

# DIGITAL LOGIC

## Lecture 1 FPGA Introduction

2024 Fall

This PowerPoint is for internal use only at Southern University of Science and Technology.  
Please do not repost it on other platforms without permission from the instructor.



# FPGA for Digital Logic

- What?
- Why?
- How?

# Calculate $a + b$ using CPU

- How to calculate  $a + b$ ?

```
int adder(int a, int b)
{
    int z = a + b;
    return z;
}
```

C Programming language

Compilation



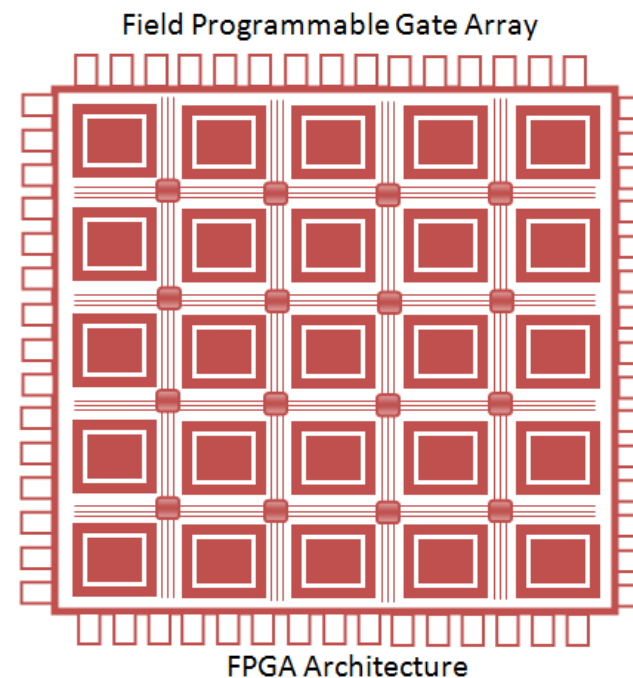
# Calculate $a + b$ using FPGA

- How to calculate  $a + b$ ?

```
module adder(  
    input wire [4:0] a,  
    input wire [4:0] b,  
    output wire [4:0] z  
);  
    assign z = a + b;  
endmodule
```

Hardware Description Language (HDL)

Synthesis

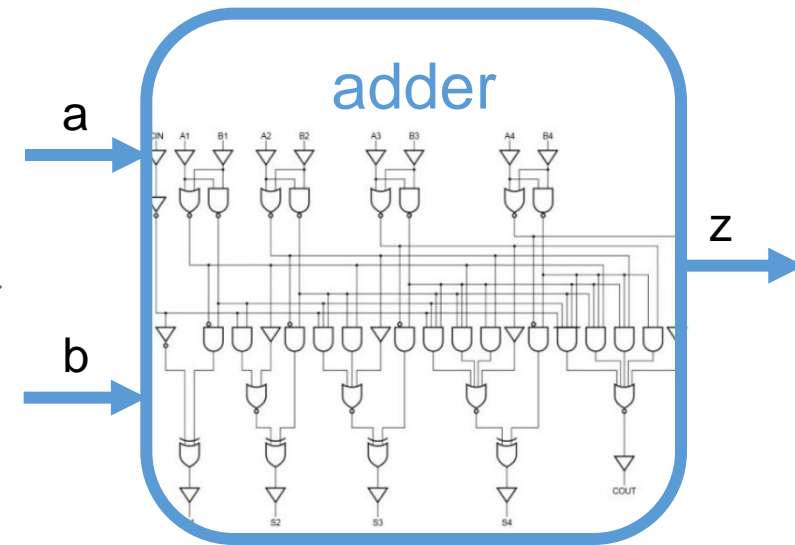


# Hardware design

- These hardware blocks are comprised completely of registers and logic gates

```
module adder(  
    input wire [4:0] a,  
    input wire [4:0] b,  
    output wire [4:0] z  
);  
    assign z = a + b;  
endmodule
```

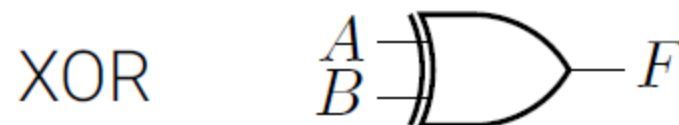
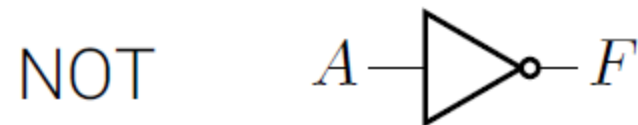
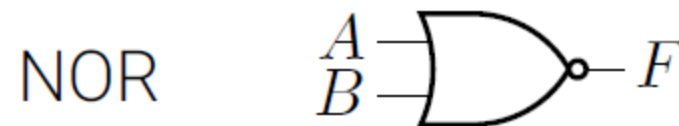
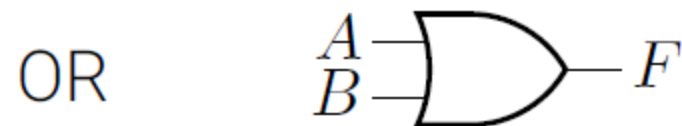
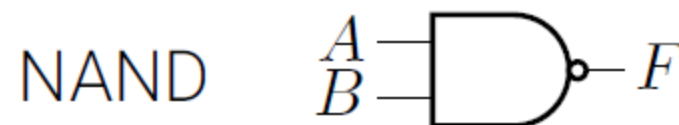
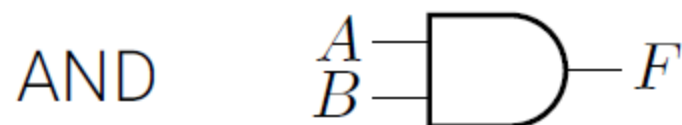
Synthesis



Hardware Description Language (HDL)

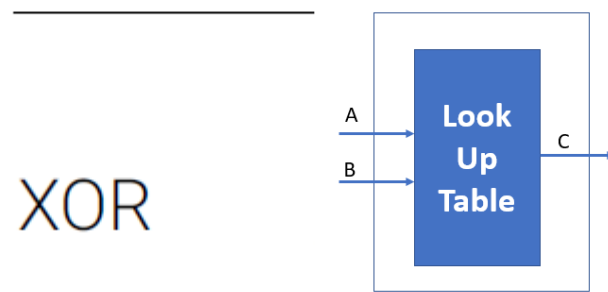
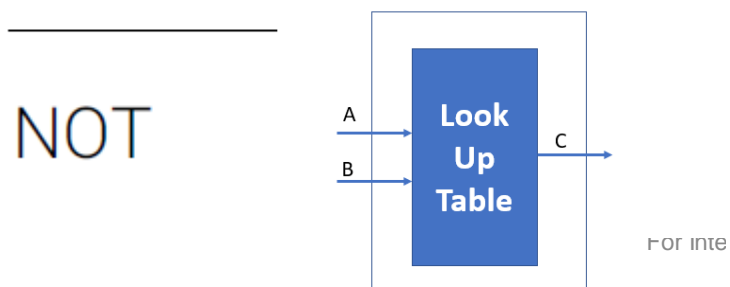
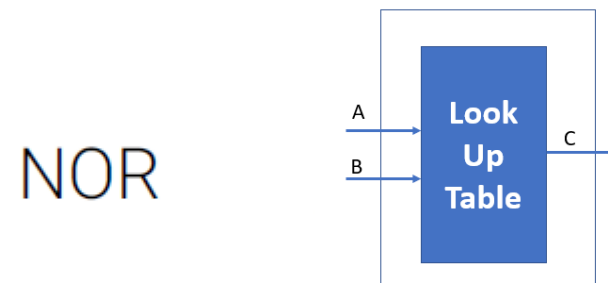
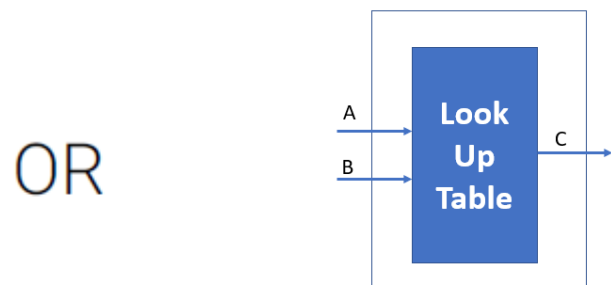
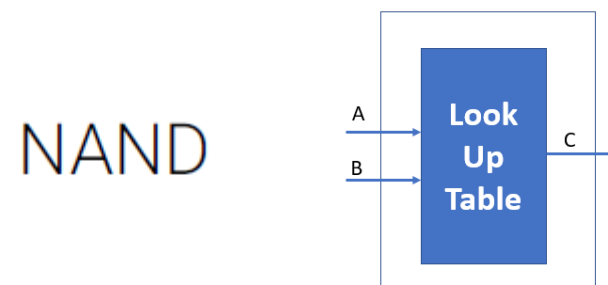
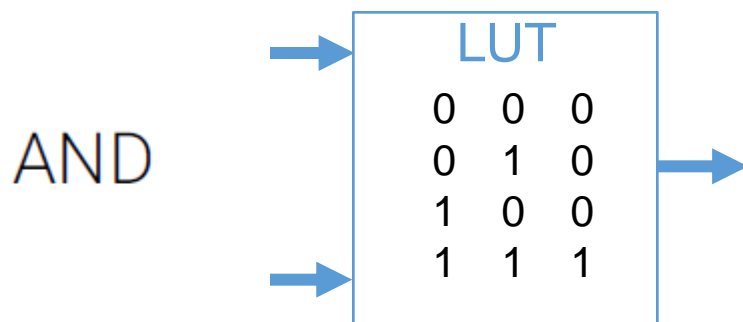
Hardware Schematic

# Logic gates



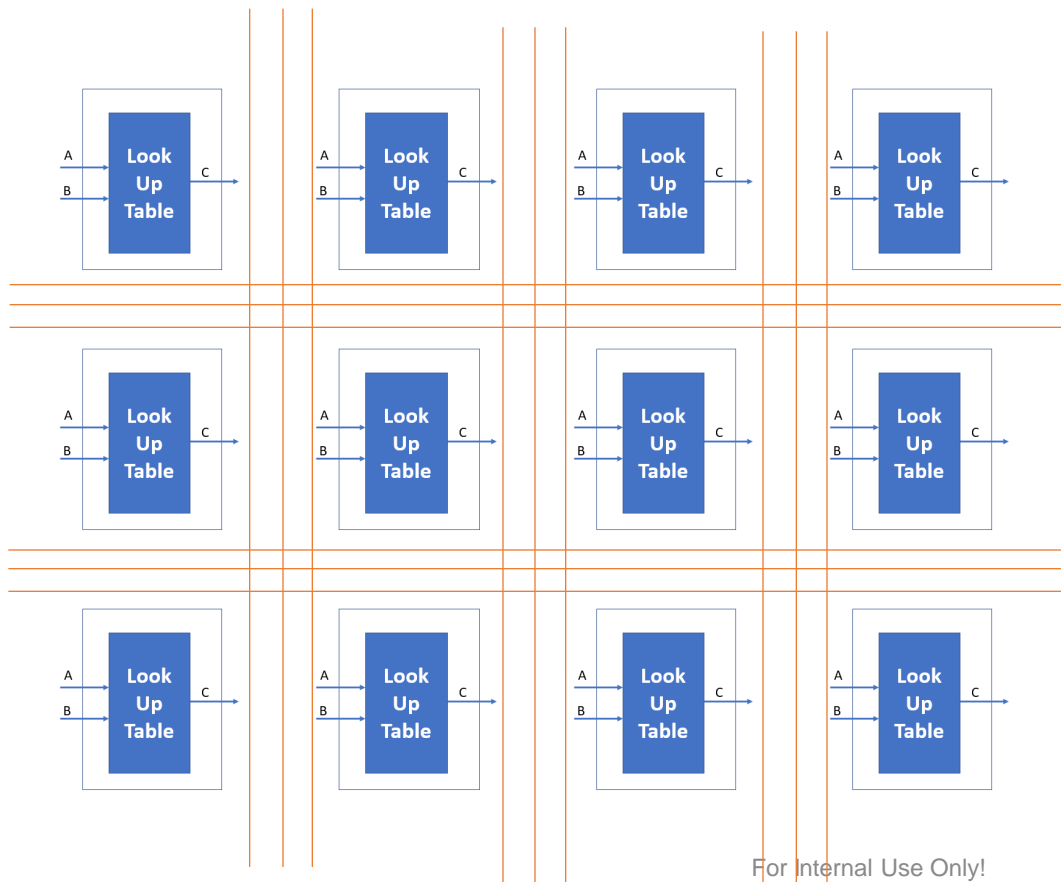
# Logic gates

- The logic gates can be implemented using look-up tables.



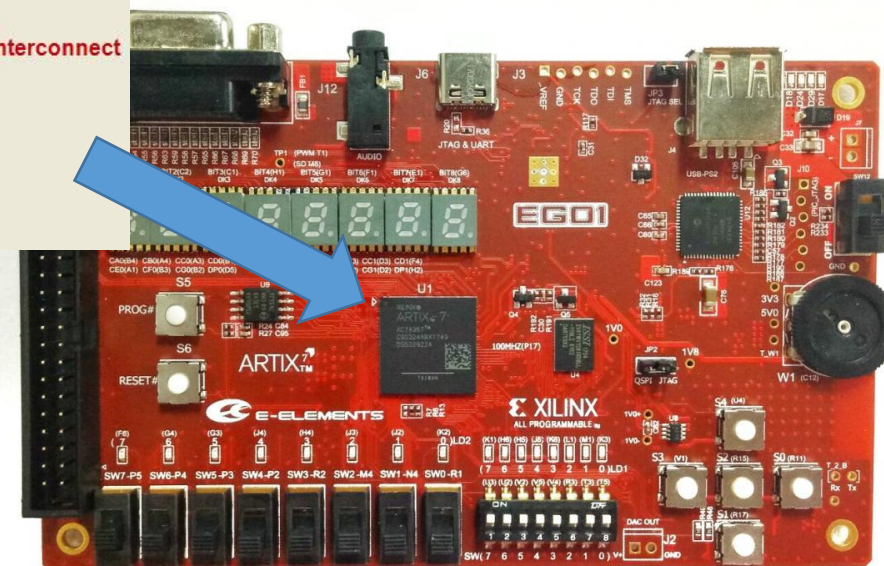
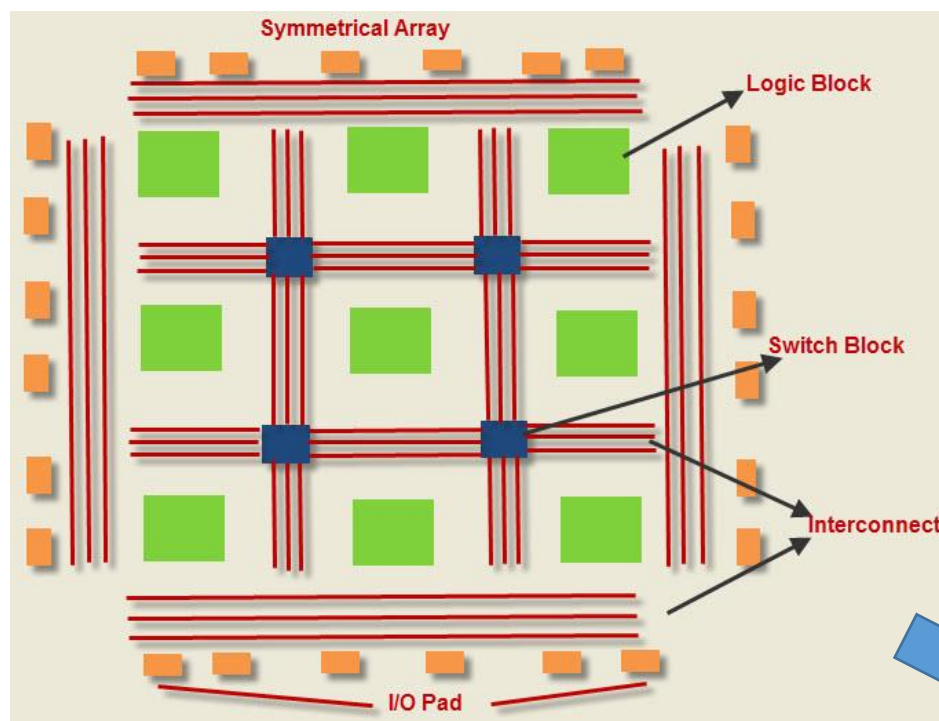
# Programmable FPGA

- If you put together a bunch of look-up tables, and make them programmable, then you add a switching fabric that can connect them all together, it's just like playing with LEGO bricks !





# FPGA design kit



# FPGA

- What
  - A type of digital logic device that can be programmed and reprogrammed to perform a wide variety of digital functions.
- Why?
  - The programmability allows easily designing and updating designs, it provides a practical way to learn about digital system design.
- How?
  - RTL (e.g. Verilog HDL) + EDA Tools (e.g. Vivado 2017.4) + FPGA board (e.g. ego1)