Early history
-1940s to 1950s

- 1940: the earliest electronic digital computers did not include operating system. Machines of the time were so primitive (ancient).
- 1950: the systems generally executed one job at a time. A job constituted the set of program instructions. These computers were called single-stream batch-processing systems. The operating systems reduced inter job transition times; programmers were required to directly control system resources.

- The 1960s

- It is also called the batch processing systems but using resources more efficiently by running several jobs at once.
- The systems improved resource utilization by allowing one job to use the processor while other jobs used peripheral devices.
- Processor bound job or compute bound job means jobs that mainly used the processor.
- I/O bound job means mainly used peripheral devices.
- Multiprogramming: systems that managed several jobs at once. The operating system rapidly switches the processor from job to job. Degree of multiprogramming or level of multiprogramming indicates how many jobs can be managed at once. Resources are shared among a set of processes.
- Interactive users: communicate with their jobs during execution via dumb terminals which were online.
- Timesharing: systems were developed to support simultaneous interactive users.
- Real-time systems: attempt to supply a response within a certain bounded time period.
- Virtual machine (VM) operating system: these systems were designed to perform basic interactive computing tasks for individuals, but their real value proved to be the manner in which they shared programs and data and demonstrated the value of interactive computing in program development environment.
- Process: to describe a program in execution in the context of operating system.
- Concurrent processes: execute independently but multiprogrammed systems enable multiple processes to cooperate to perform a common task.
- Turnaround time: the time between submission of a job and the return of its results, was reduced to minutes or seconds.

- Virtual memory: programs are able to address more memory locations than are actually provided in main memory, also called real memory or physical memory.

- 1970s

- The systems were primarily multimode multiprogramming systems that supported batch processing, time sharing and real-time applications
- Personal computers posted by early and continuing developments in microprocessor technology
- Communications between computers in local area networks (LANs) was made practical and economical by the Ethernet standard
- Security problems increased with growing volumes of information passing over vulnerable communications lines. Encryption received much attention

-1980s

- It was the decade of the personnel computers and the workstation
- Software such as spreadsheet programs, word processors, database packages and graphics packages
- Personnel computers proved to be easy to learn and use partially because of GUI(windows, icons, menus)
- Distributed computing became wide spread under client/server model. Clients request services and servers perform the requested services
- The software engineering field continued to evolve

-The 1990s

- Operating system designers developed techniques to protect computers from attacks
- Microsoft became the dominant in the 1990s. In 1981 Microsoft released DOS operating system. 1n the mid 1980 Microsoft developed its windows operating system, and then in 1990s released windows 3.0. 1993 release of Windows 3.1. After, that Windows 95, Windows 98, Windows NT, and Windows XP.
- Object technology: each software object encapsulates a set of attributes and methods. This allows applications to be built with components that can be reused in many applications. In object-oriented operating system objects represent components of the operating system and system resources. Object-oriented concepts were exploited to create modular operating system that were easier to maintain
- Open-source movement: open-source software is distributed with the source code, allowing individuals to examine and modify the software before compiling and executing (Linux operating system)

- Operating system became increasingly user friendly (GUI features)

-2000 and beyond
- Middleware: is a software that links two separate applications to communicate and exchange data via the internet
- Massive parallelism: number of systems has large of processors so that many independent parts of computations can be performed in parallel.
- Computing on mobile devices which are used for e-mail, web browsing

-application bases
- The operating system provides a series of application programming interface (API) calls which applications programmers and other operations use to accomplish detailed hardware manipulations and other operations. API provides system calls by which a user program instructs the operating system to do the work.

Application base is the combination of the hardware and the operating system environment in which applications are developed

−operating system environment
- Embedded systems are characterized by a small set of specialized resources that provide functionality to devices (phones). In embedded environments, efficient resource management is the key to building a successful operating system
- Real-time systems require tasks to be performed within a particular time frame. Real-time operating system must enable processes to respond immediately to critical events. Soft real-time systems ensure that real-time tasks execute with higher priority. Hard real-time system guarantee that all of their tasks complete on time
- Virtual machine (VM) is a software abstraction of a computer that often executes as a user application on the top of the native operating system. VM tend to be less efficient than real machines because they access the hardware indirectly or simulate hardware that is not actually connected to the computer. This increases the number of software instructions required to perform each hardware action
- Portability is the ability for software to run on multiple platforms

Definition of Operating System (OS)   ch.1

OS is a set of programs that controls effectively the computer resources and makes them conveniently available to users i.e. easy to use. OS is rather complicated software and hence designed usually by professional software companies and sold with computer system as part of it. During computer operation, some basic OS programs (Called OS Core or Kernel) are resident in main memory while others are stored on hard disk and loaded into memory when needed.

O/ S goals

1-   The primary goal of an o/s is to make o/s convenient to use
2-   A secondary goal is to use the computer H/W in an efficient manner.
3-   Provide a connection between the user and computer resources.

Computer System Components

An o/s is an important part of almost every computer system . A computer system can be divided roughly into four components.

1-   The hardware (CPU, Memory , I/O devices) .
2-   Operating system(O/S).
3-   Application programs(Assembly , Database compiler text , Editor)
4-   Users

| User 1 | User2 | User3 | ....➔ | User n |

| Compiler   Assembly   text editor   database system |

System and application programs

Operating system

Computer hardware
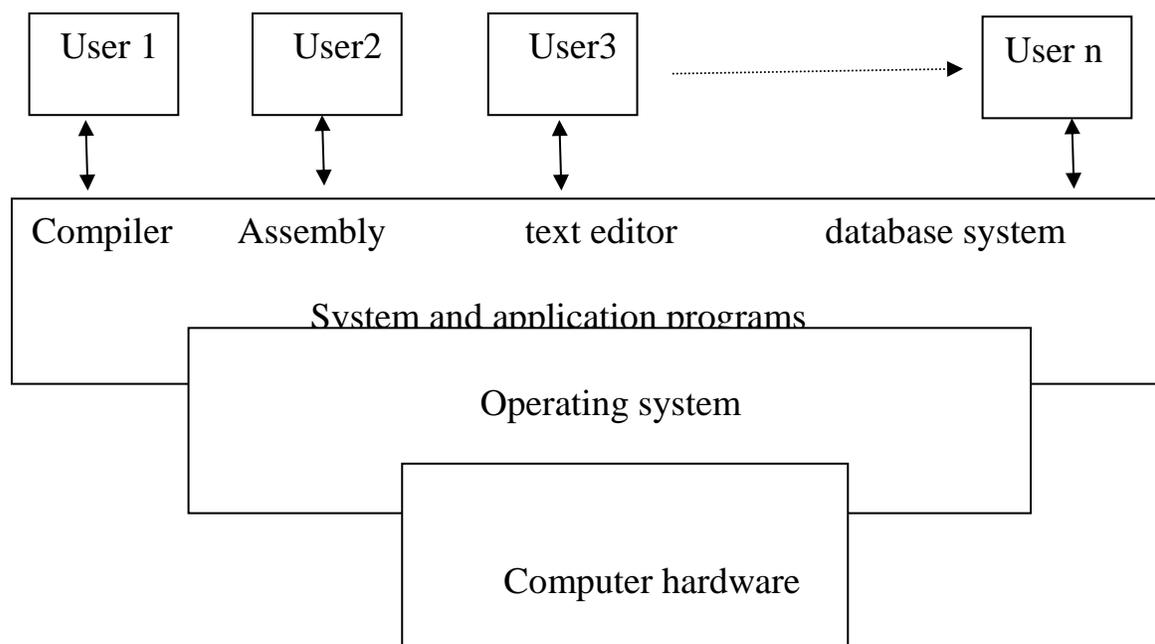
Fig 1 Abstracted view of the components of computer system

Functions of OS

The functions can be summarized as follows (will be explained later in more details):

1- Management of computer resources (processors, memory, disks, I/O devices, programs, etc.).

2- Scheduling resources among users (time sharing).

3- Protection of programs being executed in memory from one another.

4- Providing a proper user interface e.g. Graphics User Interface (GUI).

5- File management.

6- Network communication.

7- Many others.

O/S Categories

The main categories of modern o/s may be classified into Many groups , which are distinguished by the nature of inter action that take place between the computer and the users .

1- Batch system

In this type of o/s, users submit jobs on regular schedule (e.g., daily, weekly, monthly) to a central place where the user of such system did not interact directly with o/s. to speed up processing, jobs with similar needs were batched together and were run through the computer as a group. thus, the programs would have the programs with the operator, the major task of this type was to transfer control automatically from one job to the next. the o/s always resident in memory as in fig.2

```
┌─────────────────┐
│   Operating     │
│    system       │
├─────────────────┤
│                 │
│     User        │
│  program area   │
│                 │
│                 │
└─────────────────┘
```
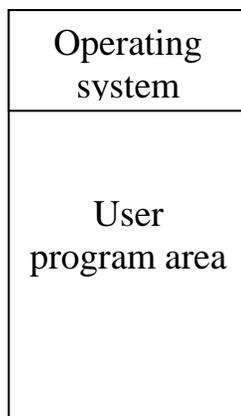
Fig 2: Memory layout for simple batch system

The output from each job would be sent back to the appropriate programmer.
- Advantage of batch system is very simple
- Disadvantages
- There is no direct interaction between the user and the job while the job is executing
- The delay between the job submission and the job completion (called turnaround time) may result from amount of computing time needed.

Performance Development

O/S attempted to schedule computational activities to ensure good performance, where many facilities had been added to o/s some of these are:

a- Spooling (Simultaneous Peripheral operation On- Line)

 1- Spooling uses the disk as a very large buffer for reading as far a Head as possible on input devices and for storing output files until the output devices are able to accept them.
2-   Spooling is now a standard feature of most O/S .
3-   Spooling allows the computation of one job can overlap with the I/O of another jobs , therefore spooling can keep both CPU and I/O devices working as much higher rates.
4-   The figure below show the spooling layout
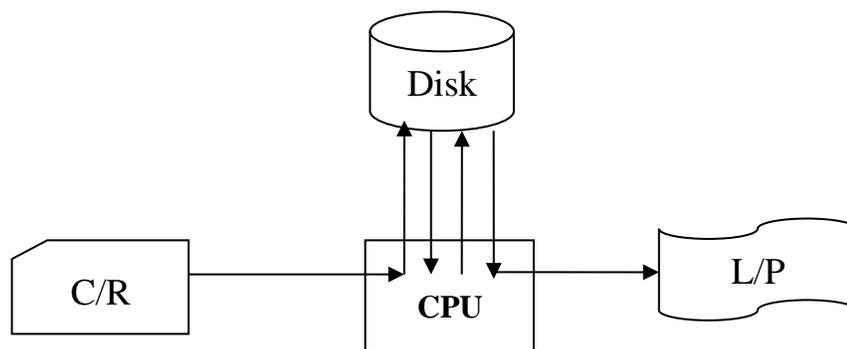
The spooling layout

b- Multiprogramming batch system

1-   Spooling provides an important data structure called a job pool kept on disk. The O/S picks one job from the pool and begin to execute it.

2-   In multiprogramming system , when the job may have to wait for any reason such as an I/O regrets , the O/S simply switches to and executes another job .when the second job need to wait the CPU is switches to another job and so on . Then the CPU will never be idle.

3-   The figure below show the multiprogramming layout where the O/S keeps several jobs in memory at a time . This set of jobs is a subset of the jobs kept in the job pool.

0	Monitor (o/s)
	Job1
10	Job2
	Job3
	Job4
32kb	Job5
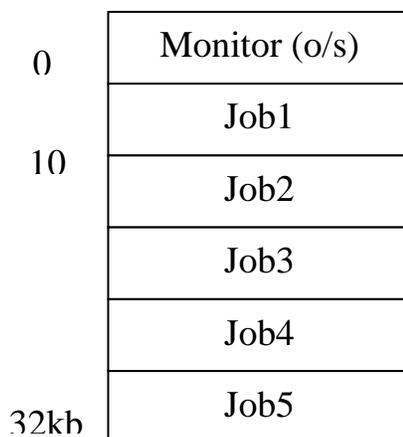
The multiprogramming layout

2-Time Sharing System

    This type of o/s provides on- line communication between the user and the system , where the user will give instruction to the o/s or to the program directly (usually from terminal) and receivers an intermediate response , therefore some time called an interactive system .

The time sharing system allows many users simultaneously share the computer system where little CPU time is needed for each user.

As the system switches rapidly from one user to the next user is given the impression that they each have their own computer , while actually one o/s shared among the many users.

-    Advantage : reduce the CPU ideal time
-    Disadvantage : more complex.

3-Parallel systems

1-   Most systems to date are simple –processor system that is they have one main CPU.

2-   There is a trend to have multiprocessor system , where such systems have more than one processor in close communication sharing the computer Bus , the clock , and sometimes memory and peripheral devices, in the figure below

3-   The advantage of this type of systems :

```
                    ┌─────────────┐
                    │    CPU      │
                    │     1       │         ┌───────┐
┌─────────────┐     │             │         │   M   │
│    I/O      │     │             │         │   E   │
│  DEVICES    │◄───►│             │◄───────►│   M   │
│             │     │             │         │   O   │
└─────────────┘     │    CPU      │         │   R   │
                    │     2       │         │   Y   │
                    │             │         └───────┘
                    └─────────────┘
```
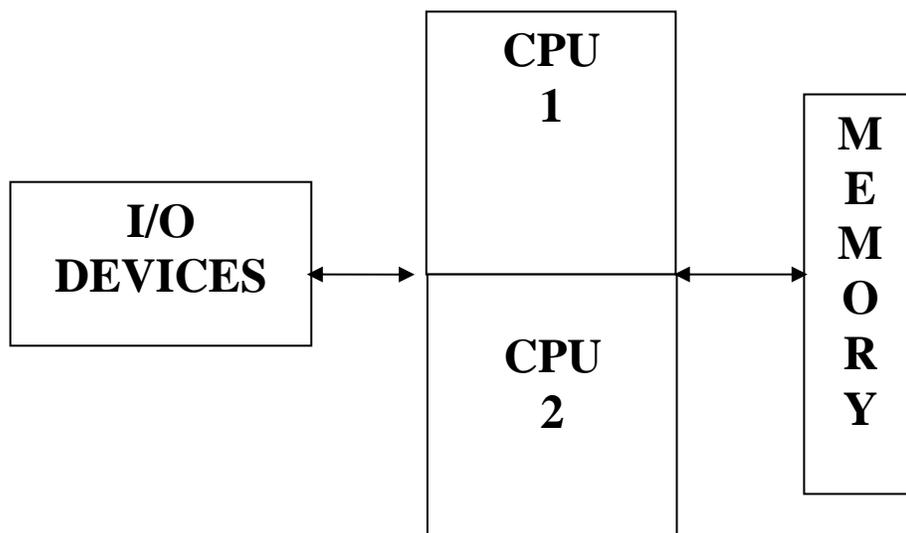
Parallel system layout

1-   Increase throughput
2-   The cost
3-   Increase reliability

There are two types of processors in multiprocessors systems:-

a-   Symmetric multiprocessor
b-   Asymmetric multiprocessor

4-Distributed systems

1-   A recent trend in C/S is to distribute computation among several processors.

2-   In contrast to the parallel system, the processors do not share memory and clock.

3-   The processors communicate with one another through various communication lines, such as high speed buses or telephone lines. This type of systems called a distributed system.

Site A   Communication line   Site B

Computer 1	← →	Computer 2

Distributed system
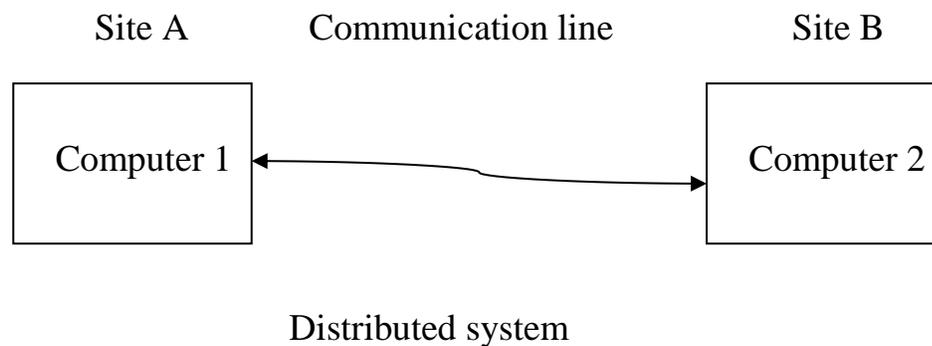
There are many reasons to build this type of system:-
1-   Resource sharing
2-   Computation speed up
3-   Reliability
4-   communication

5-Real time system

A real time system is used when there are rigid time requirement on the operation of a processor or the flow of data. A real time system guarantees that critical tasks complete on time. The secondary storage of any sort is usually limited, data instead being stored in short term memory (ROM)

There are two categories of real time system:
1-   hard real time systems
2-   soft real time systems