Chapter Two

Introduction

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Topics Covered

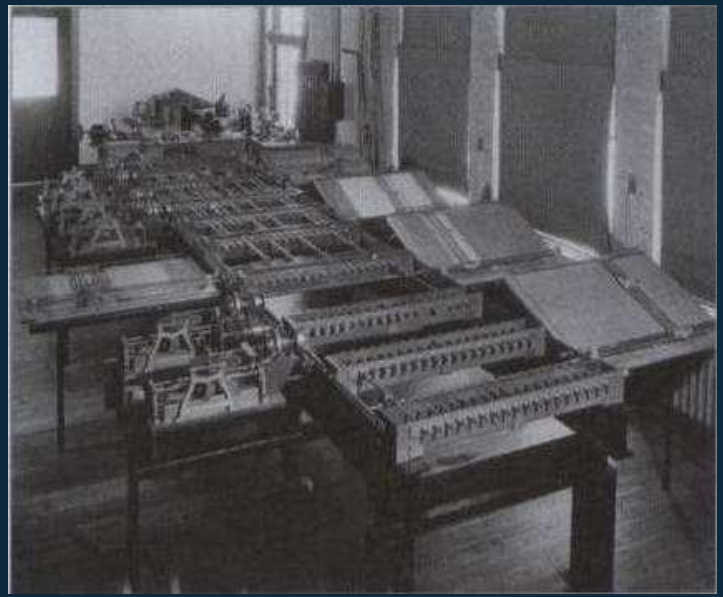
- Generations of Computers
- Milestones in Computer HW & SW Development
- Characteristics and Types of Computers *
- Components of the Computer System
- Software Generations and Evolution

Definition of a Computer

- a general purpose (stored program)
- Programmable (stored program)
- information processor
- with input and output

History of Computers

- Older computers were analog
  - represent data as variable points along a continuous spectrum of values.
  - More flexible but not necessarily more precise and reliable



An early analog computer in the late 1920s

Computer Generations

Generation 0: Mechanical Calculators (relays)

Generation 1: Vacuum Tube Computers Generation

Generation 2: Transistor Computers Generation

Generation 3: Integrated Circuits Generation

Generation 4: Microprocessors Generation

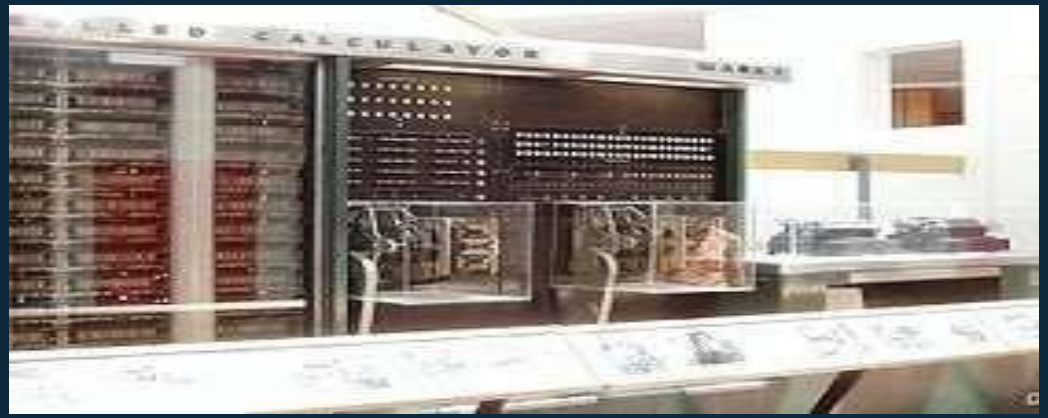
Generation 5: High Speed Networking

:Distributed Computing

Generation of Computers

Generation	Dates	Characteristics
1st	1945-58	Use Valves (Vacuum tubes)
2nd	1959-64	Use transistors (no Valves)
3rd	1965-70	Integrated Circuits & Large Scale Integrated Circuits
4th	1971 - 89	Very Large Scale Integrated Circuits (Microprocessors)
5th	1990 - Under development	Advanced new HW technologies “Artificial Intelligence” based computers

Harvard Mark I Generation 0



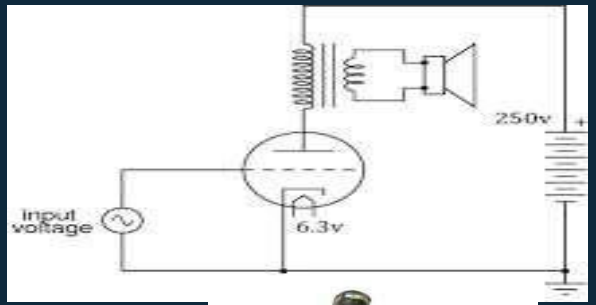
Harvard Mark I (1944)

- Built from Switches, Relays, rotating shafts and clutches
- 765,000 components
- Hundreds of meters of wires
- Volume
  - – Length (51ft) x Height (8 ft) x Depth (2 ft)
- Weight 4500 kg
- Used decimal number systems
- Called Automatic Sequence Controlled

ENIAC (Generation 1)

- 1946 First general purpose (programmable, but need to reconfigure) electronic computer
- Electronic Numerical Integrator and Computer (ENIAC)
- Technology used

– Vacuum tubes	17,468
– Crystal Diodes	7,200
– Relays	1,500
– Transistors	70,000
– Capacitors	10,000
– Hand soldered joints	1 million



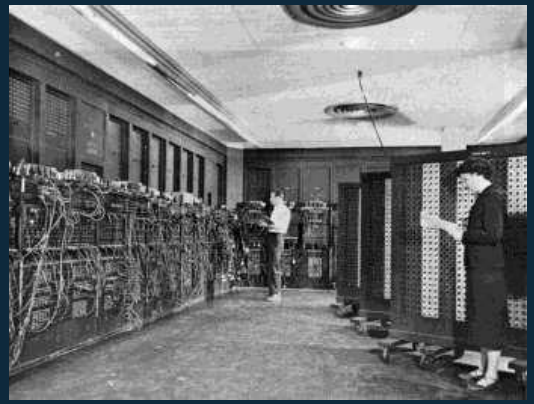
ENIAC Continued

- Weight 30 tons
- Volume 100 ft (L) X 8 ft (H) X 3 ft (D)
- Covers 1800 sq. feet
- Power consumption 150 KW

Uses punch cards

Generation 1 : ENIAC Continued

The ENIAC (Electronic Numerical Integrator and Computer) was unveiled in 1946: the first all-electronic, digital computer



Used machine languages and magnetic tapes

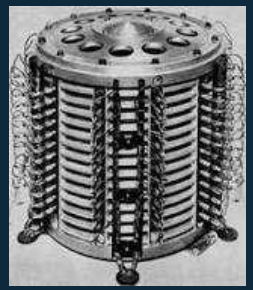
Also used assembly languages at end of generation 1 (transition period)

First Generation Hardware

Vacuum Tubes
Large, not very reliable, generated a lot of heat

Magnetic Drum
Memory device that rotated under a read/write head

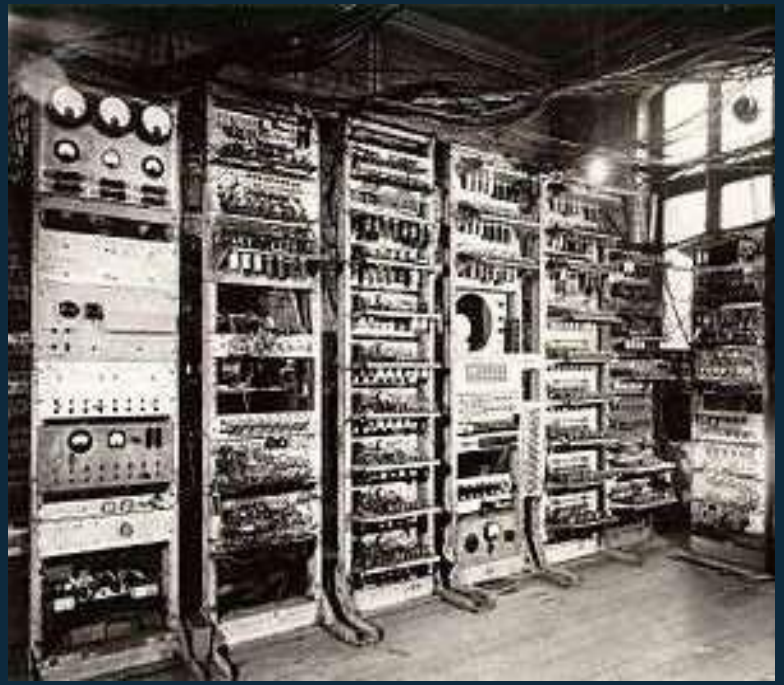
Card Readers Magnetic Tape Drives
Sequential auxiliary storage devices



Magnetic drum

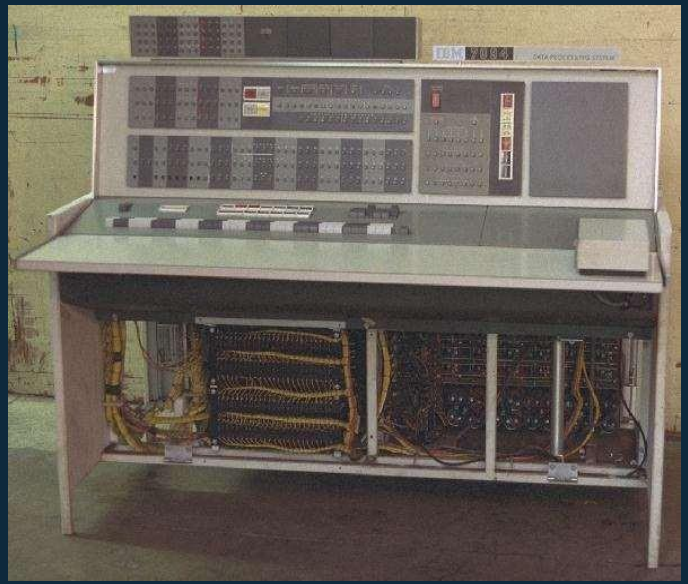
Manchester Mark I

- 1948
- First stored program computer,
- Based on Von Neumann architecture
- Manchester Mark 1 , built in UK. Using valves
- it can perform about 500 operations per second and has the first RAM .
- It fills a room the size of a small office.



- **Generation 1**

Generation 2: IBM7094

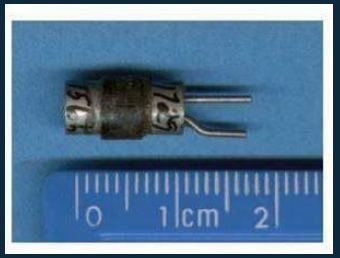


These machines used assembly language.

Second Generation Hardware

Transistors

Replaced vacuum tube, fast, small, durable, cheap, consumes less energy



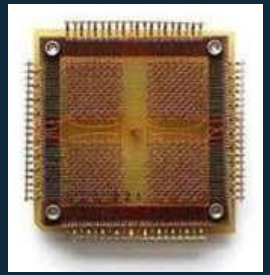
Magnetic Cores

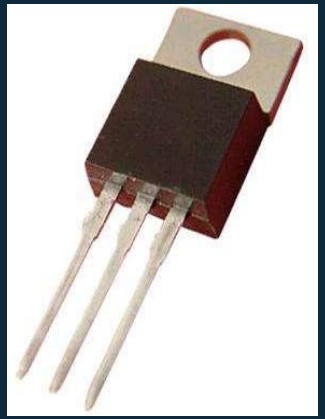
Replaced magnetic drums, information available instantly.

Magnetic Disks

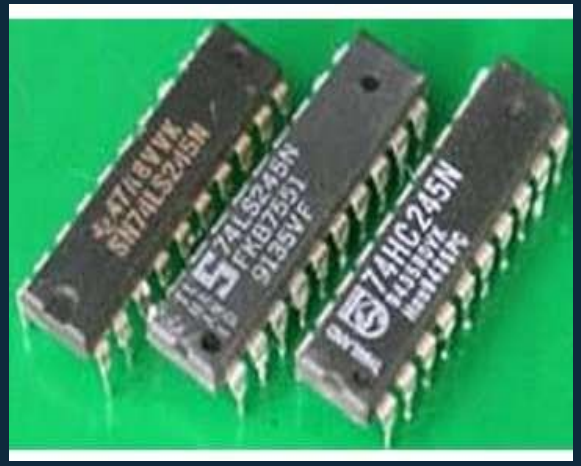
Replaced magnetic tapes, data can be accessed directly

Magnetic core





Generation 3: Integrated Circuits



Seymour Cray created the Cray Research Corporation
Cray-1: $8.8 million, 160 **million instructions per second** and 8 **Mbytes** of memory

Used high level programming languages

Third Generation Hardware

Integrated Circuits
Replaced circuit boards, smaller, cheaper, faster, more reliable

Transistors
Now used for memory construction

Terminal
An input/output device with a keyboard and screen

Generation 4: VLSI

Improvements to IC technology made it possible to integrate more and more transistors in a single chip

SSI (Small Scale Integration): 10 - 1000
MSI (Medium Scale Integration): 1000 - 10,000
LSI (Large Scale Integration): 10,000 - 100,000
VLSI (Very Large Scale Integration): > 100,000

Microprocessors

Fourth Generation Hardware

Very Large-scale Integration
Great advances in chip technology

PCs, the Commercial Market, Workstations
Personal Computers and Workstations emerge
New companies emerge: Apple, Sun, Dell …

Laptops, Tablet Computers, and Smart Phones
Everyone has his/her own portable computer

The Fifth Generation

- Based on Artificial Intelligence (AI).
- Still in development.
- The use of parallel processing and superconductors is helping to make artificial intelligence a reality.
- The goal is to develop devices that respond to natural language input and are capable of learning and self-organization.
- There are some applications, such as voice recognition, that are being used today.

Generation 5?

The term "Generation 5" is used sometimes to refer to all more or less "sci-fi" future and present developments

Voice recognition Artificial intelligence Quantum computing
Bio computing
Nano technology
Low power and Invisible Computers Learning
Natural languages
Parallelism & High Speed Networking (Pervasive & Distributed Computing)

Characterstics and Type of Computers

Characteristics & Types of Computers

Characteristics of Computers

- High Processing Speed
- Accuracy
- Reliability
- Versatility
- Diligence

DILIGENCE : A Computer can work for long hours with the same accuracy and speed because it is free from problems of boredom or lack of concentration.

VERSATILITY: The working of computer with different types of data is known as versatility.

Reliability: Produces the same or identical result repeatedly for the same input

Types of computers

- With respect to physical size, speed, storage capacity, price, and application type

- In terms of size (and in terms of processing capacity)
  - small
  - medium
  - large

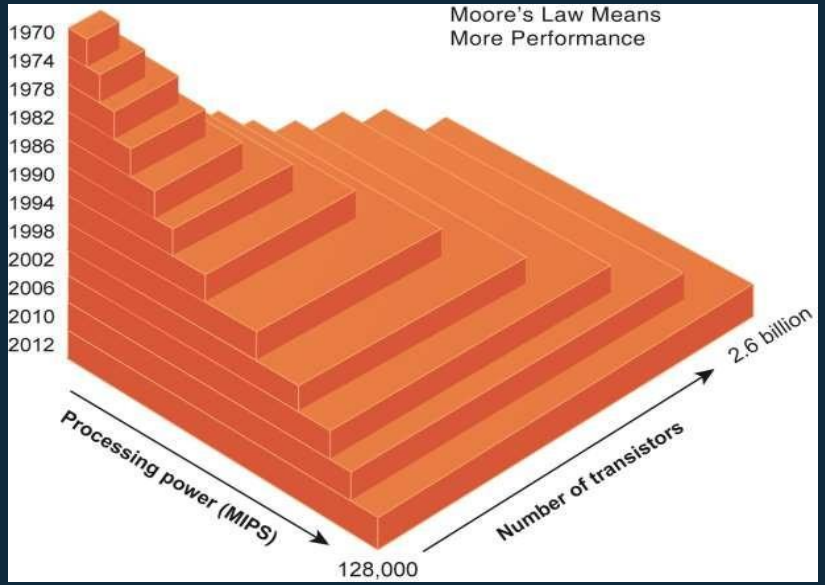
* The details are left as a Reading Assignment

- Microcontrollers (embedded systems)
- Microcomputers
- Minicomputers (Workstations)
- Mainframe Computers
- Super computers

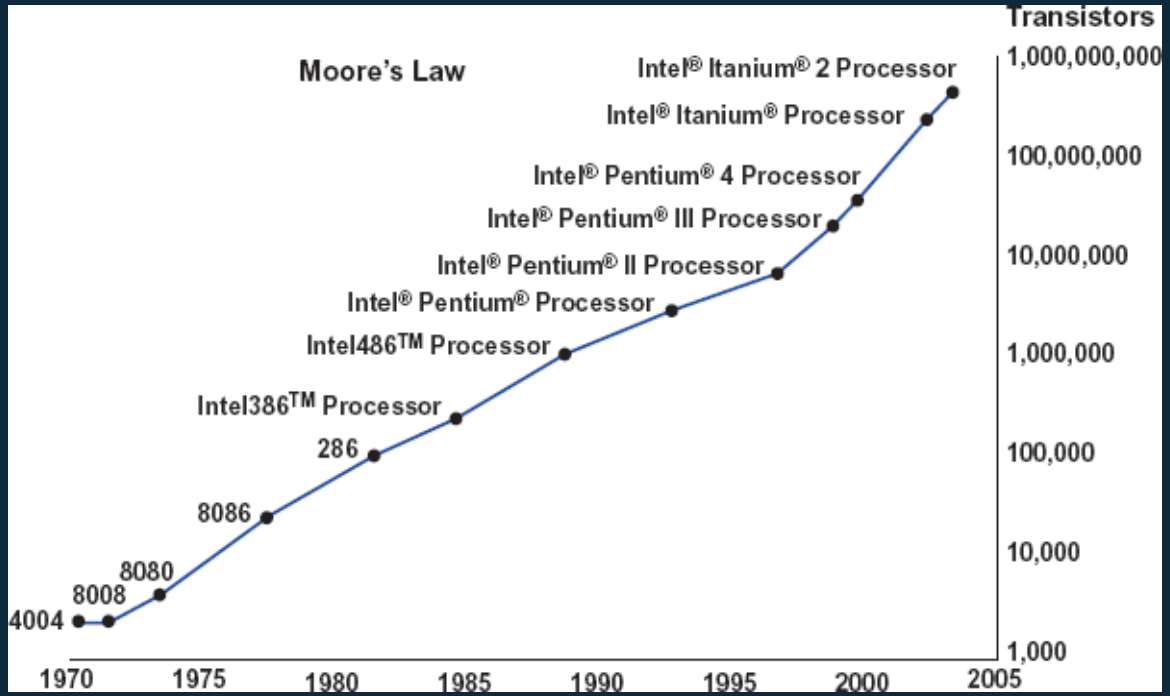
- **Technology drivers of computer HW/SW evolution**
  - **Moore's law and micro-processing power**
    - Computing power doubles every 18 months
  - **Law of Mass Digital Storage**
    - The amount of data being stored each year doubles

MOORE'S LAW AND MICROPROCESSOR PERFORMANCE

- Packing more than 2 billion transistors into a tiny microprocessor has exponentially increased processing power.
- Processing power has increased to more than 500,000 MIPS (millions of instructions per second).



Moore's law suggests that computer power will double every 18 to 24 months. So far, it has.



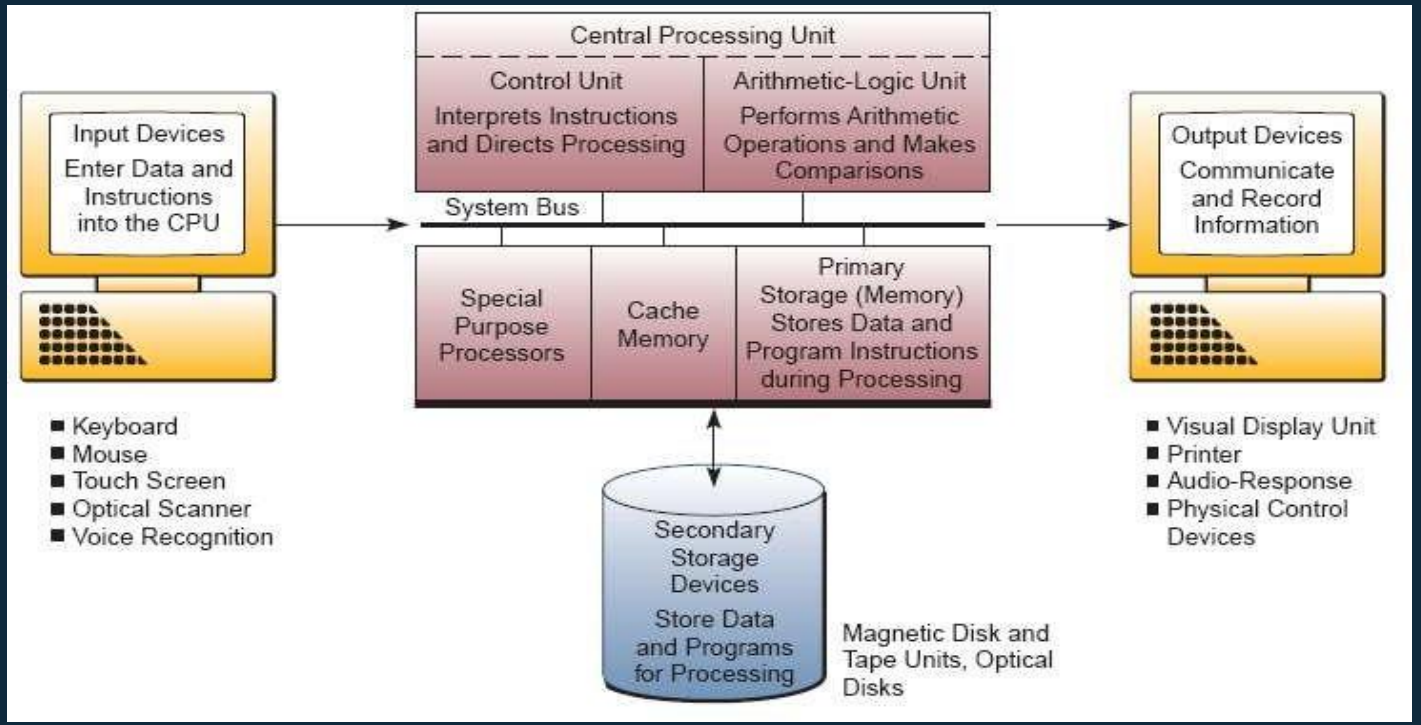
Curve shows transistor count doubling almost every two years

What Hardware Components Contribute to the Speed of a Computer?

Component	Speed measured by	Units	Description
CPU	Clock speed	gHz	The time it takes to complete a **cycle**
Motherboard (Data Buses)	Bus speed & (Bus Width)	mHz *** Bits**	How much data can move across the bus simultaneously**/s**
RAM	Data transfer rate	MB/s **- GB/s**	The time it takes for data to be transferred from memory to system.
Hard Disk	Access time	ms	The time it takes before the disk can transfer data.
	Data transfer rate	MBit/s	The time it takes for data to be transferred from disk to system.

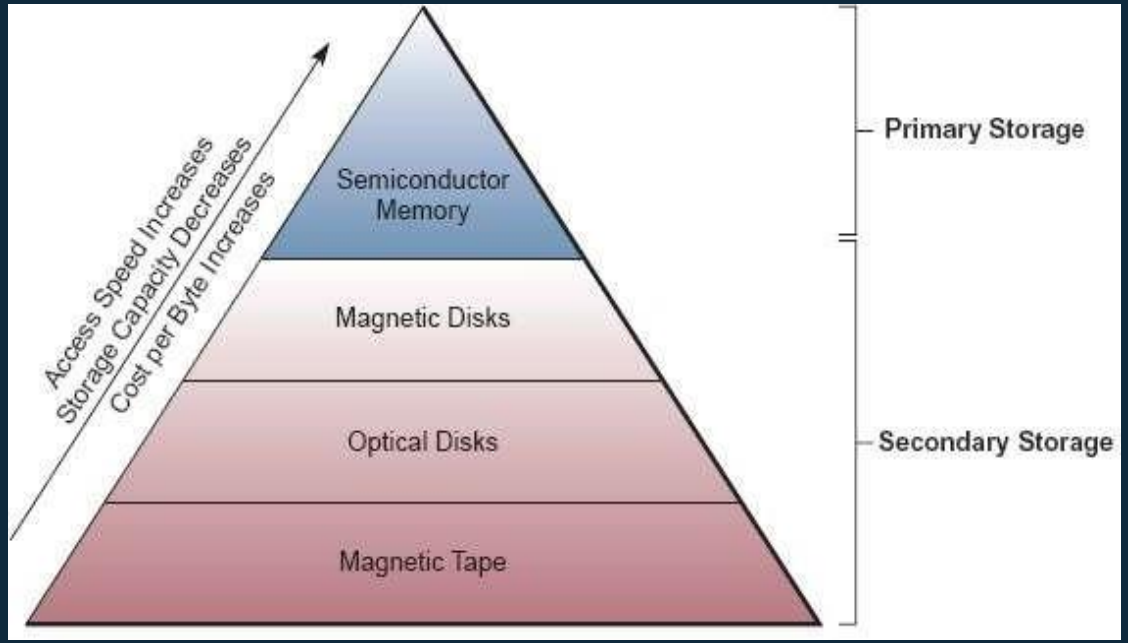
The computer system concept

- A computer is a system of hardware components and functions



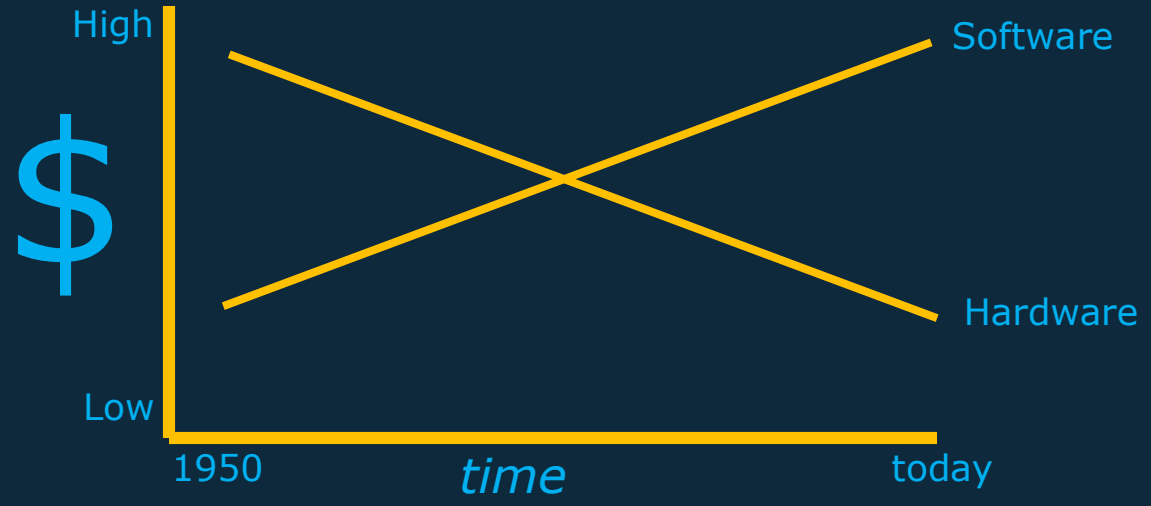
Storage media cost, speed, and capacity trade-offs.

Note : how cost increases with faster access speeds but decreases with the increased capacity of storage media.



Software Generations

Cost against Time graph for Software and Hardware



Why is cost for software always increasing?

Software Generations

- **Software** is the general term for various kinds of programs used to operate and manipulate computers and their peripheral devices

First Generation Software (1951-1959)

Machine Language

Computer programs written in binary (1s and 0s)

Assembly Languages and Translators

Programs translated into machine language

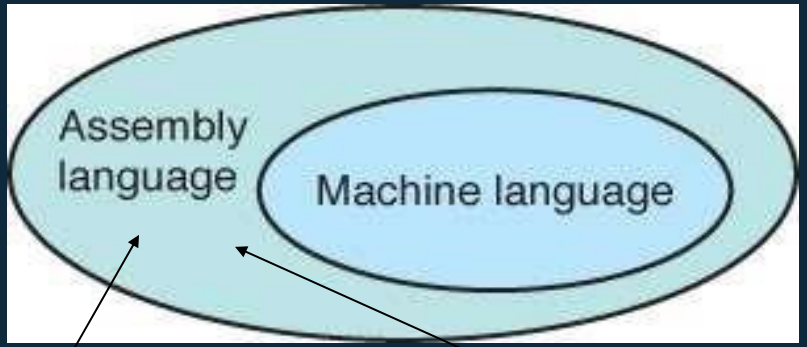
Programmer Changes

Programmers divided into two groups: application programmers and systems programmers

- Computers only for programmers, professionals, expert users
- Not for the general public and novice users (**not affordable and requires skill**)
- Universities, big organizations, military departments were using computers

First Generation Software

Assembly/Machine



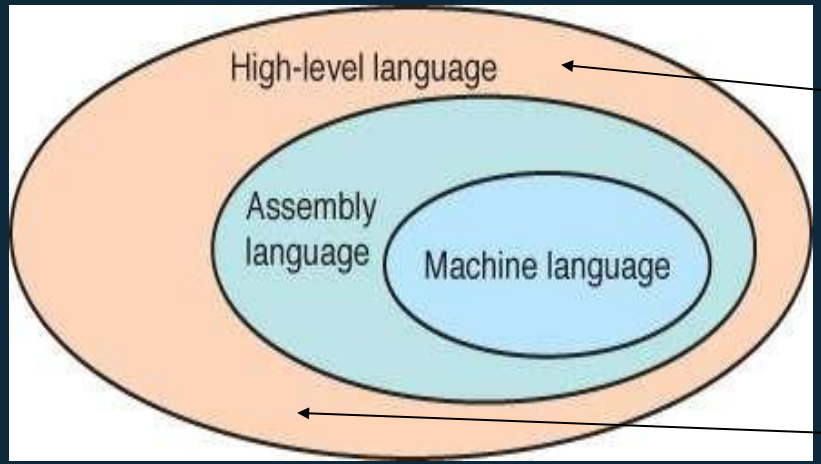
Systems programmers *write* the assembler (translator)

Applications programmers *use* assembly language to solve problems

Second Generation Software (1959-1965)

High-level Languages

English-like statements made programming easier:
Fortran, COBOL, Lisp



Systems programmers *write* translators for high-level languages

Application programmers *use* high-level languages to solve problems

Third Generation Software (1965-1971)

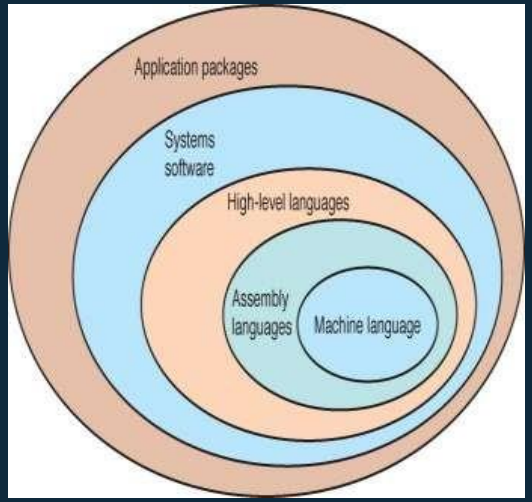
- **Systems Software**
- Utility programs
- Operating system: Decides which programs to run and when, and what resources to be allocated for which programs

Separation between Users

- Computer programmers write programs to be used by other people (i.e., nonprogrammers);
- Computer programmers began to write programs to be used by people who did not know how to program

Third Generation Software Cont... (1965-1971)

- Multi-user and multi-programming
- Real-time
- Databases
- Product software
- WINDOWS



The layers of software surrounding hardware continue to grow

- Control process (Software Engineering attempts)
- Introduction of software houses

Fourth Generation Software (1971-1989)

Structured and OOP Programming

Pascal C++
Java (Some functionalities overlap with fifth generation)

New Application Software for Users

Spreadsheets Word processors
Database management systems

With VLSI came the rise of personal computing
SW & HW Companies like Microsoft, Apple, and IBM were founded

Fourth Generation Software

- Distributed systems (networked systems)
- Low cost hardware (mass production)
- Customer impact
- Global and local area network
- High bandwidth
- **Heavy demand for software developers**

Fifth Generation Software (1990- present)

Microsoft

Windows operating system and other Microsoft application programs dominate the market

Object-Oriented Design

Based on a hierarchy of data objects (i.e. Java and C#)

World Wide Web

Allows easy global communication through the Internet

New Users

Today's user needs no computer knowledge Computer is like commodity

Fifth Generation Software

- Powerful desktop systems
- Object Oriented Technology
- Expert systems
- Artificial Neural Networks (implanted in beings)
- Parallel computing
- Pattern recognition and human like information processing capability
- Knowledge engineering (branch of AI)
- Replacing conventional Software Development approaches