CS 2190: COMPUTER ORGANIZATION

Semester Hours: 3.0  
Contact Hours: 3
Coordinator: Tianyi Song
Text: Computer organization and design: HW/SW Interface
Author(s): PATTERSON AND HENNESSY
Year: 2014, 5th Edition

SPECIFIC COURSE INFORMATION

Catalog Description:

Course type: REQUIRED

SPECIFIC COURSE GOALS

- I can explain the fundamental concepts of computer organization.
- I can use different data representations.
- I can design basic circuits using logic gates and flip-flops.
- I can utilize an assembler tool to write and execute simple assembly language programs.
- I can explain the data and control hazards in designing instruction sets for pipelining.
- I can explain basic instruction-level parallelism methods.
- I can explain how the different memory units work in the memory hierarchy.

COMPUTER SCIENCE STUDENT OUTCOMES ADDRESSED BY THIS COURSE

- CS 1 Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions
- CS 2 Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program’s discipline
LIST OF TOPICS COVERED

- Overview of Computer Design (0.5 weeks, ~3%)
  - Building blocks
  - Functional point of view
- Data Representations (1.5 weeks, ~11%)
  - Numeric representations
    - Codes, arithmetic, addition/subtraction, 2's complement, floating-point numbers
  - Character representations
- Assembly language (2.0 weeks, ~14%)
  - MIPS assembly language
  - Simulator
- Logic Design (2.0 week, ~14%)
  - Gates, truth tables, logic equations, don't care terms
  - Combinational logic
  - Basic arithmetic logic unit
  - Flip-flop (D flip-flop)
- Instruction Representation (1.5 weeks, ~11%)
  - Operation, operand
  - Instruction format
  - Addressing modes
  - Decision-making
  - Procedure/function calls
- Control & Data Flow (2.5 weeks, ~17%)
  - Structures
  - Control unit
  - Data path, data and control hazards
  - Forwarding, stalls, exception, interrupt
- Introduction to Instruction-level Parallelism (2.0 weeks, ~14%)
  - Multiple-Issues
o Speculation
  o Loop Unrolling

- Memory Hierarchy Fundamentals (1.0 week, ~7%)
  o Memory hierarchies
  o Measuring performance

- Multiple Processor Systems (1.0 week, ~7%)
  o Multicores, multiprocessors; clusters

COMPUTER SECURITY TOPICS

Faculty who recently offered CS 2190 have discussed and identified a list of topics related to computer security in this course. Below is a list for instructors to incorporate. (*) indicates topics that are mandatory.

<table>
<thead>
<tr>
<th>Security Topic</th>
<th>Description</th>
<th>Textbook Reference¹</th>
<th>Estimated Class Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Math (integer) overflows</td>
<td>Examples: adding two positive numbers exceeds the max value causing number to become negative.</td>
<td>Chapter 2.4</td>
<td>1</td>
</tr>
<tr>
<td>*Data as instruction</td>
<td>Generally, computers make no distinction b/w data and instruction - an assembly language program can modify a data location and branch to that location causing the data to be interpreted as an instruction</td>
<td>Chapter 2.5</td>
<td>1</td>
</tr>
<tr>
<td>*Virtual memory</td>
<td>Memory hierarchy and how address translation works.</td>
<td>Chapter 5.7</td>
<td>&gt;1</td>
</tr>
</tbody>
</table>