

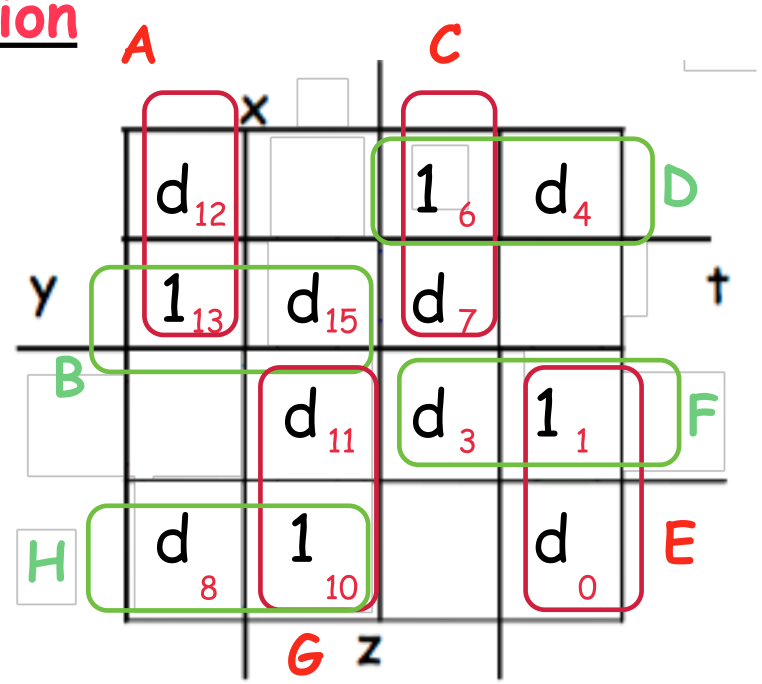
If you finished everything draw diagram:



1) Minimization of functions - Example

$F = \sum (1, 6, 10, 13) + d \sum (0, 3, 4, 7, 8, 11, 12, 15)$ **Find all minimal forms.**

Solution



Essentials: None

Each 1 can be covered by 2 size-2 implicants independently from each other.

We have four such 1s ---> # min forms is:

2x2x2x2 = 16:

$$F_{1\text{-}16} = \begin{Bmatrix} A \\ B \end{Bmatrix} + \begin{Bmatrix} C \\ D \end{Bmatrix} + \begin{Bmatrix} E \\ F \end{Bmatrix} + \begin{Bmatrix} G \\ H \end{Bmatrix} = \ldots \text{(express using variables)}$$

What if $d_0 = 1$?

Think about it and the fact that we want a minimized F.

Complete the Evaluations ASAP in one of two ways:

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Sign in with your net ID and net ID password (forgot your password? Use: https://netid.hunter.cuny.edu/verify-identity)