

CSCB58 Lab 2: Circuit Creation

1 Introduction

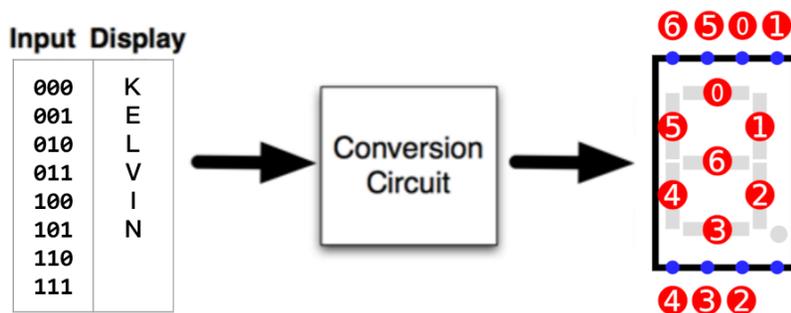
This week, we'll practice designing circuits made of logic gates using Karnaugh maps. You'll need to be familiar with the software tools we used last week; refer back to last week's lab if you need to refresh your memory.

Note that we are now moving to Quercus for lab submission the sake of consistency. MarkUs will not be used anymore. Sorry for any confusion!

PRELAB REPORT: This lab requires the submission of a prelab report to Quercus by the start of your lab section. The deadline shown on Quercus may not apply to you. Your TA will access your prelab submission during the lab and ask you about it.

2 Driving a 7-Segment Display

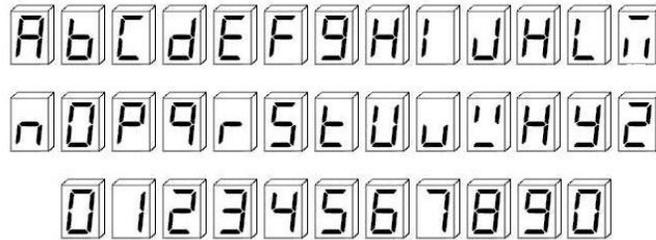
A 7-segment display takes a 7-bit number as input. The figure below is the 7 segment display in Logisim-Evolution; the number on each segment refers to index of the bit that determines whether it is lit ("on") or dark ("off").



We would like a circuit that can be used to greet your TA on the 7 segment display. The objective here is to design a circuit that takes in 3 inputs, and has 7 corresponding outputs for the 7 segment display as shown above. The input should correspond to the index of the character in the string that should be output. In the above example, this means that the input 000 should display the letter K, 010 should display the letter L, etc. Since each of the strings are 8 characters, we only need 3 bits for the input.

To display each of the letters, the circuit needs to create the correct 7 bits of output that need to be passed into the 7 segment display. So, for example if on input 001 we want to display the letter E, then the corresponding output that goes into the 7 segment display should be 1001111. The graphic below shows you how to display each of the English letters and numbers on the 7-segment

display, you need to figure out the corresponding 7 bit codes for the ones you need.



Below are the messages that you need to show to your TA for each lab section. Note that you must also properly display the space character, i.e., all segments should be off when you switch to the space.

Tutorial Section	Message
PRA0001	HI ANAND
PRA0002	AY QNGSI
PRA0003	O BOJIAN

First, **before the lab**, generate the expressions for the seven optimized circuits – one for each output (segment on the display). To do so, you’ll need to create a truth-table with 3 input bits and 7 output bits. Then, you should use seven K-maps – one for each output – to generate the optimal expression that expresses it.

PRELAB REPORT: Write up a prelab report that includes:

- Your name and student number.
- The Karnaugh-maps of the desired circuit.
- The optimized logic expressions for the circuit.

Submit the prelab report to **Quercus** as a PDF file (“prelab2.pdf”). All work in this lab including the prelab report must be completed individually.

Once you arrive in lab, create a new Logisim-Evolution project, create a new schematic in the project, and implement your fully optimized circuits. Make sure to test your circuit to verify that the circuit works as you expect.

Implement all this in a sub-circuit, and then you can use that in the top-level circuit in combination with switches and a 7-segment display module to demonstrate the functionality to your TA.

3 Summary of TODOs

Below is a short summary of the steps to be completed for this lab:

1. Before the lab, generate the optimized circuit expressions using K-map. Write the prelab report and submit it to **Quercus**. This step must be completed **individually**.
2. In the lab, implement the circuit in Logisim-Evolution.
3. Test the circuit. Once you are convinced it is working correctly, demonstrate the use of your circuit to the TA and explain why it is working correctly.

Evaluation (5 marks in total):

- 1 mark for attending and making an honest effort
- 2 mark for the prelab report
- 2 mark for demonstrating the circuit to the TA