

Lecture – 2

Fundamentals of Operating System.

What Operating System Do

- A computer system can be divided roughly into four components (Figure 1.1):
 - The hardware,
 - The operating system,
 - The application programs,
 - and a User

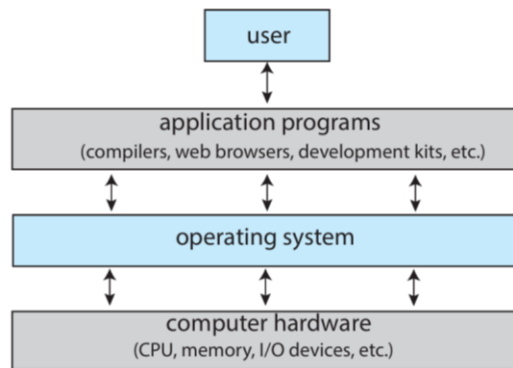


Figure 1.1 Abstract view of the components of a computer system.

- The hardware—the central processing unit (CPU), the memory, and the input/output (I/O) devices—provides the basic computing resources for the system.
- The application programs—such as word processors, spreadsheets, compilers, and web browsers—define the ways in which these resources are used to solve users’ computing problems.
- The operating system controls the hardware and coordinates its use among the various application programs for the various users.
- We can also view a computer system as consisting of hardware, software, and data.
- The operating system provides functionalities for the proper use of these resources in the operation of the computer system.
- An operating system is similar to a government system. Like a government, it performs no useful functions by itself. It simply provides an environment within which other programs can do useful work.
- To understand more fully the operating system’s role, we next explore operating systems from two view points:

- User View
- System View

User View

- The user's view of the computer varies according to the interface being used.
- Many computer users sit with a laptop or in front of a PC consisting of a monitor, keyboard, and mouse. Such a system is designed for **one user to monopolize its resources**. The goal is to maximize the work (or play) that the user is performing. In this case, the operating system is designed mostly for **ease of use**, with some attention paid to **performance and security**, and none paid to **resource utilization** how various hardware and software resources are shared.
- In other cases, a user sits at a terminal connected to mainframe or a minicomputer. Other users are accessing the same computer through other terminals. These users share resources and may exchange information. The operating system in such cases is designed to maximize resource utilization to assure that all available CPU time, memory, and I/O are used efficiently and that no individual users take more than her **fair share**.
- In still other cases, users sit at **workstations** connected to networks of other workstations and **servers**. These users have dedicated resources at their disposal, but they also share resources such as networking, and servers, including file, compute and print servers. Therefore their operating system is designed to compromise between individual usability and resource utilization.
- Increasingly, many users interact with mobile devices such as smartphones and tablets—devices that are replacing desktop and laptop computer systems for some users. These devices are typically connected to networks through cellular or other wireless technologies. The user interface for mobile computers generally features a **touch screen**, where the user interacts with the system by pressing and swiping fingers across the screen rather than using a physical keyboard and mouse. Many mobile devices also allow users to interact through a **voice recognition interface**, such as Apple's Siri.
- Some computers have **little or no user view**. For example, **embedded computers** in home devices and automobiles may have numeric keypads and may turn indicator lights on or off to show status, but they and their operating systems and applications are designed primarily to run without user intervention.

System View

- From the computer's point of view, the operating system is the program most intimately involved with the hardware. In this context, we can view an operating system as a **resource allocator**.
- A computer system has many resources that may be required to solve a problem: CPU time, memory space, storage space, I/O devices , and so on. The operating system acts as the manager of these resources. Facing numerous and possibly conflicting requests for resources, the operating system must decide how to allocate them to specific programs and users so that it can operate the computer system efficiently and fairly.
- A slightly different view of an operating system emphasizes the need to control the various I/O devices and user programs. **An operating system is a control program.** A control program manages the execution of user programs to prevent errors and improper use of the computer. It is especially concerned with the operation and control of I/O devices.

Defining Operating System

- By now, you can probably see that the term operating system covers many roles and functions. That is the case, at least in part, because of the myriad (countless) designs and uses of computers.
- Computers are present in toasters, cars, ships, spacecraft, homes, and businesses. They are the basis for game machines, cable TV tuners, and industrial control systems.
- *To explain this diversity, we can turn to the history of computers. Although computers have a relatively short history, they have evolved rapidly. Computing started as an experiment to determine what could be done and quickly moved to fixed-purpose systems for military uses, such as code breaking and trajectory plotting, and governmental uses, such as census calculation. Those early computers evolved into general-purpose, multifunction mainframes, and that's when operating systems were born.*
- *In the 1960s, Moore's Law predicted that the number of transistors on an integrated circuit would double every 18 months, and that prediction has held true.*
- Computers gained in functionality and shrank in size, leading to a vast number of uses and a vast number and variety of operating systems.
- How, then, can we define what an operating system is? In general, we have no completely adequate definition of an operating system. Operating systems exist because they offer a reasonable way to solve the problem of creating a usable computing system. **The fundamental goal of computer systems is to execute**

programs and to make solving user problems easier. Computer hardware is constructed toward this goal. Since bare hardware alone is not particularly easy to use, application programs are developed. These programs require certain common operations, such as those controlling the I/O devices. The common functions of controlling and allocating resources are then brought together into one piece of software: the operating system.

- In addition, we have no universally accepted definition of what is part of the operating system. A simple viewpoint is that it includes everything a vendor ships when you order “the operating system.” The features included, however, vary greatly across systems. ***Some systems take up less than a megabyte of space and lack even a full-screen editor, whereas others require gigabytes of space and are based entirely on graphical windowing systems.*** A more common definition, and the one that we usually follow, is that the operating system is the one program running at all times on the computer—usually called the kernel. (Along with the kernel, there are two other types of programs: **system programs**, which are associated with the operating system but are not necessarily part of the kernel, and application programs, which include all programs not associated with the operation of the system.
- The matter of what constitutes an operating system became increasingly important as personal computers became more widespread and operating systems grew increasingly sophisticated. In 1998, the United States Department of Justice filed suit against Microsoft, in essence claiming that Microsoft included too much functionality in its operating systems and thus prevented application vendors from competing. (For example, a web browser was an integral part of Microsoft’s operating systems.) As a result, Microsoft was found guilty of using its operating-system monopoly to limit competition.
- Today, however, if we look at operating systems for mobile devices, we see that once again the number of features constituting the operating system is increasing. Mobile operating systems often include not only a core kernel but also middleware a set of software frameworks that provide additional services to application developers. For example, each of the two most prominent mobile operating systems—Apple’s iOS and Google’s Android—features a core kernel along with middleware that supports databases, multimedia, and graphics (to name only a few). In summary, for our purposes, the operating system includes the always running kernel, middleware frameworks that ease application development and provide features, and system programs that aid in managing the system while it is running.

Definition:

“The operating system is an interface between the user and hardware.”

OR

“An operating system is a program that manages a computer’s hardware”

OR

“The Operating system is a resource manager which allocates the resources to running program/application based on the demand.”

OR

“The Operating system is the controller which controls the underlying hardware and coordinates to the running application or program.”

OR

“The Operating system is like the government which provides the environment to run the application or program.”

Goals of Operating System**Primary Goals**

The primary goals of an operating system (OS) are to provide a easy to use and convenient environment for executing user programs.

1. **User Convenience :** It should be easy to use, providing a user-friendly interface and making it simple to interact with the system.
2. **Program Execution:** It facilitates the execution of user programs, providing the necessary environment and services for them to run.
3. **Resource Management:** The OS manages and allocates the computer's resources, including the CPU, memory, disk storage, and input/output devices, to ensure fair utilization.
4. **Security:** The OS protects the system and user data from unauthorized access, ensuring confidentiality, integrity, and availability of information.

Secondary Goals

1. **Efficient Resource Utilization:** It should aim to maximize the performance and utilization of computer resources like CPU, Memory and IO devices, ensuring that the system runs smoothly and efficiently.
2. **Reliability:** It should be robust and reliable, able to handle errors and exceptions gracefully, ensuring that the system continues to operate smoothly. It should be modular in design and easy to debug.

References:

1. Operating System Concepts: Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Ninth Edition, Wiley India.
2. <https://www.geeksforgeeks.org/operating-systems/introduction-of-operating-system-set-1/>