

# DIGITAL LOGIC

## Lecture 1 FPGA Introduction

2025 Fall

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# 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



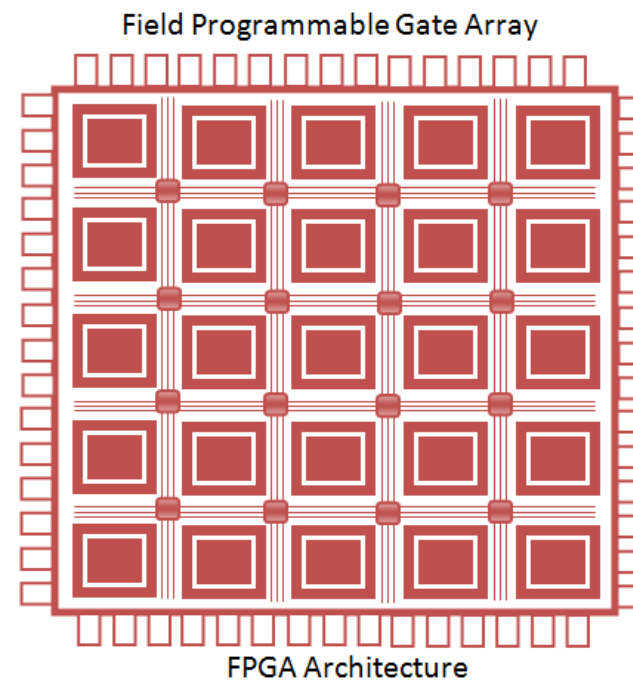
# Calculate $a + b$ using FPGA

- 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

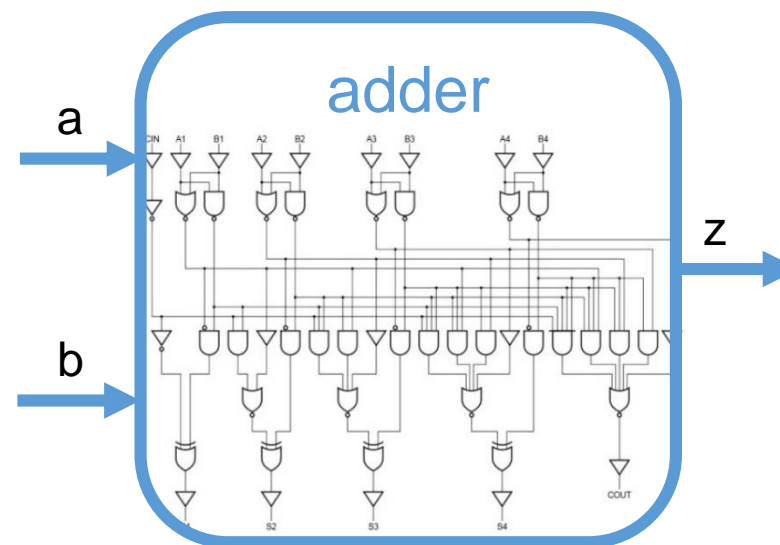


# Hardware design

- 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;  
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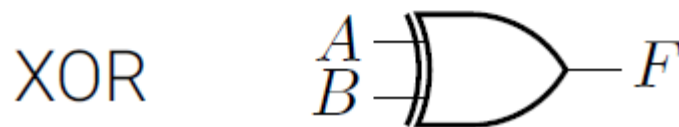
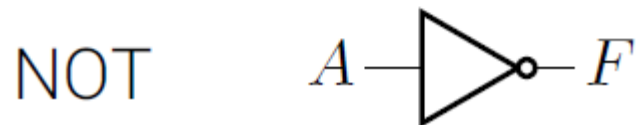
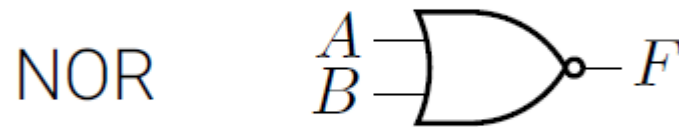
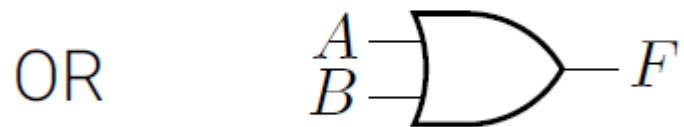
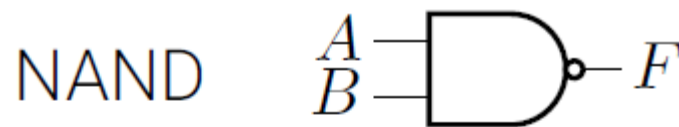
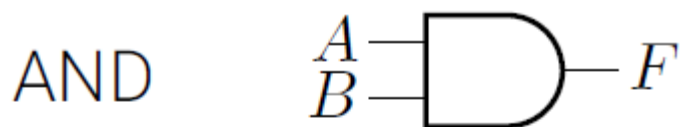
Synthesis



Hardware Description Language (HDL)

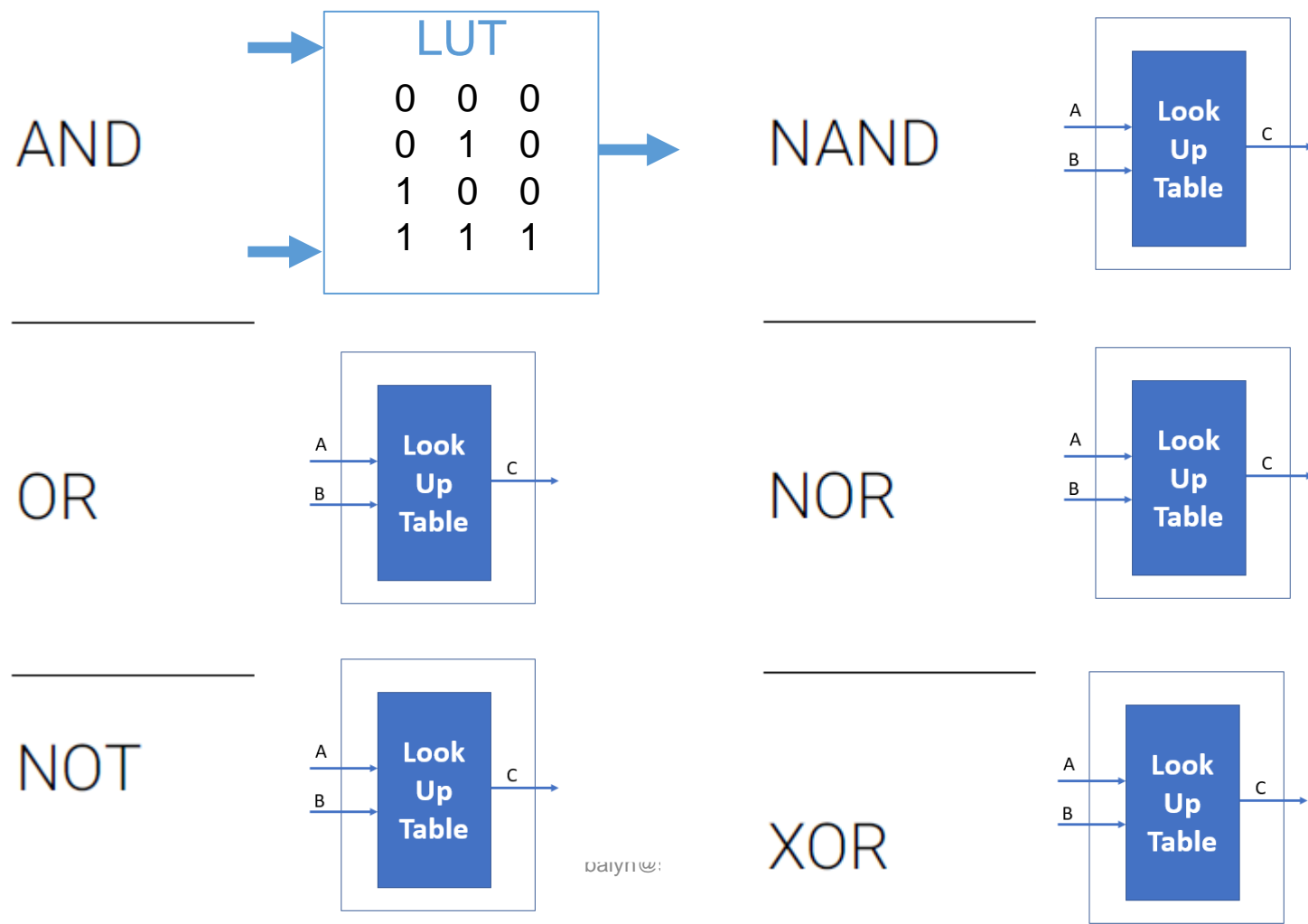
Hardware Schematic

# Logic gates



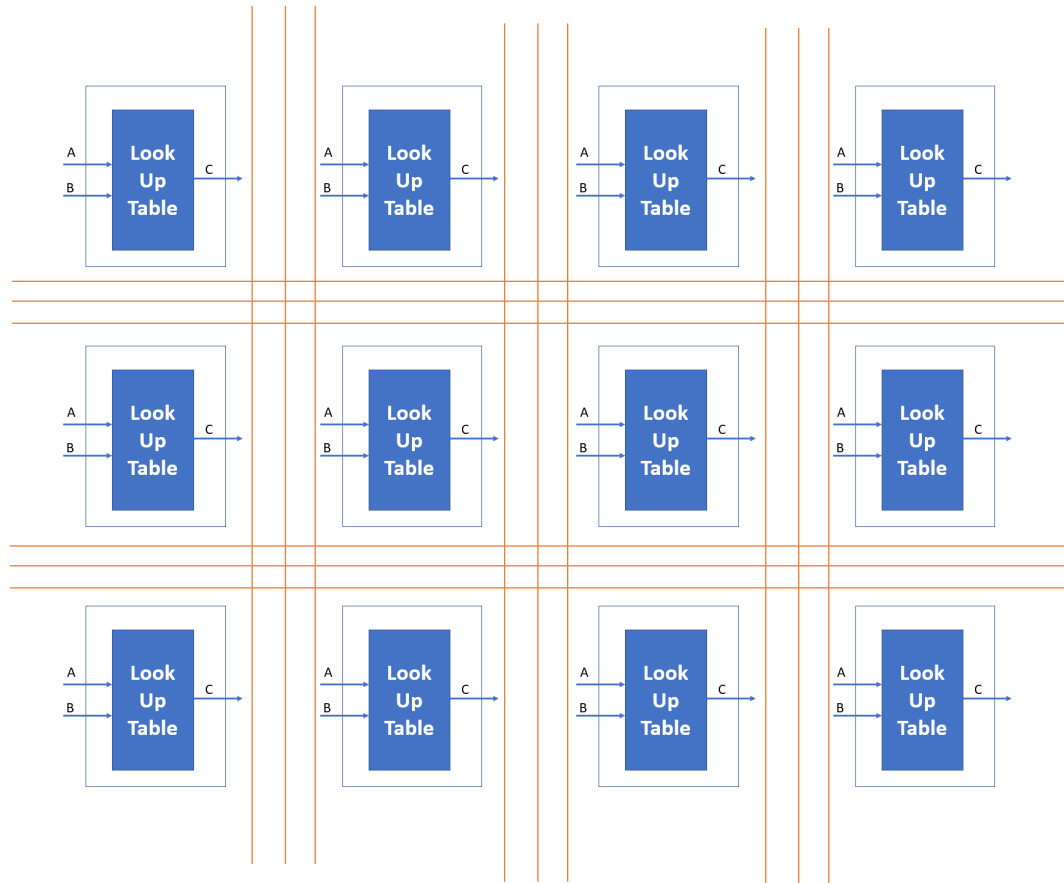
# Logic gates

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



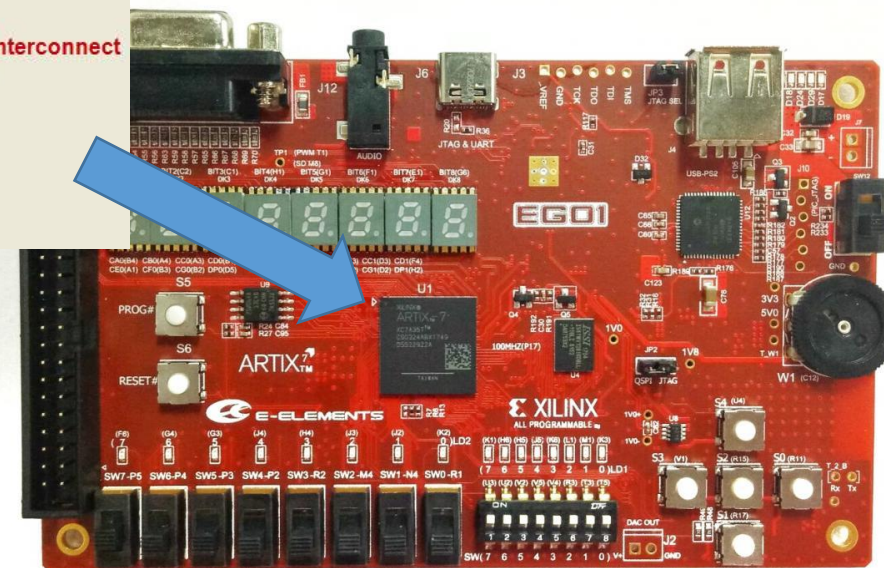
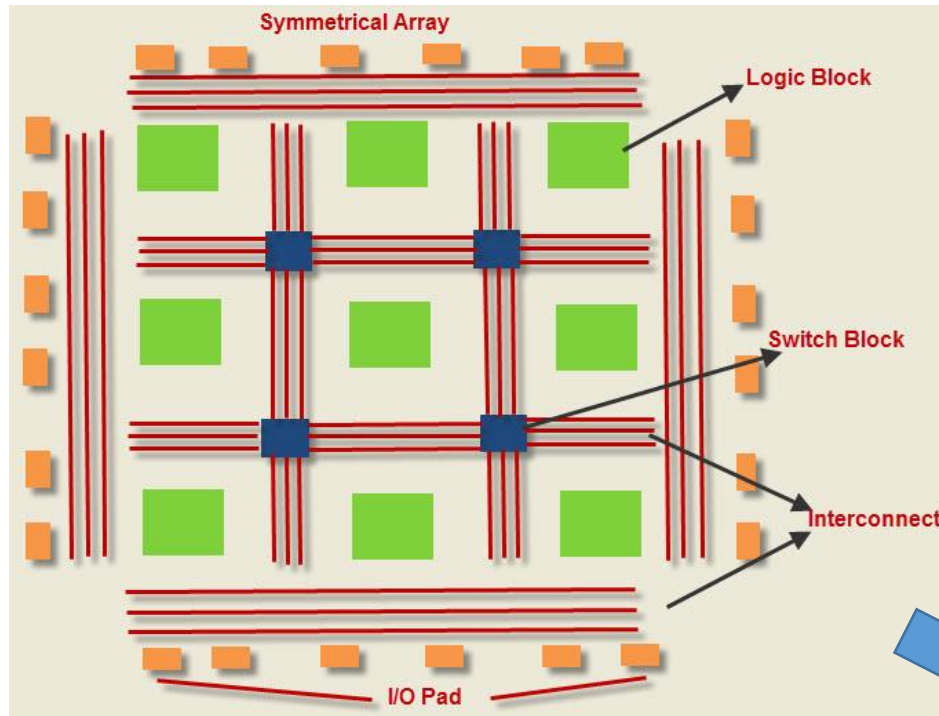
# Programmable FPGA

- 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)