

UNIVERSITY OF MALTA
FACULTY OF SCIENCE
Department of Computer Science & A.I.
B.Sc.(Hons) Year II
June 2003 Assessment Session

CSA2110: Operating Systems II

23rd June 2003

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. (a) (i) Describe the entries in the `/etc/passwd` file on Unix systems.
(ii) Explain how the password algorithm prevents even the super user from knowing the password of any user.
(iii) Describe the reason behind the introduction of the `/etc/shadow` file in relation to the `/etc/passwd` file.

[12 marks]
- (b) Describe the process that leads to the deletion of a particular file or directory.

[3 marks]
- (c) Explain the following in terms of their structure and their use
 - (i) hard links;
 - (ii) symbolic links.

[8 marks]
- (d) Why are hard links to directories allowed only for the super user? **[2 marks]**
2. (a) Using an appropriate diagram explain how two processes can share the standard output without both writing to the same screen location. **[6 marks]**
- (b) Describe the data structure used to pass environment variables to processes. Since this data structure is stored in a fixed-size location of the process memory space, what mechanism is used to enable new variables to be appended to this data structure? **[3 marks]**
- (c) How do Unix systems guarantee that no conventional user can crash the system by allocating memory infinitely? Yet how can the super-user bypass this restriction? **[6 marks]**

- (d) What is the reason for the existence of the `setjmp()` and `longjmp()` call? **[5 marks]**
- (e) Describe the Set User ID flag. What implications does this have on system security? **[5 marks]**
3. (a) Process A needs to notify process B on the same system each time a particular action occurs. This action might occur at any time and repeatedly. As a solution, Billy builds the system such that the first process sends a unix signal to the second process every time this action occurs. Why is this solution not adequate? **[5 marks]**
- (b) Explain how you would develop a clock that outputs the current time on screen every minute. **[3 marks]**
- (c) What is the purpose of signal masks? **[2 marks]**
- (d) What happens to a signal that arrives to a process that has blocked its delivery? **[3 marks]**
- (e) While having a good alcoholic drink in Paceville you get introduced to the manager of The Sun newspaper. He tells you that they have a system whereby people send e-mails to a local server with hot stories. He has three employees that 24 hours a day retrieve one of these e-mails in FIFO order and check out the story. Unfortunately he is worried that some of these e-mails are taking too long to be checked out and the competition are getting the story before him. Suggest a system that would allow the manager to know how many e-mails there are on the server at any one point in time. You can assume that his employees actually run a process on the server to retrieve the e-mails to be checked out. **[12 marks]**
4. (a) Describe why unrelated processes cannot make use of pipes to communicate. **[2 marks]**
- (b) Describe a method that would not allow more than one process to write at any one time in a shared memory region. **[3 marks]**
- (c) Describe an efficient mechanism that would allow multiple processes to write to a single message queue and another process to read from this message queue and display only the data from a particular process. **[5 marks]**
- (d) What are the four atomic operations allowed on each semaphore. Explain a scenario whereby problems would occur if these operations were not atomic. **[5 marks]**
- (e) What is the difference between automatic variables and variables stored using the `malloc()` call in terms of the location within the process space? **[5 marks]**

- (f) Describe what is referred to as the Coordinated Universal Time. [5 marks]
5. (a) Explain the role of IP addresses and the role of port numbers in terms of Internet communication. [5 marks]
- (b) What does the Transmission Control Protocol offer in addition to what the Internet Protocol offers? [2 marks]
- (c) Why can port numbers 1-1023 be used only by the super user? [2 marks]
- (d) Explain how the `connect()` system call completes both the local and the foreign part of the connection tuple. [3 marks]
- (e) Why does the `inetd` process make use of the `select()` system call? [1 mark]
- (f) You and your friends have a huge repository of files split up on several computers accessible from the internet. Each of these files can be downloaded using the ftp service from the appropriate computer. The only problem is that before your downloading session can begin, you need to figure out on which computer the file actually is. Thus you are building a directory server. This server is a program on your computer which holds a directory of where each file is stored. Your friends are allowed to connect it and ask this process where each file is. Also anyone can connect to it to add entries of new files on any computer. Describe how you would build this directory server that allows multiple concurrent connections always ensuring that the directory is consistent. [12 marks]

6. (a) Describe what is meant by the following:

- (i) Systems Programming
- (ii) Deadlock
- (iii) Race Conditions

[10 marks]

(b) Why is the `malloc()` call not a system call?

[5 marks]

(c) Explain in detail the process that leads up to the termination of a process whenever the following is executed:

```
char *c;  
*c='a';
```

Make sure you include what happens within the operating system itself.

[10 marks]
