

# Introduction to Field Programmable Gate Arrays (FPGAs)

COE 203

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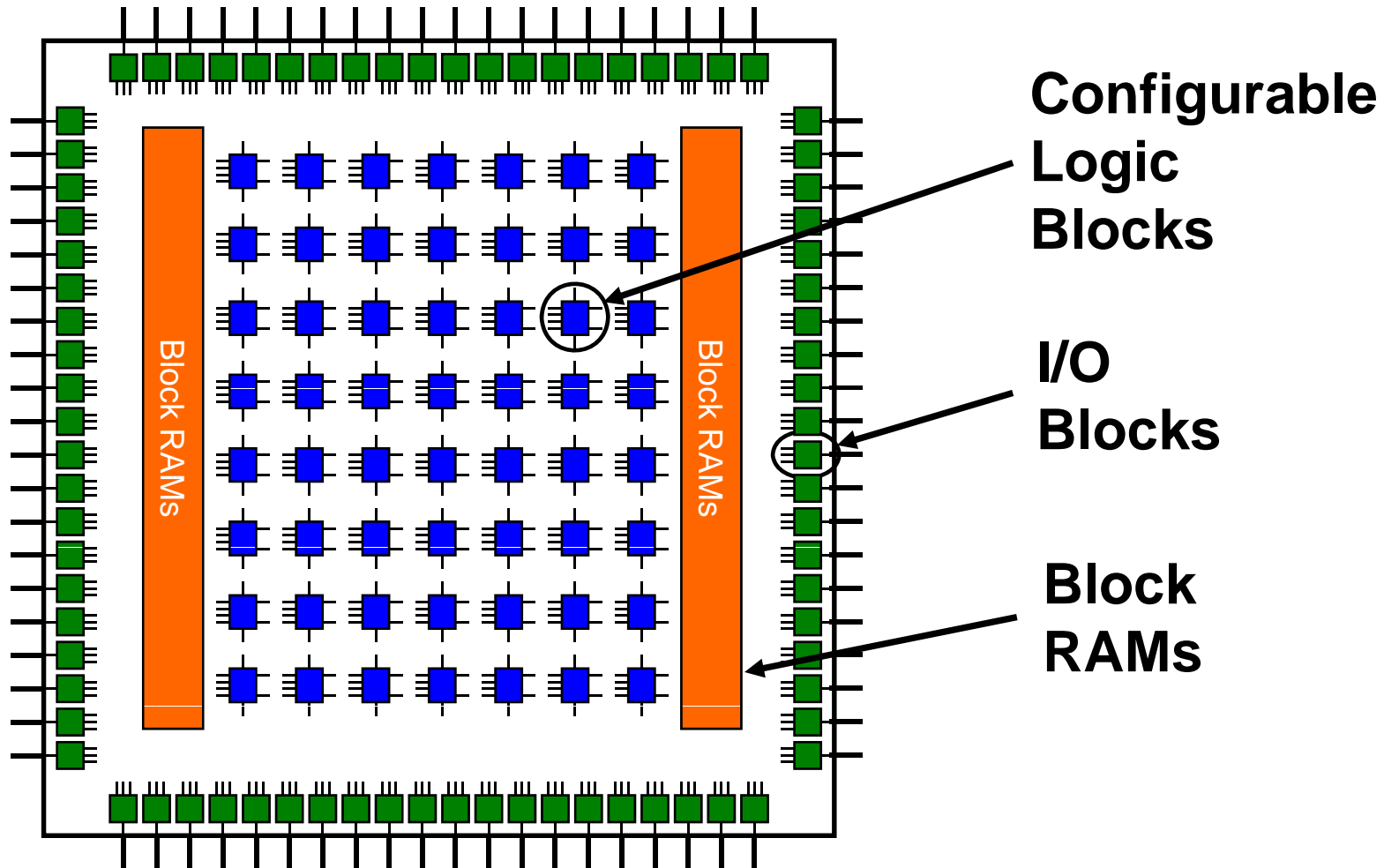
# Outline

- ❖ What is an FPGA
- ❖ CLB Slice Structure
- ❖ LUT (Look-Up Table) Functionality
- ❖ Advantages of using FPGAs
- ❖ FPGA Design Flow
- ❖ Digilent Spartan-3 Board
- ❖ FPGA Device Part Marking

# What is an FPGA? ...

- ❖ A field programmable gate array (FPGA) is a reprogrammable silicon chip.
- ❖ Using prebuilt logic blocks and programmable routing resources, you can configure these chips to implement custom hardware functionality without ever having to pick up a breadboard or soldering iron.
- ❖ You develop digital computing tasks in software and compile them down to a configuration file or bitstream that contains information on how the components should be wired together.

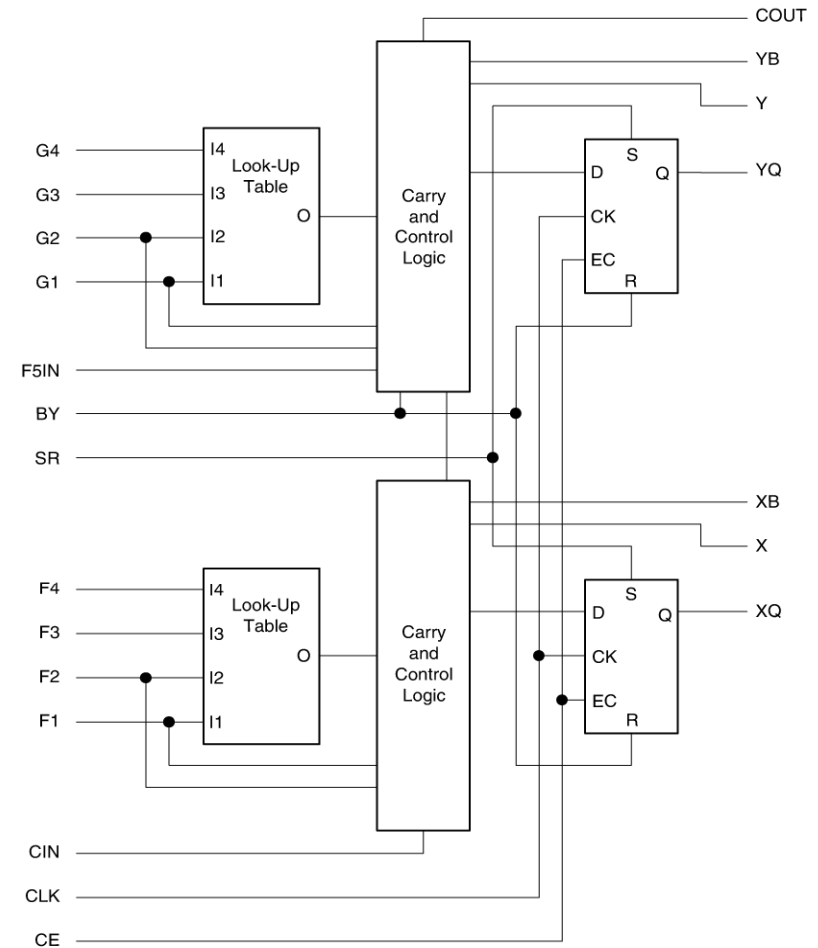
# ... What is an FPGA ?



# CLB Slice Structure

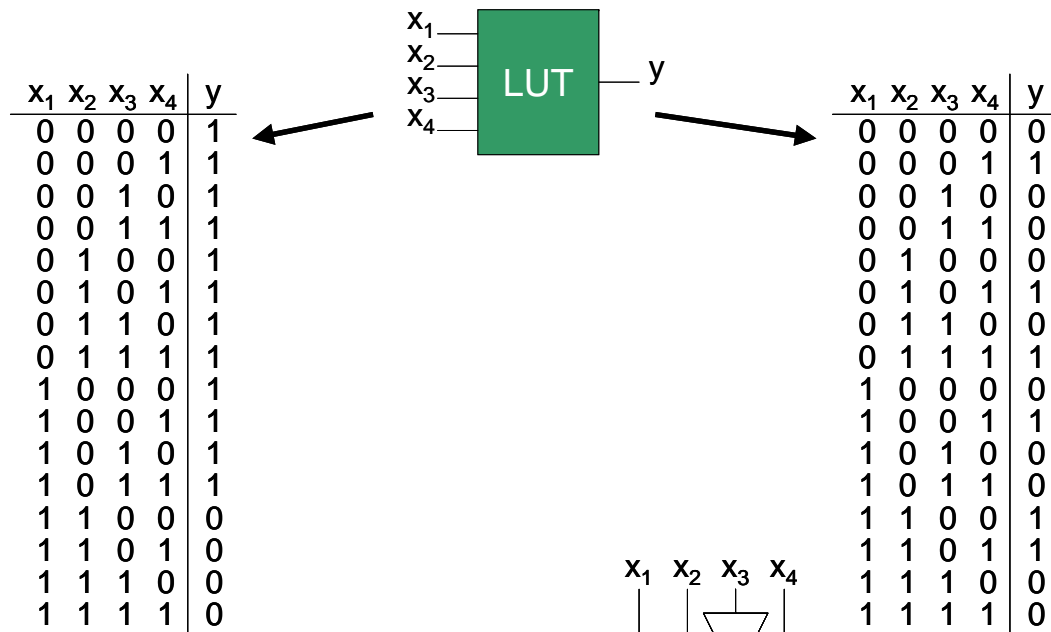
❖ Each slice contains two sets of the following:

- ✧ Four-input LUT
  - Any 4-input logic function,
  - or 16-bit x 1 sync RAM
  - or 16-bit shift register
- ✧ Carry & Control
  - Fast arithmetic logic
  - Multiplier logic
  - Multiplexer logic
- ✧ Storage element
  - Latch or flip-flop
  - Set and reset
  - True or inverted inputs
  - Sync. or async. control

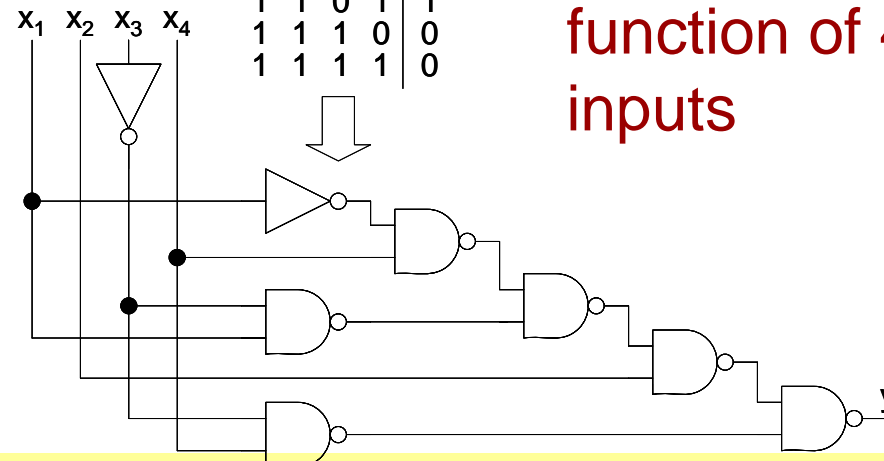
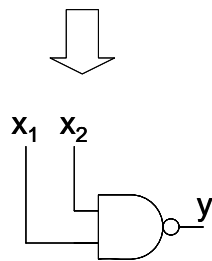


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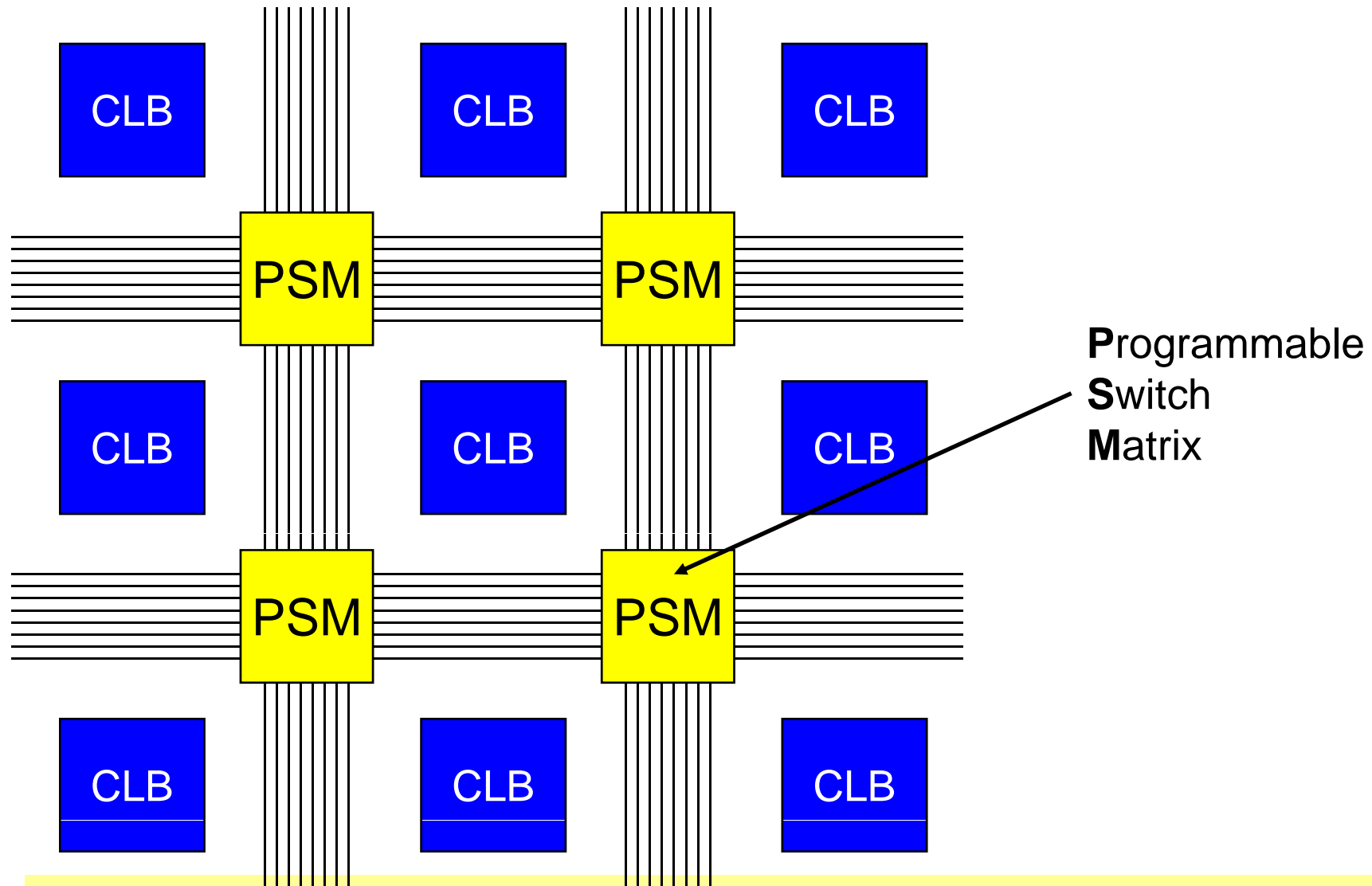
# LUT (Look-Up Table) Functionality



- Look-Up tables are primary elements for logic implementation
- Each LUT can implement any function of 4 inputs



# Routing Resources

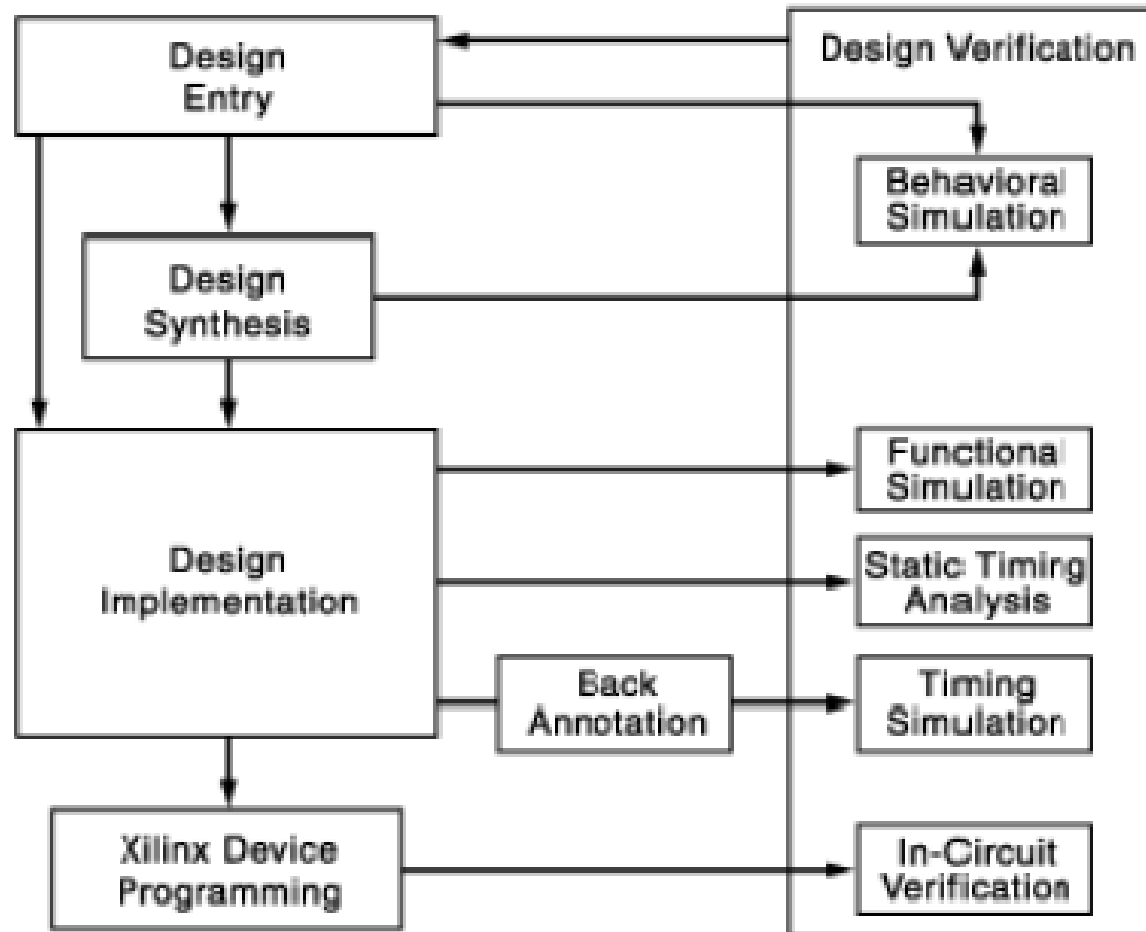


# Advantages of using FPGAs

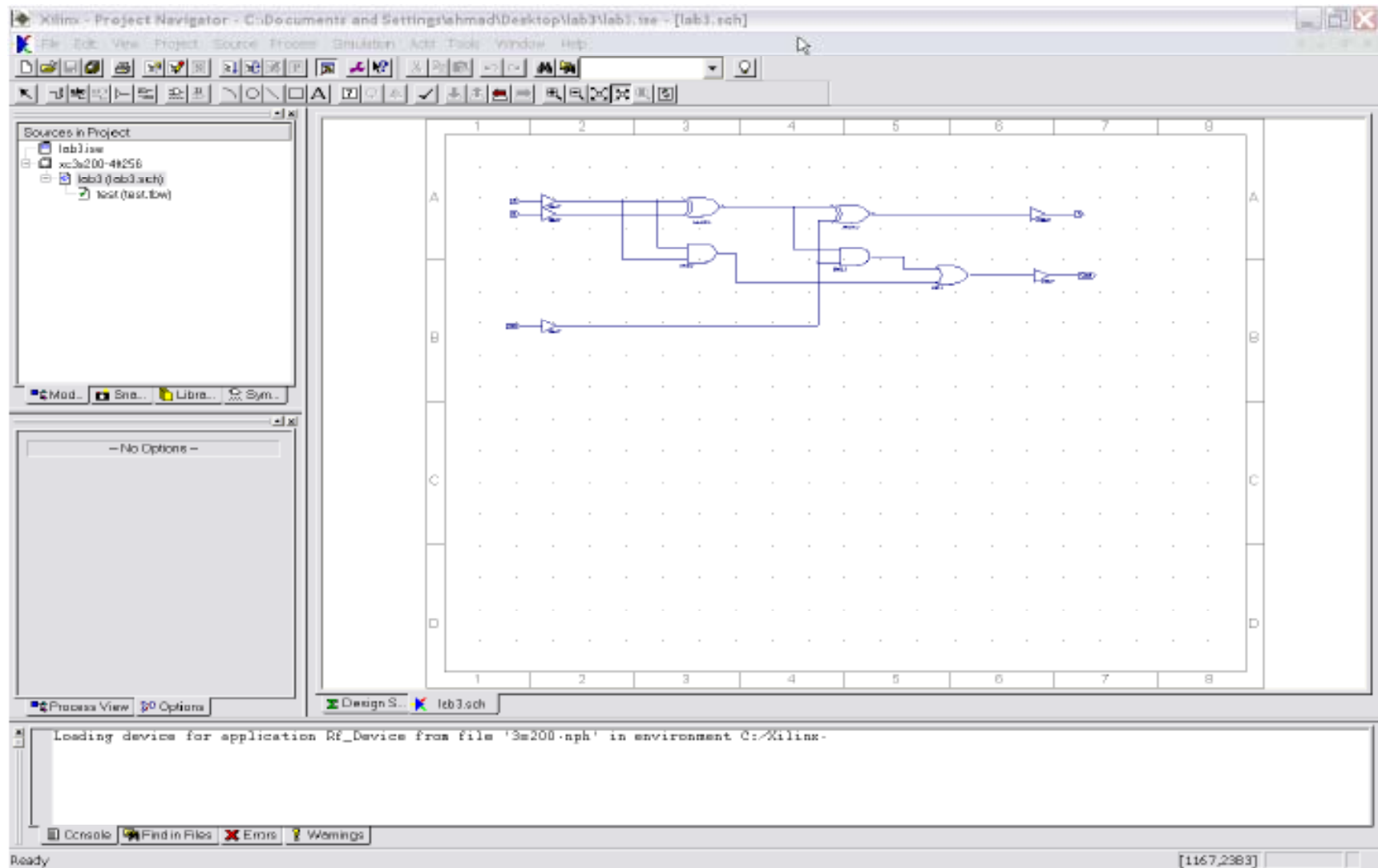
- ❖ Creating intricate circuit designs from discrete parts, such as TTL chips, can be very tedious and error prone.
- ❖ It can take a large number of chips to create a design of only moderate complexity.
- ❖ It takes a lot of time to wire together a large number of chips. Additionally, it can often be difficult to find misplaced wires when debugging a complex circuit.
- ❖ Using FPGAs, it is possible to implement a complex logic design in a manner which is easy to test, debug and even change.
- ❖ Using FPGAs, If the device does not function as it should, it is only necessary to debug the program as opposed to debugging the wiring of a circuit made from discrete chips.



# FPGA Design Flow



# Xilinx ISE 7.1i



# Digilent Spartan-3 Board

- ❖ 200K gate Xilinx Spartan-3 FPGA
- ❖ 8 slide switches
- ❖ 4 pushbuttons
- ❖ 8 LEDs
- ❖ 4-digit seven-segment display
- ❖ Serial port
- ❖ VGA port
- ❖ PS/2
- ❖ And others ....



# FPGA Device Part Marking

We're Using: Spartan 3 XC3S200-ft256

