CENG 232

Logic Design

Spring '2017-2018

Lab 1

Due date: 2 March 2018, Friday, 23:59
No late submissions

1   Introduction

This laboratory aims to get you familiar with basic logic gates and combinational circuit design. You will simplify the circuit that is explained below and draw the circuit using Logisim tool with the given gates.

2   IC Pool

- 74LS04 (Inverter)

- 74LS08 (AND)

- 74LS32 (OR)

3   Lab Work

In this assignment, you are expected to perform the operations described in the following section.

3.1   Specifications

Suppose A and B are 2-bit binary **input** numbers and X and Y are 1-bit binary **output** numbers. A and B are represented with A_1, A_0, B_1 and B_0 bits respectively where A_1 and B_1 are the most significant bits and A_0 and B_0 are the least significant bits of the relevant number. Your circuit will take A and B as inputs and give the outputs X and Y with the following instructions:

$$X = \begin{cases} 1, & (A + B) > (A * B) \\ 0, & otherwise \end{cases}$$

$$Y = \begin{cases} 1, & A_1A_0B_1B_0 \text{ is palindrome } \textbf{or } (A * B) \% 5 = 3 \\ 0, & otherwise \end{cases}$$

PS: % stands for the **mod** operation.

You have to use "pins" for your inputs and outputs. Set their labels correctly using the following names. **Please, only set "label" property of the "pin" objects, do not add a "label" object in Logisim part.**

Input pins: A1, A0, B1, B0.
Output pins: X, Y.

Each pin corresponds to a digit in a 2-bit binary number. If it is set, then the value of the digit is 1 if reset, then the value of the digit is 0.

3.2 Input Output Examples

1. Suppose $A_1 A_0 = 01$ and $B_1 B_0 = 11$. In this case, A=1 and B=3 in decimal.
   $A + B = 4$
   $A * B = 3$
   Since $(A + B) > (A * B)$ holds, the output X is 1.

2. Suppose $A_1 A_0 = 11$ and $B_1 B_0 = 11$. In this case, A=3 and B=3 in decimal.
   $A + B = 6$
   $A * B = 9$
   Since $(A + B) > (A * B)$ does **not** hold, the output X is 0.

3. Suppose $A_1 A_0 = 10$ and $B_1 B_0 = 01$. In this case,
   $A_1 A_0 B_1 B_0 = 1001$
   Since 1001 is palindrome, the output Y is 1.

4. Suppose $A_1 A_0 = 11$ and $B_1 B_0 = 01$. In this case, A=3 and B=1 in decimal.
   Since $(A * B) \% 5 = 3$, the output Y is 1.

5. Suppose $A_1 A_0 = 11$ and $B_1 B_0 = 10$. In this case, A=3 and B=2 in decimal.
   Since 1110 is **not** palindrome and $(A * B) \% 5 \neq 3$, the output Y is 0.

4 Free Session

There will be a free session week after the week which the lab is announced. You will have 2 hours in your free session slot. During the free session, you will try to build your circuit on a breadboard by using IC components, and you will practice how to handle possible problems related to physical circuit.

5 Demo Session

There will be a 2-hour-long demo session week following the free session week. In demo session:

- You will take a short quiz about the logic concepts that involve the coverage of this lab.

- You will reconstruct your circuit on your breadboard.

- You will show that the circuit drawn in Logisim works as specified.

6 Deliverables

1. Submit the circuit named `lab1.circ` prepared in Logisim, ==which is your preliminary work==, via COW until the specified deadline. The evaluation of the submission will be a black-box test. **You should use CENG version of Logisim which is available on COW. Circuits designed with other tools or not named properly will not be graded!**

2. In demo session, you will reconstruct and show that the circuit drawn in Logisim works. This part will be graded in lab. Please note that submission of a working circuit is a must to attend DEMO lab sessions.

7 What to Bring in the Lab

- Print-out submitted file of the circuit.

- Lab materials and data-sheets of chips. www.alldatasheet.com

- Pencil and eraser, as you will have a quiz at the very beginning of the DEMO lab.

8 Cheating Policy

All the lab work should be **individual** and there is zero tolerance policy for cheating. See the course website for further information about cheating policy.

9 References

CENG Logism Version.