The objective of this lab is to apply your Verilog coding skills to something somewhat useful.

For this lab, you will code a Verilog model to implement an alarm clock as described in this document.

Design Specifications for the Alarm Clock

- Time should be displayed on the 4-digits of the 7-segment display.
  - The left two digits will be the hour and the right two digits will display the minutes.
  - The decimal point between the left two digits and the right two digits should always be on so as to visually separate the hours from the minutes.
  - Hours will be displayed in "military time" (meaning 00 through 23).
  - Whenever the "alarm set" switch is on (SW12), the 4-digit 7-segment display should display the alarm setting rather than the current time.
  - Whenever the "alarm clear" button (BTNC) is pressed, the 4-digit 7-segment display should display the first 4 characters of your last name again rather than the time.
    - NOTE: If your last name contains fewer than 4 characters, the unused characters in the display may remain blank.
    - BTNC takes priority over SW12 meaning that if it is pressed at the same time that SW12 is active, the display should display the first 4 characters of your last name

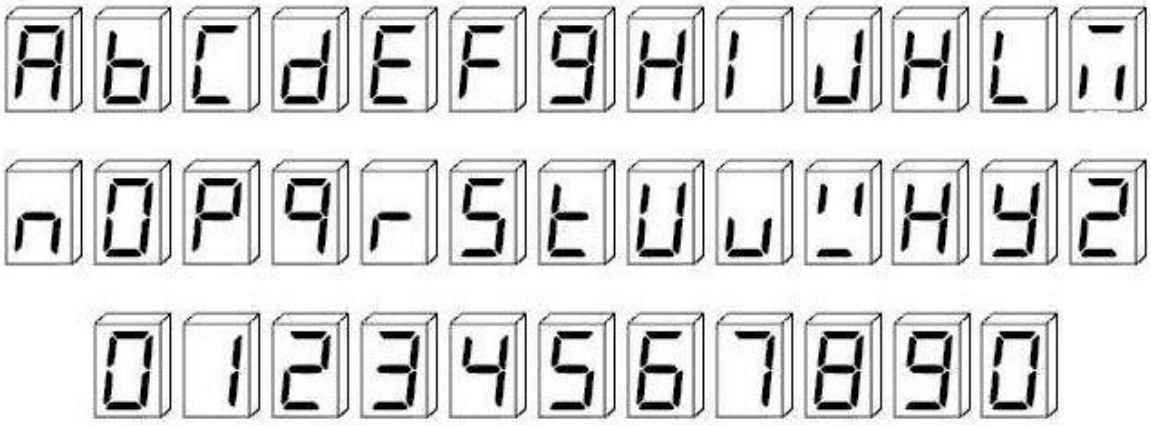
- Timing / Clock generation
  - The alarm clock should be accurate. Divide down the 100MHz clock at pin W5 as necessary to achieve this.
  - LED15 should continually count the seconds by blinking at a 1 second interval (on for half a second, off for half a second).

- Switch functions
  - SW14 will act as a reset. Both the time and the alarm time should be reset to zero if SW14 goes active. SW14 has priority over any other switch
  - SW13 is the "time set" switch. When it is on, the display freezes at whatever the time was when the button was pushed, and by pressing switches 1 and 0 at this time one can set the time to a new value.
  - SW12 is the "alarm set" switch. When it is on, the display shows whatever value the alarm is currently set to (which should be 00.00 after reset) and can be adjusted with switches 1 and 0 as described below.
  - SW11 is the "alarm activated" switch. It must be on in order for an alarm to occur.
  - SW10 is a 128x speed demo/debug mode. In this setting the minutes will increment at approximately a half second speed.
  - SW1 – When either SW13 or 14 are active, this switch causes the hours characters to count up at about a half second rate so that one can set the hours on the clock
  - SW0 - When either SW13 or 14 are active, this switch causes the minutes characters to count up at about a half second rate so that one can set the minutes on the clock

- LED functions
  - LED15 should continually count the seconds by blinking at a 1 second interval (on for half a second, off for half a second).
  - LEDs 0, 1, 10, 11, 12, 13, and 14 should turn on whenever the corresponding switches are on.
  - LEDs 2 through 9 are essentially the alarm. Whenever the clock time becomes equal to the alarm time, these LEDs should blink on and off along with LED15 until BTNC is pressed to clear the alarm.

- Button functions
  - BTNC is both the "owner" button as well as the "alarm clear" button. Whenever it is pressed, the 7 segment display should display the first 4 characters of your last name again rather than the time. NOTE: If your last name contains fewer than 4 characters, the unused characters in the display may remain blank.
  - If the alarm went off because the clock time equaled the set alarm time, pressing BTNC will clear the alarm and LEDs 3 through 10 will stop blinking.

- Other Considerations
  - SW12 and SW13 are mutually exclusive (one-hot). Only one should be active at a time. If both are active at the same time, the behavior should be the same as if neither of them was active.
  - Similarly SW0 and SW1 are mutually exclusive (one-hot). Only one should be active at a time. If both are active at the same time, the behavior should be the same as if neither of them was active.
  - Whenever the "alarm set" switch is on, or when the BTNC is pressed, time should continue to increment even though it is not visible on the 7-segment display.



Submission of Completed Lab:

Please upload the following files to the Lab3 Submission link on Blackboard:

- LAB4.bit ← The bitstream file for programming the BASYS3 board.
- LAB4.v ← The file containing the lab3 module and any additional modules you have instantiated into it. If you have submodules instantiated in any separate files, please upload those also.
- LAB4_tb.v ← The file containing your testbench file.
- LAB4.xdc ← The hardware constraints file