

# Chapter 7

## Physical Implementations Chapter 7

# Physical Implementation

- After circuit design the next step is to create a real circuit. There are multiple ways to implement a design. Each has its pros and cons.
  - Full-Custom ICs
  - Semicustom (Application-Specific) IC – ASICs
  - Off-the-shelf Programmable IC – FPGA
  - Other Off-the-shelf IC types

# Full-Custom ICs

- An integrated circuit built to implement the specific desired circuit
- Takes months to develop
- Error-prone
- Expensive
- Small size
- Low power
- High performance

# Application-Specific IC – ASICs

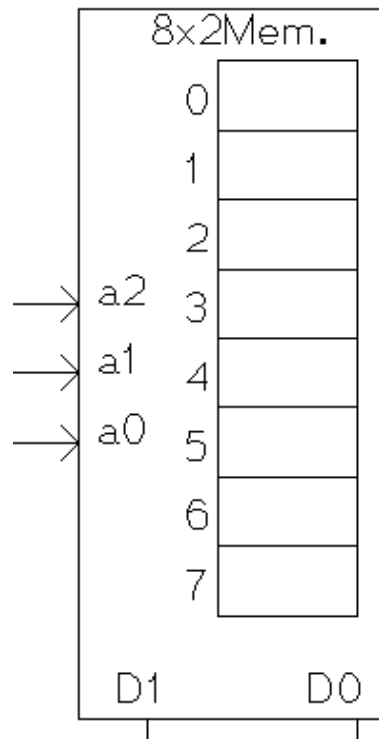
- Reduced NRE compared to Full-Custom ICs
- Standard Cell
- Gate Arrays, Structured Cell, platform ASIC
- Slower than Full-Custom
- More power that Full-Custom

# FPGAs

- Fast turn around time
- No large NRE costs
- Higher power requirements
- Larger size
- Performance not as good as Full-Custom ICs

# FPGAs

- Combinational logic is implemented using Look-Up-Tables.



# FPGAs

- FPGAs contain a large number of small LUTs
- See Figure 7.21, examples 7.7 and 7.8

# FPGAs

- Programmable interconnects (Switch Matrices)
- See figure 7.26
- Configurable Logic Block (CLB)
- See figure 7.28
- Implement a 2-bit Up/Down counter with reset using a CLB



# Overall FPGA Architecture

- A grid of CLBs and Switch Matrices
- Programming an FPGA is done as a large serial shift register.
- Different FPGA devices will have their own bit shift pattern.
- See Figure 7.31

# Off-The-Shelf Logic

- 7400 series ICs
- When you need a simple logic gate or common logic function.
- Programmable Logic Device (PLD)
- See PAL and PLA fuse maps.