Project 2

Design a 4x4 Sequential Multiplier Circuit in Logisim

# 1) Design Objectives

1. Design a sequential circuit to calculate the product of two 4-bit binary numbers, and then display the decimal result in three HEX displays.
2. Design the circuit at the register transfer level.
3. Use software tool LogiSim for your design implementation.

# 2) Description

1. The inputs include two 4-bit binary numbers, one clock signal, one reset, and one start.
2. The output includes one 8-bit binary number, one ready signal.

# 3) Design Constraints:

1. The sequential circuit uses adder only, and does not use combinational multiplier.
2. Using basic gates and the following modules in LogiSim:
   1. Counter
   2. Register
   3. Shift register
   4. Adder
3. The design shall have two circuits:
   1. A main circuit
   2. A controller circuit

# 4) Submission

**You shall upload a zip file in ecourse. The zip file shall include one file for the report and one file for the circuit.**

The report must have the following content.

1. Cover Sheet with title, name, student number, etc.
2. Use one section to provide an overview.
3. Use one section to explain the **block diagram** of the whole system.
   1. Refer to Chapter 8 for background.
   2. Refer to Figure 8.2 for a general block diagram. (see figure below)
   3. Refer to Figure 8.9a for an example of block diagram. (see figure below)
   4. Refer to Chapter 9, Section 9.18 for the discussion of block diagram.
   5. You shall draw your own block diagram, in which you must clearly indicate the inputs and outputs of the controller unit and the datapath unit for your sequential multiplier circuit.
4. Use one section to explain the **Arithmetic State Machine and Datapath** (ASMD) chart.
   1. Refer to Chapter 8 for background.
   2. Refer to Chapter 9, Section 9.18 for the discussion on ASMD chart.
   3. Refer to Figure 9.24(a) for the ASMD chart (see figure below).
   4. You will need to draw a new chart by yourself.
5. Use one section to explain the **controller** **design**.
   1. Refer to Chapter 8 for background.
   2. Refer to Chapter 9, Section 9.18 for the discussion on controller.
   3. Refer to Figure 9.24(c) for the state diagram of the controller (see figure below).
   4. You will need to draw a new diagram by yourself.
6. Use one section to explain an example of multiplication.
   1. Refer to Chapter 8 for background.
   2. Refer to Chapter 9, Section 9.18 for the discussion on example.
   3. Refer to Table 8.5 for an example (see table below).
   4. You will need to draw a new table by yourself.
7. Use one section to conclude.
8. Use one section to summarize references.





FIGURE 8.9



FIGURE 9.24(a)



FIGURE 9.24(c)



# 5) Demonstration

You shall prepare a PC in the demonstration and execute the simulation in the demonstration.