

Spring 2015 COMP 3511 Homework Assignment #4 Solution

Handout Date : April 26 Due Date: May 10

Name: _____ ID: _____ E-Mail: _____

Please read the following instructions carefully before answering the questions:

- You should finish the homework assignment **individually**.
- There are a total of **4** questions.
- When you write your answers, please try to be precise and concise.
- Fill in your name, student ID, email and Section number at the top of each page.
- Please fill in your answers in the space provided, or you can type your answers in the MS Word file.
- **Homework Collection: the hardcopy is required and the homework is collected in collection box #16. The collection boxes locate outside Room 4210, near lift 21 (there are labels attached on the boxes).**

1. (20 points) Multiple choices

1) _____ is the concept in which a process is copied into main memory from the secondary memory according to the requirement.

- A) Paging
- B) Demand paging
- C) Segmentation
- D) Swapping

Answer: B

2) When a program tries to access a page that is mapped in address space but not loaded in physical memory, then _____.

- A) segmentation fault occurs
- B) fatal error occurs
- C) page fault occurs
- D) no error occurs

Answer: C

3) A process is thrashing if _____.

- A) it is spending more time paging than executing
- B) it is spending less time paging than executing
- C) page fault occurs
- D) swapping can not take place

Answer: A

- 4) The ability to execute a program that is only partially in memory has benefits like:
- ① The amount of physical memory cannot put a constraint on the program
 - ② Programs for an extremely large virtual space can be created
 - ③ CPU utilization decreases
 - ④ Throughput increases
 - ⑤ Response time is not affected
 - ⑥ Turnaround time increases
 - ⑦ Less I/O will be needed to load or swap each user program in memory

- A) ①②④⑤⑦
- B) ②③④⑤
- C) ①②④⑦
- D) ①②④⑥

Answer: A

- 5) In the working set model, for:
2 6 1 5 7 7 7 7 5 1 6 2 3 4 1 2 3 4 4 4 3 4 3 4 4 4 1 3 2 3
if $DELTA = 10$, then the working set at time t_1 (...7 5 1) is _____.

- A) {1, 2, 4, 5, 6}
- B) {2, 1, 6, 7, 3}
- C) {1, 6, 5, 7, 2}
- D) {1, 2, 3, 4, 5}

Answer: C

- 6) The open file table has a/an _____ associated with each file.

- A) file content
- B) file permission
- C) open count
- D) close count

Answer: C

- 7) Which one of the following explains the sequential file access method?

- A) random access according to the given byte number
- B) read bytes one at a time, in order
- C) read/write sequentially by record
- D) read/write randomly by record

Answer: B

8) The path name os-student/src/vm.c is an example of _____.

- A) a relative path name
- B) an absolute path name
- C) a relative path name to the current directory of /os-student
- D) an invalid path name

Answer: A

9) In which type of allocation method each file occupy a set of contiguous block on the disk?

- A) Contiguous allocation
- B) Dynamic-storage allocation
- C) Linked allocation
- D) Indexed allocation

Answer: A

10) A mount point is _____.

- A) a root of the file system
- B) a location of a shared file system
- C) only appropriate for shared file systems
- D) the location within the file structure where the file system is to be attached.

Answer: D

2. (40 points) Q&A.

1) (10 points) Assume we have a demand-paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds.

Assume that the page to be replaced is modified 70 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds?

Answer:

$$0.2 \mu\text{sec} = (1 - P) \times 0.1 \mu\text{sec} + (0.3P) \times 8 \text{ millisecc} + (0.7P) \times 20 \text{ millisecc}$$

$$0.1 = -0.1P + 2400 P + 14000 P$$

$$0.1 \square 16,400 P$$

$$P \square 0.000006$$

- 2) (6 points) Assume that you are monitoring the rate at which the pointer in the clock algorithm (which indicates the candidate page for replacement) moves. What can you say about the system if you notice the following behavior:

- a) pointer is moving fast
- b) pointer is moving slow

Answer:

If the pointer is moving fast, then the program is accessing a large number of pages simultaneously. It is most likely that during the period between the point at which the bit corresponding to a page is cleared and it is checked again, the page is accessed again and therefore cannot be replaced. This results in more scanning of the pages before a victim page is found.

If the pointer is moving slow, then the virtual memory system is finding candidate pages for replacement extremely efficiently, indicating that many of the resident pages are not being accessed.

- 3) (4 points) Is it possible for a process to have two working sets, one representing data and another representing code? Please briefly explain your answer.

Answer: Yes, in fact many processors provide two TLBs for this very reason. As an example, the code being accessed by a process may retain the same working set for a long period of time. However, the data the code accesses may change, thus reflecting a change in the working set for data accesses.

- 4) (8 points) Consider a file system that uses inodes to represent files. Disk blocks are 8 KB in size and a pointer to a disk block requires 4 bytes. This file system has 12 direct disk blocks, plus single, double, and triple indirect disk blocks. What is the maximum size of a file that can be stored in this file system?

Answer:

$$(12 * 8 \text{ /KB}) + (2048 * 8 \text{ /KB}) + (2048 * 2048 * 8 \text{ /KB}) + (2048 * 2048 * 2048 * 8 \text{ /KB}) = 64 \text{ terabytes}$$

- 5) (6 points) What is the advantage and disadvantage of using a acyclic graph directory?

Answer: The advantages of using a acyclic graph directory include: (1) It allows directories to have shared subdirectories and files; (2) Its structure is more flexible than a simple tree structure; (3) It is simple to traverse a file when using acyclic graph directory.

The disadvantages include: (1) Deletion of file is difficult; (2) The major problem with duplicate directory is maintaining consistency if the file is modified.

- 6) (6 points) Suppose that a disk rotates at 7200 RPM. What is the average rotational latency of this disk drive?

Answer:

7200 rpm gives 120 rotations per second. Thus, a full rotation takes 8.33 ms, and the average rotational latency (a half rotation) takes 4.167 ms.

3. (20 points) Consider the following page reference string:

2, 0, 1, 5, 0, 4, 2, 3, 0, 2, 1, 5, 2, 3, 0, 5, 1, 1, 2, 0

Assuming demand paging with **four** frames allocated to a process with local allocation scheme used. Please illustrate each step that the following replacement algorithms work for this reference string and compute the page faults in each algorithm.

- 1) FIFO replacement
- 2) LRU replacement
- 3) Optimal replacement

Answer:

- 1) FIFO replacement

2	0	1	5	0	4	2	3	0	2	1	5	2	3	0	5	1	1	2	0
2	2	2	2		4	4	4	4		1	1	1	1	0		0			
	0	0	0		0	2	2	2		2	5	5	5	5		1			
		1	1		1	1	3	3		3	3	2	2	2		2			
			5		5	5	5	0		0	0	0	3	3		3			

Page faults: 14

- 2) LRU replacement

2	0	1	5	0	4	2	3	0	2	1	5	2	3	0	5	1	1	2	0
2	2	2	2		4	4	4			1	1		1	0		0		0	
	0	0	0		0	0	0			0	0		3	3		3		2	
		1	1		1	2	2			2	2		2	2		1		1	
			5		5	5	3			3	5		5	5		5		5	

Page faults: 13

- 3) Optimal replacement

2	0	1	5	0	4	2	3	0	2	1	5	2	3	0	5	1	1	2	0
2	2	2	2		2		2				2					2			
	0	0	0		0		0				0					0			
		1	1		1		1				5					1			
			5		4		3				3					3			

(or 2 0 5 1 for the last step)

Page faults: 8

4. (20 points) Disk scheduling problem

Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 2502, and the previous request was at cylinder 1805. The queue of pending requests, in FIFO order, is:

265, 2753, 3800, 1750, 2015, 850, 3586, 4893, 3507

Starting from the current head position (2502), what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?

- a) FCFS
- b) SSTF
- c) SCAN
- d) C-SCAN
- e) LOOK
- f) C-LOOK

Answer:

The FCFS schedule is 2502, 265, 2753, 3800, 1750, 2015, 850, 3586, 4893, 3507. The total seek distance is 14681.

The SSTF schedule is 2502, 2753, 2015, 1750, 850, 265, 3507, 3586, 3800, 4893. The total seek distance is 7367.

The SCAN schedule is 2502, 2753, 3507, 3586, 3800, 4893, (4999), 2015, 1750, 850, 265. The total seek distance is 7231.

The C-SCAN schedule is 2502, 2753, 3507, 3586, 3800, 4893, (4999), (0), 256, 850, 1750, 2015. The total seek distance is 9511.

The LOOK schedule is 2502, 2753, 3507, 3586, 3800, 4893, 2015, 1750, 850, 265. The total seek distance is 7019.

The C-LOOK schedule is 2502, 2753, 3507, 3586, 3800, 4893, 256, 850, 1750, 2015. The total seek distance is 8769.