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OPERATING SYSTEM – COMP 3318 – FALL 2016

Homework #1

Due on September 23, 2016

1) Explain fundamental differences between internal fragmentations and external fragmentation in your own words. Which type of fragmentation is valid for Single user, fixed, dynamic, and relocatable dynamic memory systems?

   Internal fragmentation is the memory that is left free, within the allocated memory block. This unused memory part cannot be used by other jobs/processes. Internal fragmentation is valid for a fixed partition and a single user memory system.

   External fragmentation: As opposed to Internal Fragmentation External Fragmentation leaves enough space for another process to occupy that memory, however the process cannot because the free memory is not contiguous.

2) Compare and contrast internal fragmentation and external fragmentation (for memory in your own words). Which type of fragmentation can be reduced by compaction?

   Internal fragmentation occurs when the memory allocator leaves extra space empty inside of a block of memory that has been allocated for a client. This usually happens because the processor's design stipulates that memory must be cut into blocks of certain sizes -- for example, blocks may be required to be evenly be divided by four, eight or 16 bytes. When this occurs, a client that needs 57 bytes of memory, for example, may be allocated a block that contains 60 bytes, or even 64. The extra bytes that the client doesn't need go to waste, and over time these tiny chunks of unused memory can build up and create large quantities of memory that can't be put to use by the allocator. Because all of these useless bytes are inside larger memory blocks, the fragmentation is considered internal.

   External fragmentation happens when the memory allocator leaves sections of unused memory blocks between portions of allocated memory. For example, if several memory blocks are allocated in a continuous line but one of the middle blocks in the line is freed (perhaps because the process that was using that block of memory stopped running), the free block is fragmented. The block is still available for use by the allocator later if there's a need for memory that fits in that block, but the block is now unusable for larger memory needs. It cannot be lumped back in with the total free memory available to the system, as total memory must be contiguous for it to be useable for larger tasks. In this way, entire sections of free memory can end up isolated from the whole that are often too small for significant use, which creates an overall reduction of free memory that over time can lead to a lack of available memory for key tasks.

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The type of fragmentation, which is reduced by compaction, is external fragmentation. Compaction takes all of the free memory and puts it all in one place so as to be usable for the next process(es) which are waiting for memory. This is only done with dynamic and relocatable dynamic memory systems

3) Given that main memory is composed of four page frames for public use and that program requests pages in the following order:
a, b, a, b, f, d, f ,c, g, f, a, b, d, e, k, m

a) Using FIFO removal algorithm, perform a page trace analysis and indicate page faults with asterix(*K. Then calculate failure rate.

	A	B	A	B	F	D	F	C	G	F	A	B	F	E	K	M
Page1	A*	A	A	A	A	A	A	C*	C	C	C	B*	B	B	B	M*
Page2		B*	B	B	B	B	B	B	G*	G	G	G	G	E*	E	E
Page3					F*	F	F	F	F	F	F	F	F	F	F	F
Page4						D*	D	D	D	D	A*	A	A	A	K*	K

Failure ration: Number of interrupts / Page requests made = 10/16 = 62.5%

b) Using LRU removal algorithm, perform a page trace analysis and indicate page faults with asterix(*). Then calculate failure rate.

	a	b	a	b	f	d	f	c	g	f	a	b	d	e	k	m
Page1	A*	A	A	A	A	A	A	C*	C	C	C	C	D*	D	D	D
Page2		B*	B	B	B	B	B	B	G*	G	G	G	G	E*	E	E
Page3					F*	F	F	F	F	F	A*	A	A	A	K*	K
Page4						D*	D	D	D	D	D	B*	B	B	B	M*

Failure ration: Number of interrupts / Page requests made = 12/16 = 75%

4) Describe the logic you would use to detect thrashing.

Thrashing is detected by evaluating the level of CPU utilization as compared to the level of multiprogramming. It's stopped by reducing the level of multiprogramming.

Thrashing is a phenomenon when there is an excessive amount of page swapping between the main memory and the secondary storage. The logic for detecting thrashing I would base on the speed rate of accessing the data. If time for accessing data grows and takes longer to access it, I would assume there is a thrashing within the memory, because the thrashing phenomenon is also known as the one that slows the data access.

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5) Using paged memory allocation system with a page size of 2,048 bytes and an identical page frame size, and assuming the incoming data file is 20,992 bytes, calculates how many pages the file will create. Explain whether this situation will result in internal fragmentation, external fragmentation or both.

Page number = Byte number to be located / Page size
Page number = 20992/2048
Page number = 10.25 ~ 11

This situation will end in an internal fragmentation, because the 11^{th} page will be filled up just with 25%, so the rest of the memory will be unused (free).