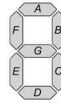


Computing Machinery II

Assignment 1

Combinational Logic: Binary-to-Seven-Segment Decoder

A seven-segment display consists of seven individual segments that can be turned off or on in particular combinations to display digits and a limited number of alphabetic characters. The arrangement and labelling of the segments are shown below:



The digits 0 to 9 and the letters A to F can be displayed as shown:



Design a combinational logic circuit that takes a 4-bit number as an input (that is, a binary number ranging from 0000 to 1111) and produces 7 outputs, one each for the 7 segments of the display unit, to show the corresponding hexadecimal number. Assume that 0 means off and 1 means on. Use the design method outlined in class, and create a report showing all steps:

1. State the problem in words.
2. Determine the input and output variables.
3. Assign letter symbols to the variables.
4. Create the truth table that defines the relationships between inputs and outputs.
5. Obtain the simplified function for each output (show all steps for this, whether done algebraically or using the map method).
6. Implement the functions using the appropriate gates (show a logic diagram for this).

This report should be printed out and submitted on paper. Your diagrams and tables can be hand written or created using a graphics program.

Circuit Simulation

Implement your design in the *Logisim* application, using the 7-Segment Display as output. This display also includes an input for a decimal point, which you should ignore (make sure it is always turned off). Arrange things so that the four inputs appear on the left, the decoder circuitry in the middle, the display unit on the right. Save your design in a file called *assign1.circ*, which will be submitted electronically using D2L.

Bonus (10% if fully implemented)

Add a 4-bit counter to your *Logisim* circuit to drive the inputs of the decoder. It should cycle through the range 0000 to 1111, and then wrap around to 0000. Arrange this circuit so that the counter increments every time a button is pushed. Save this design in a file called *assign1bonus.circ*, which will be submitted electronically using D2L.

New Skills Needed for this Assignment:

- Ability to work with binary logic, Boolean algebra, and logic gates
- Ability to minimize Boolean functions, either algebraically or by using the map method
- Ability to design combinational circuits following the prescribed design procedure

Submit the following:

1. Your report on paper. Submit this using the assignment boxes located on the main floor of the Math Sciences Building (in the main floor Computer Science lab area).
2. Your *Logisim* file: *assign1.circ* (and *assign1bonus.circ* if doing the bonus) submitted using D2L.

Computing Machinery II

Assignment 1 Grading

Student: _____

Report

Statement of problem	4	_____	
Input and output variables	2	_____	
Assign letters to variables	2	_____	
Truth table	11	_____	
Simplified functions	14	_____	
Logic diagram	14	_____	
Circuit simulation in Logisim	10	_____	
Total	57	_____	_____ %
Bonus (10% if fully implemented)			_____ %
Assignment Grade			_____ %