

COMP 304- Operating Systems: Assignment 3

Due: 13 May 2020

Notes: This is an individual assignment. Bring the hard copy to the exam and submit a soft copy through blackboard. No late assignment will be accepted. This assignment is worth 10% of your total grade.

Problem 1

(12 points) Consider the memory management methods of contiguous allocation, paging, and segmentation. Compare these methods with respect to the following: external fragmentation and code sharing among processes.

Problem 2

(10 pts) Suppose a computer that supports virtual memory and has 32-bit virtual addresses and uses page size of 8KB. If a process uses 100 pages of its virtual address space, how much space does its page table require if a single-level page table is used? Assume each table entry occupies 4 bytes.

Problem 3

(18 points) Consider the following page reference string:

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

How many page faults would occur for the page replacement algorithms: LRU, FIFO, Optimal in the following cases? Explain your answer. Remember all frames are initially empty, so your first unique pages will all cost one fault each.

- a) 5 frames are allocated for the process
- b) 6 frames are allocated for the process

Problem 4

(10 points) Consider a system where for each frame we keep track of how many pages are associated with that frame by using a counter. When we need to replace pages, our page replacement algorithm searches for a frame with the smallest number of pages associated with it.

Initially all the counters are set to zero for all frames. When a new page is associated a frame, its counter is incremented.

Show how the number of page faults for this page replacement algorithm given the following reference string of a process with four frames in memory? Is this a good algorithm for page replacement?

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

Problem 5

(6+6 points)

Consider a file system developed by one of the KU graduates for Unix-based systems. In this file system, when a file is deleted, its disk space is reclaimed but links to that file can still exist.

- What problems can arise if a new file is created with the same absolute path name?
- How can you avoid the problem related to links? Explain your solution.

Problem 6

(6+5+5 points) Consider the working-set model with the working set window Δ being 7. Given the following system with 3 independent processes and their corresponding reference strings as shown below:

Time	0	1	2	3	4	5	6	7	8	9	10
P1	2	5	7	4	4	1	2	3	7	3	3
P2	1	1	1	3	3	4	4	3	5	6	7
P3	4	9	3	2	9	8	7	7	7	1	2

- According to the given data above, what is the working set and working set size for each process at time 9 (inclusive)?
- Does the system suffer from trashing at time 9 (inclusive) if there are total 10 frames in the physical memory? Why or why not? Show your work for credit.
- How many frames should be in the physical memory so that the system doesn't suffer from trashing at time 7 (inclusive)? Show your work for credit.

Problem 7

(6+6 points) Assume page size is 1024 words and each row is stored in one page.
`int A[1024][1024] = new int[1024][1024];`

If the OS allocates 512 frames for a program and uses LRU page replacement algorithm

Program 1

```
for (j = 0; j < A.length; j++)  
... for (i = 0; i < A.length; i++)  
..... A[i][j] = 0;
```

Program 2

```
for (i = 0; i < A.length; i++)  
... for(j = 0; j < A.length; j++)  
..... A[i][j] = 0;
```

How many page faults does each program experience?

Problem 8

(5+5 points)

- a) On a system with paging, a process cannot access memory that it does not own. Why?
- b) How could the operating system allow a process to access to other memory? (give a max 2 sentence answer)