SIT222 Operating Systems Concepts

Trimester 1, 2017

Take Home Test 1

Due Date: 9am Wednesday April 19th, 2017

This assessment task must be completed individually, no group work is permitted.

All work completed/submitted as part of this assessment task must be your own, individual work. Any content drawn from other materials, including unit materials, must be clearly quoted where appropriate, and/or clearly referenced. All students should review and be familiar with the content provided by the University regarding how to reference other materials:

http://www.deakin.edu.au/students/study-support/referencing

And in particular the information provided regarding Academy Integrity:

http://www.deakin.edu.au/students/study-support/referencing/academic-integrity

Unit Learning Outcomes

As per the Unit Guide, the following Unit Learning Outcomes are relevant to this project:

ULO 1. Identify and describe different types and architectures of operating systems.

This assessment considers the types and architectures of operating systems and will require you to address one or more problems are addressed by the different types/architectures of operating systems.

ULO 2. Evaluate different approaches and algorithms used by operating systems for managing resources and demonstrate their operation.

This assessment will include one or more questions asking you to address how operating systems will use algorithms to manage both physical and logical resources given problem scenario(s).

Question 1: OS Concepts (10 + 10 + 10 = 30 marks)

a) Please describe what an operating system is from both a Top-Down view and a Bottom-Up view.
b) What is a Linux distribution? Besides CentOS and Ubuntu which we learned in this unit, please list at least 5 other popular Linux distributions including their names, founders, initial release years, release dates of the latest versions, and project/product website URLs.
c) What are the functions of an OS kernel. Discuss what are Microkernel and Hypervisor kernel structures and their pros and cons.

Question 2: Process and Thread (10 + 20 + 10 = 40 marks)

a) Discuss the differences between Process and Thread. In addition, give an example application which includes multiple threads in a single process.
b) Consider the following table of processes:

Process	Arrival	Duration
A	0	5
B	2	4
C	4	2
D	8	2
E	10	7

Draw diagrams to illustrate the execution of these processes using the following CPU scheduling algorithms: FCFS, SJF, SRTN, and RR. Calculate the wait time and turnaround time for each process. For Round Robin, use a timeslice of three and if a process arrives at a time index when a context switch occurs the arriving process is added to the ready queue after the running process.
Note: wait time is the total time spent by the process waiting in the ready queue, i.e., the process is ready to run but the CPU is being used by another process.
c) In addition to these CPU scheduling algorithms we learned in this unit, find out and describe one more popular scheduling algorithms and discuss its advantages. As the concepts of OS is pervasive, please give an example of how a CPU scheduling algorithm is applied to a problem in other fields (non-IT fields are preferred).

Question 3: Memory Management (8+10+12=30 marks)

a) Virtual memory is the dominant memory abstraction used in modern operating systems. Describe the concepts of virtual memory and briefly discuss its advantages and disadvantages. In your answer, include a figure drawn by yourself to illustrate the operation of virtual memory systems.

b) Assume one process needs one page table, for a 32-bit system with 4KB each page, if each table entry is 8 bytes and the average number of processes running in the system is 100, what's the average storage space needed for storing all tables in this system? What are the possible solutions to reduce the table size?

c) When allocating variable sized memory regions, algorithms such as first fit, next fit, best fit, worst fit, and quick fit are used. Briefly describe the operation of each of these algorithms, discuss why they are necessary, and explain how an algorithm like quick fit could result in improved performance when allocating memory and for identifying adjacent free regions.

Marking Scheme

Question 1 *(10+ 10 + 10 = 30 marks)*

- Part (a)
  - (5 marks) Correctly explained from Top-Down view.
  - (5 marks) Correctly explained from Bottom-Up view.
- Part (b)
  - (5 marks) Correctly explained what a Linux distribution is.
  - (5 marks) 1 mark each for the correct information of a Linux distribution besides CentOS and Ubuntu.
- Part (c)
  - (4 marks) Explanation of what are the functions of OS kernel.
  - (3 marks) Explanation of Microkernel and its pros and cons
  - (3 marks) Explanation of Hypervisor and its pros and cons

Question 2 *(10 + 20 + 10 = 40 marks)*

- Part (a)
  - (5 marks) Correctly explained the differences between Process and Thread.
  - (5 marks) Correct example of a single process with multiple threads.
- Part (b)
  - (3 marks) Correct illustration of First Come First Served (FCFS)
  - (3 marks) Correct illustration of Shortest Job First (SJF)
  - (3 marks) Correct illustration of Shortest Remaining Time Next (SRTN)
  - (3 marks) Correct illustration of Round Robin (RR)
  - (4 marks) Correct wait times (1 mark for each algorithm)
  - (4 marks) Correct turnaround times (1 mark for each algorithm)
- Part (c)
  - (5 marks) Explained one more CPU scheduling algorithm and discussed its advantages (must not be FCFS, SJF, SRTN and RR).
  - (4 marks) A correct illustration of a scheduling algorithm applied in everyday life.
  - (1 mark) The example is in non-IT fields.

Question 3 *(*8+10+12=30 marks*)*

- Part (a)
  - (4 marks) Correctly explained the concepts of virtual memory and its advantages and disadvantages.
  - (4 marks) Correctly include figure to illustrate the operation of virtual memory systems.
- Part (b)
  - (6 marks) Correctly calculated the storage space with clear analysis process.
  - (4 marks) At least two correct solutions are provided.

- Part (3)
    - (2 marks) Correctly illustrated the operation of first fit.
    - (2 marks) Correctly illustrated the operation of next fit.
    - (2 marks) Correctly illustrated the operation of best fit.
    - (2 marks) Correctly illustrated the operation of worst fit.
    - (2 marks) Correctly illustrated the operation of quick fit.
    - (2 marks) Using quick fit for memory allocation, correctly explained the reason for performance improvement and identification of adjacent free regions.