Year	Year 2
Semester	Semester 1
Date of Examination	Tuesday 13th January 2009
Time of Examination	9.30am – 11.30am

Prog Code	BN002	Prog Title	Higher Certificate in Science in Computing in information Technology	Module Code	COMP H2028
Prog Code	BN013	Prog Title	Bachelor of Science in Computing in Information Technology	Module Code	COMP H2028
Prog Code	BN104	Prog Title	Bachelor of Science (Honours) in Computing	Module Code	COMP H2028

Module Title	Operating Systems (Client)

Internal Examiner(s):   **Dr. Kevin Farrell**

External Examiner(s):   **Dr. Richard Studdert**
Mr. John Dunnion

Instructions to candidates:

1. Question One in Section A is COMPULSORY.
2. Candidates should attempt ALL parts of Question One in Section A
3. Candidates should attempt ONE question from Section B, and ONE question from Section C
4. This paper is worth 100 marks.
5. Question One is worth 40 marks, and all other questions are worth 30 marks each.

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SECTION A: COMPULSORY QUESTION

Question 1: Answer ALL parts of this question *(4 marks each part)*

a) Distinguish between the concept of a *soft real-time operating system* and a *hard real-time operating system*.

b) With reference to memory management, consider a paging system with the *page table* stored in memory.

   i. If a memory reference takes **200 ns**, how long does a paged memory reference take?

   ii. Consider the addition of a *translation look-aside buffer (TLB)*. If **85%** of all page-table references are found in the *TLB*, and if finding a page-table entry in the *TLB* takes **zero time** (if the entry is there), what is the *effective access time (EAT)*?

c) Explain the concept of a *link* in Linux. Distinguish between a *hard link* and a *symbolic link*.

d) List **two** possible rules of thumb when determining the *time quantum* in a *round robin* scheduling scheme.

e) List **four** objectives of a good *process scheduling policy* for an operating system?

f) Describe the difference between a *process* and a *thread*. What advantages do threads have over processes?

g) Why is it considered bad practice to log directly into a Linux GUI-based system as *root*? What command must an ordinary user type in a *terminal window*, in order to become *root*?

h)   Consider the situation where a user downloads the source-code tarball of an application they wish to install on their Linux system. Using the **tar** command, the user has extracted the files from the *tarball* into their home directory, and now wishes to install the application. List the steps that the user must type to *configure*, *compile* and *install* the software on their system. For each step, provide the command prompt symbol to indicate whether an ordinary user or root should type the command.

i)   Consider the following situation:

   - A user creates a script file, called *myscript* in their home directory of a Linux system.
   - They try to run this script by changing to their home directory, and typing the script name at the $ prompt in a terminal window, as follows:

      $ myscript

   - But, the shell returns the error *"bash: myscript: command not found"*.
   - They have correctly debugged the script, and have also set the correct executable permissions on the file.

   What do they need to type in order to run it? Give a reason for your answer.

j)   Briefly describe **four** tasks, which are generally performed by *start-up scripts* during the bootstrapping of a Linux Operating System.

(40 Marks Total)

SECTION B: ANSWER QUESTION 2 or QUESTION 3

Question 2

a)   Distinguish between *user mode* and *kernel mode* in an operating system.

(4 marks)

b)   Explain by what mechanism, and for what reasons, the switch from *user mode* to *kernel mode* takes place.

(8 marks)

c)   Describe, with the aid of a diagram, the *UNIX System V Release 4* Process State Model, indicating the transitions between states, and the reasons for those transitions.

(14 marks)

d)   Briefly explain why the *UNIX System V Release 4* operating sytem is not suitable for *real-time* processing

(4 marks)

(30 Marks Total)

Question 3

a)   In relation to memory management, explain the following terms:
        logical address, physical address, process loading, swapping

                                                                        (4 marks)

b)   Describe a simple method which allows memory to be addressed as a set of
        pages each containing a fixed number of *displacements.*

                                                                        (4 marks)

c)   Explain the term *page replacement*, and why it is needed.

                                                                        (4 marks)

d)   Describe any **two** of the following page replacement algorithms: *Least Recently
        Used (LRU), Not Recently Used (NRU), First-In First-Out (FIFO)* and *Clock.*

                                                                        (8 marks)

e)   (i)   In relation to *virtual memory* based on paging, explain the constraints regarding
                storing the *page table* of every process in *real memory.*

                                                                        (6 marks)

        (ii)   In relation to *virtual memory* based on *paging*, briefly explain how the location
                of the *page table* of the currently running process is located.

                                                                        (4 marks)

                                                                        (30 Marks Total)

SECTION C: ANSWER QUESTION 4 or QUESTION 5

Question 4

a)   What is the UNIX Shell?

$$(\textit{4 marks})$$

b)   Name and describe the **eight** features of the UNIX shell.

$$(\textit{8 marks})$$

c)   With   reference   to   the   Linux   Operating   System,   describe   the
      /etc/passwd and the **/etc/shadow** files under the following headings:

      i.   Their purpose.
      ii. The type of information do they contain.
      iii. The differences between them.

$$(\textit{6 marks})$$

d)   How many fields are used on each line in both the **/etc/passwd** and the
      /etc/shadow files? Describe the purpose of the different fields in each case.

$$(\textit{12 marks})$$

$$(\textit{30 Marks Total})$$

Question 5

a) Briefly describe **three** common logging schemes employed by UNIX/Linux System Administrators. For each scheme, outline **one** advantage and **one** disadvantage.

(6 marks)

b) Briefly explain the **three** mechanisms, by which different programs in a Linux operating system specify the log files to which they write. Give an example of **one** program for **one** of these mechanisms.

(4 marks)

c) Discuss Linux kernel logging, under the following headings:

  i. Boot-time Logging
  ii. Ongoing Logging
  iii. Message Duplication across Logfiles
  iv. Console Management

(8 marks)

d) Describe the *syslog* system under the following headings:

  i. What is it?
  ii. Components
  iii. Operation
  iv. Configuration

(12 marks)

(30 Marks Total)