

CSC235 – Project 3, Morse Code

Assignment: Create a circuit using Logisim that counts in Morse Code

Deliverable: Completed Excel spreadsheet with Karnaugh Maps for each Morse Code LED
Completed Logisim circuit delivered to D2L.

Due: The circuit MUST be turned in by the assigned date and time. Late submissions will be rejected by D2L, resulting in a grade of zero.

Overview:

This project involves creating a circuit in Logisim that makes use of sequential logic. In particular, the circuit we design will count in decimal, cycling from 0 to 9, and display the result using Morse Code.

Morse Code was widely used for communication with the telegraph before the advent of the telephone. Symbols in Morse Code are indicated with “dashes” and “dots”.

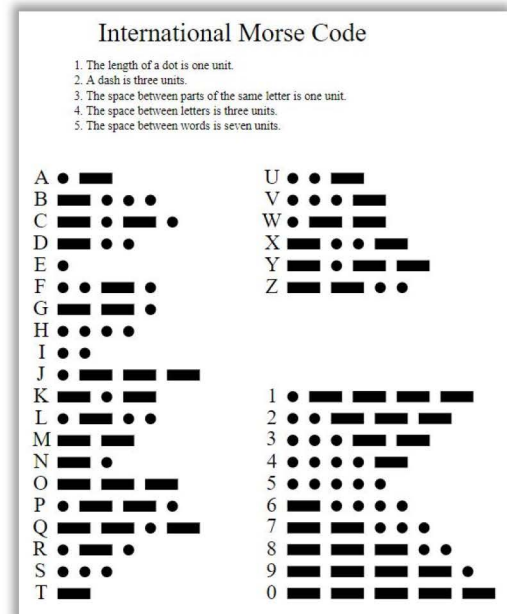
We are only interested in the symbols for the numeric digits 0 through 9. As indicated to the right, all 10 of these symbols make use of a combination of 5 dashes and dots and cycle in an easily recognizable pattern.

The circuit that we design will use 5 LED's to represent the 5 dot/dash symbols in the Morse Code numerical digits. A lit LED will indicate a dash and an unlit LED will indicate a dot.

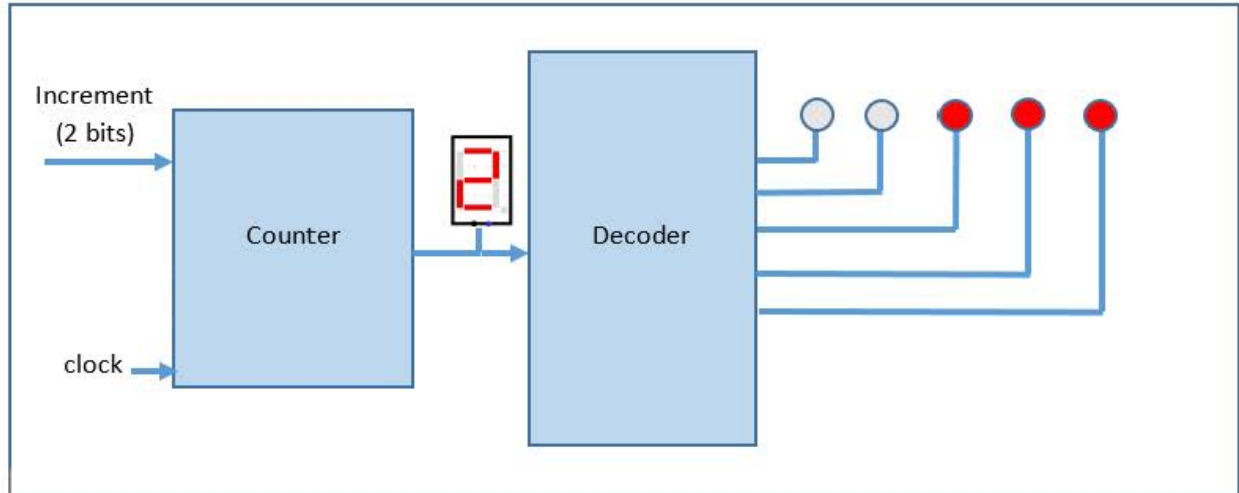
The overall circuit will consist of two major blocks. The first block will be a counter circuit. The counter will be driven by a free running clock which can be set up in the simulation section of Logisim to cycle at a user-specified rate. When the simulation is running, the count will be updated once every clock cycle.

The counter will have the following features. It can count in increments of 0, 1, 2, or 3 (0 would mean the count does not advance). When the counter reaches, or exceeds 9, it will start over with the next value being the *current count plus the increment modulo 10*. (ex: $8 + 3$ would result in 1 as the next count, if 3 were the increment.)

The second section is a decoder that takes the output of the counter and drives the individual LED's to display the numerical value in Morse Code.



The overall circuit layout should look as follows:



A sketch design for the counter circuit will be provided. You must implement the circuit in the supplied sketch – or something like it. **Do not use the library counter supplied with Logisim! You will get zero credit for the use of a Logisim library counter in your final project!** A HEX display, as indicated above, should be included at the output of the counter to make it easy to track the count.

(Note: using the Logisim counter to test your decoding would probably be a useful thing to do – just don't make it part of your final submission!)

The decoder section will involve figuring out how to decode the counter bits to drive the individual LED's representing the Morse Code number. You will be expected to use the Karnaugh mapping technique presented in class. *Watch the Karnaugh Maps video linked on the website for more information!* An Excel spreadsheet is set up for this task and provided. You should complete this spreadsheet to determine the proper Boolean formula for each LED and then use that information to construct your decoder. **You should build the decoder circuit from logic gates as demonstrated in class – do not use the built-in Logisim decoder.** Be sure to turn in the spreadsheet as well as the circuit.

Finally, there is a clock signal that is an input to the counter circuit. This input should be driven by a Clock object (in the Wiring section of Logisim). A free running simulation can be initiated by selecting "Simulation Enabled" in the Simulation pull-down and then selecting "Ticks Enabled". The clock rate can be set in "Tick Frequency" (1 or 2 Hz is a comfortable rate).