EE/CSE 469: Computer Design and Organization

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   Office hours: email w/schedule

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Office hours: (EEB-361) up-to-date times on website

Book:

Grading (approximate):
   20% - Homeworks   35% - Design Project   20% - Midterm   25% - Final Exam
Prerequisites

Basic Logic Design and Boolean Algebra
  AND, OR, NAND, NOR gates
  Boolean Algebra
  D flip-flops, registers, and memories
  Binary numbers, 2’s complement, negation, overflows

Verilog

C/C++/Java programming

If you don’t know this material, DO NOT TAKE THE CLASS

If you don’t remember this material, REVIEW NOW.
Joint Work Policy

The processor design and homeworks will be done in groups of 1-2. Groups may not collaborate on the specifics of homework or on the projects. All submitted student work must be from their own efforts, and not from any other source. Let me know if you need help forming groups.

OK:
- Studying together for exams
- Discussing lectures or readings
- Talking about general approaches
- Help in debugging, CAD tools peculiarities, etc.

Not OK:
- Developing a design between groups
- Implementing the CPU between groups
- Checking homework answers between groups

Violation of these rules is at minimum:
- Loss of twice the points of that assignment.
- Report of Academic Misconduct to Dean’s Level.
- Potentially fail class, be expelled from UW.
Late Policy

All assignments due by the end of the class period

Late penalties:
-10% for the first 24 hours
-20% for the second 24 hours (total –30%)
-30% for the third 24 hours (total –60%)
-40% for all additional hours (total –100%)
Interaction between hardware and software

- Hardware sets realities, requirements
  - Area, power, performance
- Software places demands on hardware
  - Processor only as good as software it runs

Topics:
- Instruction Set Architecture
- Application
- Operating System
  - Compiler
  - Firmware
- I/O system
- Datapath & Control
- Digital Design
- Circuit Design
- Layout
/* Swap the ith and (i+1)th element of an array */

```cpp
swap(int v[], int k) {
    int temp = v[k];
    v[k] = v[k+1];
    v[k+1] = temp;
}
```

**SWAP:**

```
LSL X9, X1, #3
ADD X9, X0, X9 // Compute address of v[k]
LDUR X10, [X9, #0] // get v[k]
LDUR X11, [X9, #8] // get v[k+1]
STUR X11, [X9,#0] // save new value to v[k]
STUR X10, [X9, #8] // save new value to v[k+1]
BR X30 // return from subroutine
```

```
11010011011 00000 00011 00001 01001
10001011000 01001 000000 00000 01001
11111000010 000000000 00 01001 01010
11111000010 000001000 00 01001 01011
11111000000 000000000 00 01001 01011
11111000000 000000000 00 01001 01010
11111000000 000001000 00 01001 01010
11010110000 00000 00000 00000 11110
```
Computer Organization

Five classic components

Memory: Store instructions, data
Datapath: Perform operations (Add, subtract, …)
Control: Orchestrate operations (who does what when)
Input: Get information from the outside world
Output: Provide results
Execution cycle

- **Instruction Fetch**
  - Obtain instruction from program storage

- **Instruction Decode**
  - Determine required actions and instruction size

- **Operand Fetch**
  - Locate and obtain operand data

- **Execute**
  - Compute result value or status

- **Result Store**
  - Deposit results in storage for later use

- **Next Instruction**
  - Determine successor instruction