ECE380 Digital Logic

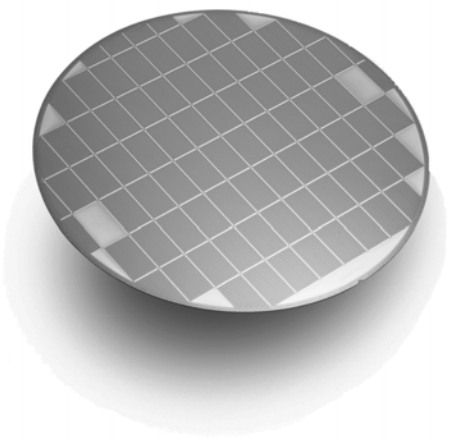
Introduction

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



Complexity in a digital design

- Complexity can, and generally does, surpass human capability
  - 10-100 million transistors/cm^2 now
  - 100-1000 million transistors/cm^2 in 10 years (?)
  - http://en.wikipedia.org/wiki/Transistor_count
- 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

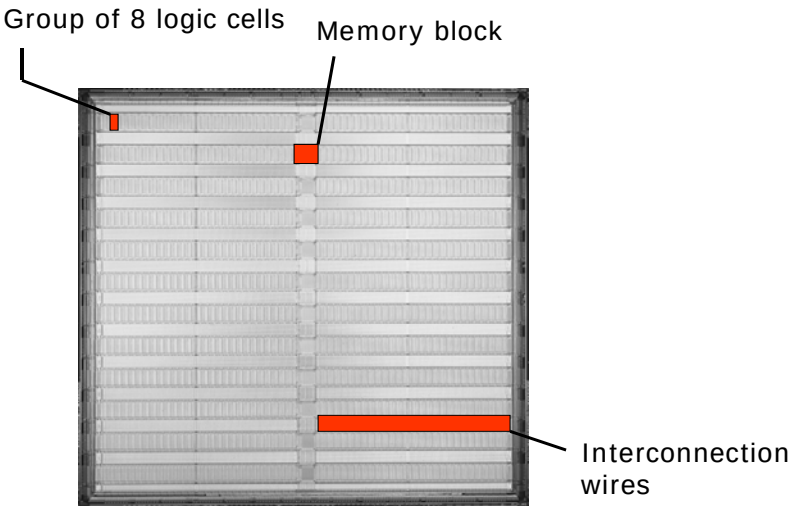
Types of chips

- Standard chips
  - Contain a small amount of circuitry (<100 transistors)
  - Performs simple functions
  - 7400 series devices
    - http://en.wikipedia.org/wiki/7400_series
- Programmable logic devices (PLD)
  - Collection of gates with programmable interconnections
  - Function is configurable by designer/user
  - Design with PLD is via a CAD tool
- Complex Programmable Logic Devices (CPLD)
- Field Programmable Gate Arrays (FPGAs)

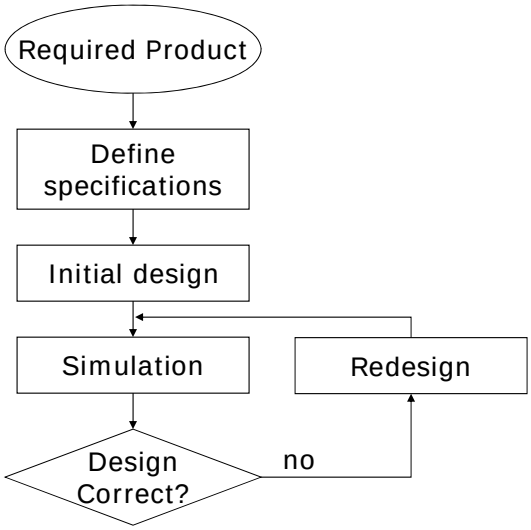
Types of chips

- 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

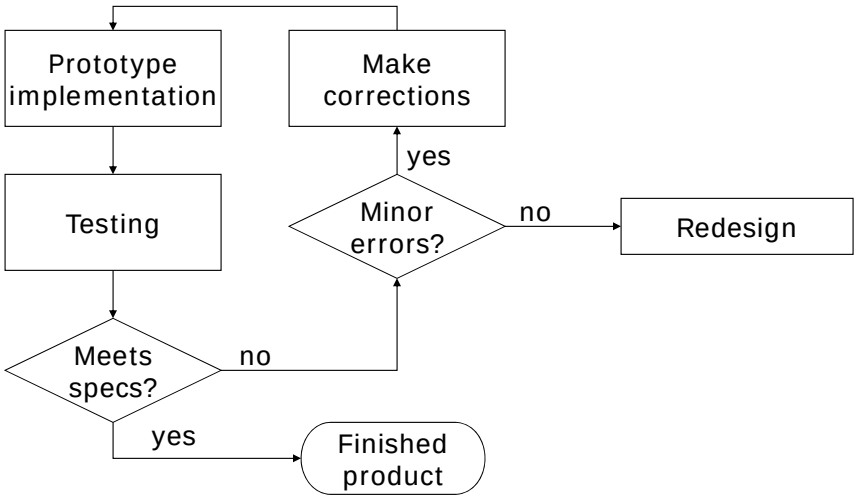
A field-programmable gate array



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