
ECE380 Digital Logic

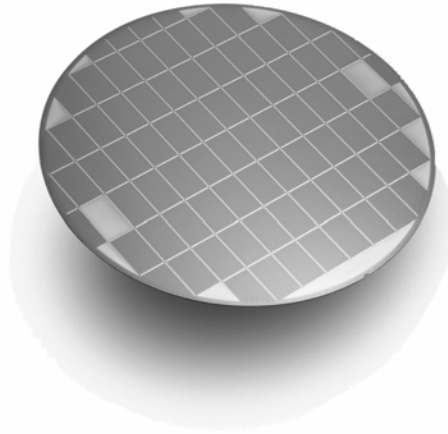
Introduction

Digital hardware

- Logic circuits are used to build computer hardware as well as other products (*digital hardware*)
- Late 1960's and early 1970's saw a revolution in digital capability
 - Smaller transistors
 - Larger chip size
- More transistors/chip gives greater functionality, but requires more complexity in the design process

Digital hardware

- Integrated circuits are fabricated on silicon wafers
- Wafers are cut & packaged to form individual chips
- Chips have from tens to millions of transistors



How complex is a digital design?

- Complexity can, and generally does, surpass human capability
 - 16 million transistors/cm² now
 - 100 million transistors/cm² in 10 years (?)
- Provides motivation for computer-based design techniques
- Most engineering work is done with CAD packages

Two design approaches

- Traditional
 - Relies on mathematical models
 - Analytical approaches
 - Provides insight and understanding of problem
 - Useful for small problems
 - Inadequate for large (real) problems
- CAD
 - Software relies on mathematical model and analytical approach
 - Transparent to user
 - Many details are abstracted
 - Useful/required for real problems

Traditional versus CAD design

- CAD tool usage is essential
- Insight and basic understanding offered by traditional approach is still important
 - Initial conceptualization is still traditional
 - Effective use of CAD tools requires some understanding of what the tools are doing
 - Use of design options requires insight

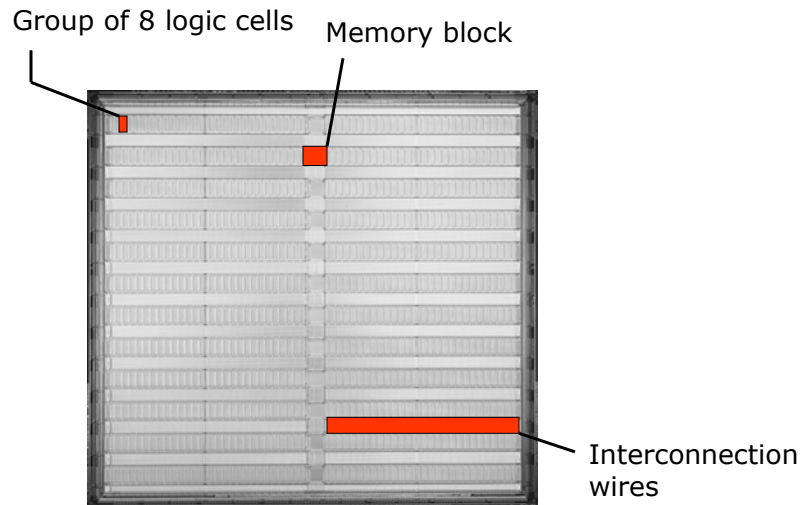
Types of chips

- Standard chips
 - Contain a small amount of circuitry (<100 transistors)
 - Performs simple functions
 - 7400 series devices
- Programmable logic devices (PLD)
 - Collection of gates with programmable interconnections
 - Function is configurable by designer/user
 - Design with PLD is via a CAD tool

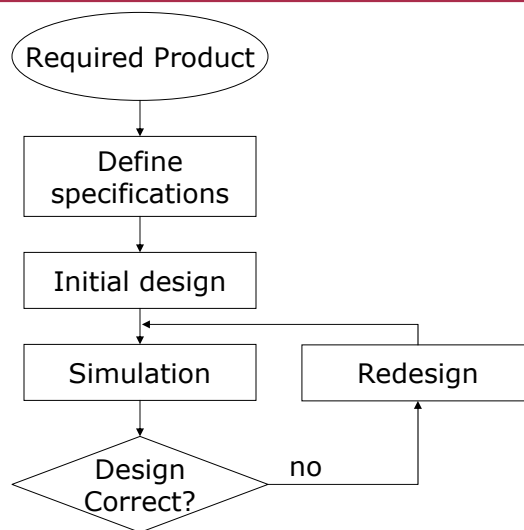
Types of chips

- Custom-designed chips
 - Optimized for a specific task – better performance
 - Larger amount of logic circuitry
 - Cost of production is high
 - Large volume required to justify cost

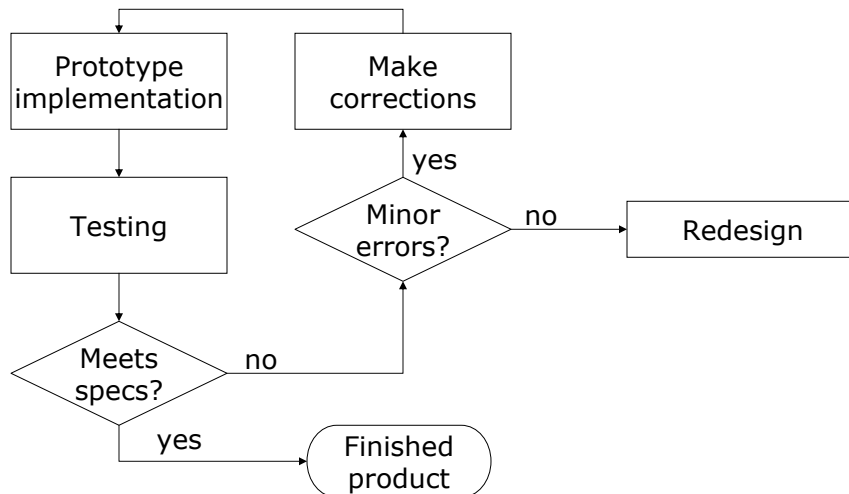
A field-programmable gate array



The development process (1)



The development process (2)



What should you expect to gain from this course?

- Understanding of concepts, models, algorithms and processes for digital logic design
 - Relevance of the material to subsequent courses and to your career
- Problem solving skills
 - Formulating and attacking new problems
 - Need to struggle with problems – evolve your problem solving skills
- Communicate solutions in a clear, concise manner