
CS2271 MIDTERM

It is the year 2080 and you have been hired by the inhabitants of planet Zanar to create calculators (their technology is a little behind the times). The Zanarians only have two fingers and a thumb on each hand, and therefore, they count in something like base 6. Your part of the ZCP (Zanarian Calculator Project) is to design the necessary electronics to display the digits (the Zanarians call them “zidgets”) of their number system. In the figure below, you will see the layout your design team has decided to use for the LED display device on the calculators, as well as the symbols that represent the equivalent of our numbers zero through five and the Zanarian symbol for “error.”

Design the necessary circuit using Logisim to implement the LED as specified in the figure. Since we only have 6 zidgets to display, and you have decided to use binary numbers to represent values internally, three inputs will suffice. For consistency, please call the inputs X, Y, and Z (with Z representing the rightmost bit in the binary representation of the zidget). Since 3 inputs yields 8 possible zidgets (and the values 6 and 7 as inputs have no meaning), your circuit should display the Zanarian symbol for error (see figure) when those binary values are input into your circuit. Your circuit should have an output for each segment of the LED. You should end up with one large circuit that correctly “lights up” the LED when given the zidget value. You should arrange your output LEDs as the actual ZCP LED display.

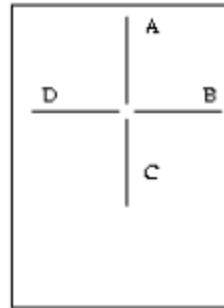
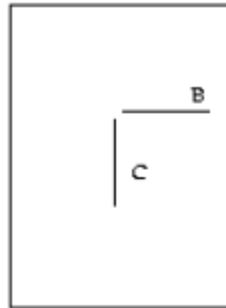
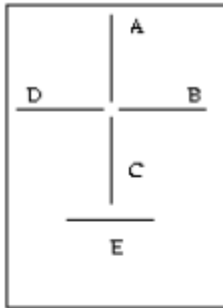
Hint: it may be useful to implement something similar to a BCD-to-7-segment-decoder. Here’s a well-done write-up on how to build one: <https://goo.gl/r8CHHN>.

Be VERY careful to get the correct function for your inputs before simplifying and designing the circuit with Logisim. You should minimize the circuit. You should investigate each output function AND its complement to determine the best combination of functions and terms (“best” defined to be minimal number). Your equations should all be left in “sum of products” form (factoring out terms in the equation results in an additional layer of circuits that requires more time to display the zidgets).

Instructions:

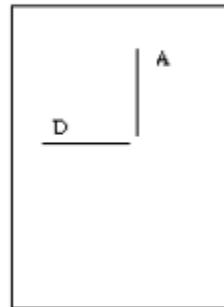
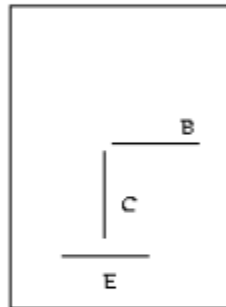
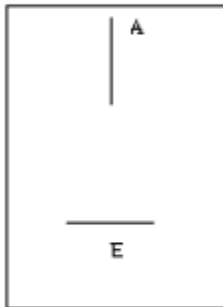
1. Derive the functions for displaying each of the zidgets zero through five and “error.”
2. Build truth tables for your functions.
3. Write each function in sum-of-products form.
4. Derive the compliment of each of your functions.

5. Build circuits implementing your functions in Logisim. Your inputs and output should be labeled.
6. Submit your written answers to steps one through four and your Logisim file.



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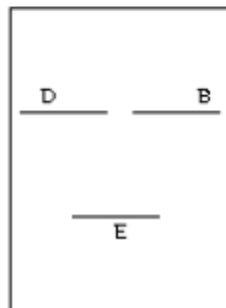
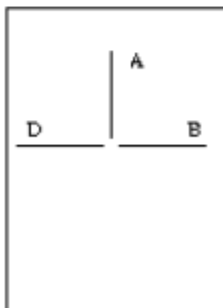
1



2

3

4



5

Error