CMPSC 312 **Name:** _____

Computer Organization and Architecture

Spring 2017

Due Date: April 5th, 2017 (6:00 p.m.)

Instructions: Please create the truth tables, Boolean expressions/Kmaps (used to simplify the circuit), and combinational circuit (designed using ***Logisim***) to solve the following problem. Submit electronic (Canvas Dropbox) and printed copies of your circuit AND neat handwritten documents containing all of your truth tables and Boolean expressions/Kmaps to me by the deadline. Please note that printouts are required if you want your submission to be considered for a grade.

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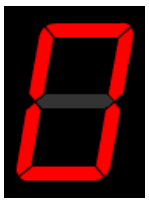
1. Create a combinational circuit that uses a seven-segment display to output selected N11 ("N-one-one") codes. A seven-segment display is a form of electronic display device that displays decimal numerals. An N11 code is a three-digit dialing telephone number within the North American Numbering Plan (NANP) that allows access to specific services.

   An image of the seven-segment display appears at right. Each of the seven display elements can be switched on and off independently through one of seven input pins. The input pins are labeled A to G according to the scheme shown in the figure below left. (An eighth pin turns on the optional decimal point that we will not use.) The figure below right shows how to switch on the element corresponding to pin A in ***Logisim***.

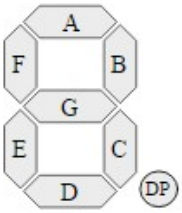
   

   Fig. 1: Individual segments of a seven-segment display

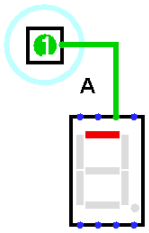
   

   *Fig. 2: Switching on segment A in **Logisim***

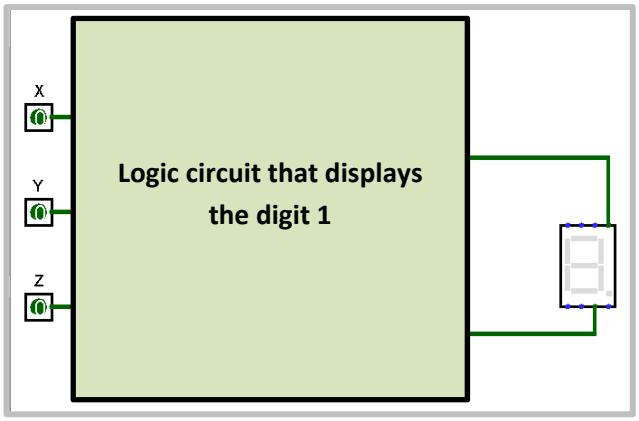
   The digits from 0 to 7 are usually represented on a seven-segment display as shown below.

   Your task is to design a circuit that takes a binary digit 1-7 encoded on three lines and displays it correctly on a seven-segment display by outputting 0/1 on the correct pins A-G of the seven-segment display. Your circuit takes the inputs X, Y, and Z on which the digits 1-7 are supplied as follows:

Digit	X	Y	Z
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

The outputs of your circuit are connected to and turn on the appropriate segments A-G as shown in Fig. 1 and Fig. 2 above. The following ***Logisim*** screen shot shows a circuit (minus the details) that displays the digit 1. Your circuit will have additional inputs to display selected digits from 2 through 7 depending on your project category. Students whose last names begin with A through K, inclusive, are to implement a circuit that outputs the N11 codes 211, 311, and 411. Students whose last names begin with L through W, inclusive, are to implement a circuit that outputs the N11 codes 511, 611, and 711. Please note that you need only provide the circuit for one digit, not three.



Important Notes:

- You may work on this assignment with up to two of your classmates (i.e., in a group of at most three). If you decide to do so, please turn in one electronic/paper submission for all of you containing all of your names. If the starting letters of your last names place you and your prospective group members in different project categories, simply choose one version of the project to do.
- Your circuit employs three inputs, not four. There are solutions to similar problems on the Web that employ four inputs. Do not even THINK about trying to use any of them to complete this assignment.
- Clearly label the inputs (X, Y, Z) to your circuit as shown in the simple circuit above. Labeling the outputs (segments being turned on such as B, C, etc.) is optional, since the inputs to the seven-segment display are very close together and therefore hard to label clearly.
- You must document ALL sources (Web, in particular) used to complete this assignment. (Note: I strongly recommend reviewing the Academic Integrity Policy on the CMPSC 312 syllabus.)

References:

- https://en.wikipedia.org/wiki/Seven-segment_display
- https://en.wikipedia.org/wiki/N11_code
- http://www.electronics-tutorials.ws/blog/7-segment-display-tutorial.html