EE/CSE 469: Computer Design and Organization

Professor Mark Oskin, mhoskin@uw.edu
Office hours: email w/schedule

TA: Eric Mullen and Xinyu Sui

Book:

Patterson, Hennessy, *Computer Organization and Design: The Hardware/Software Interface – ARM Edition*, 2016, Morgan Kaufmann. (First ARM edition).

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.

Who are you?

53 in EE

2 in CSE

1 sophomore

~ 25 junior, and ~25 senior

Hawaii

Hawaii > LA > Olympia > Whidbey Island

Who am I?

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.

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

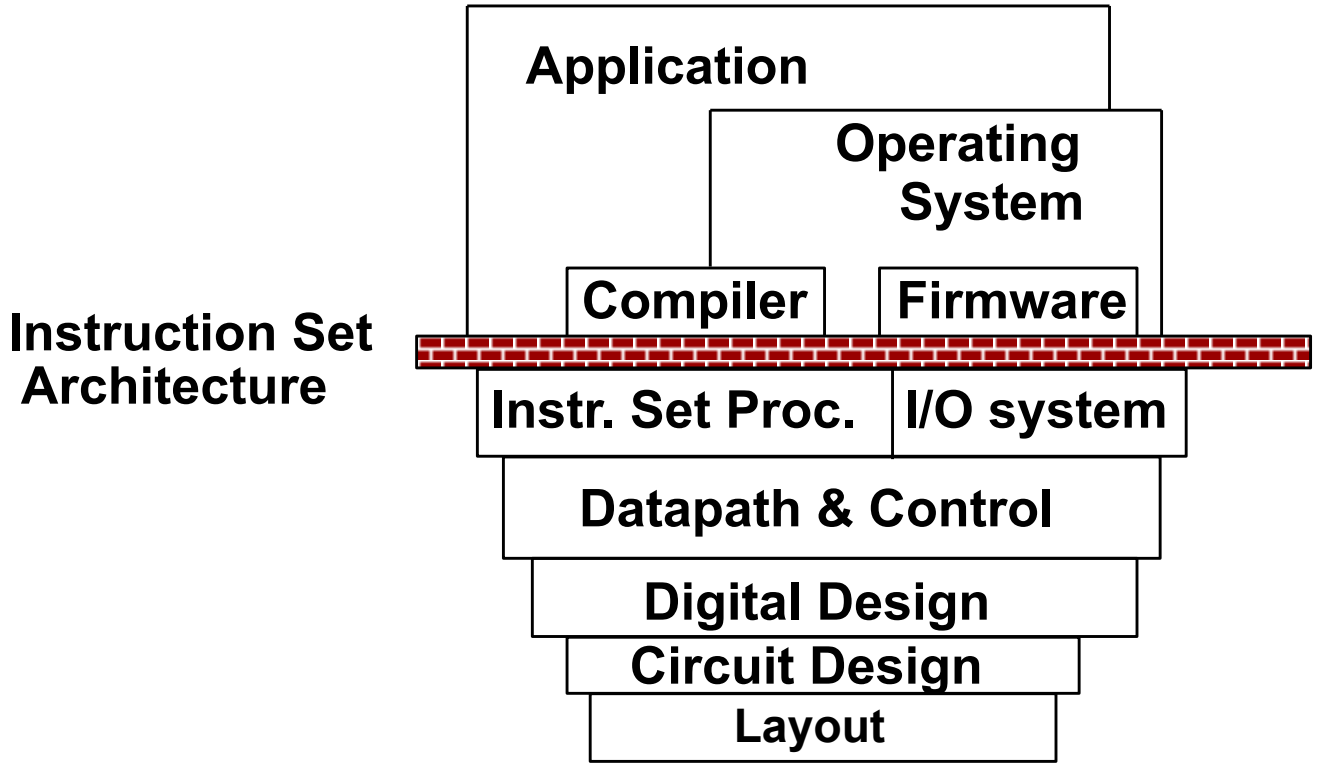
All assignments due by the end of the class period

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%)

Computer Architecture

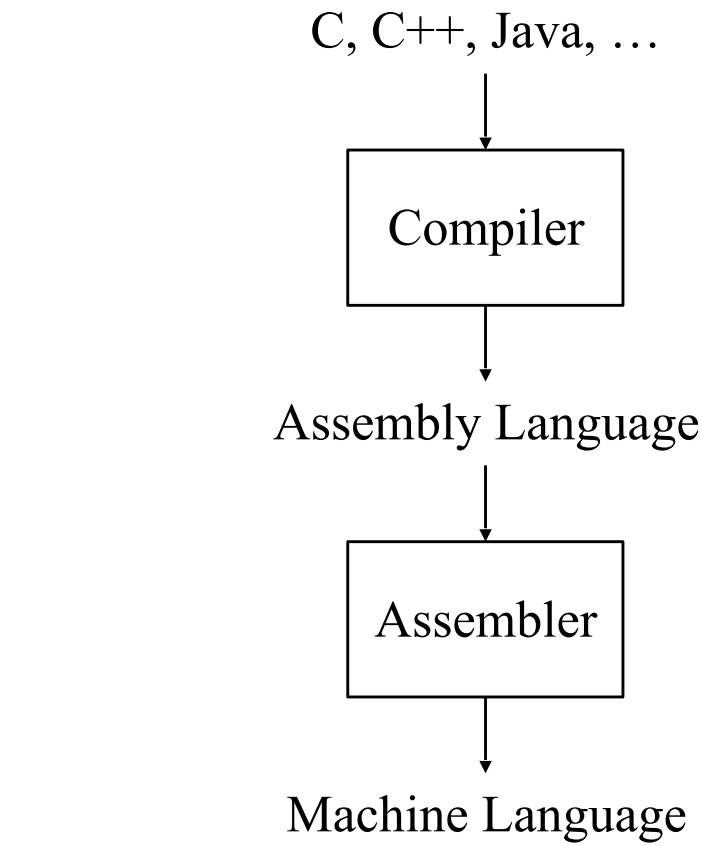
Readings: 1.1-1.4

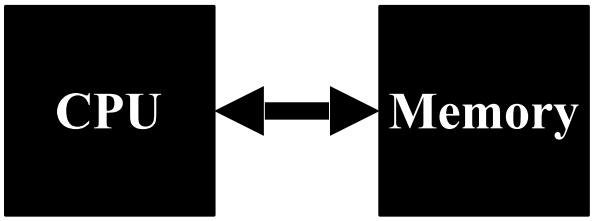


Interaction between hardware and software

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

Implementing Software – The Compilation Process





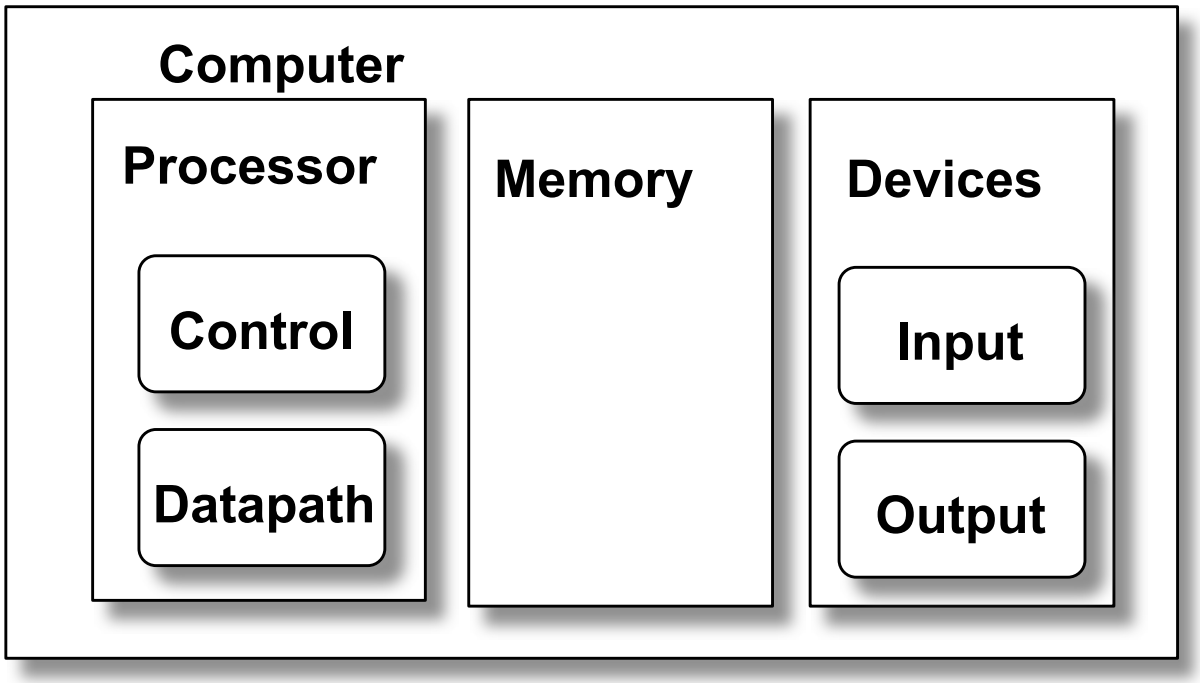

```
/* Swap the ith and (i+1)th element of an array */
swap(int v[], int k) {
        int temp = v[k];
        v[k] = v[k+1];
        v[k+1] = temp;
}

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 000011 00001 01001
10001011000 01001 000000 00000 01001
11111000010 000000000 00 01001 01010
11111000010 000001000 00 01001 01011
11111000000 000000000 00 01001 01011
11111000000 000001000 00 01001 01010
11010110000 00000 000000 00000 11110
```

Computer Organization

Five classic components



Memory: Store instructions, data

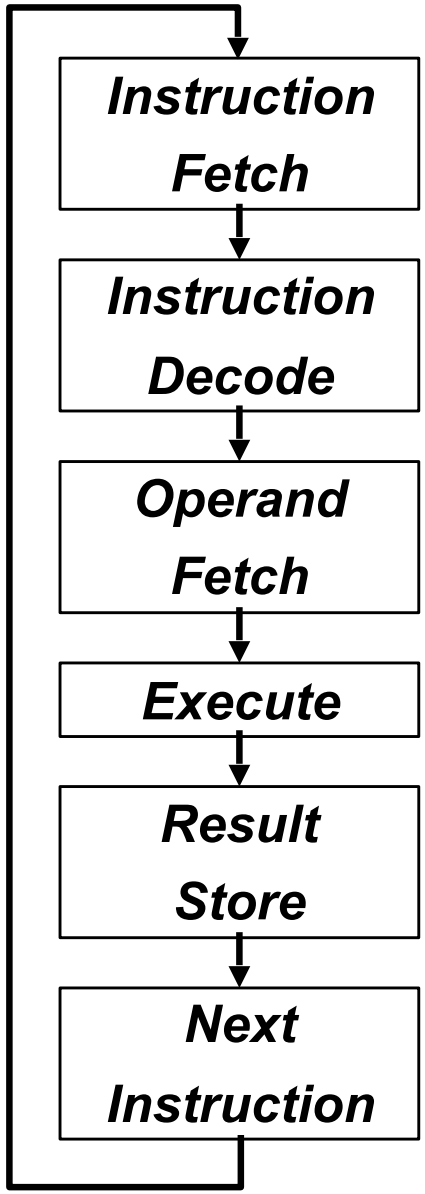
Datapath: Perform operations (Add, subtract, …)

Control: Orchestrate operations (who does what when)

Input: Get information from the outside world

Output: Provide results

Execution cycle



Obtain instruction from program storage

Determine required actions and instruction size

Locate and obtain operand data

Compute result value or status

Deposit results in storage for later use

Determine successor instruction