Introduction/Review of FPGA Programming using Quartus II

CANDACE ROSS

EECE494 COMPUTER BUS AND SOC INTERFACING

ELECTRICAL AND COMPUTER ENGINEERING

HOWARD UNIVERSITY

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Overview of Presentation

- Quartus II Software w/ De2i-150 board
  - Beginning with an idea
  - Writing and compiling code
  - Assigning I/O's to corresponding pins
  - Programming board via USB-blaster

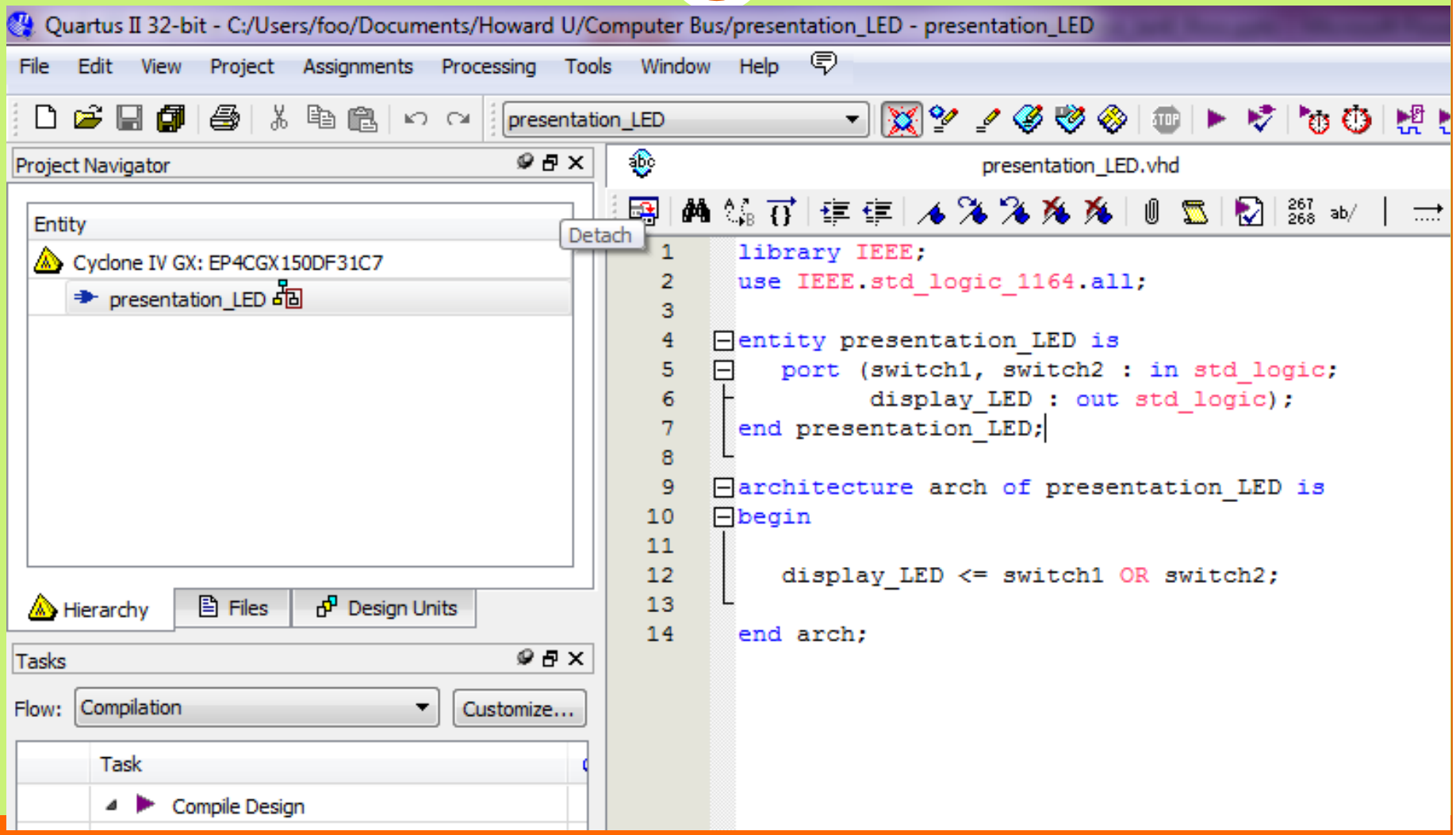
- Examples:
  1. Flashing LED based on inputs
  2. Seven segment display from binary to decimal

Example #1: Lighting LED

- Goal: Light an LED when either of two switches is on

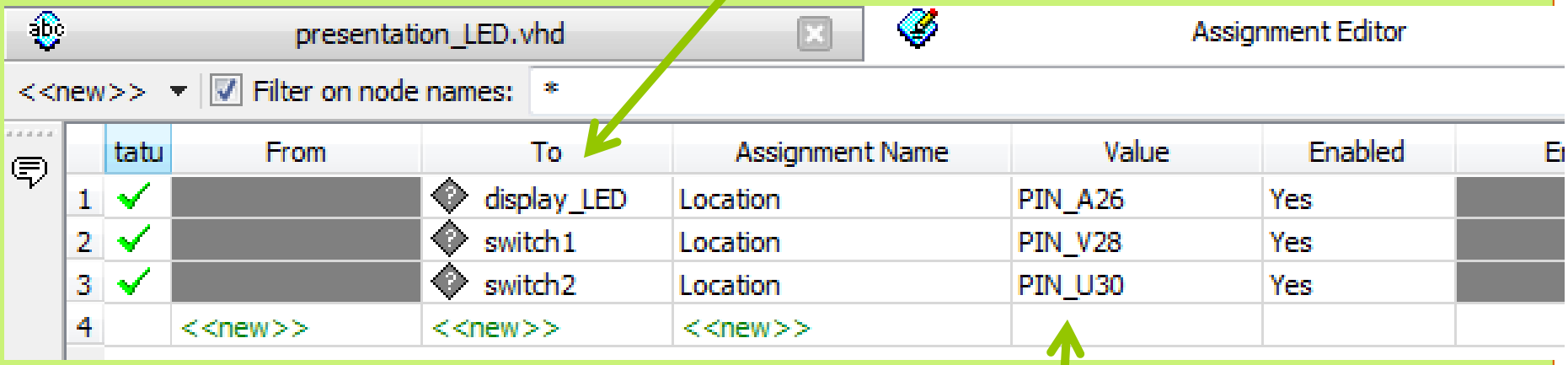
- Implementation:
  - Find the logical equivalent:
    - Y = A + B
  - Write the corresponding VHDL code to implement
  - Assign pins to the I/Os from the code
  - Compile the design
  - Load the board with the code and test!

Snip of Code


Quartus II 32-bit - C:/Users/foo/Documents/Howard U/Computer Bus/presentation_LED - presentation_LED
File Edit View Project Assignments Processing Tools Window Help
presentation_LED
Project Navigator
Entity
Cyclone IV GX: EP4CGX150DF31C7
presentation_LED
Detach
Hierarchy
Files
Design Units
Tasks
Flow: Compilation
Customize...
Task
Compile Design
presentation_LED.vhd
1 library IEEE;
2 use IEEE.std_logic_1164.all;
3
4 entity presentation_LED is
5 port (switch1, switch2 : in std_logic;
6 display_LED : out std_logic);
7 end presentation_LED;
8
9 architecture arch of presentation_LED is
10 begin
11
12 display_LED <= switch1 OR switch2;
13
14 end arch;

Pin Assignment

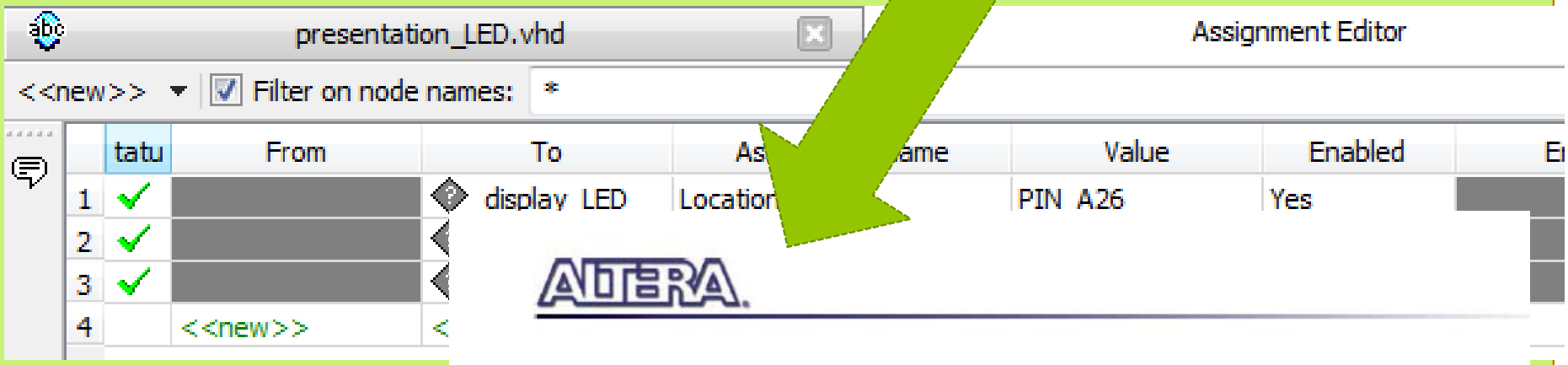
load inputs and outputs from the code



assign to specific port of board

Pin Assignment

See System Manual PDF, Table 3.2



ALTERA

Table 3-4 Pin Assignments for LEDs

Signal Name	*FPGA Pin No.*	*Description*	*I/O Standard*
LEDR[0]	PIN_T23	LED Red[0]	2.5V
LEDR[1]	PIN_T24	LED Red[1]	2.5V
LEDR[2]	PIN_V27	LED Red[2]	2.5V
LEDR[3]	PIN_W25	LED Red[3]	2.5V
LEDR[4]	PIN_T21	LED Red[4]	2.5V
LEDR[5]	PIN_T26	LED Red[5]	2.5V
LEDR[6]	PIN_R25	LED Red[6]	2.5V
LEDR[7]	PIN_T27	LED Red[7]	2.5V

Example #2: Binary to Seven Segment Display

- Goal: convert a 3-bit binary number to decimal and display on seven segment display

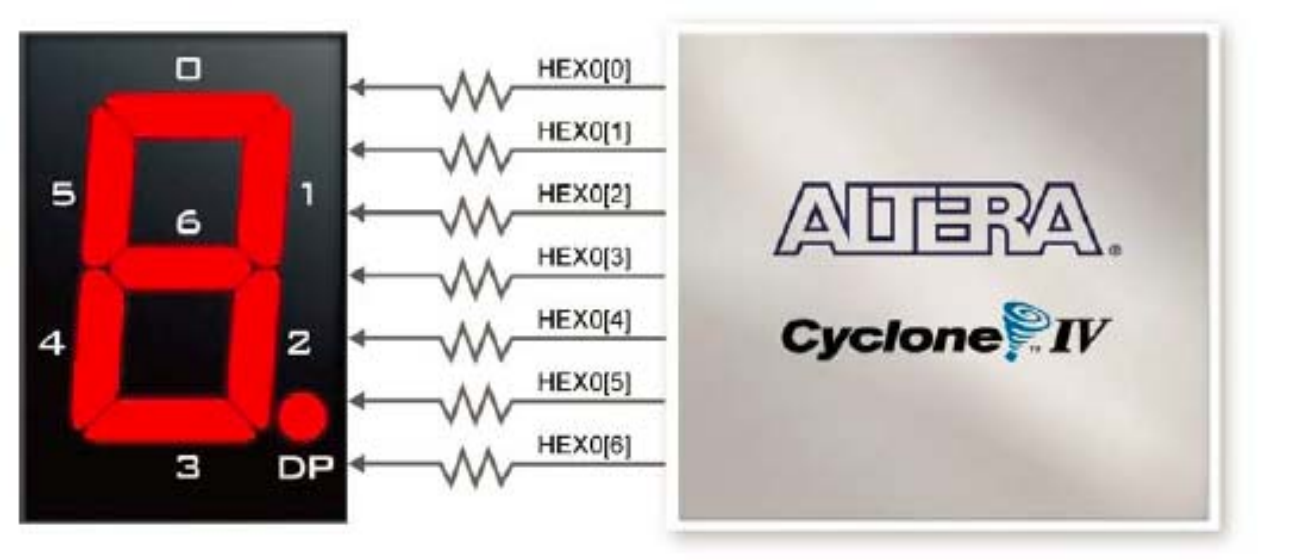
- Implementation:
  - Write the VHDL code to implement
  - Assign pins to the I/Os from the code
  - Compile the design
  - Load the board with the code and test!

VHDL Code to Implement

- Necessary I/Os:
  - 3 bits for binary number (000_2 to 111_2)
  - 7 bits to display decimal (0_{10} to 7_{10})
- Implementation:
  - Each switch is assigned to a bit, and the seven segments are each a pin on the display
  - We'll run through the display from decimal numbers zero to seven

Focusing on the Seven Segment Display..

- Each segment is active low
- In this example, the segments are represented as a seven bit vector with the LSb corresponding to HEX0



Quick Debugging Tips

- Check the assigned input and output pins
  - Is an input mistakenly assigned to an LED?
- Save changes by both compiling the design AND reloading the board
  - It's easy to forget to reload the board, hence there are not any design changes
- Ensure the logic is being used correctly
  - Truth tables, K-maps