Class 21 JK Flip Flop
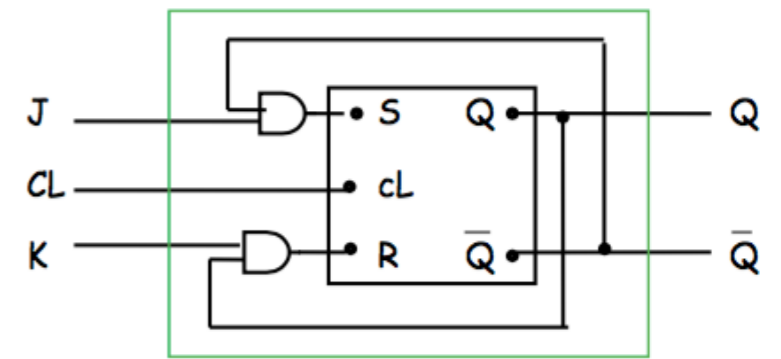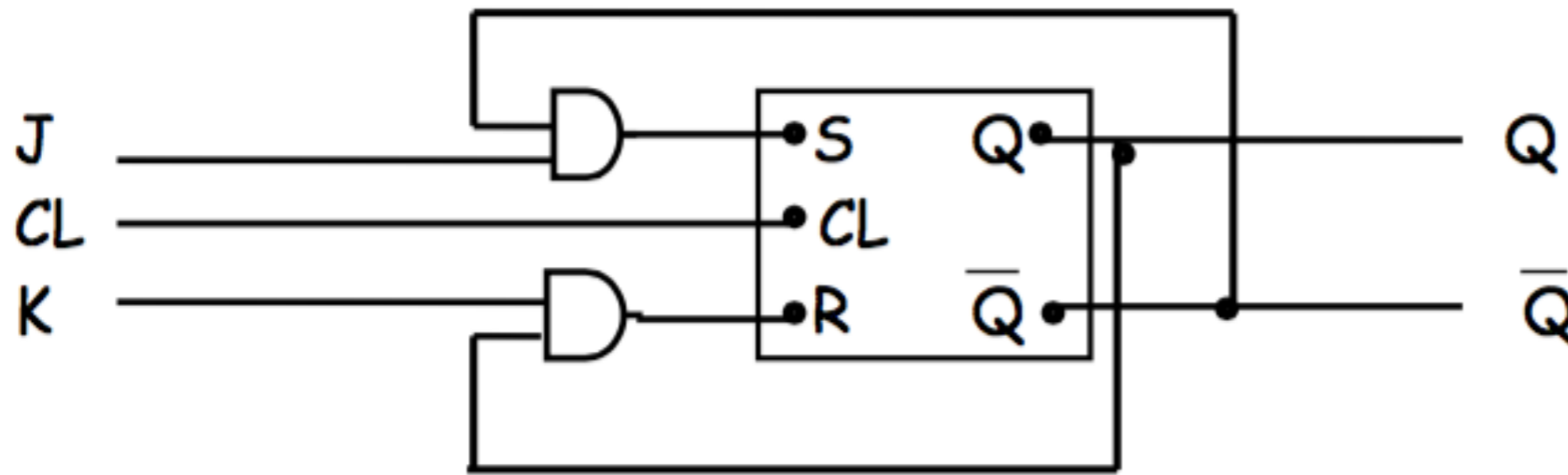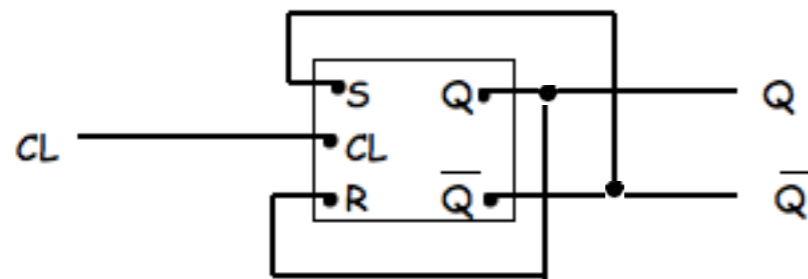# &
Review

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

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

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

Put together, the answer is:

For CL = 1 (F-F enabled)

For oscillating CL

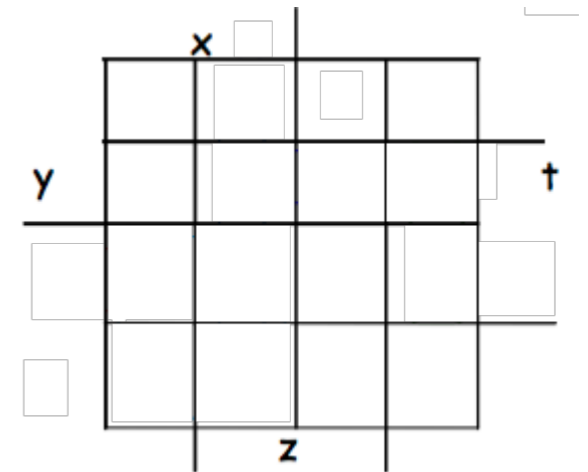| J	K	Q
0	0	PS
0	1	J
1	0	J
1	1	T flip-flop 2 x slower than CL

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

REVIEW 2 - TOPICS

1) & 2) Minimization of functions – K-map

                        - Tabulation

                        - d's

                        - Circuit design

and no other!

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

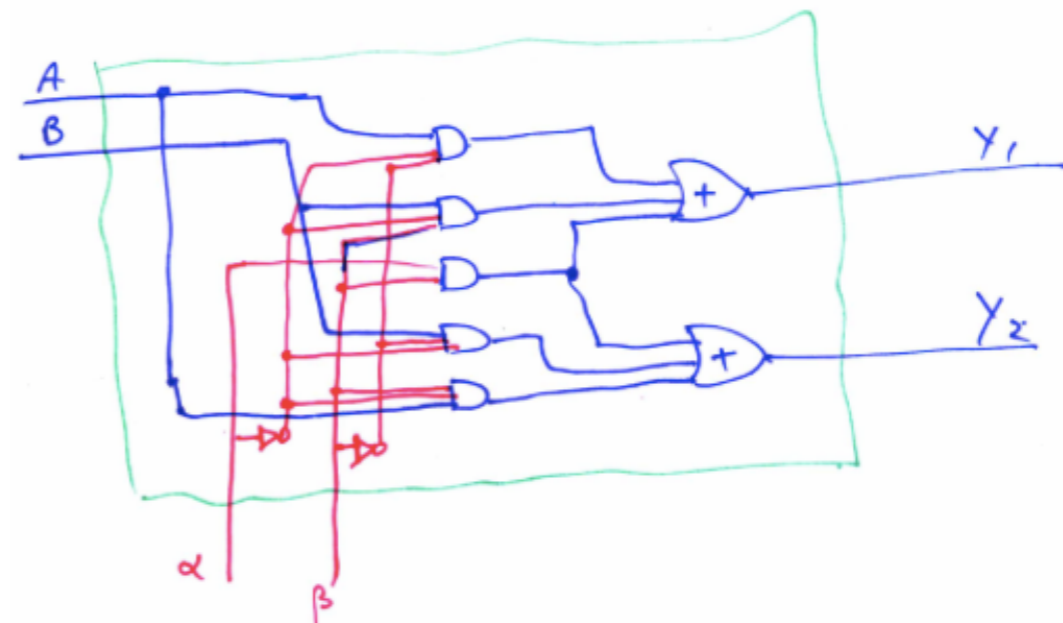|	Y_1:	Y_2:
* at times	A	B
* at other times	B	A
* yet at other times	0	0
* yet at other times	1	1

Solution

4 possible outcomes $\implies$ 2 control lines

$$Y_1 = \alpha'\beta'A + \alpha'\beta B + \alpha\beta$$

$$Y_2 = \alpha'\beta'B + \alpha'\beta A + \alpha\beta$$

α	β	Y_1	Y_2
0	0	A	B
0	1	B	A
1	0	0	0
1	1	1	1

If you finished everything draw diagram:

3) Adders, subtractors - Example

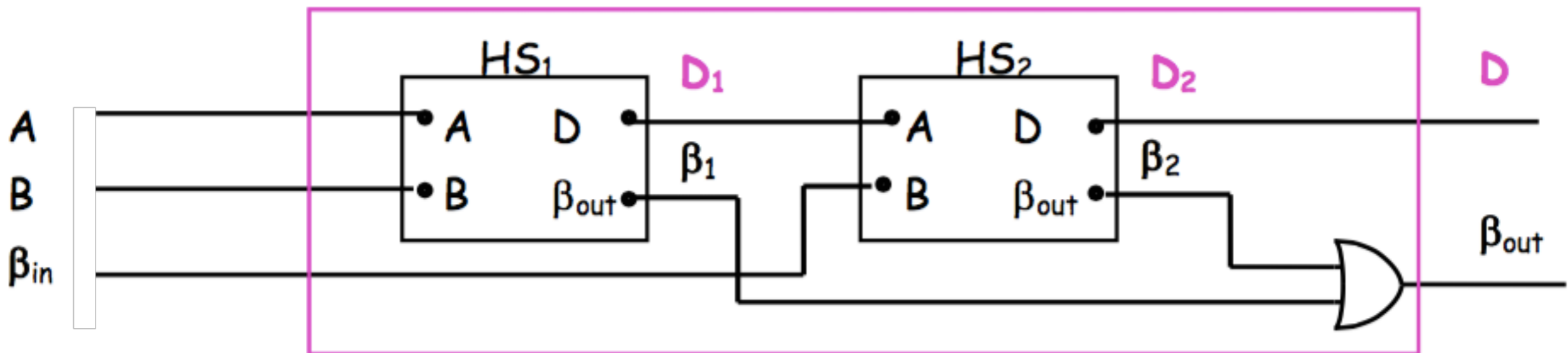HW (older): Construct FS using HS's and one other gate.

Solution

β_{out}

(FS)

A -
B -
β_{in}
___
D

β_1

(HS₁)

A -
B
___
$D1$

β_2

(HS₂)

$D1$ -
β_{in}
___
$D2$

Important to Note (solution not finished otherwise):

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

⟹ We can use an OR gate for β_1, β_2.

Remember:

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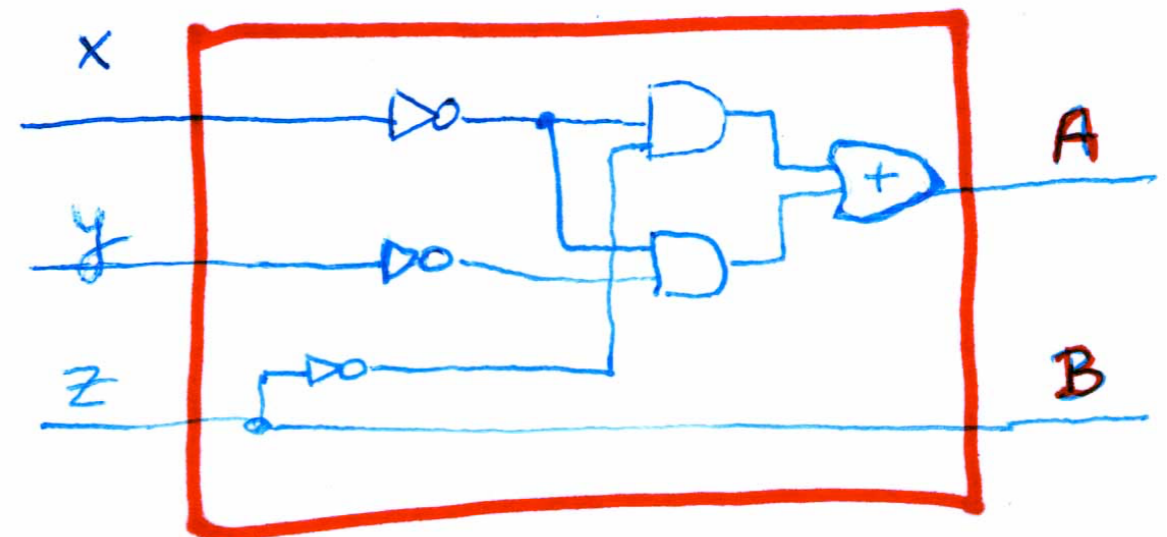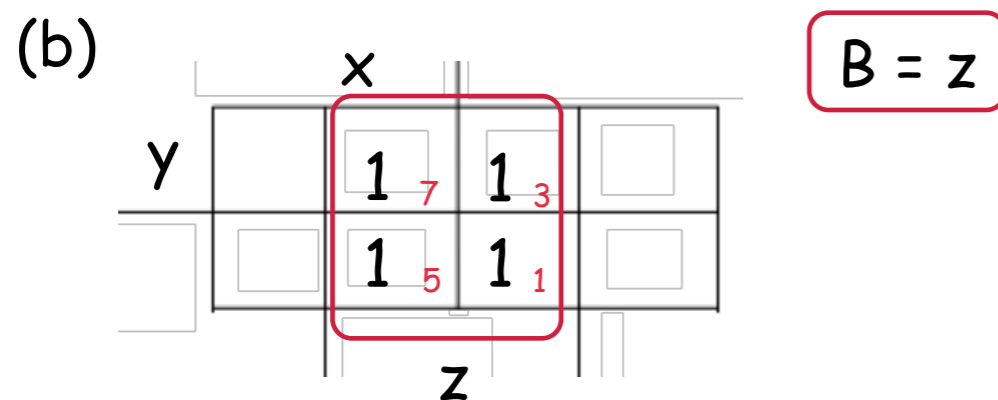
(a) $A = 1$ exactly when xyz, the value of the input (in decimal), is less than 3.
(b) $B = 1$ exactly when xyz, the value of the input, is odd.

Solution

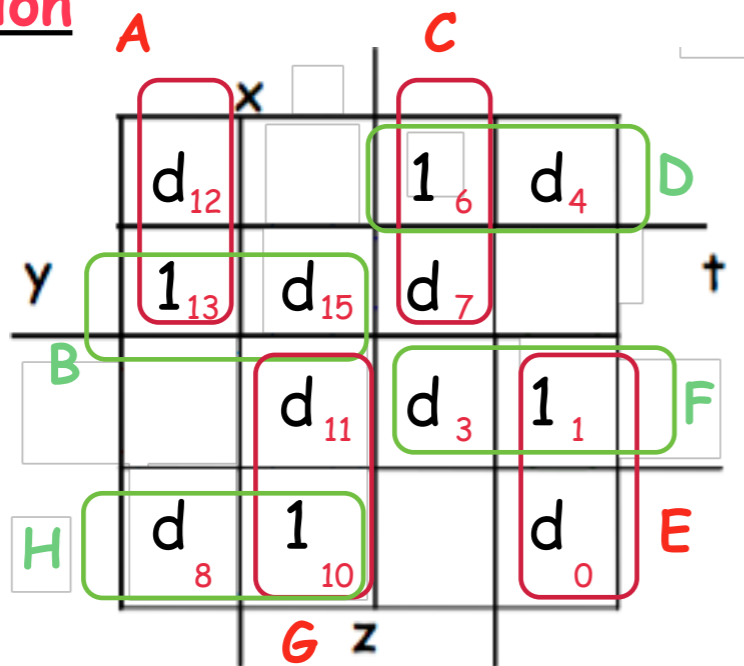|	x	y	z	A	B
0	0	0	0	1	0
1	0	0	1	1	1
2	0	1	0	1	0
3	0	1	1	0	1
4	1	0	0	0	0
5	1	0	1	0	1
6	1	1	0	0	0
7	1	1	1	0	1

(a)

$A = x'y' + x'z'$

If you finished everything draw diagram:

(b)

$B = z$
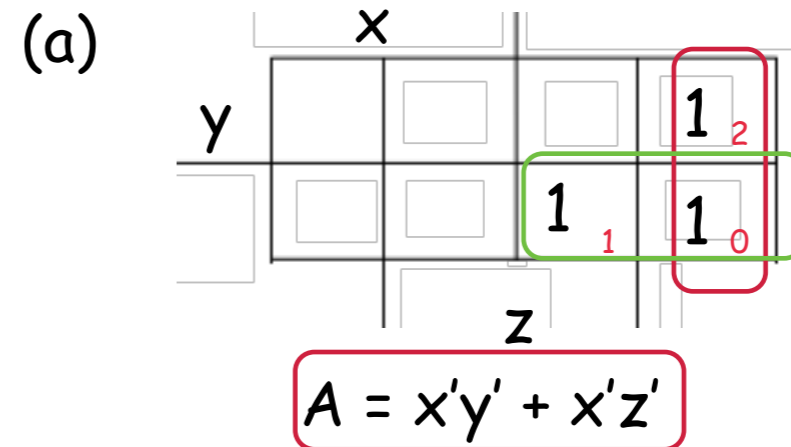
1) Minimization of functions - Example

$F = \sum (1, 6, 10, 13) + d \sum (0, 3, 4, 7, 8, 11, 12, 15)$ **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:

$$2 \times 2 \times 2 \times 2 = 16:$$

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

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)