Cairo University
Faculty of Engineering
Computer Engineering

Computer Architecture
Lab 1

You are required to design a 16-bit ALU that accepts a 2 16-bit input values "A" and "B" and provides a 16-bit output "F" and a 1-bit output Cout. The ALU has 4-bit selection inputs "S" (S0->S3) and Cin input. The ALU will provide 16 operations according to the following table:

	S3	S2	S1	S0	
Part A	0	0	0	0	Next time
	0	0	0	1	
	0	0	1	0	
	0	0	1	1	
Part B	0	1	0	0	F = A or B, Cout = 0
	0	1	0	1	F = A and B, Cout = 0
	0	1	1	0	F = A nor B, Cout = 0
	0	1	1	1	F = Not A, Cout = 0
Part C	1	0	0	0	F = Logic shift left A, Cout = shifted bit
	1	0	0	1	F = Rotate left A, Cout = rotated bit
	1	0	1	0	F = Rotate Left A with carry (cin), Cout = rotated bit
	1	0	1	1	F = 0000, Cout = 0
Part D	1	1	0	0	F = Logic shift right A, Cout = shifted bit
	1	1	0	1	F = Rotate right A, Cout = rotated bit
	1	1	1	0	F = Rotate right A with carry (cin), Cout = rotated bit
	1	1	1	1	F = Arithmetic Shift right A

Requirement:

1- Implement part B

2- Compile your code without any errors or warning

3- Simulate the code with the given inputs below

4- Save the do files to submit

5- Write a testbench to test the code you implemented

S	Operation	A	B	Cin	F	Cout
0100	OR	F000	00B0	-	F0B0	0
0101	AND	F000	000B	-	0000	0
0110	NOR	F000	B000	-	0FFF	0
0111	NOT	F000	-	-	0FFF	0

Assignment:

1- Implement part C and part D each one in a separate file

2- Compile your code without any errors or warning

3- Create a new component to integrate part B,C,D using a multiplexer

4- Write a testbench to test the code you implemented using the testcases in the table below where S = 01 chooses part B, S= 10 chooses part C, S = 11 chooses part D.

S	Operation	A	B	Cin	F	Cout
1000	Logic shift left	A00A	-	-	4014	1
1000	Logic shift left	000A	-	-	0014	0
1001	Rotate left	B00C	-	-	6019	1

1001	Rotate left	000C	-	-	0018	0
1010	Rotate left with cin	A00A	-	0	4014	1
1010	Rotate left with cin	A00A	-	1	4015	1
1011	F=0000	A00A	-	-	0000	0

S	Operation	A	B	Cin	F	Cout
1100	Logic shift right	000F	-	-	0007	1
1101	Rotate right	0F0F	-	-	8787	1
1110	Rotate right with cin	0F0F	-	0	0787	1
1111	Arithmetic shift right	F000	-	-	F800	0
1110	Rotate right with cin	0F00	-	1	8780	0