CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA
COLLEGE OF ENGINEERING

LAB 1

Switch ↔ LED Interface

ECE 3300L Summer 2025

Digital Circuit Design using Verilog

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Objective

Build a Verilog module on the Digilent Nexys A7-100T that reads 16 switches and drives 16 LEDs and learn HDL I/O mapping, constraints files, synthesis, and FPGA programming.

Hardware Components

Nexys A7-100T Kit

- Artix-7 FPGA with 16 user switches and 16 LEDs.
- Digilent part #410-292 (available on Digi-Key).
- Use the provided XDC template to match sw[i] → SWITCH pins and led[i] → LED pins.

Verilog Code

verilog
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```
module switch_led_interface(
input wire [15:0] sw,
output wire [15:0] led
);
assign led = sw;
endmodule
```

Constraints Mapping

css
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```
set_property PACKAGE_PIN E3 [get_ports {sw[0]}]
set_property IOSTANDARD LVCMOS33 [get_ports {sw[0]}]
...
set_property PACKAGE_PIN J6 [get_ports {led[0]}]
set_property IOSTANDARD LVCMOS33 [get_ports {led[0]}]
```

– Repeat for sw[0]...sw[15] and led[0]...led[15].

XDC Snippets

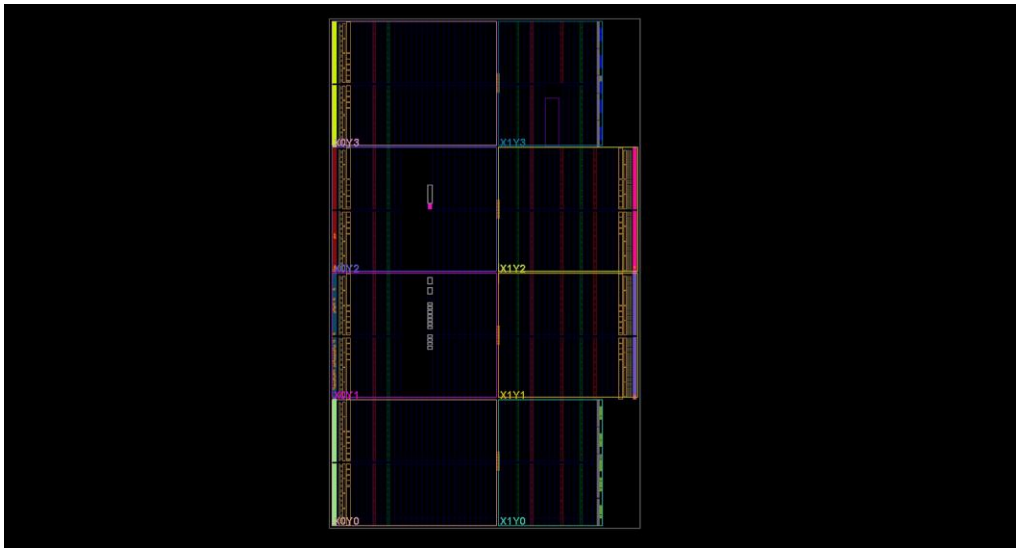
```
#Switches
set_property -dict { PACKAGE_PIN J15   IOSTANDARD LVCMOS33 } [get_ports { sw[0] }];
#IO_L24N_T3_RS0_15 Sch=sw[0]
```

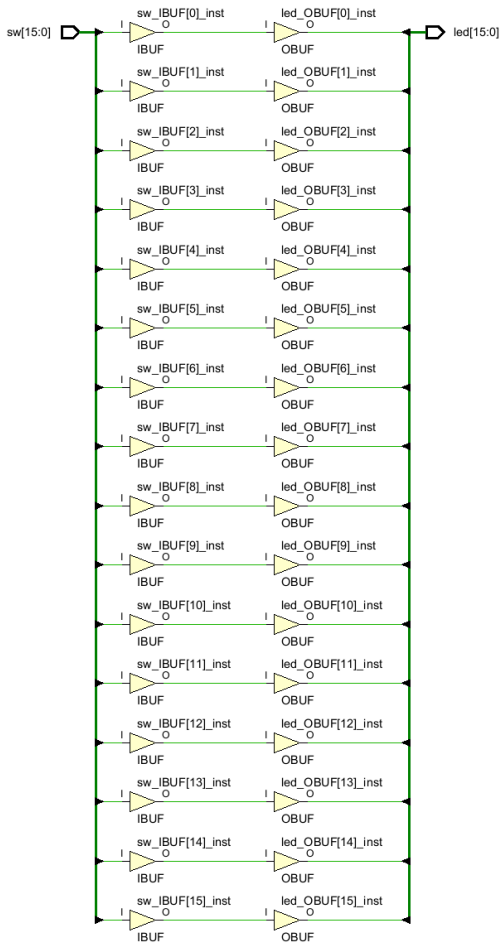
```
set_property -dict { PACKAGE_PIN L16   IOSTANDARD LVCMOS33 } [get_ports
{ sw[1] }]; #IO_L3N_T0_DQS_EMCCLK_14 Sch=sw[1]
set_property -dict { PACKAGE_PIN M13   IOSTANDARD LVCMOS33 } [get_ports
{ sw[2] }]; #IO_L6N_T0_D08_VREF_14 Sch=sw[2]
set_property -dict { PACKAGE_PIN R15   IOSTANDARD LVCMOS33 } [get_ports
{ sw[3] }]; #IO_L13N_T2_MRCC_14 Sch=sw[3]
set_property -dict { PACKAGE_PIN R17   IOSTANDARD LVCMOS33 } [get_ports
{ sw[4] }]; #IO_L12N_T1_MRCC_14 Sch=sw[4]
set_property -dict { PACKAGE_PIN T18   IOSTANDARD LVCMOS33 } [get_ports
{ sw[5] }]; #IO_L7N_T1_D10_14 Sch=sw[5]
set_property -dict { PACKAGE_PIN U18   IOSTANDARD LVCMOS33 } [get_ports
{ sw[6] }]; #IO_L17N_T2_A13_D29_14 Sch=sw[6]
set_property -dict { PACKAGE_PIN R13   IOSTANDARD LVCMOS33 } [get_ports
{ sw[7] }]; #IO_L5N_T0_D07_14 Sch=sw[7]
set_property -dict { PACKAGE_PIN T8    IOSTANDARD LVCMOS18 } [get_ports { sw[8] }];
#IO_L24N_T3_34 Sch=sw[8]
set_property -dict { PACKAGE_PIN U8    IOSTANDARD LVCMOS18 } [get_ports { sw[9] }];
#IO_25_34 Sch=sw[9]
set_property -dict { PACKAGE_PIN R16   IOSTANDARD LVCMOS33 } [get_ports
{ sw[10] }]; #IO_L15P_T2_DQS_RDWR_B_14 Sch=sw[10]
set_property -dict { PACKAGE_PIN T13   IOSTANDARD LVCMOS33 } [get_ports
{ sw[11] }]; #IO_L23P_T3_A03_D19_14 Sch=sw[11]
set_property -dict { PACKAGE_PIN H6    IOSTANDARD LVCMOS33 } [get_ports
{ sw[12] }]; #IO_L24P_T3_35 Sch=sw[12]
set_property -dict { PACKAGE_PIN U12   IOSTANDARD LVCMOS33 } [get_ports
{ sw[13] }]; #IO_L20P_T3_A08_D24_14 Sch=sw[13]
set_property -dict { PACKAGE_PIN U11   IOSTANDARD LVCMOS33 } [get_ports
{ sw[14] }]; #IO_L19N_T3_A09_D25_VREF_14 Sch=sw[14]
set_property -dict { PACKAGE_PIN V10   IOSTANDARD LVCMOS33 } [get_ports
{ sw[15] }]; #IO_L21P_T3_DQS_14 Sch=sw[15]


#LEDs
set_property -dict { PACKAGE_PIN H17   IOSTANDARD LVCMOS33 } [get_ports
{ led[0] }]; #IO_L18P_T2_A24_15 Sch=led[0]
set_property -dict { PACKAGE_PIN K15   IOSTANDARD LVCMOS33 } [get_ports
{ led[1] }]; #IO_L24P_T3_RS1_15 Sch=led[1]
set_property -dict { PACKAGE_PIN J13   IOSTANDARD LVCMOS33 } [get_ports { led[2] }];
#IO_L17N_T2_A25_15 Sch=led[2]
set_property -dict { PACKAGE_PIN N14   IOSTANDARD LVCMOS33 } [get_ports
{ led[3] }]; #IO_L8P_T1_D11_14 Sch=led[3]
```

```
set_property -dict { PACKAGE_PIN R18   IOSTANDARD LVCMOS33 } [get_ports
{ led[4] }]; #IO_L7P_T1_D09_14 Sch=led[4]
set_property -dict { PACKAGE_PIN V17   IOSTANDARD LVCMOS33 } [get_ports
{ led[5] }]; #IO_L18N_T2_A11_D27_14 Sch=led[5]
set_property -dict { PACKAGE_PIN U17   IOSTANDARD LVCMOS33 } [get_ports
{ led[6] }]; #IO_L17P_T2_A14_D30_14 Sch=led[6]
set_property -dict { PACKAGE_PIN U16   IOSTANDARD LVCMOS33 } [get_ports
{ led[7] }]; #IO_L18P_T2_A12_D28_14 Sch=led[7]
set_property -dict { PACKAGE_PIN V16   IOSTANDARD LVCMOS33 } [get_ports
{ led[8] }]; #IO_L16N_T2_A15_D31_14 Sch=led[8]
set_property -dict { PACKAGE_PIN T15   IOSTANDARD LVCMOS33 } [get_ports
{ led[9] }]; #IO_L14N_T2_SRCC_14 Sch=led[9]
set_property -dict { PACKAGE_PIN U14   IOSTANDARD LVCMOS33 } [get_ports
{ led[10] }]; #IO_L22P_T3_A05_D21_14 Sch=led[10]
set_property -dict { PACKAGE_PIN T16   IOSTANDARD LVCMOS33 } [get_ports
{ led[11] }]; #IO_L15N_T2_DQS_DOUT_CSO_B_14 Sch=led[11]
set_property -dict { PACKAGE_PIN V15   IOSTANDARD LVCMOS33 } [get_ports
{ led[12] }]; #IO_L16P_T2_CSI_B_14 Sch=led[12]
set_property -dict { PACKAGE_PIN V14   IOSTANDARD LVCMOS33 } [get_ports
{ led[13] }]; #IO_L22N_T3_A04_D20_14 Sch=led[13]
set_property -dict { PACKAGE_PIN V12   IOSTANDARD LVCMOS33 } [get_ports
{ led[14] }]; #IO_L20N_T3_A07_D23_14 Sch=led[14]
set_property -dict { PACKAGE_PIN V11   IOSTANDARD LVCMOS33 } [get_ports
{ led[15] }]; #IO_L21N_T3_DQS_A06_D22_14 Sch=led[15]
```

Synthesis and Implementation

Screenshots:





1. Slice Logic

Site Type	Used	Fixed	Prohibited	Available	Util%
Slice LUTs*	0	0	0	63400	0.00
LUT as Logic	0	0	0	63400	0.00
LUT as Memory	0	0	0	19000	0.00
Slice Registers	0	0	0	126800	0.00
Register as Flip Flop	0	0	0	126800	0.00
Register as Latch	0	0	0	126800	0.00
F7 Muxes	0	0	0	31700	0.00
F8 Muxes	0	0	0	15850	0.00

Group Video

Link: https://youtu.be/Otpw31HJS6w

Reflections

For this lab, our group successfully implemented a Verilog module on the Digilent Nexys A7-100T, creating a switch-to-LED interface where each of the 16 LEDs mirrors its corresponding switch. Through this first lab, we gained practical experience in HDL I/O mapping, utilizing constraints files (specifically the Nexys-A7-100T-Master.xdc) for pin assignments, performing synthesis, and programming the FPGA. Each team member contributed to various aspects, including Verilog code development, XDC file configuration, synthesis and analysis of LUT and FF counts, and comprehensive testing to ensure the board functioned as expected. We documented our work with screenshots and a group video, demonstrating our build and the live board functionality.