

IC150 Lecture 2

Computer Organisation & Programming

Timothy A. Gonsalves

PSK, NSN, DK – IIT-M, TAG – IIT Mandi

1

Review

Computers:

- Almost everywhere these days
- Banks, shops, railway reservations, internet/web
- Communications, entertainment, information
- Engineering
 - VLSI chip design, machine design (CAD/CAM)
 - Structural analysis of buildings, bridges, etc
 - Process control in manufacturing
 - Control of airplanes, cars, washing machines, doorbells, ...

Life without computers? *Unimaginable!*

PSK, NSN, DK – IIT-M, TAG – IIT Mandi

2

Computer Hardware

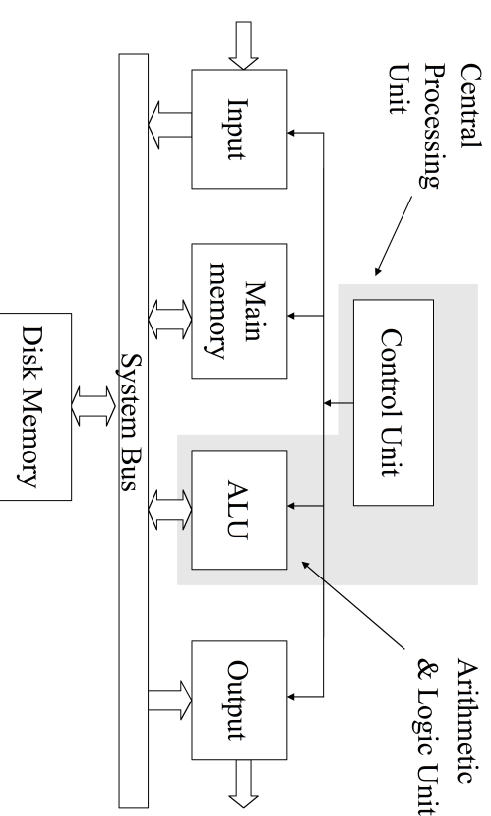
- Memory to store data and programs
- CPU to execute the instructions
- Input and output to interact with the real world
- Peripherals for printing, long-term storage of data, communicating with other computers, etc
- **All the above are interconnected**

PSK, NSN, DK – IIT-M, TAG – IIT Mandi

3

Building Blocks

(Computer Architecture)



PSK, NSN, DK – IIT-M, TAG – IIT Mandi

4

The Blocks, Their Functions

To be useful, a programme must take inputs from the outside world and give back its output

- **Input unit**

Takes inputs from the external world via variety of input devices:
keyboard, mouse, touchscreen
temperature sensors, odometers, wireless devices etc.

- **Output Unit**

Sends information (after retrieving, processing) to output devices:
monitor/display, speaker
projectors, switches, relays, gearbox etc.

More (try *more filename* on your Unix/Linux machine)

- **Memory**

Place where information is stored.

- *Main memory*

Electronic devices, used for temporary storage. Characterized by speedy response (ns).

- *Secondary (Disk) Memory* – Devices for long-term storage.

Contain mechanical components, magnetic storage media – floppies, hard disks, CDs

Compact Disks use optical technology.

Used to store user data (programs, inputs, results etc.), also used extensively during computation.

Low-cost, high capacity but slow (ms).

Some More (Commands are in */bin, /usr/bin*. Use *ls*)

- **System Bus**

Essentially a set of wires, used by the other units to communicate with each other.
transfers data at a very high rate

- **ALU** – Arithmetic and Logic Unit

Processes data - add, subtract, multiply, ...
Decides – eg. after comparing two values

Finally (check *man cp, man mv, man ls, man -k* search string)

- **Control Unit**

Controls the operation of the other units.

Controls the interaction between the other units.

Control Unit + ALU is called the CPU

The CPU

(editors *emacs*, *vi*, *gedit* used to create text)

- Can *fetch* an instruction from memory
- *Execute* the instruction
- *Store* the result in memory
- An instruction has the following structure:
Operation, operands
- Source operand and destination operand may be the same
- A simple operation
add a, b *Adds the contents of memory locations a and b and stores the result in location a*

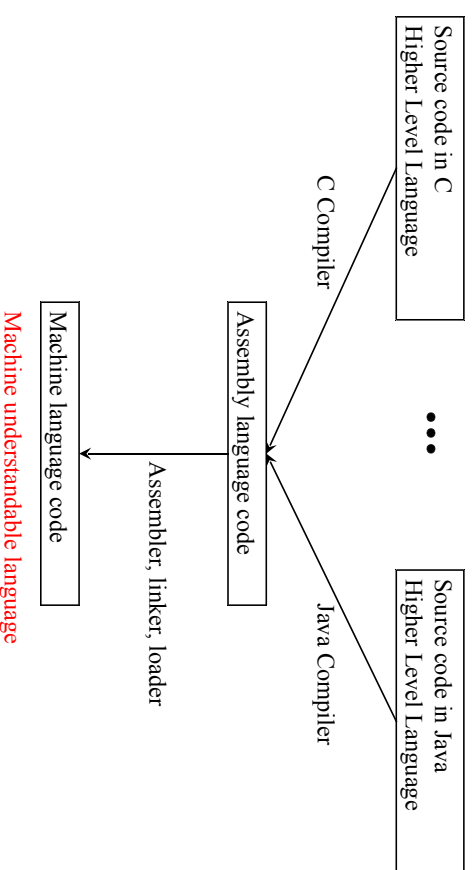
Software

Very critical component in a computer application
Considerable complexity

- large collection of programs
- subdivided into modules with specific purposes
- developed by a team of individuals
- involves - system design, choice of algorithms, choice of data structures, language of implementation, testing, maintenance

Compilers

Human friendly languages → source code



Assembly language

- An x86/IA-32 processor can execute the following binary instruction as expressed in machine language:
Binary: 10110000 01100001
Asm: mov al, 061h
HLL: al = 97;
– Move the hexadecimal value 61 (97 decimal) into the processor register named "al".
– assembly language representation is easier to remember (*mnemonic*)

From Wikipedia

High Level Languages

- High level statement = many assembly instructions
- For example “ $X = Y + Z$ ” could require the following sequence
 - Fetch into R1 contents of Y
 - Fetch into R2 contents of Z
 - Add contents of R1 and R2 and store it in R1
 - Move contents of R1 into location named X
- HLLs can be at many levels

Programs = solutions

- A program is a sequence of instructions
 - *This is from the perspective of the machine or the compiler!*
- **A program is a (frozen) solution**
 - *A program is a representation of a solution (usually) devised by the human. Once frozen (or written and compiled) it can be executed by the computer – much faster, and as many times as we want.*

Programming = Problem Solving

- Software development involves the following
 - A study of the problem (requirements analysis)
 - A description of the desired solution (specification)
 - Devising an actual solution (design)
 - Writing the program (coding)
 - Testing
- The critical part is the solution design:
 - Must work out the steps to solve the problem
 - Analyse the steps
 - Code them into a programming language

Summary

- Computer hardware – blocks to:
 - input from outside world
 - compute and store data
 - output to the world
- Software:
 - Instructions to tell the hardware blocks what to do and when
 - Hardware understands assembly language
 - Programmers prefer to use high level languages