CO327 : ASSIGNMENT 01

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1. We have stressed the need for an operating system to make efficient use of the computing hardware. When is it appropriate for the operating system to forsake this principle and to "waste" resources? Why is such a system not really wasteful?

Efficient use of computing hardware must be met along with providing better usability and performance to the user. This principle is appropriate for single user operating systems in mobile phones and desktop computers, where a GUI is used to provide a user friendly background for the user. This kind of a system is not really a waste full system as this particular environment (GUI) is a requirement by the user and it should be provided even though computing hardware gets not used efficiently.

2. What is the main difficulty that a programmer must overcome in writing an operating system for a real-time environment?

In a real time environment the response time has to be real time and the operating system has to finish certain tasks at a given time and proceed on to the next and by failing to do so the operating system will crash. Hence, a proper scheduling scheme has to be maintained.

3. How does the distinction between **kernel mode** and **user mode** function as a rudimentary form of protection (security) system?

User mode doesn’t allow one to change the core operations (accessing hardware devices, using privileged instructions etc) in the system and in kernel mode al the privileges of changing the system is allowed. Only system administrators have this privilege. If users are allowed to change or access sensitive operations in the system, some might accidently change certain core operations which will cause problems to the system. Hence, this acts as a rudimentary form of protection for the system.

4. Some early computers protected the operating system by placing it in a memory partition that could not be modified by either the user job or the operating system itself. Describe two difficulties that you think could arise with such a scheme.

- If the operating system cannot be modified then it cannot be updated, patched or removed to install another one. This could leave the system vulnerable to new threats to the system as it is not protected to newly created threats.

- Sensitive information such as user passwords and account details must be protected. It shouldn't be allowed to be accessed by other users. If they cannot be stored in the secure memory partition then they become revealed as they are stored in insecure locations.

5. Give two reasons why caches are useful. What problems do they solve? What problems do they cause? If a cache can be made as large as the device for which it is caching (for instance, a cache as large as a disk), why not make it that large and eliminate the device?

- Cache is useful because,

    1. It can store frequently used data which is needed by the processor and the processor can access it quickly to get that data (no need of getting data from other memory or storage device, cache is faster than them)

    2. It acts as a buffer when transferring data between two devices with different speeds so that no data gets lost during transfer. Slower device's Cache stores frequently used data which allows the faster device to access data quickly from the cache.

- Cache solves,
    1. Improves speed of transfer of data between devices with different speeds.
    2. Improves CPU performance by letting the process access pre-fetched data quickly.
- Why not make it a large device,
    1. Because cache is very expensive than disk storage or other memory.
    2. Because cache is volatile and cannot be used for disk storage as it doesn't store data after power is lost.

6. In a multi programming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems.

1. What are two such problems?
    1. One can restrict or prevent another user from getting anything done. This is also called as denial of service.
    2. One user can change or manipulate data of another user.

b) Can we ensure the same degree of security in a time-shared machine as in a dedicated machine? Explain your answer.

Same level of security can be achieved only if we can ensure that operating system prevent any sharing of data between users, either for reading or writing and if the user programs fairly shares the computer.

7. Describe the differences between symmetric and asymmetric multiprocessing. What are three advantages and one disadvantage of multiprocessor systems?

The main difference is that in symmetric processing all the processors are treated equally and I/O can be processed in any of the processors. But in asymmetric processing, there's one master processor which controls I/O and other processors work on computational work designated by the master processor.

Advantages:

1. Increased reliability
2. Execute programs quickly
3. Save cost by sharing resources such as power supplies, housings and peripherals.

Disadvantages:

1. Complexity in hardware and software

8. How are network computers different from traditional personal computers? Describe some usage scenarios in which it is advantageous to use network computers.

Network computers unlike personal computers rely on a centralized computer for its services. Personal computers in the other hand provide all services on its own without relying on a centralized computer. Network computers are preferred in situations where administrative cost are high and sharing resources leads to more efficient use of resources. It can also be used in occasions where a bunch of devices has to be taken in to control under one centralized device.

9. What is the purpose of interrupts? How does an interrupt differ from a trap? Can traps be generated intentionally by a user program? If so for what purpose?

Transferring program control to a given address based on some event is the main purpose of interrupts. These events can be either system programs or hardware events. When an interrupt is called, the current process stops and interrupt request is carried out in priority basis.

A trap is a software generated interrupt and it is different from an interrupt because an interrupt is only triggered by a signal to the processor. Traps are synchronous, predictable while interrupts are asynchronous and not predictable

Traps can be caused by exceptions or through explicit instructions in the program. The purpose of this is that this allow user to force a mode switch to the kernel mode.

10. Direct memory access is used for high-speed I/O devices in order to avoid increasing the CPU's execution load.

a) How does the CPU interface with the device to coordinate the transfer?

CPU set up DMA registers at first which includes pointers to the source, destination of the transfer and a counter of the number of bytes to be transferred. The DMA controller starts to place addresses on the bus to perform the transfer while CPU is free for other tasks.

b) How does the CPU know when the memory operations are complete?

DMA controller interrupts the CPU once the entire transfer is over.

c) The CPU is allowed to execute other programs while the DMA controller is transferring data. Does this process interfere with the execution of the user programs? If so, describe what forms of interference are caused.

There may be a problem if both CPU and DMA controller access the memory at the same time and hence, CPU should be prevented for a certain time from accessing main memory when DMA gets hold of the memory bus. User

programs get interfered only when DMA controller sends the transfer completion interrupts to the CPU.

11. Some computer systems do not provide a privileged mode of operation in hardware. Is it possible to construct a secure operating system for these computer systems? Give arguments both that it is and that it is not possible.

It is possible to construct a secure operating system for those computers which don't have privileged modes, only if the computer is constantly monitored.

It will not be possible to construct a secure operating system because not having a privileged mode makes the system less secure and likely to be destroyed by misbehaving users. Privileged mode protects the OS from users and it also protects users from each other as well.

12. Many SMP systems have different levels of caches; one level is local to each processing core, and another level is shared among all processing cores. Why caching systems are designed this way?

These different levels of caches are based on speed and size. Faster caches are typically more expensive. When cache is closer to the CPU access speed is much more. Hence, small and faster caches are kept near to each CPU and shared caches that are larger and a bit slower are shared between other processors.

13. Describe a mechanism for enforcing memory protection in order to prevent a program from modifying the memory associated with other programs.

It can be done by keeping track of the locations associated with each process and by limiting access to locations which are outside the program. This restricts accessing another process by another one. These Boundaries has to be maintained using base and limits registers while performing a check for every memory access happening.

14. Identify several advantages and several disadvantages of open-source operating systems. Include the types of people who would find each aspect to be an advantage or a disadvantage.

Open source operating systems are debugged by many people and are accessible easily as well as it has rapid updates. These updates make sure that the system is kept secured from most recent threats as well. The users get the advantage of modify and view the source code as well. For students, it is advantageous as most of open source operating systems are freely available.

The improvement of open source operating systems is not in much of a interest in commercial operating system companies as there's competition. Open source operating systems are developed by many people of many back grounds and because of that the reliability of the system can be a little less. Another aspect is that since it's developed frequently the user should always try to update and be with the latest changes.