COL215 – Digital Logic and System Design
Department of Computer Science & Engineering, IIT Delhi
Semester I, 2025-26
Lab Assignment 2

7-Segment Display

1   Introduction

Design and implement a circuit that takes as input the switches SW0-SW9 in the Basys3 board and displays the corresponding decimal digit 0–9 on one of the four 7-segment displays on the board. For example, if SW9 is turned ON (and switches SW0–SW8 turned OFF), then the digit 9 should appear on the display as shown in Figure 1.

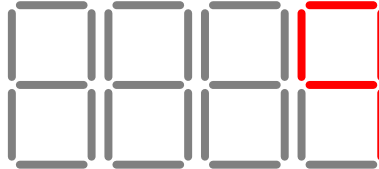| Slider switch turned ON	Digit to be displayed
SW9	9
SW8	8
SW7	7
SW6	6
SW5	5
SW4	4
SW3	3
SW2	2
SW1	1
SW0	0

Figure 1: Display configuration with switch SW9 set

2   Problem Description

The assignment requires you to design the following:

Specify/simulate in Verilog and implement circuit for which the inputs are the 10 switches (SW0-SW9) indicating the given decimal number and the outputs correspond to the 7 cathode pins. Map the cathode and anode pins in the basys3 constraint file. For the exact name of the pins, refer to the Basys 3 reference manual **Section 8.1 Seven-Segment Display**.

- Use only one 7-segment display unit, the LSB display, the one shown in Figure 1

- Inputs: 10 switches for 0..9

- Outputs: 7 bits for 7-segment display

- Function: Output decimal digit 0..9 corresponding to switch position

- Write only behavioural Verilog code with IF/CASE statements.

NOTE: In case if two switches are both turned ON, e.g., SW9 and SW7, the priority should be given to the one corresponding to larger digit, i.e., 9 in this case. In such a case, digit 9 should be displayed. Your IF/CASE construct should take care of this prioritization. If none of the switches is ON, nothing should be displayed.

2.1 Seven segment decoder

Figure 2 shows the pin-out details for the display unit. It has 7 cathode pins, 1 anode pin (connected to all 7 LEDs) and 1 pin for decimal point. To switch an LED on, the anode should be driven HIGH and the cathode LOW. In general, the LED display is activated via driving anode HIGH and the corresponding digit via varying cathode signals. Now, if the SW0 is ON, then all the LEDs except G should be switched ON. Similarly, if SW3 is ON, then LEDs F and E should be OFF, and the rest should be ON.
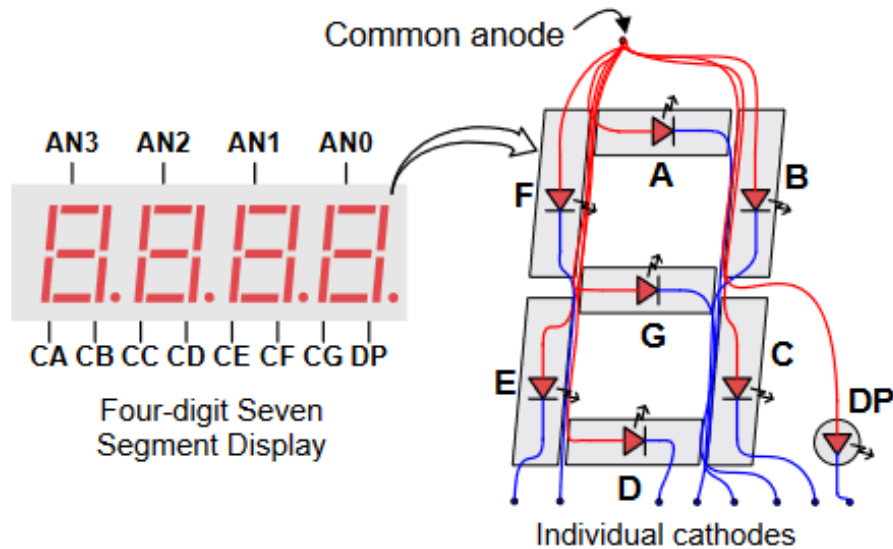

Figure 2: Pin details for 7 seven display on Basys 3 board

On Basys 3 board, anode/cathode are ACTIVE LOW pins (i.e., 0 = ACTIVE, 1 = INACTIVE). For details, refer to the Basys 3 reference manual **Section 8.1 Seven-Segment Display**.

3 Submission and Demo Instructions

1. Demo should be given in the assigned lab slot.

2. You are required to submit the following on Gradescope:

   - Verilog files for all the designed modules
   - Constraint file (.xdc)
   - Bit file
   - A short report (2-3 pages) outlining your design decisions, simulation snapshots, synthesis report (particularly resource counts: Flip-flops, LUTs, BRAMs, and DSPs) and generated schematics.

3. We advise you to be ready with your design before the lab session, and during the session, perform validation by downloading it into the FPGA board.

4 Resources references

- IEEE document: `https://ieeexplore.ieee.org/document/1620780`

- Basys 3 board reference manual: `https://digilent.com/reference/_media/basys3:basys3_rm.pdf`

- Online Verilog simulator: `https://www.edaplayground.com`