FIT2100 Tutorial #6 Memory Management, I/O Management, and Disk Scheduling Week 11 Semester 2 2017

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Acknowledgement

The majority of the content presented in this tutorial was adapted from:

- William Stallings (2015). *Operating Systems: Internals and Design Principles (8th Edition)*, Pearson.

Contents

1 Background

This tutorial provides students with the opportunity to explore further on the various concepts of memory and I/O managements as discussed in the lectures.

You should complete the suggested reading in Section 2 before attending the tutorial. You should also prepare the solutions for the two sets of practice tasks given in Section 3 and Section 4 respectively.

2 Pre-tutorial Reading

You should complete the following two sets of reading:

- Lecture Notes: Weeks 8, 9, and 10
- Stalling's textbook (7th/8th Edition): Chapters 7, 8, and 11

3 Memory Management

3.1 Review Questions

Question 1

What is the difference between *internal* and *external* fragementation?

Question 2

What is the difference between a *page* and a *frame*?

Question 3

What is the difference between a *page* and a *segment*?

Question 4

How does the use of *virtual memory* with paging improve system utilisation?

Question 5

Define the alternative *page fetch* policies.

Question 6

What is the relationship between **FIFO** and **clock** page replacement algorithms?

3.2 Problem-Solving Tasks

3.2.1 Task 1

Given free partitions in memory of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the **first-fit**, **best-fit**, and **worst-fit** algorithms place processes of 212K, 417K, 112K, and 426K (in order)? Which algorithm makes the most efficient use of the memory? (Note: For the worst-fit algorithm, a process is allocated with the largest free block of memory.)

3.2.2 Task 2

A page replacement algorithm should minimise the number of *page faults*. Some common page replacement algorithms are: **FIFO**, **LRU**, and **Optimal** algorithms. How many page faults occur for each algorithm for the following sequence of page references with four page frames (assuming all four page frames are initially free)?

1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2

3.2.3 Task 3

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

Segment #	Starting Address	Length (bytes)
0	660	248
1	1752	422
2	222	198
3	996	604

For each of the following logical addresses (segment number, offset), determine the physical adddress or indicate if a segment fault occurs:

(a) 0, 198

(b) 1, 515

(c) 3, 445

4 I/O Management and Disk Scheduling

4.1 Review Questions

Question 1

Define three techniques for performing I/O.

Question 2

What is the difference between *block-oriented* devices and *stream-oriented* devices?

Question 3

Discuss how could the system performance be improved by using *double buffering* rather than a *single buffer* for I/O operations?

Question 4

What *delay elements* are involved in a disk read or write?

Question 5

Define the following disk scheduling algorithms: **FIFO**, **SSTF**, **SCAN**, and **C-SCAN**.

4.2 Problem-Solving Tasks

4.2.1 Task 1

Assume that the disk head is initially positioned on track 100 and is moving in the direction of decreasing track number. For the following sequence of disk track requests:

27, 129, 110, 186, 147, 41, 10, 64, 120

(a) Describe or trace the order in which these requests are served based on the four disk scheduling algorithms: (i) FIFO, (ii) SSTF, (iii) SCAN, and (iv) C-SCAN.

(b) Calculate the average seek length (in terms of the number of tracks traversed) for each of the disk scheduling algorithms.

4.2.2 Task 2

Calculate how much disk space (in sectors, tracks, and surfaces) will be required to store 300,000 120-byte logical records if the disk is fixed sector with 512 bytes per sector, with 96 sectors per track, 110 tracks per surface, and 8 usable surfaces. (Note: You may assume that records cannot span across two sectors.)