

COS214 Tutorial 1

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SOLUTIONS

1. What are the **main** functions of an operating system?

Answer

Functions of an operating system are:

- Shield the user from the intricate low-level details and provide an easier to program and more powerful interface to the machine or network => *virtual machine*.
- Manage the system resources: protection, scheduling, sharing, file system, accounting, etc. This function is obviously important for multitasking (OS2) and mutiusing/multitasking (UNIX, VMS) operating systems. Even for single-user/single task, resource management is important (e.g. file system allocation and structure).

2. What is meant by the term *virtual machine*? What is the benefit of viewing a system such as an operating system as a set of layers? Why shouldn't an operating system be built as one large program?

Answer

Virtual machine: Operating system provides the user with a higher-level way to control the underlying hardware of the machine.

For example: Using the high-level *read(fp, buf, n)* system call to read a byte from the hard disk which the OS translates to the low-level assembly language sequence to set up and perform the disk transfer

Viewing the operating system as a set of layers has the following advantages:

- Easier to understand OS. Presents an ordered view of an OS.
- Easy to improve OS by modifying a layer. Layers are assumed independent in operation with well-defined interfaces. Layering is an example of software modularity.
- Possibility of standardisation of different layers.
- Different teams can be responsible for software development of different layers.
- Easy to debug and maintain OS. Makes it possible to develop sophisticated systems.

On the other hand a monolithic OS has the following problems:

- Very large intricate source code. A nightmare to program and maintain.
- Not easy to develop OS as a team: can't allocate programming tasks.
- Harder to debug any problems.

3. Explain the terms *time-sharing* and *multi-programming*.

Answer

Muti-programming: Multiple programs or jobs are kept in memory and executed together. Job execution scheduling will allow the CPU to be used by one job while the other job is waiting for I/O. This permits almost 100% utilisation of CPU and other resources (note that the scheduler is an overhead).

Time-sharing: Allows many users to access the computer directly and on-line and at the same time. Concept relies on the fact that users are idle for the majority of the time. Both compute-intensive jobs and interactive service can be provided.

4. What is *pooling* and what are the benefits? Is it useful on a single-user system?

Answer

Spooling: refers to queuing jobs on disk and having the system service each job in turn as resources become available. A good example is print job spooling. Spooling is useful on single-user system as it allows the user to submit a job for printing or processing without having to wait for the current job to finish.

5. Which of the following instructions should be allowed only in kernel mode?

- (a) Disable all interrupts.
- (b) Read the time of day clock.
- (c) Set the time of day clock.
- (d) Change the memory map.

Answer

Choice a), c) and d) should be restricted to kernel mode.

6. Why is the process table needed in a *timesharing* system? Is it also needed in personal computer systems in which only one process exists, that process taking over the entire machine until it is finished?

Answer

The process table is needed to store the state of a process that is currently suspended, either ready or blocked. It is not needed in a single process system because the single process is in control of the system and there is no need to "track" it.

7. 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 (even in a single-user system)?

Answer

Single-user systems should maximise use of the system for the user. A GUI might "waste" CPU cycles but it optimises the user's interaction with the system.