# Operating System
# Session 1

## Hakim Sabzevari University
## Dr.Malekzadeh

# Grading

- Grading:
  - Midterm exam:         35%      <u>14/9/1400</u>
  - Final exam:         35%
  - Project:         30% (Due: max six days after final exam)
  - 
  - 

- Website:
  - piazza.com/hakimcomputer/summer2016/os93

- 

- Textbooks:
  - Operating System Concepts, Abraham Silberschatz (9th Edition)
  - Operating Systems Design & Implementation, Andrew Tanenbaum (3rd Edition)
  - Operating Systems Internals and Design Principles, William Stallings (6th Edition)
  - کتاب پارسه دکتر حقیقت

# Project

- Traffic generators: Iperf vs. Netperf vs. D-ITG
- Performance Monitoring of Various Network Traffic Generators:
- https://core.ac.uk/download/pdf/83123236.pdf.
- Only in Ubuntu or Kali
- No VMware
- Real source and destination
- Real network
- Minimum 3 performance metrics

# Fundamental of operating system
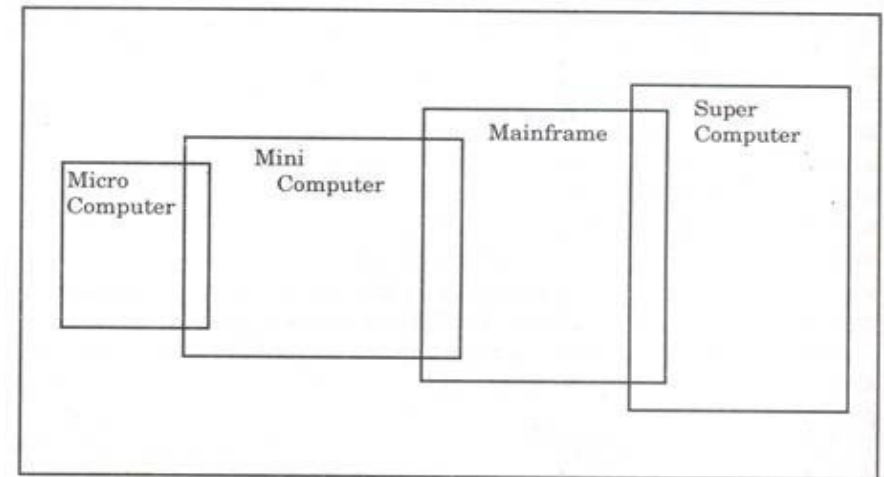
# Types of computer systems

□ Computers can be broadly classified by their speed, use, size, and computing power:

- Microcomputers/PC
- Minicomputer
- Mainframe/Macrocomputer
- Supercomputer



Common areas between two adjoining rectangles represent the fact that the higher end of smaller computer system may have the capacities equivalent to lower end of bigger computer system. For example, a highly configured micro computer may be as good as smaller minicomputer.

13

# Micro-computers

- It is used by <span style="color:red">one user at a time</span> (<span style="color:magenta">single user</span> computer system).
- It has <span style="color:red">moderately powerful microprocessor</span>.
- Microcomputers can be classified as:
  - Desktop computers
  - Laptops
  - personal digital assistant (PDA)
  - Tablets
  - Smart phones
  - Calculators
  - Gaming consoles
  - Navigation system of cars

# Mini-computer

- **Multi-user** computer system. Minicomputer is a **multi-processing** system that can **serve up to 200 computers/users simultaneously**.

- A mini-computer is **larger than a PC** but generally **smaller than a mainframe**.

- Individual departments of a large company or organizations use Mini-computers for specific purposes. For example, a production department can use Mini-computers for **monitoring certain production process**.

# Minicomputer cont…

- Previously, minicomputers were considered to be superior to personal systems. They have also been used as <span style="color:red">main servers for local area networks of microcomputers.</span>

- But these days, advancement in technology has made minicomputers <span style="color:red">almost obsolete</span> because the PCs today are highly advanced.

- Example of minicomputers are:
  - K-202
  - Texas Instrument TI-990
  - SDS-92

16

# Mainframe

- Mainframe computers are large, powerful computers capable of handling processing requests for large numbers of users simultaneously.

- For this reason, banks, educational institutions and insurance companies use mainframe computers to store data about their customers, students and insurance policy holders.

- Traditionally, users would connect to a mainframe using a terminal which is a device that has a screen and keyboard for input and output, but it does not do its own processing (they are also called dumb terminals since they can't process data on their own).
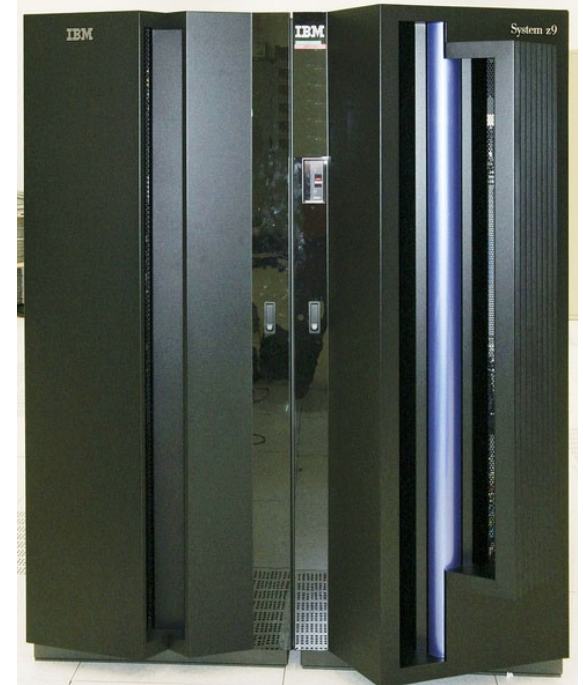
# Mainframe cont…

- The simple example of Mainframe application is automated teller machine (ATM) to interact with the corresponding bank account.

- Another example is POS (point of sale). If we swipe a credit card the information is passed to a mainframe machine via POS to process further.

- Mainframe is used mainly due to its capacity to handle millions of data or transactions per second.

- Example of Mainframe computers ar
  - Fujitsu's ICL VME
  - Hitachi's Z800

MAINFRAME COMPUTER

# Supercomputer

- Supercomputers are very large computers with very large computing power and huge RAM. What distinguishes a supercomputer from the others is the use of massively parallel processing. For example, one supercomputer contains 5800 processors and more than a terabyte RAM.

- They are extremely fast computers, which can perform hundreds of millions of instructions per second. Supercomputers are very expensive and are employed for specialized applications that require enormous amounts of mathematical calculations.

# Supercomputer cont…

- For example, weather forecasting, scientific simulations (molecular modeling), (animated) graphics, petroleum research works, nuclear energy research, crypt analysis, electronic design, and analysis of geological data.

- Some example of supercomputers are:

# Supercomputers; http://www.top500.org/

| Name | Place | CPU number of core | **TFlop/s** |
| --- | --- | --- | --- |
| Stampede | دانشگاه تگزاس | Xeon intel | 5186 |
| shaheenII | دانشگاه ملک عبدالله عربستان (تنها در خاور میانه) | Xeon intel-196608 core | 5537 |
| Hazel hen | دانشگاه اشتوتگارت آلمان | 185,088 | 5640 |
| Piz daint | سویس | NvidiaTesla – 73808 core | 6271 |
| Trinity | آزمایشگاه نیومکزیکو | | 8100 |
| Mira | آمریکا IBM | 786432 | 8596 |
| Kcomputer | فوجیتسو ژاپن | 705024 sparc | 105 |
| Sequoia | آزمایشگاه ملی کالیفرنیا | 1572864 | 17173 |
| Titan | وزارت انرژی آمریکا تنسی | | 17590 |
| Tianhe-2 | دانشگاه ملی فن آوری چین | Xeon phi intel-3120000 | 33862 |

# Performance Metrics of speed

- Rate/ Data rate/Speed: units of work per unit time
- We need to use proper metrics to measure the rate. For example:
  - Frame/second
  - Sample/second
  - Image/second
  - Bit/second
  - Byte/second
  - Millions of bytes/second
  - Instruction/second
  - Millions of instructions
- For example for image processing the instruction/second is not proper but frame/second is better.

# CPU Performance Metrics

□ In order to <span style="color:red">measure CPU speed</span>, there are two metrics:

- Instructions per second (IPS)
- floating point operations per second (FLOPS)

# CPU Performance Metrics: IPS

□ Instructions per second (IPS) is a measure of CPU speed:

- KIPS: thousand instructions per second
- **MIPS**: million instructions per second
- GIPS: Giga instructions per second

□ CPU instruction rates are different from clock frequencies (Hz), as each instruction may require several clock cycles to complete or the processor may be capable of executing multiple independent instructions at once.

# CPU Performance Metrics: OPS

- MOPS: million operations per second
- FLOPS: FLoating-point Operations Per Second
- MFLOPS: Mega  floating-point ops per second
- GFLOPS: Gigaflops
- TFLOPS: Teraflops
- PFLOPS: PetaFLOPS
- EFLOPS: ExaFLOPS  (by 2020)

- The PC performance is measured in GFLOPS.
- The supercomputer performance is measured in TFLOPS.

# Know more!

- KiB, MiB vs. KB, MB

- KiB: kibibytes →kilo binary byte
- MiB: mebibytes → mega binary byte

- It shows the differences between power-of-2 and power-of-10:
    - MiB = Mebibyte = 1024 KiB
    - KiB = Kibibyte = 1024 Bytes
    - MB = Megabyte = 1,000 KB
    - KB = Kilobyte = 1,000 Bytes

# Layers of a computer system

□ Computer system components provide different layers including:

- Hardware: provides basic computing resources (CPU, memory, I/O devices).

- Users: people, other computers

- Software/programs: define how the hardware are used to solve the computing problems of the users.

  □ Application software (e.g., web browser)

  □ System software/utilities/tools (e.g., compiler, linker)

- **Operating system**: controls and coordinates the use of the hardware among the various programs for various users.

# Layers of a computer system cont…
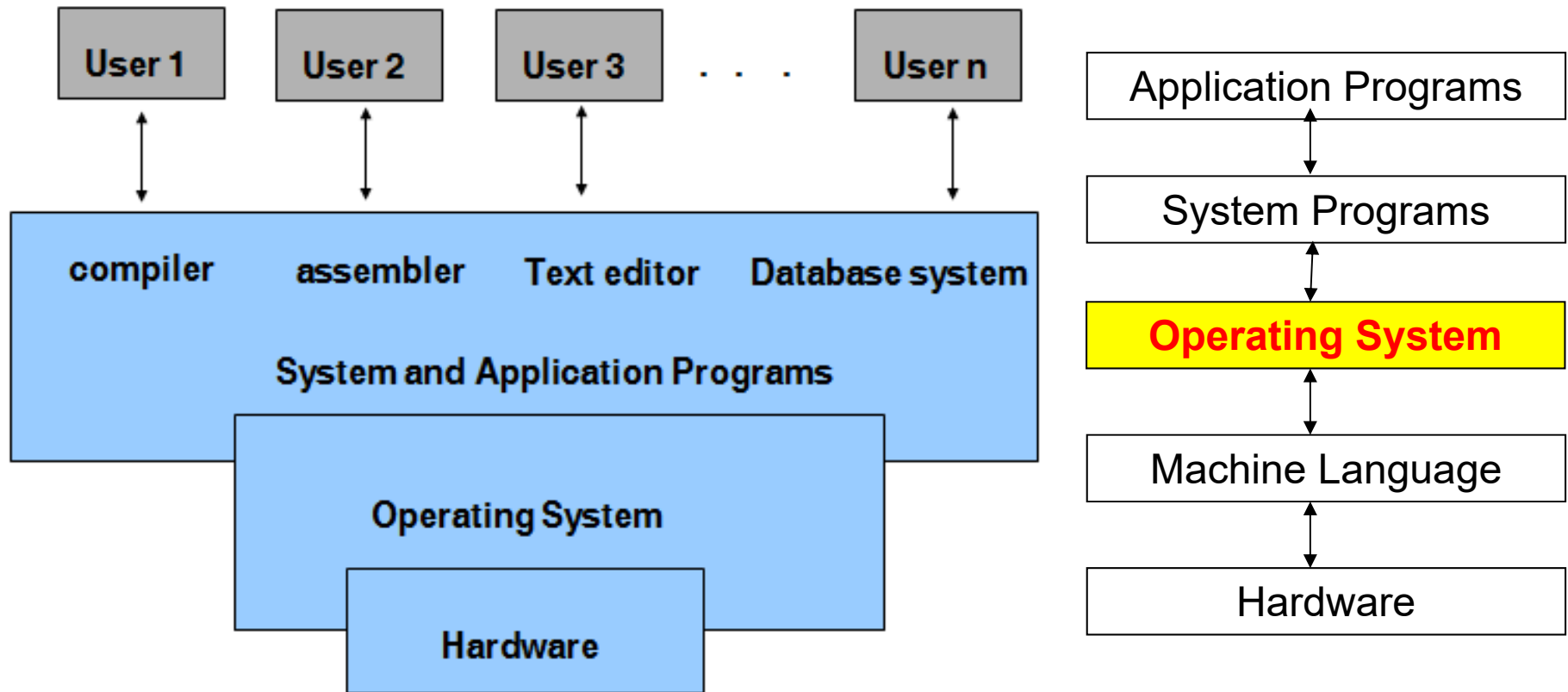
# Operating System definition: user view

□ An Operating System is an interface between user and hardware of a computer system. We need OS due to:

- Convenient and Efficient use of computer hardware resources (GUI)

- Sharing of limited or expensive physical resources.
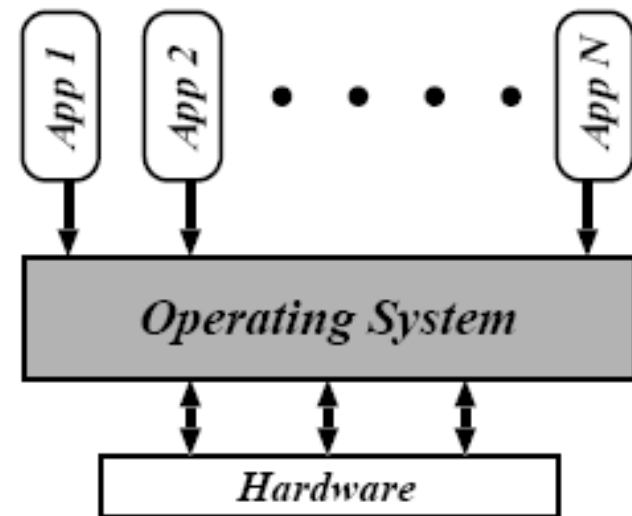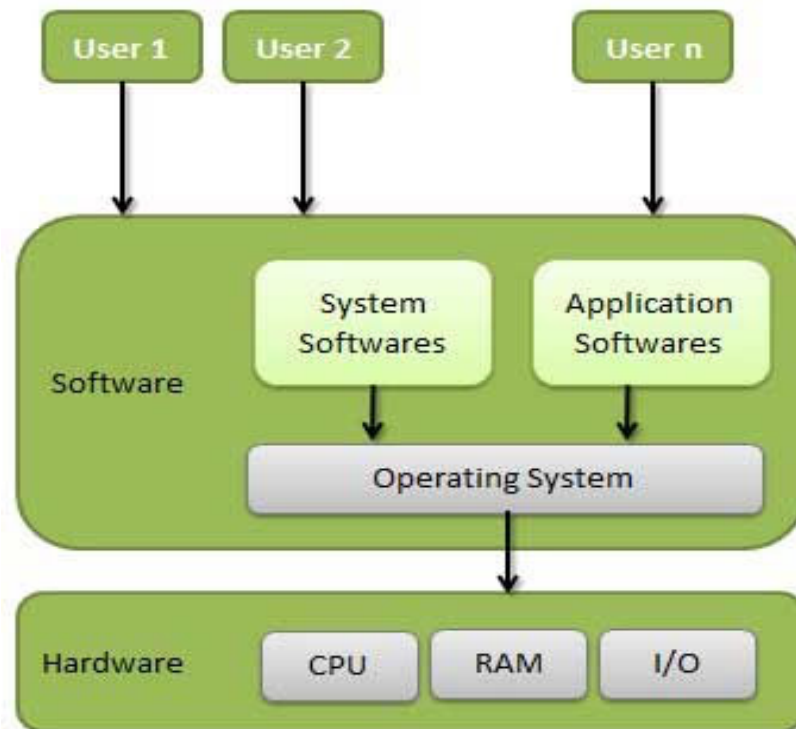
# Operating System definition: system view

- Operating system controls and coordinates (هماهنگ) the use of resources among various computer programs for various users.
  - Resources: can be
    - Physical: CPU, memory, I/O devices (storage, modem, monitor, etc.)
    - Logical: files, data
  - Control (Control Program): OS controls the execution of programs to ensure proper use of the hardware resources and to prevent errors.
  - Coordination (Resource allocator): OS acts as a manager of underlying resources and allocates/de-allocates resources efficiently and fairly.
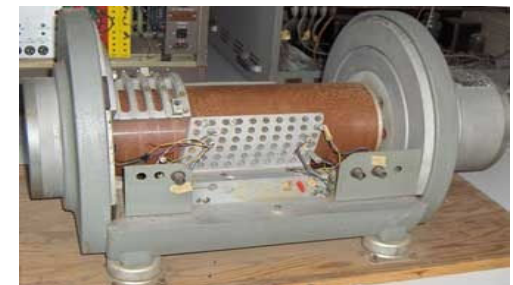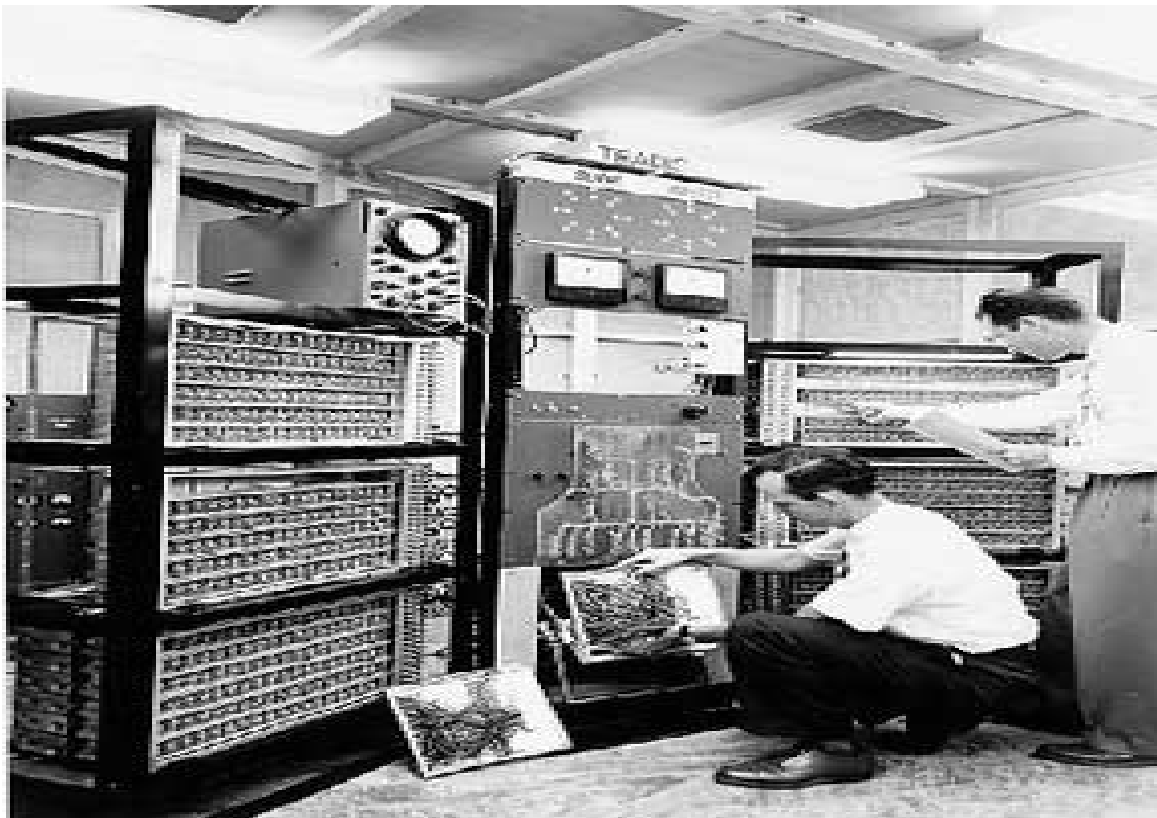
# Know more! API

- Through an application program interface (API), an application program can communicate with the operating system and make requests for the services provided by the operating system.

- The API defines the correct way for a developer to write a program that requests services from an OS or other applications.

# Evolution of Operating Systems

- Computer Generation in computer terminology is a change in technology a computer is used. Initially, the generation term was used to distinguish between varying hardware technologies. But nowadays, generation includes both hardware and software, which together make up an entire computer system.

- There are totally five computer generations:

# First Generation (1945–55); Vacuum Tubes and Plug-boards

- The vacuum tubes (لامپ خلا) used as primary electronic components.
- The magnetic drums (استوانه) implemented as memory units.
- The magnetic tapes implemented as secondary storage media.

# First Generation cont…