Area 5: Computer Hardware

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Courses

- Kernel Course
  - ECE342: Computer Hardware
- Technical Electives
  - ECE532: Digital Systems Design
  - ECE552: Computer Architecture
  - ECE451: VLSI Systems and Design

What is computer hardware?

- Complex components working together
  - How do you build them?
  - How do you interface them together?

What will you learn in ECE342?

- How to create complex logic circuits
- How to implement interfaces
- How to implement algorithms as hardware circuits
- How to build Embedded Systems
- How to analyze asynchronous circuits
- How to test and debug your work

How will you learn in ECE342?

- Fundamentals explained in lectures
- Practical laboratory exercises

What is Digital Systems Design (ECE532)?

- A system comprises many interacting components of hardware and software

- A chip with many types of processing elements and interfaces
- A circuit board with many chips
- A box with many circuit boards

What is in ECE532

- A practical follow on to ECE342 (a prereq)
- Utilize knowledge in hardware design, computer architecture and often some application area (e.g., DSP, image processing) that will use your system
- Provided an FPGA board + tools
  - Build a working system that must have at least one embedded processor and one custom hardware block of your own design
  - Utilize any other blocks and software you find
- Lectures support projects and cover other advanced high-speed design concepts not utilized in the projects

What is Computer Architecture (ECE552)?

- Selecting and interconnecting hardware components to create computers that meet functional, performance and cost goals
  - Functional: ECE243
  - Performance: ECE552
- Design of modern, high performance processors
  - Leveraging growing transistor counts
- Design of parallel processors
- Power and energy considerations in modern architectures

What is in ECE552?

- Lecture covers a range of topics
  - Uniprocessor architectures
    - Pipelining, branch prediction, dynamic scheduling
  - Memory system
    - Cache hierarchies
  - Multi-core processors
    - Cache coherence, synchronization, memory consistency
- 6 Labs
  - Implement advanced architecture techniques in a performance simulator
  - Exposure to cutting-edge research

What is VLSI Systems and Design (ECE451)?

- Design and implementation of VLSI circuits for complex digital systems
  - Focus on CMOS technology
- Covers
  - Deep submicron design
  - Clocking
  - Power dissipation
  - CAD tools and algorithms
  - Simulation, verification, testing and design methodology

ECE451 (cont)

- Course contains 6 labs
  - Use Micromagic, Cadence and Synopsys CAD tools
  - Design and layout a CMOS adder circuit
  - Design and layout a 4-bit microprocessor
    - Datapath using a custom approach
    - Control using a standard-cell approach

Opportunities enabled by Area 5

- Potential employers
  - Intel, AMD, Altera, Xilinx, Qualcomm, nVIDIA, start-ups, etc
- Graduate school
  - Research in Computer Architecture, FPGAs, Digital and embedded systems
- Complements Area 6: Computer Software