Unit:

Computer Systems

Assignment title:

Sample Assessment Marking Scheme

Markers are advised that, unless a task specifies that an answer be provided in a particular form, then an answer that is correct (factually or in practical terms) **must** be given the available marks. If there is doubt as to the correctness of an answer, the relevant NCC Education materials should be the first authority.

This marking scheme has been prepared as a **guide only** to markers and there will frequently be many alternative responses which will provide a valid answer.

Each candidate's script must be fully annotated with the marker's comments (where applicable) and the marks allocated for each part of the task.

Throughout the marking, please credit any valid alternative point.

The TWO (2) important functions of modern operating systems are *process management* and *memory management*.

A process is the name given to a program that is put in a queue waiting and ready to run when the operating system decides. When there are multiple programs queued and waiting to run, the operating system is responsible for deciding which one runs, when it runs and for how long. This is managed by the scheduling algorithms and is called process management.

Each process also requires some memory to be able to run and for its data to be stored. When there are many programs waiting to run, it is the responsibility of the operating system to decide where in primary memory and how much of that memory to allocate for each process data. This is called memory management.

When there are too many programs wanting a piece of free primary memory to utilise, eventually there comes a time when free space runs out. When this happens, the operating system starts using the secondary memory space as virtual memory (e.g. hard drive or solid-state drive). This is called virtual memory management.

You are asked to study process and memory management mechanisms and write an overview report. This is comprised of the following tasks.

Task 1: Process Management (30%) – 700 words

Total 30 Marks

A Real Time Operating System (RTOS) has different process scheduling and memory management requirements than a general-purpose multi-threading operating system. Research RTOS scheduling algorithms **and** provide the following:

a) Scheduling requirements of RTOS for process scheduling.

(10 Marks)

Marking Scheme
The following aspects need to be included and satisfactorily explained:

- ***Priority-based (5 marks)***
- ***Pre-emptive priority (5 marks)***

b) Memory requirements of RTOS processes (sometimes called tasks).

(10 Marks)

Marking scheme
The following aspects need to be included and satisfactorily explained:

- ***Fixed memory requirement (2 marks)***
- ***Pre-allocated memory locations (2 marks)***
- ***Statically allocated (by the compiler) memory requirement (3 marks)***
- ***Dynamically allocated (at run time) memory requirement (3 marks)***

c) Description of TWO (2) RTOS schedulers used in practice.

(10 Marks)

Marking scheme
There are several RTOS scheduling mechanisms used in practice. Any TWO (2) satisfactorily explained (5 marks each)

Task 2: Memory Management (20%) – 400 words

Total 20 Marks

The memory manager of the operating system is responsible for finding suitable free spaces in memory to allocate to processes according to some decision-making strategy. This is called the placement strategy. Research the following placement strategies:

a) First fit strategy
b) Best fit strategy
c) Worst fit strategy
d) Compare **and** contrast the THREE (3) strategies above.

Marking scheme

It is expected that there will be an explanation of free memory sizes and locations being maintained in a linked list that can be easily extended, modified, and searched. (5 marks)

The following aspects need to be identified and satisfactorily explained.

a) First free memory entry in the list of sizes greater than or equal to the required size will be chosen (3 marks)

b) First free memory entry in the list of exactly the size as the required size will be chosen (3 marks)

c) Free memory entry in the list of largest size that is greater than or equal to the required size will be chosen (3 marks)

d) First fit: Faster as not all of the list is searched (2 marks)
Best fit: Minimises free memory space fragmentation (2 marks)
Worst fit: Leads to free memory space fragmentation (2 marks)

Task 3: Cache Mappings (40%) – 700 words

Total 53 Marks

The CPU cache is a special type of fast primary memory. It is much smaller than the RAM. The CPU frequently fetches instructions and data from the cache but under certain conditions, it needs to fetch these from the RAM. Research the following with respect to the cache memory:

a) The rationale behind the use of a cache memory.

(12 Marks)

Marking scheme
The following aspects are satisfactorily explained (3 marks for each below, maximum 12 marks)

- ***A small part of the program is executed repeatedly (e.g. a loop)***
- ***Not all of the program code needs to be in the cache.***
- ***Cache memory is much faster than RAM.***
- ***A cache is part of the CPU, not separate memory as in RAM.***

b) Conditions that decide whether data is fetched from cache or RAM.

(15 Marks)

Marking scheme
The following aspects are satisfactorily explained.

- ***If data or instructions are in the cache CPU fetches them from the cache (3 marks)***
- ***If data or instructions are not in the cache, they are fetched from RAM and the block of data or instructions containing the required data or instruction are copied from RAM into the cache. (6 marks)***
- ***If modified data is stored back, then it is put in the cache and may also be stored in the RAM under certain conditions. (6 marks)***

c) What cache mapping is **and** what different types of mappings there are?

(26 Marks)

Marking scheme

The following aspects are satisfactorily explained

- ***Cache is divided into equal-sized blocks of data or instructions. (2 marks)***
- ***A RAM block of the same size is mapped onto ONE (1) of the cache blocks for transferring data or instructions to the cache from RAM. (3 marks)***
- ***Mapping involves deciding which block in the cache to choose for transferring data or instructions. This may require overwriting the data or instructions in this block (re: replacement strategy) (6 marks)***
- ***The THREE (3) cache mapping strategies are direct mapping, set-associative mapping, and fully associative mapping. Set-associative mapping is used mostly. Different levels of caches may use different mapping strategies. Fully associative mapping is not used. (15 marks)***

The report (10%) – 350 words (not including the tasks)

The structure of the report should include the following:

- Table of contents

  Mark Scheme
  Table of contents (1 mark)

- Introduction

  Mark Scheme
  Introduction (3 marks)

- Separate sections for each of Task 1, Task 2, and Task 3

  Mark Scheme
  Conclusion (3 marks)

- Conclusion

  Mark Scheme
  Conclusion (3 marks)

- References

  Mark Scheme
  References (3 marks)

- Appendices (optional)

Notes to marker(s):

The students are not expected to carry out detailed research into above topics as they are relatively advanced topics at this level. They only need to demonstrate some basic understanding of the principals involved. The marking schemes should be applied with this in mind and with discretionary marking where appropriate, guided by the marking schemes.

Notes to students:

- Use any credible sources of information you can find. The preferred primary sources are textbooks, but Internet sources are acceptable as long as they are from trusted sources (e.g. online documents from learned societies, university lecture notes/slides, product manufacturers, etc.).

- You must always reference any source of information within the text.

- Total size of the report is 2250 (+/- 10%) words.

- The word count does not apply to the contents of any appendices.

- You must use the Harvard referencing style.

Learning Outcomes matrix

Task	Learning Outcomes assessed	Marker can differentiate between varying levels of achievement
1	LO2	Yes
2	LO2	Yes
3	LO6	Yes

Grade descriptors

Learning Outcome	Fail	Referral	Pass	Merit	Distinction
Understand and identify the main types and components of computer systems	None or inadequate description of computer systems and components	Some credible but incomplete attempt to demonstrate understanding of computer systems and components	Limited but satisfactory demonstration of understanding of computer systems and components	Good demonstration of understanding of computer systems and components	Excellent demonstration of understanding of computer systems and components
Describe the structure and role of modern operating systems	None or very basic description of components of operating systems	A very limited and basic description of components of operating systems	Limited and above basic description of components of operating systems	Good description of most components of operating systems	Excellent and full description of all components of operating systems
Understand and work with binary numbers and computer logic	No demonstration of working with binary numbers and logic operators	A basic demonstration of restricted range of working with binary numbers and logic operators	An above basic demonstration of of working with restricted range of binary numbers and logic operators	A good demonstration of working with a wide range of binary numbers and logic operators	An excellent demonstration of working with full range of binary numbers and logic operators
Understand the essential structure of computer programs	None or trivial explanation of instruction sets, addressing modes and interrupts	Limited understanding and explanation of instruction sets, addressing	Basic understanding and explanation of instruction sets, addressing modes and interrupts	Good understanding and explanation of instruction sets, addressing	Excellent understanding and explanation of instruction sets, addressing

		modes and interrupts		modes and interrupts	modes and interrupts
Explain the hierarchy of computer software	No or wrong explanation of computer software hierarchy	Limited and very basic explanation of computer software hierarchy	Basic but limited explanation of computer software hierarchy	Good and competent explanation of computer software hierarchy	Excellent and complete explanation of computer software hierarchy
Describe alternative computer systems	No or insufficient description of performance enhancing technologies	Limited and very basic description of performance enhancing technologies	Basic and partly satisfactory description of performance enhancing technologies	Good description of performance enhancing technologies	Excellent and complete description of performance enhancing technologies
Discuss the role of Data Communications and Networks in computer systems	No or very trivial discussion of data communications protocols and components	A very basic discussion of data communications protocols and components	Basic but credible discussion of data communications protocols and components	Good and wide-ranging discussion of data communications protocols and components	Excellent and complete discussion of data communications protocols and components