Computer Aided Design

Instructor: Dr.Beitollahi

Homework 4

Topic: Advanced VHDL & FPGA

Lectures: 7-8-9-10-11

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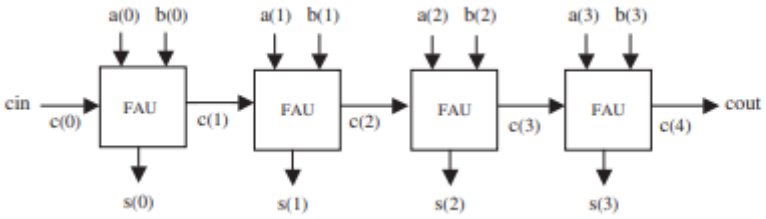
Implementation:

Q1) Consider the *Carry Ripple Adder* given below. Design a FAU (Full Adder Unit), to be used as a COMPONENT. Write a code for the complete *Carry Ripple Adder* containing instantiations of FAU. Compile and simulate the synthesized circuit. (15 points)



a b cin	s cout
0 0 0	0 0
0 1 0	1 0
1 0 0	1 0
1 1 0	0 1
0 0 1	1 0
0 1 1	0 1
1 0 1	0 1
1 1 1	1 1

Implementation without component is not acceptable.

Q2) Write a function capable of converting an INTEGER to a STD_LOGIC_VECTOR value. Call it *conv_std_logic*( ). Then write an application example, containing a call to your function, in order to test it. Construct a solution containing the function in the main code itself. (15 points)

Implementation without function is not acceptable.

Q3) Design a password system such that its inputs are *0*, *1* and *Reset*. The system should recognize the input pattern *0110* as the correct password and, in this case, change the output state of the lock to *1* (*Unlocked*). If the input pattern is incorrect or the Reset button is pressed, the system should return to the initial state and change the output to 0 (*Locked*). The states and transitions between them should be clearly defined in the code. (20 points)

Theory:

Q4) Design a Finite State Machine (FSM) for a smart home lighting system that can turn the lights on/off, dim, and brighten. (10 points)

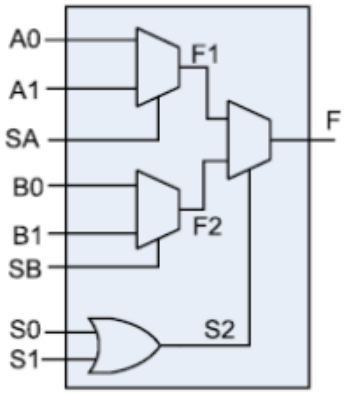
Q5) Implement these two functions on a <u>single</u> PAL with minimum number of resources. (10 points)
(*hint:* You can use S_0 to construct S_1)

$$S_0 = \overline{A_1}\,\overline{A_0}\,B_0\,B_1 + \overline{A_1}\,\overline{A_0}\,B_0\,\overline{B_1} + \overline{A_1}\,A_0\,\overline{B_0}B_1 + \overline{A_1}\,A_0\,\overline{B_0}\,\overline{B_1} + A_1\,\overline{A_0}\,B_0\,B_1 + A_1\,\overline{A_0}\,B_0\,\overline{B_1} + A_1\,A_0\,\overline{B_0}\,B_1 + A_1\,A_0\,\overline{B_0}\,\overline{B_1}$$

$$S_1 = A_0\,\overline{B_0}\,(A_1 + \overline{B_1}) + \overline{A_0}\,B_0\,(\overline{B_1} + A_1) + \overline{A_1}\,B_1\,(\overline{A_0}\,\overline{B_0} + A_0\,B_0)$$

Q6) Implement the following function on the given logic module. (15 points)

$$F = (A.B) + (B'.C) + D$$



Logic Module

Q7) Using the programmable logic device shown below, implement a circuit in which input is a 3-bit number x and its output is $x + 3$. (15 points)
Put a cross in the circles or fill up the circles where the connection should be made.