CPE462 - VHDL: Simulation and Synthesis - Fall'11

Prof. Nuno Alves (nalves@wne.edu), College of Engineering

Midterm Exam #2 - Nov. 18, 2011 - 9:00am to 11:00am @ Sleith-101

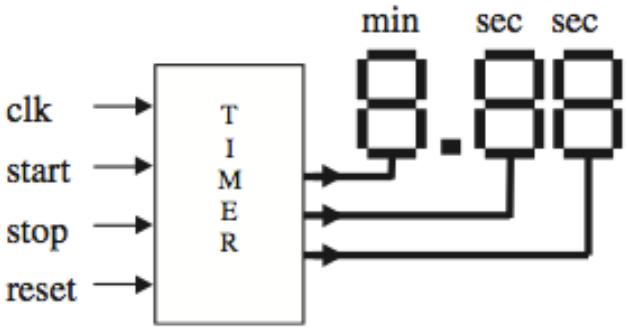
Exam instructions:

1. You have two hours to solve the proposed problem.
2. You can only use the class book, homework solutions or your class-notes as a reference.
3. You are **NOT** allowed to use any form of communication with any classmate.
4. There is a single problem. Once you are done with it, email nalves@wne.edu a copy of your solution in a word document. Use the font `Courier New` for your report.
5. You do **NOT** need to give the instructor a print-out of your simulation.
6. You may **NOT** modify the entity portion of your code.

Question - Design a timer capable of running from 0min:00sec to 9min:59sec.

- The circuit must have only two buttons, one which must perform the start/stop and the other which performs the circuit reset.
- Look at the output wave-form so you can see the expected outcomes.
- The outputs must be seven segment display (SSD) coded.
- The input CLK is a reliable 2 Hz clock signal.
- Make sure the circuit is synthesizable in hardware; for example do **NOT** initialize variables!
- You must use the following entity:

```
ENTITY timerCircuit IS
PORT (clk_2hz, start_stop,reset : IN STD_LOGIC;
       min, sec1, sec2 : OUT STD_LOGIC_VECTOR (6 DOWNTO 0));
END timerCircuit;
```



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Some useful information #1 - Modulus operation

Given two positive numbers, a (the dividend) and n (the divisor), a modulo n (abbreviated as a mod n) can be thought of as the remainder, on division of a by n. For instance, the expression "5 mod 4" would evaluate to 1 because 5 divided by 4 leaves a remainder of 1, while "9 mod 3" would evaluate to 0 because the division of 9 by 3 leaves a remainder of 0; there is nothing to subtract from 9 after multiplying 3 times 3.

VHDL has a modulus operation (MOD). Assuming signal *a* is an integer, MOD works as follows:

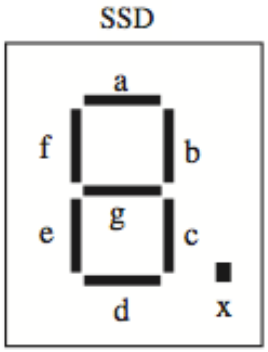
a MOD 2

Some useful information #2 - Seven Segment Displays SSD

A seven segment display is just a set of 7 LEDs, which becomes a 7 bit output. To write a coded zero into a seven segment display, all individual LEDS must be on, except LED g. So if the output signal was defined as:

signal temporary_bus : std_logic_vector (6 downto 0);

Then, the operation *temporary_bus <= "1111110";* will make sure a zero would appear on the display. Using the same rationale *temporary_bus <= "0110000";* will write a zero.

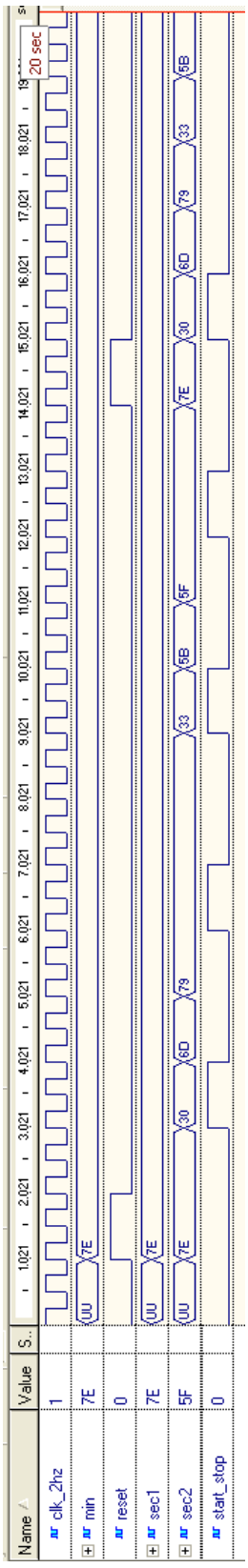


Input: "xabcdefg"

For your convenience, here is the full list of SSD coded digits.

```
0 ..... "1111110";     --7E
1 ..... "0110000";     --30
2 ..... "1101101";     --6D
3 ..... "1111001";     --79
4 ..... "0110011";     --33
5 ..... "1011011";     --5B
6 ..... "1011111";     --5F
7 ..... "1110000";     --70
8 ..... "1111111";     --7F
9 ..... "1111011";     --7B
```

Using the provided test-bench and running it for 20 seconds



Start timer (starts counting from zero)

Reset was pressed

Stop timer

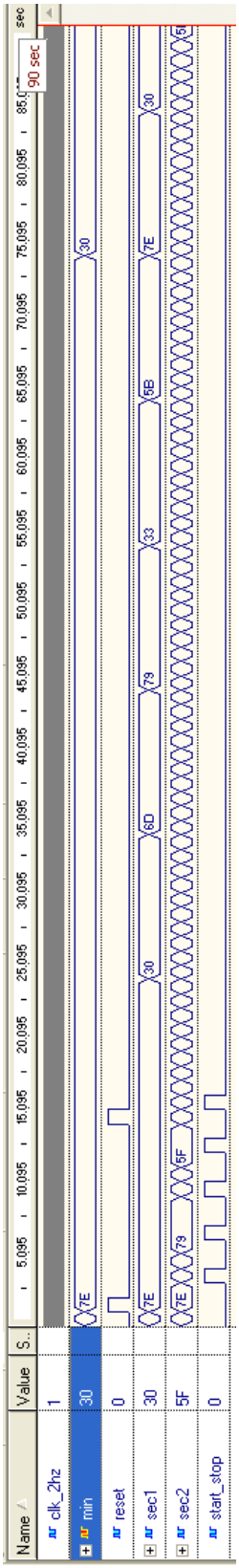
Re-start timer (reset was not issued so counting resumes)

Stop timer

Start Timer

Reset was pressed so everything goes to zero

Using the provided test-bench and running it for 90 seconds

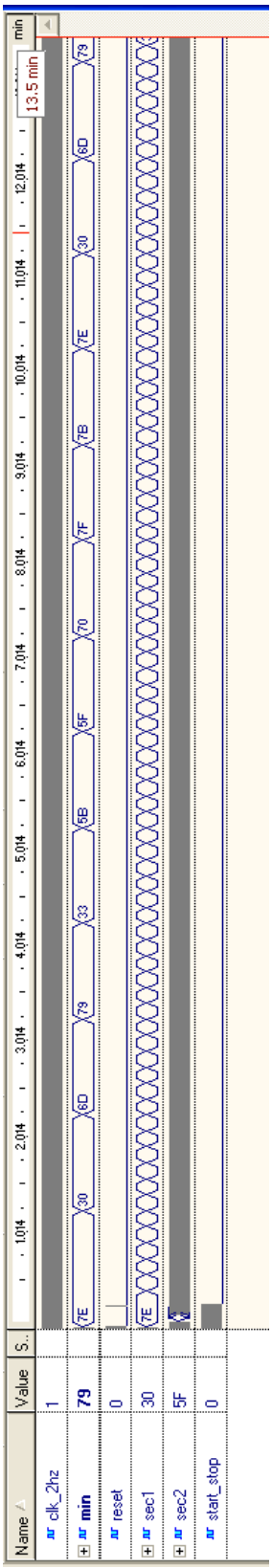


1 minute has passed!

50 seconds have passed

10 seconds have passed

Using the provided test-bench and running it for 810 seconds



After 9:59 minutes, the timer will reset to zero.