

UNIVERSITY OF MALTA
BOARD OF STUDIES FOR INFORMATION TECHNOLOGY
Department of Computer Science & A.I.
B.Sc. I.T.(Hons.) Year II
June 2002 Assessment Session

CSM211: Operating Systems II

1st June 2002

0915-1145

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

1. (a) Files in UNIX have ownership and access rights properties. List these properties and discuss how they relate to system security. [5 marks]
- (b) Describe the purpose and use of the file SUID flag. Explain how executing such a file will affect the process's rights. [5 marks]
- (c) Describe the concept of record locking and how it can be used to ensure file integrity when used in a concurrent operating system. [5 marks]
- (d) Illustrate through the use of a diagram, the i-node list (giving the i-node number and the link number) and the contents of the directory block for the following directory structure:

```
      temp
      /  \
    dir1  file1
      /  \
    file2  file3
```

[10 marks]

2. (a) How are environment variables passed to a new process, in terms of the structures used and the location in the process memory layout? [5 marks]
- (b) When the number of environment variables are increased within a running process, where are they stored in the process memory layout? [3 marks]
- (c) (i) Each process returns an exit value to its parent process. Yet the parent process might not retrieve this value immediately on child termination. Describe the approach taken by the UNIX operating system to handle such situations. [4 marks]
- (ii) What happens to the child process's exit value when the parent process terminates before the child process? [3 marks]
- (d) Describe COW in conjunction with *fork()* and the reason for its use. [5 marks]
- (e) Describe the difference between *fork()* and *vfork()*. [5 marks]
3. (a) Describe the use of signals in the UNIX operating system. [5 marks]
- (b) What is the biggest disadvantage of signals when multiple processes send signals to the same process? [5 marks]
- (c) Describe signal masks and the purpose of their use. [3 marks]
- (d) A nuclear research company has just built a particle accelerator which generates a series of values at a very large rate. They have also built a program that retrieves a value from the accelerator and performs a mathematical operation on it. The result of this operation is then combined to a second value from the accelerator and a further new result is obtained. This operation is repeated until a total of 4 values have been taken from the accelerator output to generate a final value. Unfortunately, their software cannot cope on the current hardware. Design a system which would be able to run on a 4 processor machine and take advantage of the parallelism available. [12 marks]
4. (a) What is network byte ordering and why is it used in socket communication? [5 marks]

- (b) What is the difference between a server and a client in socket programming? [5 marks]
- (c) How do iterative and concurrent servers differ? [2 marks]
- (d) On the Internet there are several servers that allow users to connect and engage in 2-player games. Design such a system, clearly stating the communication protocol, making sure that once the game is initiated the server does not suffer from excessive network traffic. [13 marks]
5. (a) Describe the concept of pipes and how they can be used to forward the output of one program to the input of another program. [5 marks]
- (b) What is the main advantage of FIFO files over pipes? [3 marks]
- (c) (i) List the 3 most popular flavours of System V IPCs [2 marks]
(ii) Describe ways how System V IPC keys or identifiers can be advertised to multiple processes. [5 marks]
(iii) If 4 client processes continuously send requests to a server process using a single message queue, how can the central process service one request at a time and also make sure that each of the client processes are serviced in order? [5 marks]
- (d) What are debugging symbols and why are they necessary for code debugging? [5 marks]
6. (a) Clearly state the advantages of user-level multithreading over kernel-level multithreading. [6 marks]
- (b) What is the problem with blocking system calls in user-level thread schedulers? [6 marks]
- (c) Compare and contrast techniques for avoiding blocking systems calls through
- (i) multiplexing,

- (ii) system call wrappers and
- (iii) scheduler activations.

[13 marks]
