# Operating System

**Fastrack REVISION**

▶ **Operating System:** An Operating System is a collection of programs that manages and controls the two major components of a computer system, *i.e.,* hardware and software. Computer hardware is of no use if we do not install the essential operating system software in the computer.

▶ **Need for an Operating System:**

➤ An Operating System (OS) is the software component of a computer system that is responsible for the management and coordination of all its activities.

➤ It shares the resources of the computer. It acts as a host for the application programs that run on the machine. As a host, one of the main purposes of an OS is to handle the details of the operations of the hardware.

➤ This relieves application programs from having to manage these details and makes it easier to write applications.

➤ An operating system acts as a bridge between a user and a computer system.

➤ It actually provides an interface through which a user can interact with and also use the computer hardware and software.
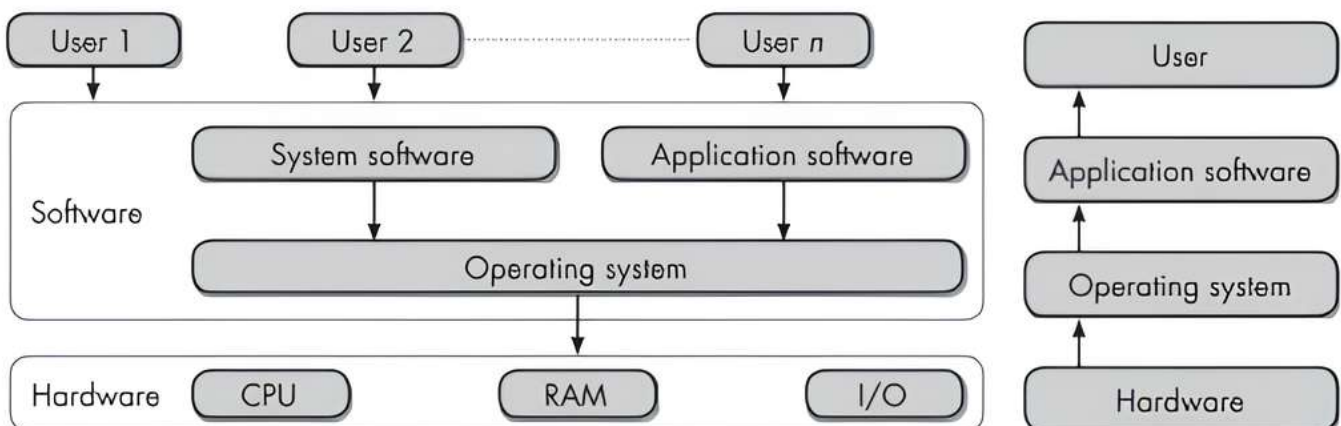


Fig. Overview of the Role of an Operating System

▶ **Functions of an Operating System:** The following are the major functions that are performed by an operating system:
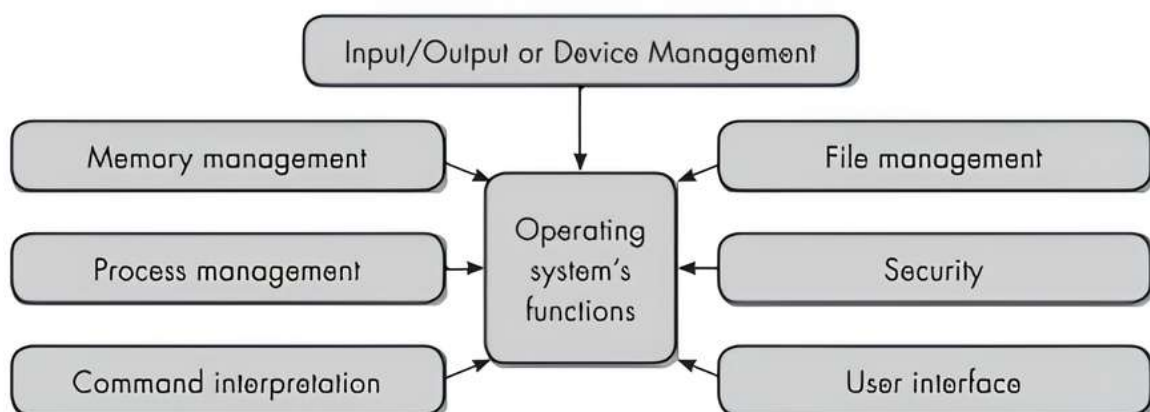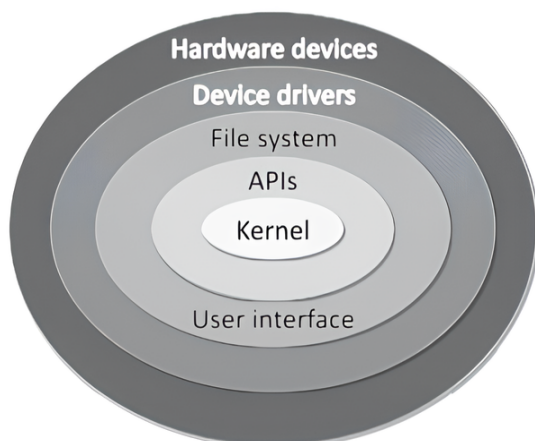


Fig. Functions of an Operating System

➤ **Process Management:** This feature of multitasking/multiprogramming is managed by the operating system. The OS decides which process gets the processor, when and for how much time.

➤ **Memory Management:** All data and programs are saved in the computer memory. The memory management module of an operating system takes care of the allocation and reallocation of the primary memory or main memory.

➤ **File Management:** File management module of an operating system involves keeping track of all the different files and also maintaining the integrity of

data stored in the files including the file directory structure.

- ➤ **Security:** The security modules of an operating system protect the resources and information of a computer system against destruction and unauthorised access.
- ➤ **Command Interpretation:** The command interpretation module of an operating system takes care of interpreting user commands and directing the system resources to handle the requests.
- ➤ **Input/Output or Device Management:** The part of OS that keeps a track of all the devices is known as the I/O controller. An OS manages device communication *via* their respective drives. It allocates and de-allocates the devices among the processes.
- ➤ **User Interface:** The OS establishes a means of communication between users and their computer systems *via* a user interface. User interface is a medium for users to communicate with the computer.

▶ **Bootstrap Loader:** It is a program that is stored on the ROM. It loads the OS into the RAM, when we start a computer. This process is known as booting.

▶ **Traffic Controller:** The program of operating system that performs the task of keeping the track of processes and allocating and de-allocating the CPU to them, is known as traffic controller.

▶ **Internal Structure of an Operating System:** It includes different components to perform different tasks. The following figure shows the basic structure of an operating system:



**Fig. Internal Structure of an Operating System**

- ➤ **Kernel:** The kernel works at the bottom layer of an operating system. It is the main component of an operating system as it handles all the hardware. Kernel actually performs the two major functions of device and memory management. It also does the CPU management and assigns the processor to different processes. The kernel is the first component to be loaded in the memory when an operating system is loaded into the memory and it remains in the memory till the time a computer is shut down.
- ➤ **API:** Application Programming Interface (API) is the second layer of an operating system after the

kernel. They are the routines or small program codes that are required for the communication among the software applications.

- ➤ **File System:** The file system component of an operating system facilitates the task of creating, storing and accessing the files in a computer. There are different types of file system that can be set-up in a computer such as FAT, NTFS, GFS and HFS. The most common file system used with Windows operating system is NTFS.
- ➤ **Device Drivers:** Device drivers are the software programs that handle and manage all the devices attached to a computer system. They facilitate the communication between an operating system and a device.

▶ **Types of Operating Systems:** The operating systems are there from the very first computer generation and they keep evolving with time. Different types of operating systems have been evolving till date.

- ➤ **Operating Systems Based on User Interface:** CUI and GUI are the two types of user interfaces provided by operating systems for user interaction with a computer system.
  - • **Character User Interface (CUI) Based Operating Systems:** It provides a character based interface to interact with a computer. There are no images or graphics on the screen and it is a primitive type of interface. In the early days, this interface was used to operate computers. Some examples of CUI are DOS, UNIX, etc.
  - • **Graphical User Interface (GUI) Based Operating Systems:** GUI often pronounced as

    'Gooey' stands for Graphical User Interface. It is the most popular and widely used interface. This is an interface that makes use of graphics, images and icons. Some other examples are Linux, Symbian, Mac OS, etc. The GUI operating system is also known as WIMP (Windows, Icons, Menus, Pointer).
- ➤ **Operating Systems Based on the Number of Users Supported:** On the basis of the number of users supported, an OS can be classified into two types—Single-user and Multi-user operating system.
  - • **Single-user Operating System:** It supports only one user at a time. It provides the facilities to be used on one computer by only one user. It provides a platform for only one user and lets a single user interact with several programs at a time. Some examples are MS-DOS, Windows 95, Windows NT Workstation, Windows 2000 Professional, etc.
  - • **Multi-user Operating System:** It has been designed for more than one user to access the computer at one time. A multi-user operating system allows many different users to take advantage of the computer's resources, simultaneously. It provides regular access for a number of users by maintaining a database of known users.

➤ **Operating Systems Based on the Tasks Supported at a Time:** Depending upon the number of programs that can be opened at a time, OS can be classified into two types—Single-tasking operating system and Multi-tasking operating system.

- **Single-tasking Operating System:** It allows only one program to be opened and used at a time. This operating system is designed to manage the computer so that one user can effectively do one thing at a time. Some examples are MS-DOS and Palm OS for handheld devices.

- **Multi-tasking Operating System:** It is an operating system in which multiple processes, also called tasks, can run on a single computer, simultaneously and without interfering with each other.

- **Batch Operating System:** Batch OS executes the number of jobs in groups called 'Batches'. Each user gave his number of jobs to be executed punched on devices like punched cards and submitted it to the operator.

- **Time Sharing Operating System:** Time sharing OS assigns the CPU to multiple processes by switching the CPU between the processes. Time sharing OS reduces idle CPU time and provides a quick user response.

- **Distributed Operating System:** It allows multiple processors to be used by multiple programs at the same time so that multiple real-time applications and multiple users can be served. The processors communicate with one another through various communication lines.

- **Network Operating System:** It usually works in the client and server or networked environment. It is installed on the server computer and does the task of managing data, users, groups, security and other networking applications.

- **Real-time Operating System:** It is defined as a data processing system in which the time interval required to process and respond to inputs, is small and it guarantees to process that input in a specified time. It is further divided into two types.
  - o **Hard Real-time OS:** This operating system ensures that critical tasks finish on time, for example, air traffic control, weapon systems, etc.
  - o **Soft Real-time OS:** This operating system is less restrictive. In this OS, critical tasks are given priority over other tasks, for example, multimedia, virtual reality, etc.

➤ **Some Commonly Used Operating Systems:** The most typical operating systems in ordinary desktop computers and laptops are Windows, Linux and Mac OS.

- ➤ **Windows:** Microsoft Windows is one of the most popular operating systems. It is a commercial OS that uses Windows to execute the programs. It has a GUI interface. It is a multi-user and multi-tasking OS. Windows is the most popular OS for home PCs and there are several versions of it such as Windows XP, Windows Vista, Windows 7, etc.

- ➤ **Linux and Unix** Linux is an Open Source OS, which means that its program code is freely available to the program developers. That is why thousands of programmers around the world have developed Linux and it is considered the most tested OS in the world. Linux has been largely influenced by the commercial Unix OS.

- ➤ **Mac OS:** Apple's Mac computers have their own operating system, OS X. The Mac version of the Microsoft Office suite cannot be installed on a Windows computer.

- ➤ **Android:** It is an operating system designed for phones and other mobile devices. It is not available for the desktop computers, but for mobile devices, it is an extremely popular operating system.

- ➤ **BOSS (Bharat Operating System Solutions):** It is a GNU/Linux distribution developed by C-DAC, Chennai, in order to benefit the usage of Free/Open Source software in India. BOSS GNU/Linux advanced server has unique features such as web server, proxy server, database server, mail server, network server, etc.

- ➤ **Solaris:** This OS is a free Unix-based operating system developed by Sun Microsystems. The first version of SunOS was published in 1982.

- ➤ **Symbian:** Symbian OS was the most widely-used smartphone operating system in the world till 2010, when it was overtaken by Android. Development of Symbian OS was discontinued in May 2014.

# Practice *Exercise*

## ? Multiple
### Choice Questions

**Q 1.** What is the other name of GUI?
- a. CLI
- b. CUI
- c. WIPM
- d. WIMP

**Q 2.** Which type of OS requires a group of jobs to be handed over to an operator for processing?
- a. Batch operating system
- b. Distributed operating system
- c. Real-time operating system
- d. Multitasking operating system

**Q 3.** Which of the following operating systems is available in the mobile devices?
- a. MAC OS X
- b. Windows XP
- c. Android
- d. Linux

**Q 4.** Which type of operating system will allow a number of users to use the same computer at the same time?
- a. Multi-tasking
- b. Multi-user
- c. Multi-processing
- d. None of these

**Q 5.** Which among the following has the fastest response time?
- a. Multi-user Operating System
- b. Multi-processing Operating System
- c. Distributed Operating System
- d. Real-time Operating System

**Q 6.** Which of the following does not come under the memory management of the Operating System?
- a. It keeps track of the main memory and checks which part is in use and by which process. It also keeps track of the part that is not in use.
- b. It checks whether the RAM is physically broken or not and gives a relevant message during the booting process.
- c. It makes a decision on which process will get memory when and by how much.
- d. It allocates the memory according to the requirement of the process.

**Q 7.** Which among the following is not a type of system call?
- a. Process Control
- b. File Management
- c. BIOS
- d. Device Management

**Q 8.** Which among the following is not a type of kernel?
- a. Macrokernel
- b. Microkernel
- c. Nano Kernel
- d. Hybrid Kernel

**Q 9.** Which of the following is a part of an operating system that acts as the command interpreter, which takes commands from the user, interprets them and takes action accordingly?
- a. Kernel
- b. Device Creator
- c. Shell
- d. Disk Defragmenter

**Q 10.** A ......................... operating system runs on a server and provides the server the capability to manage data, users, groups, security, applications and other networking functions.
- a. batch system
- b. uniprocessing
- c. network
- d. multi-tasking

**Q 11.** An operating system is a ......................... .
- a. Collection of application programs
- b. Collection of hundreds of different types of software available on a CD
- c. Set of programs which controls the working of a computer
- d. Set of programs which convert high level language to machine language

**Q 12.** Select the correct match.
- a. Windows — GUI based batch processing system
- b. DOS — Offers command line interface
- c. Android — Mobile operating system developed by Apple inc
- d. Palm OS — Latest operating system for smart watches

**Q 13.** Which part of the operating system connects the application software to the hardware of the computer?
- a. Shell
- b. Application program
- c. Kernel
- d. Interrupt

**Q 14.** ......................... is the amount of work that a system is able to do per unit time.
- a. Throughput
- b. Turnaround time
- c. Response time
- d. All of these

# ? Fill in the Blanks
### Type Questions

**Q 15.** We can open many ......................... at a time on a computer.

**Q 16.** Operating system takes care of the ......................... and ......................... of processes.

**Q 17.** ......................... is directly accessed by the CPU to speed up the processing.

**Q 18.** ......................... interface makes the use of graphics, images and icons.

**Q 19.** The ......................... works at the bottom layer of an operating system.

# ? Assertion and Reason
### Type Questions

**Directions (Q. Nos. 20-24):** *In the questions given below, there are two statements marked as Assertion (A) and Reason (R). Read the statements and choose the correct option.*
- a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- b. Both Assertion (A) and Reason (R) are true, but Reason (R) is not correct explanation of Assertion (A).
- c. Assertion (A) is true, but Reason (R) is false.
- d. Assertion (A) is false, but Reason (R) is true.

**Q 20.** Assertion (A): An Operating System is a collection of softwares that manages and controls the two major components of a computer system, *i.e.*, hardware and software.
Reason (R): Computer hardware is of no use if we do not install the essential operating system software in the computer.

**Q 21.** Assertion (A): An operating system acts as a bridge between a user and a computer system.
Reason (R): An operating system actually provides an interface through which a user can interact with and also use the computer hardware and software.

**Q 22.** Assertion (A): File management module of an operating system involves keeping track of all the different files and also maintaining the integrity of data stored in the files including the file directory structure.
Reason (R): Process management feature of multi-tasking/multi-programming is not managed by the operating system.

**Q 23.** Assertion (A): The security modules of an operating system protect the resources and information of a computer system against destruction and unauthorised access.

Reason (R): The Command Interpretation module of an operating system takes care of interpreting user commands and directing the system resources to handle the requests.

**Q 24.** Assertion (A): The part of OS that keeps a track of all the devices is known as the I/O controller. An OS manages device communication *via* their respective drives. It allocates and de-allocates the devices among the processes.

Reason (R): The OS establishes a means of communication between users and their computer systems *via* a user interface. User interface is a medium for users to communicate with the computer.

## Answers

| | | | | |
|---|---|---|---|---|
| 1. (d) | 2. (a) | 3. (c) | 4. (b) | 5. (d) |
| 6. (b) | 7. (c) | 8. (a) | 9. (c) | 10. (c) |
| 11. (c) | 12. (b) | 13. (c) | 14. (a) | |
| 15. programs | | 16. creation. deletion | | |
| 17. Main memory | | 18. GUI | | |
| 19. Kernel | | | | |
| 20. (d) | 21. (a) | 22. (c) | 23. (b) | 24. (b) |

## ? Case Study Based
### Questions

## Case Study 1

Operating system is the most important program that is required by the computer to communicate with the user and other hardware devices (peripherals) attached to it. An operating system is also a platform that decides the types of applications that can be run on a computer. An operating system is a system software which acts as an interface between the user and the computer.

- Computer has many resources like processor, files, memory, devices, etc. Operating system acts as a resource manager.
- Operating system provides an interface between the user and the machine.
- Operating system boots the computer.
- Operating system provides a platform for executing various application programs.
- Operating system secures the user programs.
- Operating system helps in performing input/output operations.
- When one process requires to communicate with another process, operating system makes this communication possible.

- Errors like printer offline, failed memory allocation are all detected by operating system. For many errors, operating system itself takes appropriate action.

**Q 1.** An operating system manages:
  a. memory           b. processor
  c. disk and I/O devices  d. All of these

**Q 2.** An operating system of a computer serves as a software interface between the user and the:
  a. hardware          b. peripheral
  c. memory           d. screen

**Q 3.** Suppose you have bought all hardware components required for assembling a computer. After assembling the computer system, which will be the very first software to be installed?
  a. Hardware drivers
  b. Operating system
  c. Antivirus software
  d. Word processing software

**Q 4.** Identify the option, which is not a feature covered under device management?
  a. Speed           b. Spooling
  c. Sharing         d. Programming

## Answers

| | | | |
|---|---|---|---|
| 1. (d) | 2. (a) | 3. (b) | 4. (d) |

## Case Study 2

Response time is the time taken by a system to react to a given input. In a Real Time Operating System (RTOS), the response time is very critical and is fixed. In case of any event, the system has to respond within a fixed duration of the time or else the system might collapse. So, we can say that RTOS is time-driven.

Usually in a RTOS, the output of one unit acts as an input for another unit. So, delay in receiving output from a unit delays the supply of input to the next unit. The second unit does not respond to the delayed input and so does not give any output for which the third unit might be waiting. So, the whole system crashes. The best examples of RTOS are airbags in a car, fire alarm system, aircraft control system.

Generally, RTOS are embedded systems meaning that they are a part or a unit of a larger system. For example, temperature control system in ACs and refrigerators, digital watches, MP3 players, in mobile phones, etc. Some, of the widely used RTOS are LINUX, Windows CE, RT LINUS, OSE, QNX, etc.

**Q 1.** Define Real-time operating systems.

**Q 2.** Amoeba is an example of?

**Q 3.** A thread is a .............................. process, which is managed by OS scheduler.

**Q 4.** Which of the following is like a heart of operating system?

## Answers

1. In a Real Time Operating System (RTOS), the response time is very critical and is fixed. In case of any event, the system has to respond within a fixed duration of the time or else the system might collapse. So, we can say that RTOS is time-driven.

2. Amoeba is an example of Distributed OS.

3. A thread is a light weight process because it executes sequentially.

4. Kernel is like heart of operating system which plays a vital role in modern OS.

## ? Very Short Answer
Type Questions

**Q 1. What is an operating system?**

**Ans.** An Operating System (OS) is software that manages computer hardware and software resources and provides common services for computer programs.

**Q 2. What are system calls?**

**Ans.** In computing, a system call is the programmatic way in which a computer program requests a service from the kernel of the operating system it is executed on.

**Q 3. What is a real-time operating system?**

**Ans.** A Real Time Operating System (RTOS) is an Operating System (OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays.

**Q 4. State any one function of the memory management of the operating system.**

**Ans.** The memory management function of an operating system keeps track of the main memory and checks which part is in use and by which process. It also keeps track of the part that is not in use.

**Q 5. What is a user interface?**

**Ans.** User Interface refers to the visual part of an operating system through which a user interacts with a computer or a software.

**Q 6. For which devices is the Android mainly designed?**

**Ans.** Android is mainly designed for touchscreen mobile devices such as smartphones and tablets.

**Q 7. Write the full form of the term GUI.**

**Ans.** Graphical User Interface

**Q 8. Name atleast two functions performed by an operating system.**

**Ans.** Functions performed by an operating system are:
(i) Memory management (ii) Process management

**Q 9. Which OS is developed by the Indian Government?**

**Ans.** BOSS (Bharat Operating System Solutions) is developed by Indian Government.

**Q 10. What is the major advantage of BOSS?**

**Ans.** The major advantage of BOSS is that it is available in different local languages, so more people can understand and use it easily.

**Q 11. Give some examples of multi-tasking OS.**

**Ans.** Some examples of multi-tasking OS are Linux, Mac OS and Android.

**Q 12. Write the names of two user interfaces.**

**Ans.** CUI and GUI

**Q 13. Why is GUI also known as WIMP?**

**Ans.** GUI is also known as WIMP (Windows, Icons, Menus, Pointer) as the most common combination of elements using which a user interacts in a GUI environment.

## ? Short Answer
Type Questions

**Q 1. What are distributed systems?**

**Ans.** Distributed OS allows multiple processors to be used by multiple programs at the same time so that multiple real-time applications and multiple users can be served. The processors communicate with one another through various communication lines.

**Q 2. What is symbian operating system?**

**Ans.** Symbian OS was the most widely-used smartphone operating system in the world till 2010, when it was overtaken by Android. Development of Symbian OS was discontinued in May 2014. It was primarily used by Nokia for its phones. It is designed for the specific requirements of 2.5G and 3G mobile phones.

**Q 3. Why is an operating system needed for a computer system?**

**Ans.** In earlier day's user had to design the application according to the internal structure of the hardware. Operating System was needed to enable the user to design the application without concerning the details of the computer's internal structure. In general the boundary between the hardware and software is transparent to the user.

**Q 4. What is an interactive operating system?**

**Ans.** Interactive (GUI based) Operating System: GUI or Graphical User Interface based Operating System allows the use of icons, windows and menus as tools to interact with the computer.

**Q 5. What do you understand by the term "Device Management"?**

**Ans.** It is used to keep track of all I/O (Input/Output) devices like monitor, keyboard, mouse, scanner, etc., and the program responsible for this task is known as the I/O controller.

**Q 6. What is traffic controller?**

**Ans.** The program of operating system that performs the task of keeping the track of processes and allocating and de-allocating the CPU to them, is known as traffic controller.

**Q 7. Define process scheduling?**

**Ans.** The OS allocates the processor (CPU) to a process and de-allocates processor when a process is no longer required. The process management module of an OS takes care of the creation and deletion of the processes and scheduling of various system resources to the different processes requesting them. This function is known as process scheduling.

**Q 8. What is command interpretation?**

**Ans.** The Command Interpretation module of an operating system takes care of interpreting user commands and directing the system resources to handle the requests.

**Q 9. Define bootstrap loader.**

**Ans.** Bootstrap loader is a program that is stored on the ROM. It loads the OS into the RAM when we start a computer. This process is known as booting.

**Q 10. What do you mean by the term API?**

**Ans.** Application Programming Interface (API) is the second layer of an operating system after the kernel. They are the routines or small program codes that are required for the communication among the software applications.

## CHAPTER TEST

### Multiple Choice Questions

**Q 1.** Which of the following is not an example of operating system?
- a. Linux
- b. Windows
- c. Unix
- d. Java

**Q 2.** Which of the following is an example of GUI based OS?
- a. Windows 7
- b. MS Word
- c. MS-DOS
- d. Unix

**Q 3.** In how many types is the real-time operating system further divided?
- a. Three
- b. One
- c. Two
- d. Four

**Q 4.** Which type of a user interface requires a mouse?
- a. CUI
- b. GUI
- c. Both a. and b.
- d. None of these

**Q 5.** Which of the following operating systems is not used for smartphones and tablets?
- a. Unix
- b. Symbian
- c. IOS
- d. Android

### Fill in the Blanks

**Q 6.** A computer system is made up of two main components ........................ and ......................... .

**Q 7.** The ............................ is the collection of programs that manages the whole computer system.

### Assertion-Reason Type Questions

**Directions (Q. Nos. 8-9):** *In the questions given below, there are two statements marked as Assertion (A) and Reason (R). Read the statements and choose the correct option.*

- a. Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- b. Both Assertion (A) and Reason (R) are true. but Reason (R) is not correct explanation of Assertion (A).
- c. Assertion (A) is true. but Reason (R) is false.
- d. Assertion (A) is false. but Reason (R) is true.

**Q 8.** **Assertion (A):** The program of operating system that performs the task of keeping the track of processes and allocating and deallocating the CPU to them, is known as traffic controller.

**Reason (R):** Bootstrap loader is a program that is stored on the RAM. It loads the OS into the ROM, when we start a computer. This process is known as booting.

**Q 9.** **Assertion (A):** Application Programming Interface (API) is the second layer of an operating system after the kernel. They are the routines or small program codes that are required for the communication among the software applications.

**Reason (R):** Device drivers are the software programs that handle and manage all the devices attached to a computer system. They facilitate the communication between an operating system and a device.

### Case Study Based Questions

**Q 10.** Operating system manages overall activities of a computer and the input/output devices attached to the computer. It is the first software you see when you turn on the computer and the last software you see when the computer is turned off. It is the software that enables all the programs you use. At the simplest level, an operating system does two things:

The first, it manages the hardware and software resources of the computer system. These resources include the processor, memory, disk space, etc. The second, it provides a stable, consistent way for applications to deal with the hardware without having-to know all the details of the hardware.

The second task *i.e.,* providing a consistent application interface is especially important. A consistent Application Program Interface (API) allows a user (or S/W developer) to write an application program on any computer and

to run this program on another computer, even if the hardware configuration is different like as amount of memory, type of CPU or storage disk. It shields the user of the machine from the low-level details of the machine's operation and provides frequently needed facilities.

**(i)** **Which of the following operating systems is developed by the Indian government?**
a. Unix          b. BOSS
c. Windows 7     d. Android

**(ii)** **What is the other name of CUI?**
a. CLI           b. GUI
c. WIPM          d. WIMP

**(iii)** **Which among the following is not a type of kernel?**
a. Macrokernel   b. Microkernel
c. Nano Kernel   d. Hybrid Kernel

**(iv)** **Which among the file system is no longer supported by the developer?**
a. FAT 32        b. NTFS
c. HFS           d. None of these

**Q 11.** **Operating System as Resource Manager:** Files, devices, peripherals, CPU, memory, etc., are some of the major resources of a computer. A computer has various processes running simultaneously at any point of time. These processes require different resources at different times and for different durations. The major work of operating system as a resource manager are:

- To keep track of available resources, *i.e.*, to keep a note of which resource is free.
- To decide which process has to be allotted a resource, when and for how long. For taking this decision, it takes help of some algorithms like First come First serve, Shortest Duration First, Round Robin, etc.
- To allocate the resource to the process.
- To de-allocate the resource after the allotted time is over.

**(i)** **What is the full form of FCFS?**

**(ii)** **Data can be transferred in which form?**

**(iii)** **What do you mean by buffering?**

**(iv)** **What is the first program that loads in memory?**

## Very Short Answer Type Questions

**Q 12.** **What do you mean by multi-tasking?**

**Q 13.** **Mention the names of any two operating system used in mobile phones.**

**Q 14.** **What was the first version of Apple iOS released?**

**Q 15.** **Define shell.**

## Short Answer Type Questions

**Q 16.** **Define LINUX.**

**Q 17.** **Write any two features of LINUX.**