

CS 303 Operating System Concepts

Assignment 01 - S/17 | 355

- ① Explain the difference between system software and application software?

 - # System software is meant to control, coordinate and administer system resources, it also serves as a kind of platform for running application software.
 - # Application software is meant to enable the user to carry out some specific task or function. Some examples of application software include word processing, compilers, web browsers and games.

③ what is an Operating System?

Operating System is a program which acts as an intermediary between the user of a Computer and the Computer hardware.

Operating systems make computer system convenient to use and it uses computer hardware in an efficient manner. Common examples for operating systems are windows, linux, macos etc.

Q) what are the three main purposes of an OS?

- * ability to evolve.
 - * Convenience.
 - * efficiency.

(4) provide the most well known examples of O&P and cont'd

- Standard, Linux, Unix, Mac OS, Intel processor
CPU, RAM, hard disk, monitor, keyboard, mouse

⑤ Compare and Contrast the difference between Windows and Linux OS?

- * Linux is an Open Source operating system.
- * Windows is a Commercial Operating System.
- * Linux is more efficient in operation as compared to Windows.
- * Windows is less efficient in operations.
- * Windows provide less security as compared to Linux.
- * Linux is highly secure as compared to Windows.

⑥ Explain the role of an OS as a resource allocator?

- * The Operating System manages all the resources of the Computer, and decides between conflicting requests for efficient and fair resource use.

⑦ Explain the role of an OS as a Control program?

- * The Operating System Controls execution of programs to prevent, error and improper use of the Computer.

⑧ What does a bootstrap program do?

- * When the Computer is powered up or rebooted, it needs to have an initial program called the bootstrap program. The bootstrap program is usually stored in ROM or EPROM generally known as hardware. It is used to initialize all aspects of a Computer system.

The bootstrap program is responsible to load the operating system kernel and start execution.

⑨ State and Explain the functionality of a bootstrap program?

- * Initialized all aspects of a computer system.
- * Loads the operating system kernel and start execution.
- * Executed the initial process and waits for some event to occur.
- * When the CPU is interrupted, it stops what it is doing and immediately transfer execution to a fixed location and performs interrupt service routine.

⑩ How an OS kernel differ from an application program?

- * Kernel is part of the operating system and closer to hardware, it provides low level services like device driver, process management, memory management and system calls, whereas Application programs are programs designed to use system resources to solve the computing problem specific to a user such as word processing, computers, web browser and games.

⑪ What is the purpose of an Interrupt?

- * Interrupt is a signal from a device attached to a computer or from a program within the computer that requires the OS to stop and figure out what to do next. This allows the operating system to have multi-process multi-tasking, to handle many different programs by switching in and out of various tasks, with minimal inconvenience to the user.

⑫ How does an interrupt differ from a trap?

- * Are Trap is a signal raised by a user program (Software generated) instructing the operating system to perform some functionality

immediately. In contrast, the interrupt is a signal to the CPU emitted by hardware to indicate an event that requires immediate attention.

- (13) Can trap be generated intentionally by a user program? If so, for what purpose?

Yes, software traps interrupt the flow of data by causing them. An alert trap is triggered when a program that need assistance cannot handle errors or special events that occur during the execution of the program. This can be used for debugging purposes such as catching arithmetic errors.

- (14) How does an OS preserve the state of CPU?

The operating system preserves the state of the CPU by storing the registers which are special data storage and manipulation areas on the microprocessor. This includes the program counter register which keeps track of the address of the next instruction to be loaded into the instruction register.

- (15) Explain the functionality of system call.

System call provides the services of the operating system to the user program via application program interface (API). It provides an interface between a process and operating system to allow user level processes to request service of the operating system.

16) Rank the following storage systems according to speed, cost and volatility: (01)

Registers

Cache

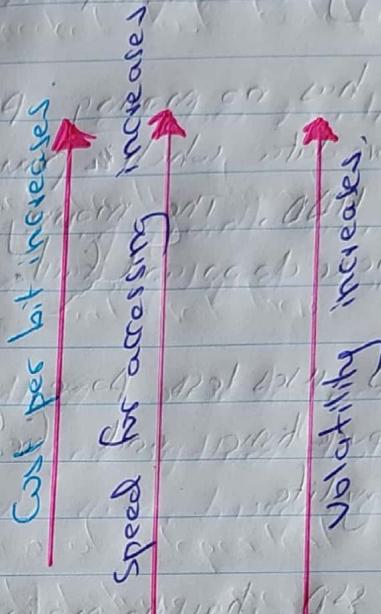
Main memory

Non-volatile memory

Hard disk

Optical disks

Magnetic tapes



17) Discuss the difference between main memory and secondary storage.

Main memory

Secondary storage

* Main memory is temporary.

* Secondary storage is permanent.

* Main memory is directly accessible by processor/ CPU.

* Secondary storage is not directly accessible by CPU.

* Main memory is volatile in nature meaning it loses its data once the power is off.

* Secondary storage is non-volatile meaning it retains data even when the power is off.

* Examples for main memory are RAM, Cache memory, registers.

* Examples for secondary memory are Hard disk, floppy disk, magnetic tape etc.

Q) What are the advantages of solid state drives (SSD) over hard drives (HDD)?

- * SSD has faster access speed means programs can run quickly when compared to HDD which are relatively slow.
- * SSD has no moving parts since it uses flash memory to store data which provide better performance and reliability over HDD. The moving parts present in HDD are prone to wear down and fail.
- * SSD uses less power than HDD which means lower energy bill over time and for laptop will result in increase of battery life.
- * Since SSD has no moving part, they ~~generate~~ ^{do not} generate any noise when compared to HDD.

Q) Briefly explain how a device driver engages to manage I/O operations?

- * To start an I/O operation, the device driver loads its appropriate registers within the device controller.
- * The device controller, in turn, examines the content of these registers to determine what action to take (such as "read a character from the keyboard").
- * The controller starts the transfer of data from the device to its local buffer.
- * Once the transfer data is complete, the device controller informs the device driver via an interrupt that it has finished its operations.
- * The device driver then returns control to the OS.

(20) Explain how Caching works in searching for information?

- * Caching is used in many levels of a Computer where information is copied from slower to faster storage temporary.
- * The faster storage (Cache) is checked first to determine if information is there.
 - if it is there, information is used directly from the Cache which is faster.
 - If not, data copied to Cache and used there.

(21) What is a distributed System?

- * Distributed System is a Collection of independent Components located on different machines that share messages with each other in order to achieve common goals.
- * The distributed system will appear as if it is one interface or Computer to the end user. The hope is that together, the system can maximize resources and information while preventing failures, as if one system fails, it won't affect the availability of the service.

(22) Compare and Contrast a single processor system and multi-processor systems.

- * Single processor system.
 - There is one main CPU capable of executing a general purpose instruction set, including instructions from user processes.
 - Most systems have special-purpose processors as well.
 - All of these special purpose processors run a limited instruction set and do not run user programs.

* Multi-processor Systems

- known as parallel systems, highly coupled systems.
 - These systems have two or more processes in close communication sharing the computer bus, clock memory and peripheral device.
- Advantages includes:

1. Increased throughput - By increasing the number of processors, we expect to get work done in less time.

2. Economy of scale - multiprocessor systems can cost less than equivalent multiple single processor systems, because they can share peripheral, mass storage and power supplies.

3. Increased reliability - function can be distributed properly among several processors, then the failure of one processor will not halt the system, only slow it down.

(23) what is the major difference between Asymmetric multiprocessing and symmetric multiprocessing?

1. Asymmetric multiprocessing - each ~~processor~~ is assigned a specific task.
2. Symmetric multiprocessing - each processor performs all tasks.

Asymmetric multi-processing Architecture

- A master processor controls the system, the other processors either talk to the master for instructions or have predefined tasks.
- This scheme defines a master-slave relationship.
- The master processor schedules and allocates work to slave processors.

Symmetric multi-processor Architecture.

- Most common systems use symmetric multiprocessing (Smp) in which each processor performs all the task within the OS.
- Smp means that all the processors are peers, no master-slave relationship exist between processors.

Q2 Explain how multi-programming is efficient in working with jobs?

- * A single program cannot keep the CPU or the I/O devices busy at all times.
- * Multi programming increases CPU utilization by organizing jobs (Code and data) so that the CPU always has one to execute.
- * The OS keeps several jobs in memory simultaneously.
- * Since, in general, main memory is too small to accommodate all jobs, the jobs are kept initially in the job pool.
- * One job is selected and run via job scheduling.
- * When it has to wait (for I/O for example), OS switches to another job.
- * Eventually, the first job finishes waiting and gets the CPU back. As long as at least one job needs to execute, the CPU is never idle.

(25) Explain the term "Time Sharing" in the OS context?

Ans Time Sharing is a logical extension of multi-programming in which CPU switches jobs so frequently that the user can interact with each job while it's running, creating interactive Computing.

- Time sharing requires an interactive Computer System which provides direct communication between the User and the System.
- The user gives instructions to the OS using an input device such as a keyboard, mouse or touch screen and wait for immediate result on an output device, the response time should be < 1 seconds.
- A time sharing OS uses CPU scheduling and multi-programming to provide each user with a small portion of a time-shared Computer.
- Each user has at least one program executing in memory.
- If several jobs are ready to run at the same time, the system must choose among them.
- If processes don't fit in memory, swapping moves them in and out to run.
- Virtual memory allows execution of processes not completely in memory.

(26) State the two mode of operation, in dual mode operation and explain the procedure of transition from user mode to kernel mode when a system call occurs?

1. User mode

2. Kernel mode (also called supervisor mode, system mode or privileged mode)

- » A mode bit is added to the hardware of the Computer to indicate the current mode.
- » kernel(0) and user(1) with the mode bit.
- provided ability to distinguish when system is running kernel Code or user Code.
- Some instructions designated as privileged can only be executed in kernel mode.
- when the user application request a service from the OS via a system call, it must transition from user to kernel mode, return from call reset it to user mode.
- At system boot time, the hardware start in kernel mode.
- The OS is then loaded and starts user applications in user mode.
- whenever a trap or an interrupt occurs, the hardware switches from user to kernel mode (by setting the mode bit to 0).
- whenever the OS gain control of the Computer, it is in kernel mode.
- The system always switches to user mode (by setting the mode bit to 1) before passing control to a user program.

Q7) Explain how a timer can be used to prevent infinite loop.

- » Timer is set to interrupt the Computer after some time period.
- » keep a Counter that is decremented by the Physical clock.
- » Operating System set the Counter (privileged instruction).
- » When Counter Zero generated an interrupt.
- » Set up before scheduling process to regain control or terminate processes that exceeds allotted time.

- Q. State the process management activities, memory management activities and storage management activities in the OS & responsible?

Process Management.

- A process is a program in execution. It is a unit of work within the system. Program is a passive entity and the process is an active entity.
- A process needs resources to accomplish its tasks.
 - CPU, memory, I/O, files.
 - Initialization data, memory protection, scheduling, priority, synchronization, shared resources, work assignment, interrupt handling, time delays.
- Process termination requires reclaim of any reusable resources.
- Single threaded process has one program counter specifying location of next instruction to execute.

- Process executes instructions sequentially one at a time until completed.
- Multi-threaded process has one program counter per thread.
- Typically system has many processes, some user, some operating system running concurrently on one or more CPUs.
- Concurrency by multiplexing the CPU among the processes / threads.

Process Management Activities.

1. Creating and deleting both user and system processes.
2. Suspending and resuming processes.
3. Providing mechanisms for process synchronization.
4. Providing mechanisms for process communication.
5. Providing mechanisms for deadlock handling.

Memory Management Activities.

1. Keeping track of which parts of memory are currently being used and by whom.
2. Deciding which processes (or parts thereof) and data to move into and out of memory.
3. Allocating and deallocating memory space as needed.

Storage Management Activities.

1. Creating and deleting files and directories.
2. Supporting primitive to manipulate files and directories.
3. Mapping files onto secondary storage.
4. Backing files onto stable (non-volatile) storage media.

(29) Briefly explain the terms Buffering, Caching and Spooling in memory management.

- » Buffering - Storing data temporarily while it is being transferred.
- » Caching - Storing parts of data in faster storage for performance.
- » Spooling - The overlapping of output of one job with input of the other job.

(30) Discuss the main advantages and disadvantages of open source OS?

Advantages:

1. Cheaper than Commercially marketed products.
2. Generally an open source software is free to use. The user doesn't require to pay for the usage.

Disadvantages:

1. Open source software is less reliable.
2. It may contain viruses or spyware.

2. Reliability.

- High reliability can be ensured when using an open source software since it is created by passionate developers who are experts. Since there are large community going through the code, the chance someone would identify a flaw in a program and rectify it is higher when compared to commercial products which might have limited number of developers at their disposal.

3. Flexible.

- Unlike in proprietary software, users in Open Source software does not experience vendor lock-in. Even if there are irrelevant features user can remove them. This is because the source code is free to modify. Users do not have to stick to providers requirements.

4. Licensing.

Open source software offers convenient licensing schemes thus no user do not need to worry about monitoring and tracking.

Disadvantages.

1. User friendly. - not all the open source application are easy to use. The graphical user interface may not be user friendly for the users to understand, only tech savvy people will be able to understand this interface.

5. Security issues.

- The source code present in open source software is free to edit. The problem comes when someone misuses the code for their own benefit.

3. Compatibility Issues.

- Some applications cannot support both open source and proprietary software. If proprietary hardware is needed to run an open source machine, it may require third party driver.

6. Lack of Support.

- when using open source software, it is common to experience technical issues. unlike proprietary software, an open source software does not offer extensive support. for fixing problems we will have to rely on the internet.

Sharing & Reuse of code.

another advantage of open source software is that it can be shared and reused. this is because the source code is available for everyone to see and use. this makes it easier for developers to build upon existing code and create new applications. it also allows for collaboration between different teams and individuals.

Cost Savings.

another advantage of open source software is that it is often free or low-cost. this is because the cost of development and maintenance is shared by a large community of users. this makes it a more cost-effective option for businesses and individuals who may not have the budget for proprietary software.

Flexibility & Customization.

another advantage of open source software is that it is highly customizable. this means that users can modify the source code to suit their specific needs. this is particularly useful for businesses that need to create unique solutions for their industry. it also allows for experimentation and innovation, as users can try out new ideas and features without worrying about intellectual property rights.

Community Support.

another advantage of open source software is that it has a large and active community of users and developers. this means that there is a wealth of knowledge and expertise available online, which can be used to troubleshoot problems and learn new skills. it also provides opportunities for collaboration and networking, as users can connect with others who share similar interests and goals.