Assignment 4

Part 1

Table with connection of 7-segment displays on Nexys A7 board

Segment	I/O Port	Anode	I/O Port
CA	T10	AN0	J17
CB	R10	AN1	J18
CC	K16	AN2	T9
CD	K13	AN3	J14
CE	P15	AN4	P14
CF	T11	AN5	T14
CG	L18	AN6	K2
DP	H15	AN7	U13

Decoder truth table for common anode 7-segment display.

Hex	Inputs	A	B	C	D	E	F	G
0	0000	0	0	0	0	0	0	1
1	0001	1	0	0	1	1	1	1
2	0010	0	0	1	0	0	1	0
3	0011	0	0	0	0	1	1	0
4	0100	1	0	0	1	1	0	0
5	0101	0	1	0	0	1	0	0
6	0110	0	1	0	0	0	0	0
7	0111	0	0	0	1	1	1	1
8	1000	0	0	0	0	0	0	0
9	1001	0	0	0	0	1	0	0
A	1010	0	0	0	1	0	0	0
b	1011	1	1	0	0	0	0	0
C	1100	0	1	1	0	0	0	1
d	1101	1	0	0	0	0	1	0
E	1110	0	1	1	0	0	0	0
F	1111	0	1	1	1	0	0	0

Part 2 - Seven-segment display decoder

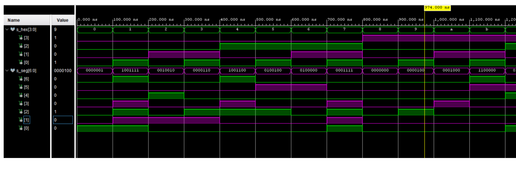
VHDL architecture from source file hex_7seg.vhd

```
begin

  p_7seg_decoder : process(hex_i)
    begin
        case hex_i is
            when "0000" =>
                seg_o <= "00000001";
            when "0001" =>
                seg_o <= "1001111";
            when "0010" =>
                seg_o <= "0010010";
            when "0011" =>
                seg_o <= "0000110";
            when "0100" =>
                seg_o <= "1001100";
            when "0101" =>
                seg_o <= "0100100";
            when "0110" =>
                seg_o <= "0100000";
            when "0111" =>
                seg_o <= "0001111";
            when "1000" =>
                seg_o <= "0000000";
            when "1001" =>
                seg_o <= "0000100";
            when "1010" =>
                seg_o <= "0001000";
            when "1011" =>
                seg_o <= "1100000";
            when "1100" =>
                seg_o <= "0110001";
            when "1101" =>
                seg_o <= "1000010";
            when "1110" =>
                seg_o <= "0110000";
            when others =>
                seg_o <= "0111000";
        end case;
    end process p_7seg_decoder;

end Behavioral;
```

VHDL stimulus process from testbench file tb_hex_7seg.vhd

```
p_stimulus : process
    begin
        -- Report a note at the begining of stimulus process
        report "Stimulus process started" severity note;


        s_hex  <= "0000"; wait for 100 ns;
        s_hex  <= "0001"; wait for 100 ns;
        s_hex  <= "0010"; wait for 100 ns;
        s_hex  <= "0011"; wait for 100 ns;
        s_hex  <= "0100"; wait for 100 ns;
        s_hex  <= "0101"; wait for 100 ns;
        s_hex  <= "0110"; wait for 100 ns;
        s_hex  <= "0111"; wait for 100 ns;
        s_hex  <= "1000"; wait for 100 ns;
        s_hex  <= "1001"; wait for 100 ns;
        s_hex  <= "1010"; wait for 100 ns;
        s_hex  <= "1011"; wait for 100 ns;
        s_hex  <= "1100"; wait for 100 ns;
        s_hex  <= "1101"; wait for 100 ns;
        s_hex  <= "1110"; wait for 100 ns;
        s_hex  <= "1111"; wait for 100 ns;
        -- Report a note at the end of stimulus process
        report "Stimulus process finished" severity note;
        wait;
    end process p_stimulus;
```

Screenshot with simulated time waveforms



VHDL code from source file top.vhd

```
hex2seg : entity work.hex_7seg
        port map(
            hex_i   => SW,
            seg_o(6) => CA,
            seg_o(5) => CB,
            seg_o(4) => CC,
            seg_o(3) => CD,
            seg_o(2) => CE,
            seg_o(1) => CF,
            seg_o(0) => CG
        );
```

Part 3 - LED(7:4) indicators

LEDs(7:4) truth table

Hex	Inputs	LED4	LED5	LED6	LED7
0	0000	1	0	0	0
1	0001	0	0	1	1
2	0010	0	0	0	1
3	0011	0	0	1	0
4	0100	0	0	0	1
5	0101	0	0	1	0
6	0110	0	0	0	0
7	0111	0	0	1	0
8	1000	0	0	0	1
9	1001	0	0	1	0
A	1010	0	1	0	0
b	1011	0	1	1	0
C	1100	0	1	0	0
d	1101	0	1	1	0
E	1110	0	1	0	0
F	1111	0	1	1	0

VHDL code for LEDs(7:4)

```
LED(4) <= '1' when SW = "0000" else '0';
    LED(5) <= '1' when (SW > "1001") else '0';
    LED(6) <= '1' when (SW = "0001" or SW = "0011" or SW = "0101" or
                        SW = "0111" or SW = "1001" or SW = "1011" or
                        SW = "1101" or SW = "1111")
                  else '0';
    LED(7) <= '1' when (SW = "0001" or SW = "0010" or SW = "0100" or
                        SW = "1000")
                  else '0';
```

Screenshot with simulated time waveforms