**CO327 – Operating systems assignment 1**

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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?***

If we first look at the main goal of operating systems we can’t really define that using single definition. Because there is no perfect definition. We can categorized it to three main category.

1. Resource allocation
2. Supervision
3. Managing i/o devices

Resource allocation is right at the top. But PCs or handheld computers designed mostly for individual usability, for ease of use, with some attention paid to performance, and none paid to resource utilization. Therefore it’s appropriate for the operating system to forsake this principle and to “waste” resources. Single-user systems should maximize use of the system for the user. A GUI might “waste” CPU cycles, but it optimizes the user’s interaction with the system. Therefore we can’t say such a system is really wasteful.

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

Operating system (OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays. Processing time requirements (including any OS delay) are measured in tenths of seconds or shorter increments of time. Therefore main difficulty is keeping the operating system within the fixed time constraints of a real-time system. Because if the task is not fully done within that time it may leads to break the entire system which is running. Therefore when scheduling the processes program writer should make sure that it don’t allow response time to exceed the time constraint.

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

 Kernel mode is generally reserved for the lowest-level, most trusted functions of the operating system.

* It is mandatory that certain instructions must be executed only when the operating system is in kernel mode.
* Access to hardware Devices can be done only when the program is executing in kernel mode.
* Interrupts can be controlled only when the CPU is executing in kernel mode.
* The privileged instructions can be executed only when the CPU is in kernel mode.

Therefore in this way kernel mode provide rudimentary form of protection system. In user mode code has no ability to direct access the hardware or reference memory. Due to the protection afforded by this sort of isolation, crashes in user mode are always recoverable. Therefore kernel mode and user mode function as a rudimentary form of protection (security) 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****.*

* Because of the data in there can’t access by the operating itself The critical data such as passwords and access control information that are required by or generated by the operating system would have to be passed through or stored in unprotected memory slots and would be accessible to unauthorized users.
* Other major drawback is that the operating system could never be updated or patched, since it is not modifiable or accessible by the user or the operating system itself.

***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?***

* Caches are useful because they can increase the speed of the average memory access, and they do so without taking up as much physical space as the lower elements of the memory hierarchy. Using spatial and partial locality.
* Caches are useful when two or more components need to exchange data, and the components perform transfer at different speeds. Caches solve the transfer problem by providing a buffer of intermediate speed between the components

The data in the cache must be kept consistent with the data in the components. If a component has a data value change, and the datum is also in the cache, the cache must also be updated .And then the problem arise when more than one processor access the datum.

Making caches large tends to be more expensive. That’s why it not make that large.

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

***a) What are two such problems?***

Memory management - the system must allocate the memory to several jobs

CPU scheduling - the system must choose among several jobs ready to run.

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

We can't ensure the same degree of security in a time-shared machine as we have in a dedicated machine, because in a time-shared machine there are several jobs simultaneously in memory. Since any protection scheme devised by humans.

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

1. In symmetric multiprocessing (SMP)

* All processors are peers.
* All processors runs a copy of operating system.
* Processors communicate with one another as needed.
* No special hardware / software needed to differentiate as neither master nor slave exist.

Advantages:

* It is a cost-effective way to increase throughput.
* If a task seems too big or is taking too long, multiple processors are assigned to said task in order to speed up the process.
* Allows for scaling related to data sharing.

Disadvantage

* The Operating System and programs/applications running an SMP system *need*to be compatible with it; otherwise the multiple processors are completely wasted.

1. In asymmetric multiprocessing (ASMP)

* Processor will have master-slave relationship scheme.
* Each processors is assigned by a specific task. (by a master processor)
* A master process controls the system.
* Special hardware or software can only differentiate one master and multiple slaves.

Advantages:

* Each has its own address space. Hence the speed is high.
* Each CPU may or may not run an OS the OSes need not be the same.
* Each of which may be a different architecture.

Disadvantage

* It is not a cost-effective way.

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

A network computer relies on a centralized computer for most of its services. It can therefore have a minimal operating system to manage its resources. A personal computer on the Other hand has to be capable of providing all of the required functionality in a standalone manner without relying on a centralized manner. Scenarios where administrative costs are high and where sharing leads to more efficient use of resources are precisely those settings where network computers are preferred.

***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?***

 Trap is a software-generated interrupt. An interrupt can be used to signal the completion of an I/O to obviate the need for device polling. A trap can be generated intentionally by a user program. An interrupt is a hardware-generated change of flow within the system. An interrupt handler is called to deal with the cause of the interrupt; control is then returned to the interrupted context and instruction. A trap is a software-generated interrupt. An interrupt can be used to signal the completion of an I/O to obviate the need for device polling. A trap can be generated intentionally by a user program. It can be used to call operating system routines or to catch arithmetic errors.

***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?***

To initiate a direct memory access transfer, the CPU first sets up the direct memory access registers, which contain a pointer to the source of a transfer, a pointer to the destination of the transfer, and a counter of the number of bytes to be transferred. Then the direct memory access controller proceeds to place addresses on the bus to perform transfers, while the CPU is available to accomplish other work.

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

.Once the entire transfer is finished, the direct memory access controller interrupts the CPU.

***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.***

CPU and the DMA controller want to access the memory at the same time. Accordingly, the CPU should be momentarily prevented from accessing main memory when the DMA controller seizes the memory bus. However, if the CPU is still allowed to access data in its primary and secondary caches, a coherency issue may be created if both the CPU and the DMA controller update the same memory locations.

***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.***

Privileged mode means the kernel mode. These kind of computer system remain in control mode all time. That could be accomplished by following ways.

* Software interpretation of all user programs (like some BASIC, Java, and LISP systems, for example). The software interpreter would provide, in software, what the hardware does not provide.
* Require meant that all programs be written in high‐level languages so that all object code is compilerproduced. The compiler would generate (either inline or by function calls) the protection checks that the hardware is missing.

***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?***

This is because of size and the access speed of the cache. Normally, the closer the cache is to the CPU, the faster the access. However, faster caches are typically more costly. Therefore, smaller and faster caches are placed local to each CPU, and shared caches that are larger, yet slower, are shared among several different processors.

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

The processor could keep track of what locations are associated with each process and limit access to locations that are outside of a program’s extent. Information regarding the extent of a program’s memory could be maintained by using base and limits registers and by performing a check for every memory access.

***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 have the advantages of having many people working on them, many people debugging them, ease of access and distribution, and rapid update cycles. Further, for students and programmers, there is certainly an advantage to being able to view and modify the source code. Commercial operating system companies usually do not like the competition that open source operating systems bring because these features are difficult to compete against. Some companies avoid open source projects because they need paid support, so that they have some entity to hold accountable if there is a problem or they need help fixing an issue.