# ECEN 2350: Digital Logic

## Assignment #10

1. [10 points.] The Boolean board provides a 100 MHz clock (`mclk` in the constraint file). In this part, you will make a clock divider to divide this down to a 1 Hz clock, and connect it to to the right-most LED. Thus, the LED should blink once per second (instead of 100 million times per second, if you connected the 100 MHz clock directly to the LED!)

   In other words, the LED should appear on for a half second, then off for a half second, giving it a period of 1 second (and a frequency of 1 Hz, or 1 time per second).

   More notes on dividing clocks can be found here:
   https://www.realdigital.org/doc/9c21eab4a0f85c50486858a87380d1f6

   Here's a video of what your board should look like:
   https://youtu.be/2c1SIjS5ysM

   Turn in your top-level module as `lab10-q1.txt`.

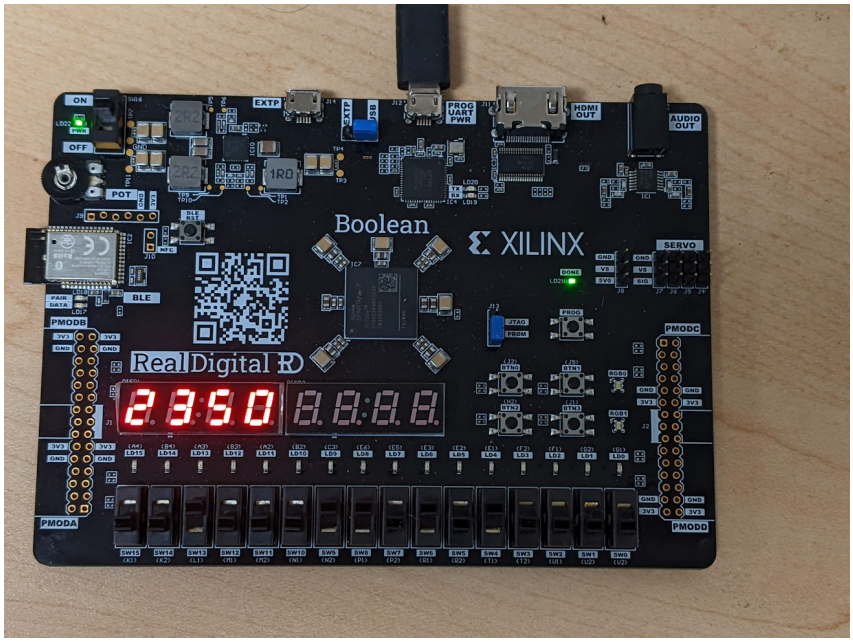
2. [5 points.] Make a 1 kHz clock, and use it to increment a 16-bit count. Output the 16-bit count on the LEDs.

   Notice that the least-significant bits are not visible as changing, because they are blinking too fast for your eye to perceive (thousands of times per second)! Consider how long it should take for count to exceed 16-bits, and verify your design takes about that long to repeat. Your board should look something like this:
   https://youtu.be/C0htvcHeTo4

   Turn in your top-level module as `lab10-q2.txt`.

3. Recall from Lab 6 that the 7-segment (hex) display is multiplexed, meaning only one hex digit can be output at a time. For each of the two banks, there is an 8-bit segment value (e.g. `D0_seg`) which determines what segments should be on, and a 4-bit anode value (e.g. `D0_a`) which determines which digit(s) should display that segment.

   For this part, you will use a (divided) clock to switch between which displays you are outputting to, in order to make it seem like more than one digit is on at a time:




**Given the 16-bit (unsigned) binary number input on the switches (`sw[15:0]`), display the number as hexadecimal on the 4 left-most hex displays**. You may use your solution (or the posted on in Canvas) from Lab 6 to help with this (recall that one part had you display different parts of the 16-bit number, one digit at a time, which may be useful here!).

More notes on driving the hex displays can be found here:
`https://www.realdigital.org/doc/586fb4c3326dcd493a5774b2a6050f41`

Note that the Boolean board hex displays need each digit to be held on for a certain time (at least 100 microseconds) for persistance of vision to work correctly. We recommend using the 1 KHz clock from above for this purpose, where each cycle of the 1 KHz clock should display a different group of switches on its respective display. For instance, in the first cycle, display `sw[3:0]` on the right-most digit, and in the next cycle, display `sw[7:4]` on the next digit left, and so on.

Turn in your top-level design as `lab10-q3.txt`