CS2310   Modern Operating System Exercises   Spring 2023

Exercise 4: Memory Management
Due date: Mar. 24, 2023

1. Consider a single level paging scheme. The virtual address space is 256 MB and page table entry size is 4 bytes. What is the minimum page size, such that the entire page table fits well in one page?

2. Consider six memory partitions of size 200 KB, 400 KB, 600 KB, 500 KB, 300 KB, and 250 KB. These partitions can be allocated to four sequentially arrived processes with sizes of 357 KB, 210 KB, 468 KB, and 491 KB. Perform the allocation of processes using
   1) First Fit Algorithm
   2) Best Fit Algorithm
   3) Worst Fit Algorithm

3. Suppose there are 8 virtual pages and 4 page frames. Using the following reference string, calculate the number of page faults for FIFO, LRU, and second-chance page replacement algorithm. Clearly mark each hit or miss in the table. **Show Hit by "H" and miss by an "M" in the table below.**
   1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6

1) FIFO page replacement algorithm

Ref String	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Hit/Miss																				

Page Faults : _____   Hit Ratio:_____

2) LRU page replacement algorithm.

Ref String	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Hit/Miss																					

Page Faults : _____   Hit Ratio:_____

3) Second-chance page replacement algorithm.

Ref String	1	2	3	4	2	1	5	6	2	1	2	3	7	6	3	2	1	2	3	6
Hit/Miss																				

Page Faults : _____   Hit Ratio:_____

4.   Address Translation
1)   Consider a machine with a physical memory of 8 GB, a page size of 8 KB, and a page table entry size of 4 bytes. How many levels of page tables would be required to map a 46-bit virtual address space, such that every page table fits into a single page? Be explicit in your explanation.
2)   Without a cache or TLB, how many memory operations are required to read or write a single byte?
3)   How much physical memory is needed for the above process with three in-memory pages (i.e., one code page, one data page, and one stack page)?