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Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Theknolotši ya Tshedimošo

Department of Computer Science

COS 122 Operating Systems

Assignment 4

Due: 20 October 2022 @ 23:00

PLAGIARISM POLICY

UNIVERSITY OF PRETORIA

The Department of Computer Science considers plagiarism as a serious offence. Disciplinary action will be taken against students who commit plagiarism. Plagiarism includes copying someone else's work without consent, copying a friend's work (even with consent) and copying material (such as text or program code) from the Internet. Copying will not be tolerated in this course. For a formal definition of plagiarism, the student is referred to `http://www.ais.up.ac.za/plagiarism/index.htm` (from the main page of the University of Pretoria site, follow the *Library* quick link, and then click the *Plagiarism* link). If you have any form of question regarding this, please ask one of the lecturers, to avoid any misunderstanding. Also note that the OOP principle of code re-use does not mean that you should copy and adapt code to suit your solution.

Objectives

This assignment evaluates the understanding and application of various key concepts and functions found in computer and operating systems. It covers chapters 7 and 8 of the prescribed textbook. This assignment has 5 tasks for a total of 20 marks.

Upload Instructions

You need to provide written answers to the tasks in this assignment. You are then required to submit a document containing these answers in order for them to be marked. Show all the intermediate and calculation steps in your answers (excluding the multiple choice task). Some marks will be awarded for intermediate steps.

- Upload your document to the Assignment 4 assignment slot on COS 122 ClickUP before 23:00 on 20-Oct-2022. **No late submissions will be accepted!**
- All documents must be in either text, Word or PDF format (typed not handwritten) as **no other formats** will be marked.
- **Failure to upload your answers will result in 0 marks being awarded for your assignment!**

Task 1 ..... (5 marks)

1.1 Which policy is concerned with determining when a modified page is written to secondary memory? (1)

A. Placement policy
B. Replacement policy
C. Fetch policy
D. Cleaning policy

1.2 Which page replacement policy results in the fewest number of page faults? (1)

A. Optimal
B. FIFO
C. Clock
D. LRU

1.3 Due to what is space wasted in a system employing a paging scheme for memory management? (1)

A. External fragmentation
B. Page relocation
C. Internal fragmentation
D. Segment sizing

1.4 Which problem is associated with the largely obsolete Fixed Partitioning memory management technique? (1)

A. Fixed number of processes
B. Inefficient use of memory
C. Internal fragmentation
D. All of the above

1.5 What is the binding time when the loader translates the relative addresses to physical address? (1)

A. Programming time
B. Compile time
C. Load time
D. Run time

Task 2 ..... (4 marks)

2.1 A 1024 KB block of memory is allocated using the buddy system. Show the results of the following sequence of requests and returns in a table similar to Figure 7.6 of the prescribed textbook. In your table, also provide the amount of internal fragmentation at each stage of allocation/de-allocation. (4)

Request A:200;
Request B:40;
Request C:120
Return A;
Request D:60;

Return B;
Return D;
Return C.

Task 3 ..... (5 marks)

Consider a simple segmentation system that has the following segment table:

Segment	Starting (Base) Address	Length (bytes)
0	500	148
1	648	122
2	770	812
3	1582	408
4	1990	510

For each of the following logical addresses, determine the physical address or indicate if a segment fault occurs:

3.1 : 0, 350 (1)

3.2 : 2, 220 (1)

3.3 : 3, 762 (1)

3.4 : 1, 300 (1)

3.5 : 4, 237 (1)

Task 4 ..... (2 marks)

4.1 A system has a total of 256 frames. There are four processes in the system with the following memory requirements: (2)

$$p_1 : 30; \qquad p_2 : 90; \qquad p_3 : 60; \qquad p_4 : 120$$

Use the Proportional Allocation Algorithm to compute the number of frames allocated to each of the processes. Answers must be given in whole frames.

Task 5 ..... (4 marks)

Assume a task is divided into four equal-sized segments, and the system builds an sixteen-entry page descriptor table for each segment. Thus, the system has a combination of segmentation and paging. Assume also the page size is 4 KB.

5.1 What is the maximum size of each segment? (½)

5.2 What is the maximum logical address space for the task? (½)

5.3 Assume an element in physical location $012ABC_{16}$ is accessed by this task. Provide the format of the logical address that the task generates for it and explain how this format is produced. What is the maximum physical address space for the system? (3)