

UNIVERSITY OF MALTA
BOARD OF STUDIES FOR INFORMATION TECHNOLOGY
Department of Computer Science & A.I.
B.Sc. I.T.(Hons.) Year II
May/June 2001 Assessment Session

CSM211 Operating Systems II

5th June 2001

0915-1145

*Answer **four** questions out of the **six** provided. Each question carries 25 marksB (subsequently normalised to 70% of the total mark).*

1. (a) Describe the UNIX filesystem, making reference to i-nodes and the directory and data blocks. What is the use of storing the number of links per i-node entry? **[10 marks]**
- (b) When a UNIX process accesses a file, describe the file related structures used in the process and kernel space to access that file. Describe how this structure allows more than one process to access the same file while not sharing the same file offset. **[10 marks]**
- (c) Describe the `dup` function and draw a diagram representing the process and kernel space after this function is executed. Describe the difference between the `dup` and `dup2` function. **[5 marks]**
2. (a) Each process goes through a series of function calls throughout its execution. List these functions and their order of execution. **[5 marks]**
- (b) Describe the concept of resource limits and the allowed operations available to the user and the superuser. **[5 marks]**
- (c) (i) What happens when the `fork` system call is executed. What structures are duplicated ?

- (ii) How does `vfork` vary from `fork`?
- (iii) Describe Copy-On-Write (COW) and the reason why its used?
[10 marks]
- (d) Describe what happens in the process user space when `mmap` is called? What are the advantages of using `mmap` to the normal file I/O access?
[5 marks]
3. (a) Describe the concept of a signal and the purpose for their use. [5 marks]
- (b) (i) Describe the functionality of `signal`, `alarm`, `kill` and `raise`.
(ii) Describe how re-entrant functions relate to signal handling.
[8 marks]
- (c) Describe the relationship between child termination and signals. [5 marks]
- (d) If one has `sigprocmask` followed by `pause`, describe a scenario which could lead to the process sleeping for ever. How would the same behavior be replicated without the risk of indefinite sleep and why is this guaranteed? [7 marks]
4. (a) List and describe the advantages of threads over processes. Describe the differences between kernel-level threads and user-level threads. [10 marks]
- (b) (i) Describe an inexpensive primitive used for thread synchronisation on SMP machines. [2 marks]
(ii) What two types of scheduling strategies could be used for scheduling threads on SMPs. What are the advantages and disadvantages of each. [7 marks]
- (d) (i) Describe the concept of deltas in `rcs` and the reason for their use.
(ii) Describe the process of extraction of a specific revision in `rcs`. Make use of diagrams to aid your explanation.
[6 marks]

5. (a) Describe the necessary steps required for a server and a client to connect using sockets making reference to specific system calls used. [4 marks]
- (b) Describe the difference between an iterative and a concurrent server. [3 marks]
- (c) Describe the `select` system call and its use in the `inetd` background process. [5 marks]
- (d) Describe a communication protocol which will allow a central concurrent server to maintain a list of connected users and that also allows peer-to-peer connections upon request. Describe how the list of connected users is made accessible to all processes making up the server. [13 marks]
6. (a) Describe the key protocol for System V IPCs. [5 marks]
- (b) Why are pipes only relevant to related processes, and what alternative to pipes can one use for unrelated processes. [5 marks]
- (c) List all the forms of System V IPCs. [3 marks]
- (d) Describe what is meant by the atomicity of semaphores and why it is useful. [3 marks]
- (d) Design an IPC protocol where multiple unrelated clients can make requests to a central server and the server can relay replies back to the clients. [9 marks]
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