Introduction to Computer Systems

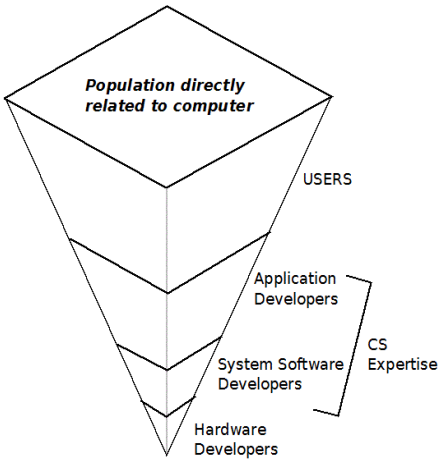
Kaushik Patra
(kaushik.patra@sjsu.edu)

CS47 Objective

- This is a precursor to computer architecture (CS147) study.
  - To be familiar with the architectural components of a computer system: CPU (registers, ALU), memory, buses
  - To be able to convert between decimal, binary, and hexadecimal notations.
  - To work with two's complement integers, floating-point numbers, and character encodings
  - To be able to write assembly programs that use load/store, arithmetic, logic, branches, call/return and push/pop instructions.

  - To understand the gate-level operations of basic ALU

Why Computer Hardware?



- It is an inverted pyramid – less number of people knows the base and larger number knows the top.
- As CS personnel, one will probably land in application development area or system software area.
- Why would someone in CS care about hardware?

3

Why Computer Hardware?

- We have a program to multiply integers by 4 in an array. An implementation is a following. Can we improve the performance?

```
boolean cs147_multiply_by_2(float_array arr) {
        for(int i=0; i<arr.size(); i++) {
                arr[i] = arr[i] * 4.0;
        }
        re
}
```

```
boolean cs147_multiply_by_2(int_array arr) {
        for(int i=0; i<arr.size(); i++) {
                arr[i] = arr[i] * 4;
        }
        retu
}
```

```
boolean cs147_multiply_by_2(int_array arr) {
        for(int i=0; i<arr.size(); i++) {
                arr[i] = arr[i] << 2;
        }
        return true;
}
```

4

Why Computer Hardware?

- Software development without knowledge of hardware is similar to driving a car with manual transmission capability in 'cruise control' mode.
- Programs can be tuned for faster performance with smaller memory footprint and minimized execution error with prior knowledge of the target hardware.
- Debugging of a complex software often requires knowledge of target hardware.
- Often, business decision needs prior knowledge of target hardware.

5

Why Computer Hardware?

- As a subject, understanding of hardware needs background in electrical engineering.
  - For CS study, which can be bit overwhelming and unnecessary.
- However, it is possible abstract out details of the hardware components and operations, which defines:
  - Interface and operational characteristics of individual components.
  - Integration of components into overall system.
  - Implication to program implementation.

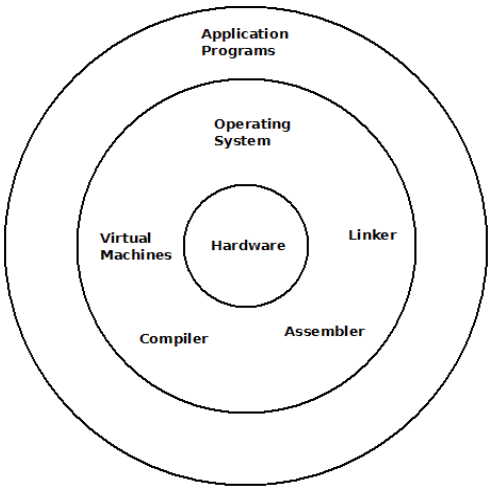
6

Why Computer Hardware?

- Essentially architectural definition of a hardware platform is conceptually equivalent to 'blueprint' used in other engineering field.
- Computer organization / architecture is essentially a handshake between software developers and hardware developers.
- Since computer organization / architecture is a common understanding between software and hardware developers on the target computing platform, it is very much important for a CS personnel to have concept of such common understanding.

7

What to expect?



- As subject, computer science is related directly to application program space and system software space.
- When we write program to solve target mathematical problem, we are cushioned by system software from complicated nature of underlying hardware platform.
- In this course, these cushions will be removed and we'll be exposed to the intricate details of the hardware.

8

What to expect?

- We'll have more hands-on approach to understand this subject in details.
- We'll review basic digital logic.
- We'll review programming perspective of computer system models.

9

The Green Sheet

- The green sheet is available on Canvas system.
- Let's review it …

10

Introduction to Computer Systems

Kaushik Patra
(kaushik.patra@sjsu.edu)