Two hours - online

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UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Operating Systems

Date: Friday 25th January 2019

Time: 14:00 - 16:00

This is an online examination. Please answer all Questions

This is a CLOSED book examination

The use of electronic calculators is NOT permitted

Answer all questions

1. Explain the role of *processor* privilege mode(s) (as represented in the hardware) in running a secure operating system.

(2 marks)

2. Give an example of a part of a processor address space which should *not* be cacheable. Explain why this would be the case for your chosen answer. (2 marks)

3. Given that a process can be in one of the three states {ready, running, blocked}, which *state transition* cannot happen and why? (2 marks)

4. Files are a potential *insecurity* in a computer system; what measure(s) does a 'traditional' Unix system use to control file access? Also, very briefly, outline a more flexible means of securing data in a filing system. (2 marks)

5. What is meant by a "race condition"? Illustrate your answer with a short example.

(2 marks)

6. Processes are isolated in their own *contexts*, but sometimes processes need to communicate with each other for various purposes. Choose *four* different ways processes might interact – the more diverse the better – name them and *briefly* describe what communications facility each might provide or when it might be appropriate to use it.

(10 marks)

7. Define what is meant by a computer "file system". (2 marks)

8. Why might a computer support code to handle more than one file system *implementation*.

(2 marks)

9. What are the advantages and disadvantages of running a file system's code in an *unprivileged* mode? In what type of operating system *architecture* is this done?

(6 marks)

10. You need to run an image-processing application, which will take some time to complete, on a Linux desktop workstation. The application is capable of processing different sized images which are stored in disk files as pixel maps up to 10 MiB in size. You also have some other work to do on the computer whilst the image-processing utility is running. Outline the different stages the application is likely to go through from invocation to completion, highlighting instances of the different interactions between the application and the operating system and any background services the operating system is performing to support the application. (20 marks)

11. A multiprocessor computer system with a multiprocessing operating system is running several copies of an application which uses dynamic memory allocation. Any process may require a new page of physical memory, allocated from an adequately large, shared pool of free pages, at any time. What resource conflicts might occur and how might you design a page allocator to guarantee fault-free operation? (4 marks)

12. Why do operating systems typically include "device driver" abstractions rather than allowing direct access to peripheral devices?

(2 marks)

13. Two Linux processes are using a block of *shared memory*. The programmer notices that the address of this memory appears at different addresses in the two processes, although the software works properly. How is this possible? (2 marks)

14. In a high-performance computer with several layers of memory caching, the *first level* of the cache must be *flushed* on a process context switch. Why is this? (2 marks)

END OF EXAMINATION