

Exercise Sheet No. 2 – Operating Systems – Memory Management

Exercise 1

Consider the following sequence of allocation (+) and deallocation (-) requests in a memory space of 1000 blocks, using contiguous allocation with variable partitions:

+300, +200, +260, -200, +100, -300, +250, +400, -260, +150, +120, -100, -120, +200, -150, -250, +100, -400, -100, -200

Indicate how, starting from an initially free memory, the operating system performs the allocation using the FIRST-FIT, BEST-FIT, and WORST-FIT strategies.

Exercise 2

The main memory of a machine is characterized by the following data: 16 GB RAM, page size 16 KB.

If this memory is managed by a 64-bit OS (virtual address size), calculate: the size of the physical address, the offset size, the number of bits for the physical page number, the number of bits for the virtual page number, the number of entries in the page table, and the size of the virtual memory.

Exercise

3

Consider a computer system with 2 KB of physical memory offering 1 MB to its users. The memory manager of this system has a physical page table containing 8 entries, each describing a physical page with a presence bit and the corresponding virtual page number, for example:

Physical Page Number	Presence Bit	Virtual Page Number
0	1	2345
1	1	4
2	1	123
3	1	1010
4	1	546
5	1	12
6	0	/
7	1	339

1. What happens if a program accesses a variable stored at address 1027?
2. What happens if a program accesses a variable stored at address 153,475?
3. What happens if the program then accesses a variable stored at address 262,146?

Exercise

4

A program has a virtual space of 600 words. Consider the following sequence of virtual addresses: 34; 123; 145; 510; 456; 345; 412; 10; 14; 12; 234; 336; 412.

1. Give the reference string assuming the page size is 100 words.
2. Find the number of page faults in each of the following cases, assuming there are 300 contiguous words available in free memory. Then try with 200 words.
 - a) FIFO algorithm
 - b) LRU algorithm
 - c) Optimal algorithm
 - d) FINUFO algorithm

Exercise 5

Suppose we have a computer with memory for 4 pages. The loading time, last access time, and values of bits R and M for each page are given:

Page	Load Time	Last Reference Time	R	M
0	115	273	0	0
1	222	250	1	0
2	109	256	1	1
3	148	286	1	1

Which page will be replaced using:

1. FIFO
2. NRU
3. LRU
4. FIFO second chance