DAT 103
Datamaskiner og operativsystemer (Computers and Operating Systems)

Supplementary exercises (Set 2)

Some questions about operating systems

Problem 1

What are the three main purposes of an operating system?

Solution.

The three main purposes are:

- To provide an environment for a computer user to execute programson computer hardware in a convenient and efficient manner.

- To allocate the separate resources of the computer as needed to solve the problem given. The allocation process should be as fair and efficient as possible.

- As a control program it serves two major functions: (1) supervision of the execution of user programs to prevent errors and improper use of the computer, and (2) management of the operation and control

Problem 2

Which one of the following is **not** an activity of an operating system?

(a) To control I/O devices and user programs

(b) To allocate resources to various programs

(c) To provide mechanisms for process synchronisation

(d) To load the BIOS to boot a computer

(e) None of the above

Solution.

To load the BIOS to boot a computer

Problem 3 (Ex 1.1 in [B1])

In a multiprogramming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems. What are two such problems?

Solution.

Stealing or copying one's programs or data; using system resources (CPU, memory, disk space, peripherals) without proper accounting.

Problem 4 (Ex. 1.4 in [B1])

1. Describe the differences between *symmetric* and *asymmetric* multiprocessing.

2. What are the advantage and disadvantages of multiprocessor systems?

Solution.

1. Symmetric multiprocessing treats all processors as equals, and I/O can be processed on any CPU. Asymmetric multiprocessing has one master CPU and the remainder CPUs are slaves. The master distributes tasks among the slaves, and I/O is usually done by the master only.

2. Multiprocessors can save money by not duplicating power supplies,housings, and peripherals. They can execute programs more quickly and can have increased reliability. They are also more complex in both hardware and software than uniprocessor systems.

Problem 5

Which one of the following can characterise *symmetric multiprocessing*?

(a) Each processor is assigned with a specific task

(b) All processors are peers

(c) It always uses uniform memory access (UMA) model

(d) All of the above

(e) None of the above

Solution.
All processors are peers

Problem 6 (Ex 1.5 in [B1])

How do clustered systems differ from multiprocessor systems? What is required for two machines belonging to a cluster to cooperate to provide a highly available service?

Solution.
Clustered systems are typically constructed by combining multiple computers into a single system to perform a computational task distributed across the cluster. Multiprocessor systems on the other hand could be a single physical entity comprising of multiple CPUs. A clustered system is less tightly coupled than a multiprocessor system.Clustered systems communicate using messages, while processors in a multiprocessor system could communicate using shared memory.In order for two machines to provide a highly available service, the state on the two machines should be replicated and should be consistently updated. When one of the machines fail, the other could then take-over the functionality of the failed machine.

Problem 7

Which **one** of the following is mainly stored in read-only memory (ROM) chips?

(a)   System files

(b)   Root directories

(c)   Firmware

(d)   All of the above

(e)   None of the above

Solution.
Firmware

Problem 8 (Ex. 1.13 in [B1])

Discuss, with examples, how the problem of maintaining coherence of cached data manifests itself in the following processing environments.

1. Single-processor systems
2. Multiprocessor systems
3. Distributed systems

Solution.

1. In single-processorsystems, the memory needs to be updated when a processor issues updates to cached values. These updates can be performed immediately or in a lazy manner.
2. In a multiprocessor system, different processors might be caching the same memory location in its local caches. When updates are made, the other cached locations need to be invalidated or updated.
3. In distributed systems, consistency of cached memory values is not an issue. However, consistency problems might arise when a client caches file data.

Problem 9

What is the purpose of system calls?
Solution.
System calls allow user-level processes to request services of the operating system.

Problem 10 (Ex. 2.10 in [B1])

1. How do user programs and system services interact in a microkernel architecture?
2. What is the main advantages and disadvantages of the microkernel approach to system design?

Solution.

1. User programs and system services interact in a microkernel architecture by using interprocess communication mechanisms such as messaging. These messages are conveyed by the operating system.
2. Typical advantages: (a) adding a new service does not require modifying the kernel, (b) it is more secure asmore operations are done in user mode than in kernel mode, and (c) a simpler kernel design and functionality typically results in a more reliable operating system. Main disadvantages: the overheads associated with interprocess communication and the frequent use of the operating system's messaging functions in order to enable the user process and the system service to interact with each other.