**COMP 25111**

Two hours - online

The exam will be taken on line.
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**UNIVERSITY OF MANCHESTER**
**SCHOOL OF COMPUTER SCIENCE**

Operating Systems

Date: Thursday 18th January 2018

Time: 09:45 - 11:45

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**Please answer all 18 Questions.**

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This is a CLOSED book examination

The use of electronic calculators is NOT permitted

**[PTO]**

Answer all questions

1. Briefly describe two advantages of dynamic shared libraries. (2 marks)

2. Briefly explain two ways in which a hard real-time process scheduler is likely to differ from the scheduler in a desktop computer. (2 marks)

3. Why might a user-mode library buffer data from a character stream on its way to being written into a disk file? (2 marks)

4. Why might it be useful to be able to prevent instruction fetches (execution) from memory whilst still being able to read it? (2 marks)

5. In a Unix filing system, explain how the following are implemented: a *soft* link; a *hard* link. (2 marks)

6. A *running* process on a multiprocessor desktop workstation needs a large block of data which needs to be fetched across a network interface. Explain the sequence of operations which are likely to take place to complete this operation. Your answer should include the roles of:

    - Device driver
    - DMA
    - Interrupt
    - Process state
    - Scheduler
    - System call

    (Listed above in alphabetical order.) (10 marks)

7. Explain the difference between a file's *attributes* and its *contents*. (2 marks)

8. List *three* different *attributes* a file might have, in each case with a brief explanation of what they represent. (5 marks)

9. In a Unix-like file system, describe how a directory entry is related to a file. Explain how this structure enables one file to exist in several different directories at the same time. (3 marks)

10. Imagine a computer with a 32-bit address space, which is divided into 4 KiB pages. (Each byte has a unique address.) The computer is limited to 4 GiB of physical memory. What is the maximum number of pages a single process could have? (2 marks)

11. For the same computer in Q.10, Assuming a single-level page table, suggest a sensible size for each page table entry. Outline the various information which might be kept there; include estimates of the number of bits used for each function. (You may need to make some reasonable assumptions, which should be justifiable.) (6 marks)

12. For the same computer in Q.10, a particular process uses 5 different pages in its virtual space. Given a single-level page look-up scheme, state how much memory the page table for this process would occupy. (2 marks)

13. For the same computer in Q.10, would a two-level page look-up scheme use more or less memory? Explain your reasoning. Give an *estimate* of how different (if at all) this would be. Exact numbers are *not* required. (4 marks)

14. What is meant by a "*memory mapped*" peripheral device? (2 marks)

15. In a system using paged memory management, what *properties* might a page associated with I/O devices have? (4 marks)

16. For *each* of the following types of structure, choose two *distinct* examples of how they might be used in a typical operating system and say why each application is appropriate.

    - Linked list
    - Multi-way tree
    - FIFO queue

    (6 marks)

17. Choose two different examples of *exceptions* which cause kernel entry and justify why they are required. (2 marks)

18. Choose two distinct examples of *virtualisation* provided by a typical workstation operating system and justify their use.

    (2 marks)


**END OF EXAMINATION**