

CSE140L Exercises

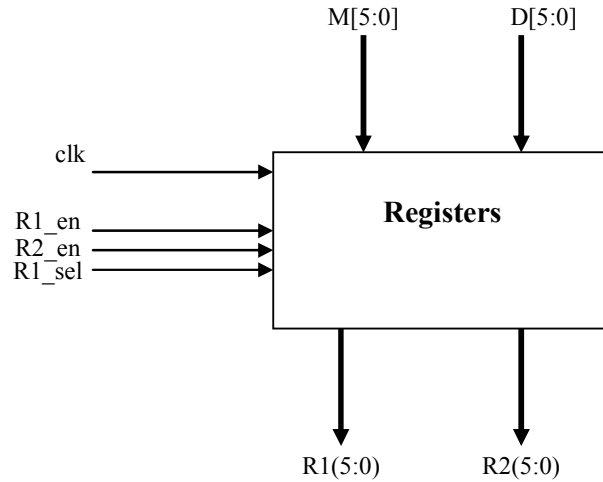
- Use CMOS complementary logic to implement the following functions. Draw the circuit to show your design.
 - $f(a) = a'$.
 - $f(a,b) = (a+b)'$.
 - $f(a,b,c) = ((a+b)c)'$.
- Design a 3-bit Johnson counter. Show the function behavior of the counter.
 - Suppose the flip-flops are reset initially, list all possible states (Q_2, Q_1, Q_0) generated by the counter.
 - Suppose the flip-flops are not reset initially. Instead, the initial state is $(Q_2, Q_1, Q_0) = (0, 1, 0)$. List all possible states generated by the counter.
- Given a Mealy machine as described by the following state table. Transform the Mealy machine to a Moore machine. Write the state table.

PS	x=0	x=1
A	A, 1	B, 0
B	C, 1	D, 1
C	A, 0	E, 0
D	B, 0	E, 0
E	B, 1	D, 1
	NS, z	

- Assume a computer system has a simple instruction set described as follows:

Command	2-bit Instruction	6-bit Data	Description
Move1	00	$d_5d_4d_3d_2d_1d_0$	Move data $d_5d_4d_3d_2d_1d_0$ to register R1.
Move2	01	$d_5d_4d_3d_2d_1d_0$	Move data $d_5d_4d_3d_2d_1d_0$ to register R2.
shift	10	$XXXd_2d_1d_0$	Left rotate the content of R1 by $d_2d_1d_0$ bits and store the result back to R1.
mask	11	XXXXXX	Mask the contents of R1 and R2; store the result back at register R1.

The registers block has two 6-bit input data ports: $M[5:0]$ and $D[5:0]$; the former is from the memory source and the latter is from the datapath. The outputs of R1 and R2 are connected to the datapath module. Control signals $R1_en$ and $R2_en$ are the enable signals for R1 and R2 respectively. Control signal $R1_sel$ is used to select the sources of R1.



The function of the registers block is described in the following table:

R1_en	R2_en	R1_sel	clk	R1[5:0]	R2[5:0]
1	0	0	↑	M[5:0]	No Change
1	0	1	↑	D[5:0]	No Change
0	1	X	↑	No Change	M[5:0]

- Write the truth table of the instruction decoder (control subsystem). Use the 2-bit instruction as inputs and R1_en, R2_en, R1_sel as outputs.
- Complete the following program that performs the divide-by-two function. By the end of your program you should have data (0,0,a₅,a₄,a₃,a₂) stored in R1.

move1 a₅a₄a₃a₂a₁a₀ -- move data a₅a₄a₃a₂a₁a₀ into R1