OPERATING SYSTEM

Operating System –

It is a system software or program that manages the computer hardware and software resources.

An operating system acts as an interface between the computer user and computer hardware.

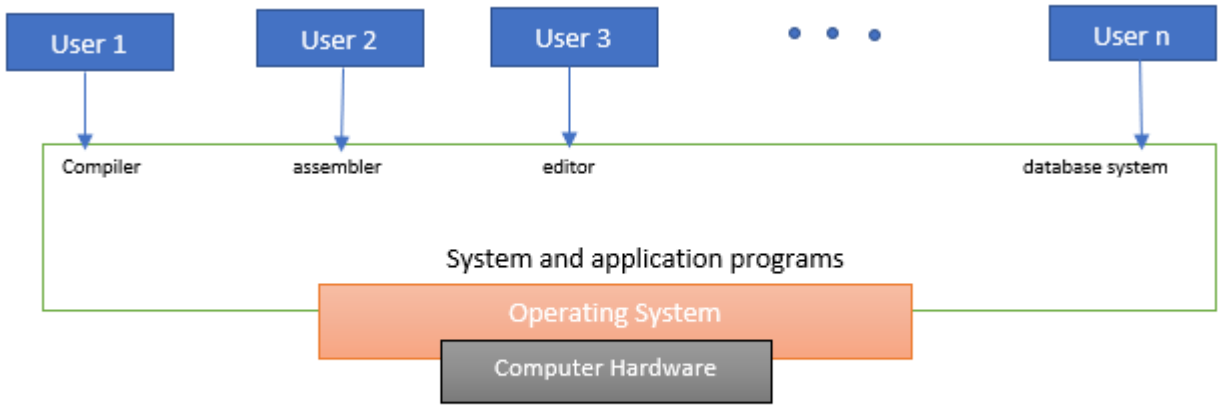
Purpose of an Operating System –

1. It provides an environment for application programs.
2. Manages the computer hardware.
3. It is a control program that manages the execution of user programs.
4. It also acts as a resource allocator (resource allocation is important where many users want to access common resource).
5. Operating system (one piece of software) = controlling and allocating resources.
6. It provides fair sharing of resources among users and programs and keep track of who is using which resource.
7. It is the one program running at all time on the computer (usually called KERNEL), with all else being other programs (system and application).

Kernel – It is a part of operating system which interacts directly with the computer hardware and performs crucial tasks.
Microkernel- It is much smaller in size and supports only the functionalities of core operating system.

Functions of OS –

1. Convenience - OS makes computer convenience to use.
2. Efficiency – OS allows computer system resources (CPU time, memory space, file storage space, I/O devices etc.).



Components of Computer System

Duties of Operating System-

1. **Process Management** –
   Program is in execution is known as Process. As program does nothing unless its instructions are executed by CPU and when these instructions are executed then process comes into picture. So Process needs some resources (CPU time, memory, files, I/O devices) to accomplish its task. These resources can be allocated to process when it is created or allocated to it while it is running.

Responsibilities of an OS in Process Management -

a. Creating and deleting user and system process.
a. Suspending and resuming processes.
b. Process synchronizing.
c. Process communication.

2. **Memory Management**-

As main memory is the area from where CPU and I/O devices quickly access shared data.

Responsibilities of an OS in Memory Management-

a. OS keep track of memory i.e. what part of it is free, what part of it is in use or what part of it is in used by whom and it allocates the free memory when process request it.
b. Decides which process (or part of process) and data to move into and out of memory.

3. **File System Management** –

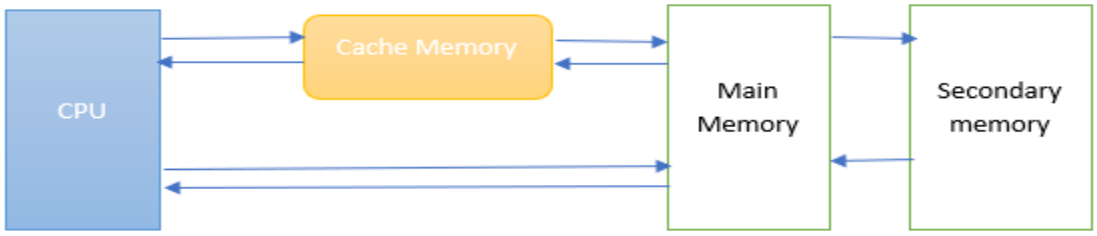
A file is a collection of related data. Different type of files can be used like data files (binary, numeric, alphabetic), free-form files (text files), formatted rigidly files etc. Files are organized into directories to make them easier to use.

Responsibilities of an OS in Memory Management-

a. Creating and deleting files.
b. Creating and deleting file directories.

4. **Caching** –

As Cache memory is very high-speed memory and it is costlier than main memory or disk memory. So, the process of storing data in Cache memory is known as Caching. Caching helps in reducing the average time to access data from main memory. Caching helps in storing the most frequently used data in cache.



5. **I/O Management** –

OS keeps track of all the I/O devices like which I/O device is used by which process, when and for how much time.

6. **Security**–

OS prevents programs and data from unauthorized access.

***** Now you are able to understand what an Operating system is, what is the roles and responsibilities of an Operating system, what is the purpose and functionalities of operating system.

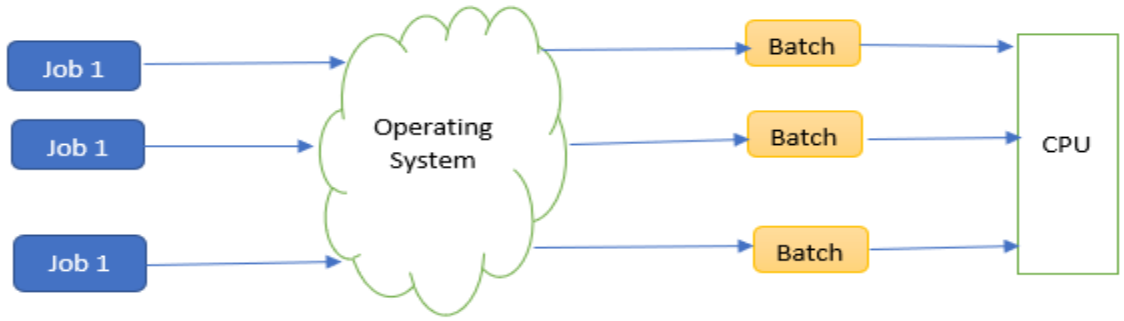
So, to explore more look into these references -

1. https://www.tutorialspoint.com/computer_fundamentals/computer_operating_system.htm
2. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
3. https://www.geeksforgeeks.org/functions-of-operating-system/

Types of Operating System-

1. **Batch Operating System** –

   It collects jobs (program and data together) before processing starts. There is an operator which is responsible for grouping similar type of jobs having same requirement in batches. It keeps number of jobs in memory and executes them without manual interventions. Jobs are processed in First Come First Serve manner i.e. order of submission.



Advantage –

a. New job gets started as soon as the previous job is finished, without any manual intervention.
b. In batch system, it is easy to manage large work repeatedly.

Disadvantage-

a. Debugging is very difficult.
b. The other job will have to wait for unknown time when any job fails.

2. **Multiprogramming –**

   Multiprogramming increases CPU utilization by organizing jobs (code and data) in memory so that CPU always has one to execute.

3. **Multitasking-**

   It is the logical extension of multiprogramming. It helps in executing multiple task at a time. It is based on the time sharing. Multitasking is executing multiple jobs simultaneously by switching among them. Switches occur so frequently that user may interact with each program while it is running.

4. **Time sharing operating System**-

   Each task is given some time to execute. Each task gets equal opportunities to execute. CPU Idle time can be reduced. It uses CPU scheduling and multiprogramming to provide each user with small portion of time-shared computer. It allows many users to share computer simultaneously.

5. **Real time operating system-**

   This system is used when there are time constraints i.e. time requirements are very strict. These are usually embedded or dedicated. These embedded systems are found in microwave ovens, car engines, robots etc. embedded system have little or no interface. Embedded system almost always run real time systems. Real time system has rigid or fixed time constraints and processing is done within that defined constraints, or the system will fail.
   Real time system is of two types –
   a. **Hard Real Time system** – where time constraints are very strict and even shortest delay is not acceptable or the system will fail. E.g. Air bags.
   b. **Soft Real Time system** – where time constrains are less strict.

❖ **Examples of Operating System** - Windows, Macintosh, Android etc.

References-

1. https://www.geeksforgeeks.org/operating-system-difference-multitasking-multithreading-multiprocessing/
2. https://www.geeksforgeeks.org/types-of-operating-systems/
3. https://www.tutorialspoint.com/operating_system/os_properties.htm

Memory –

Memory is most essential part in Computer system without it CPU cant perform any task. Memory is repository of quickly accessible data shared among CPU and I/O devices. CPU reads data from memory or writes data to main memory during operations.

Memory is of two type –

1. **Random Access Memory (RAM)** – It is also known as primary memory, main memory or Read Write memory. It is volatile memory as data loses when power is turned off. All the data that CPU requires during execution of program are stored in this memory.
2. **Read Only Memory (ROM)** – It is non-volatile memory and it always retains data even after the power is turned off. It stores crucial data that is used by system to operate.

References –

To know more about types of RAM and ROM - https://www.geeksforgeeks.org/types-computer-memory-ram-rom/

What happen when you switch on your computer?

When we turn on our computer then system goes through different phases like booting, BIOS, MBR (Master Boot Record), init.

Booting –

Booting process happens every time when we turn on our system. It happens very fast. Booting process starts when we push the power button (power switch on) which sends signal to the boot loader. Boot loader responsible for loading and starting the boot time task and processes the operating system. A bootloader also knows as boot manager or bootstrap loader. Boot loader manages and executes the boot sequence of computer system.

BIOS (basic input/output system) –

when BIOS start up our system then it first test all the attachment are in place and functions properly then it loads the operating system from hard disk to our memory (RAM).

POST (power-on self-test) –

It is the initial set of diagnostic tests that run to determine if the attachments (keyboard, disk drives, memory etc.) works properly. It can detect some errors with keyboard, video cards, memory, motherboard, processors etc. Most BIOS chips use different beep codes to indicate the POST status or the problems find with devices.

MBR (Master Boot Record) –

It is the information that is read from first sector of the hard disk i.e. the first 512 bytes on a hard drive contains MBR. MBR contains boot code and partition table where –

Boot code processes the partition table to identify which partition is bootable. It knows where the operating system code is present and how to load that code.

Partition table identifies the file system on the disk partitions. Every entry in the partition table gives the information about where each partition is going to begin.

Init –

It is the last step in boot sequence. Once the kernel is loaded, find init and executes it. First thing that init does is reading initialization file i.e. */etc/inittab* that helps init to read an initial configuration script for the environment which check the file system, sets the path etc.

REFRENCES –

https://www.geeksforgeeks.org/what-happens-when-we-turn-on-computer/

System Structure

System call –

It provides a way for programs to interact with the operating system or we can say, it provides a programmatic way in which program requests services from the kernel of the operating system.

System calls provide an interface between program and operating system.

Since user program don't have permission to perform operations like accessing I/O devices etc. So, user program invokes system calls when it requires such services.

Examples of system call – fork, exit, wait etc.

Services provided by System calls –

a. Process management.
b. Memory management.
c. File system management.
d. Protection.

- **Please go through this link to understand in detail –**
  System call - https://www.geeksforgeeks.org/operating-system-introduction-system-call/

Kernel –

It is the core part of an operating system. It manages operations of the computer, hardware (memory) and the CPU time. It directly interacts with the hardware and perform most crucial tasks. It is the most fundamental part of an operating system which controls programs on the computer system.

There are two types of kernels –

a. Monolithic Kernel – which contains many device drivers.
b. Micro Kernel – which contains basic functionality. It only deals with the critical activities like controlling the memory and CPU.

- **Please go through these links to understand in detail -**

What is kernel and role of kernel - https://www.geeksforgeeks.org/operating-system-microkernel/

Key difference between Monolithic and Micro Kernel - https://www.geeksforgeeks.org/operating-system-monolithic-kernel-key-differences-microkernel/

At that point you able to understand Kernel and its types and now we are going to learn **Dual Mode Operations**.

Dual Mode Operations –

Since the operating system and the user share the hardware and software resources of the computer system, so we need to make sure that an error occur in user program could not cause problems in other programs. With sharing, bug in one program could cause adverse effect in many processes. So, to ensure the proper execution of the operating system, we must able to understand the distinguish between the execution operating system program and user program.

So, for this we need two separate mode of operation – User Mode and Kernel Mode.

Kernel Mode also knowns as supervisor mode or system mode or privileged mode

Mode Bit – With the help of mode bit we can distinguish between a task that is executed on behalf of the operating system and one that is executed on behalf of user. This bit is added to the hardware of computer to indicate the current mode of operation.

Mode Bit = 0, indicated kernel mode i.e. Kernel (0).

Mode Bit = 1, indicates User Mode i.e. User (1).

If a user program requests a service from operating system, then there is transition from user mode to kernel mode to fulfill the request.

Dual mode operation in detail - https://www.geeksforgeeks.org/dual-mode-operations-os/

Privileged and non-privileged instructions –

As we already studied about the dual mode of operation in previous link (https://www.geeksforgeeks.org/dual-mode-operations-os/) that it separated out the kernel and user mode .

Privileged instructions are those instructions that can run only in kernel mode. To provide protection to the hardware, we use privileged instructions as it execute only in kernel.

Non-Privileged instructions are those instructions that can run only in user mode.

To learn functionalities of these instruction - https://www.geeksforgeeks.org/operating-system-privileged-and-non-privileged-instructions/