UNIVERSITY OF MALTA

BOARD OF STUDIES FOR INFORMATION TECHNOLOGY

Department of Computer Science & A.I.

B.Sc. I.T.(Hons.) Year II

June 2004 Assessment Session

CSA2110: Operating Systems II **June 2004**

09.00-11.30

Answer **four** *questions out of the* **six** *provided. Each question carries 25 marksB (subsequently normalised to 60% of the total mark).*

1. **Files and File Systems**

   (a) Describe a typical operating system technique that guarantees that user passwords are not visible by anyone, including the superuser. **[5 marks]**

   (b) Assume a typical filesystem, whereby the root directory contains one file (*file1*) and one directory (*dir1*). The directory *dir1* contains only one file *file2*. Draw up this directory structure in terms of partition details, i-nodes, and data and directory blocks. **[8 marks]**

   (c) Describe the difference between a *hard link* and a *soft link* and give a typical usage example of each. **[3 marks]**

   (d) Explain the use of memory-mapped IO for normal files. Make use of a process space diagram in your discussion. **[6 marks]**

   (e) Describe the typical permission flags that exist on files in the filesystem. **[3 marks]**

2. **Processes**

   (a) Two important entries in a process space is the *heap* and the *stack*. Explain why and how these entries are used in a typical user program. **[5 marks]**

   (b) Describe why resource limits exist in operating systems. Also explain why resource limits normally have a hard and a soft limit definition. **[5 marks]**

   (c) Explain why **C**opy-**O**n-**W**rite exists. **[5 marks]**

   (d) Most operating systems also offer the *SUID* flag in the file permission suite. What is this flag used for and what effect does this flag have on the process's real, effective and saved user id? **[5 marks]**

(e) Describe one scenario when `vfork()` would be used. **[5 marks]**

3. **Signals and Case Study**

(a) Describe why signals are used. **[3 marks]**

(b) Whenever a signal arrives, describe the three actions that can be performed by a Unix process. **[3 marks]**

(c) Describe what are *re-entrant* calls in relation to signal handling. **[6 marks]**

(d) You were asked to develop a system whereby multiple processes can efficiently manipulate a single file. All the actions performed on the file (additions, deletions, and searches) have to be atomic while always maintaining the file in a consistent state. You can assume that both the file and all the processes exist on the same computer. Describe a mechanism that would make this possible. **[13 marks]**

4. **IPC Structures**

(a) List the System V IPC structures giving an example of where each might be used. **[6 marks]**

(b) Explain pipes and how they would normally be used on a Unix operating system. **[4 marks]**

(c) Give a scenario where FIFO files might be more suitable than pipes. **[4 marks]**

(d) System V IPC structures generally make use of a system-wide unique key to allow access to them by several processes. How can this key be communicated to other processes. What provisions need to be catered for in a system where a fixed-valued key might already be in use by another process? **[6 marks]**

(e) While semaphore operations normally are made up of the *signal* and *wait* operating on a single semaphore, list the extra operations that are normally implemented on semaphores by operating systems. Describe typical scenarios where these extra operations might be required. **[5 marks]**

5. **Socket Programming**

(a) Sockets are usually connection-oriented communication structures. Describe the mechanism on both the client-side and the server-side that results in a connection between these two parties. Make reference to the connection tuple structure in your discussion. **[5 marks]**

(b) Explain why all Internet-traffic has to follow the network-byte ordering convention. **[3 marks]**

(c) Explain why the use of `select` is a better alternative that non-blocking I/O. Also describe a scenario where an iterative server using `select` might be a better solution that a concurrent server. **[5 marks]**

(d) Describe a system that would enable users to share files in a Peer-to-Peer fashion while also allowing server-based searches on filenames. Include in your discussion diagrams showing the communication protocol and the processes involved. **[12 marks]**

6. **Multi-Threading and SMPs**

(a) Describe the difference between *Processes*, *Kernel-Level Threads* and *User-Level Threads* making reference to their performance. **[6 marks]**

(b) Describe the problems that crop up in terms of caching when two threads, each on a separate processor in an SMP system, share the same data. **[4 marks]**

(c) Describe the terms *locality* and *load balancing*. **[5 marks]**

(d) Describe the relationship between the above two terms and *per-processor* run-queues and *shared* run-queues in a multi-processor system. **[5 marks]**

(e) Explain what is meant by the blocking problem on user-level thread schedulers. Explain one technique that would solve this problem. **[5 marks]**

---

end of paper