**CSE3502, Operating Systems**

**Homework 2**

1. (5 points) What is segmentation for?

*Segmentation separates many different items in memory and groups them together in the physical memory of a computer. It is dynamically allocated, which means that multiple users can access the same segment.*

2. (15 points) For each of the following decimal virtual addresses, compute the virtual page number and offset for a 4-KB page: 20000, 32768, 60000.

*4k:*

|  |  |  |
| --- | --- | --- |
|  | *Page number* | *offset* |
| *20000* | *4* | *3616* |
| *32768* | *8* | *0* |
| *60000* | *14* | *2656* |

3. (10 points) Given a two-level page table with 4-KB pages and. Assume that each level uses 10 bits. What would be the virtual address if PT1=2, PT2=3, offset=5?

*0000000001 0000000010 000000000101*

4. (10 points) Describe how does the clock page replacement algorithm work?

*The pages in memory are arranged in a circular linked list, and the head points to one item at a time. There is a Referenced bit that is set to 1 if the item has been used recently (it is set to 0 periodically). If a page fault occurs, the page that the head is pointing to will be replaced if R=0. Otherwise, R is set from 1 to 0, and the Head advances until it reaches a page that can be replaced.*

5. (15 points) Consider a system with 3 physical frames of memory that is given the following page memory reference sequence: 1, 3, 6, 7, 1, 3, 6, 7, 1, 3, 6, 7. What is the number of page faults that would occur for each of the following page replacement algorithms?

a. An optimal page replacement algorithm 7

b. FIFO 12

c. LRU 12

7. (5 points) Compare the following free memory management algorithms: first-fit, best-fit, and worst-fit.

*First-fit identifies the first available segment linearly, which results in a fast time to allocate memory, but it can result in fragmentation. Best fit identifies the smallest segment available, and this algorithm results in efficient memory usage with a trade-off for allocation time. Worst fit allocates the memory in the largest available segment of memory available, which results in highly fragmented memory.*

8. (10 points) Discuss the advantages and disadvantages of contiguous allocation, linked list allocation, and FAT.

*Contiguous allocation assigns memory with consecutive addresses, so the memory can be fragmented. Linked List allocation is when memory is allocated dynamically, and memory can be expanded or reduced, but more memory must be used for the page table, which means the memory is less fragmented but has a RAM trade-off. The File Allocation Table is a linked list that points at a cluster of contiguous memory. It is fast, but the table must always be in memory.*

9. (5 points) Why the index allocation (e.g., i-node) requires much less space than FAT?

*There is much less memory needed for index allocation because the index is only needed when the file is open.*

10. (5 points) What is symbolic linking?

*A symbolic link is a file that contains a reference to another file.*

11. (20 points) Suppose that a disk drive has 300 cylinders, numbered 0 to 299. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 15. The queue of pending requests, in FIFO order, is 86, 147, 291, 18, 95, 151, 12, 175, 30. Starting from the current head position, 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 1115

b. SSF 427

c. Elevator algorithm 410