ENGN1640: Design of Computing Systems
Topic 00: Class Overview

Professor Sherief Reda
http://scale.engin.brown.edu
Electrical Sciences and Computer Engineering
School of Engineering
Brown University
Spring 2019
Custom versus Programmable HW

**ENGN 1630: Hardware**
(Application Specific Integrated Circuits)

Advantages:
• very high performance and efficient

Disadvantages:
• not flexible (can’t be altered after fabrication)
• expensive

**ENGN1640: Software-programmed processors**

Advantages:
• Hardware can run man programs
• software is very flexible to change

Disadvantages:
• performance can suffer
• fixed instruction set by hardware
Computing systems in general

- Computing has evolved from its mainframe and personal origins to being embedded and ubiquitous.
Objectives of computing system design

• Performance
• Power
• Cost
• Flexibility
• Reliable
• Secure

Exact design objectives depend on the context and intended field of deployment
1. Evaluating computing systems: performance, power, cost
2. Trends and current bottlenecks in computing
Topic 02. FPGAs and HDL for labs

• Learn basics of programmable logic
• Learn how to use design and simulation tools
• Learn a popular hardware definition language (HDL) Verilog
• Lab incorporated in most class topics
• Instruction set architecture design (ISA) choices
• Principles of instruction set design
• ISA classifications and trade-offs
• Encoding and assembly language
• Examples of assembly languages
• Scalar processor design
• Pipelined processor design
• Hazards and hazard elimination techniques
• Labs will develop and boot a real processor
Topic 05. Advanced processor design

- Vector instructions
- Superscalar processors
- Multi-threading and multi-core processors
Topic 06. Memory hierarchy

- Memory hierarchy design
- Cache memory organizations
- Memory technologies: SRAM (cache), DRAM, Flash
- Virtual memory
Topic 07. Input / Output

- Communication between processor, memory and I/O devices
- Interrupts and interrupt handling
- Direct Memory transfer
Prerequisites:

- ENGN1630: digital logic design: binary numbers, combinational circuits, arithmetic circuits, sequential circuits.

- Or Pass the digital logic evaluation quiz

Course Book:

Website: http://scale.engin.brown.edu/classes/EN164S19/

OHs: Tu 3:30-5:30pm in B&H196 or B&H349.
Grading and logistics

• **Grading philosophy**: class is about design and better designs should get higher grades.

• HWs / Labs are always due on Fridays at 12 pm.

• HW or lab collaborations are not allowed unless stated otherwise.

- NOT ALLOWED: not permissible collaboration or copying from colleagues or internet sources → Any detected similarity is a violation of academic code → code committee.

- Distractions (e.g., laptops, tablets) are not allowed during lecture except with permission.
Examples of allowed & not-allowed lab discussions

• Allowed discussions should be centered on essential or common factor lab issues. Examples:
  – Where is that menu option to determine the pin locations?
  – Do you know what does this error message mean?
  – Do you remember the name for command that does …?
  – How can I prepare my project archive?

• Discussions on lab design **choices** are NOT allowed:
  – Did you design a 2-stage or 3-stage pipeline?
  – How did you manage to get your design so fast?
  – How many elements of the internal memory did you use?