

## Homework Assignments on Memory Management

Q1. Answer True/False and briefly justify your answer:

- (a) A smaller page size leads to smaller page tables.
- (b) Seek time is time for a disk to rotate to the desired sector.
- (c) The Least Recently Used (LRU) page replacement strategy is based on the principle of spatial locality (locality in space) as opposed to temporal locality (locality in time)
- (d) Contiguous allocation of files leads to both internal and external disk fragmentation.
- (e) Swap space exists in primary memory.

Q2. (a) Consider the following page reference string : 1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6. For LRU page replacement algorithm with 5 frames, the number of page faults is :

- i) 10    ii) 14    iii) 8    iv) 11

(b) A process is thrashing if :

- i) it spends a lot of time executing, rather than paging
- ii) it spends a lot of time paging, than executing
- iii) it has no memory allocated to it
- iv) none of the mentioned

(c) Memory management technique in which system stores and retrieves data from secondary storage for use in main memory is called

- i) fragmentation    ii) mapping    iii) paging    iv) none of the mentioned

(d) The page table contains

- i) base address of each page in physical memory    ii) page offset    iii) page size
- iv) none of the mentioned

Q: What are the three popular strategies for allocating free memory blocks to processes in dynamic memory partitioning? Explain briefly how each strategy works.

Q: True or False?

Buddy Strategy always allocates memory in chunks of size power of two and uses a data structure based on a binary tree.

Q: What interrupt is created when a desired page frame is not currently resident in RAM?

Q: How does the hardware 'know' that a desired page frame is not currently resident in RAM?

Q: What precisely does it mean if the 'dirty bit' is set for a page frame?

Q: What is 'good' vs. 'bad' program locality?

Q: Explain when/how internal fragmentation may occur.

Q: Explain when/how external fragmentation may occur.

Q: What is a global allocation scheme?

Q: What is a working set model?

Q: Comparing global allocation vs. working set allocation, which would be more adversely affected by a program with 'bad' locality? and WHY would that be true?

Q: Which one of the following is not among the set of events that may take place between the time a page fault occurs and the time the faulting process resumes execution?

- (a) OS blocks the process and puts it into a wait queue.
- (b) One of the processes in the ready queue is selected to run.
- (c) A DMA is initiated to load the page from disk into main memory
- (d) A page replacement strategy is used to find a page frame to load the new page
- (e) Page table is updated to reflect the change.
- (f) none of the above

Q: Which one of the following is not among the set of events that may take place between the time a page fault occurs and the time the faulting process resumes execution?

- (a) OS blocks the process and puts it into a wait queue.
- (b) One of the processes in the ready queue is selected to run.
- (c) A DMA is initiated to load the page from disk into main memory
- (d) The last page that the faulting process was executing is replaced with the newly loaded page.
- (e) Page table is updated to reflect the change.
- (f) none of the above

Q: True or False?

While DMA (Direct Memory Access) is taking place, processor is free to do other things. The processor is only involved at the beginning and end of the DMA transfer.

Q: What is the "largest" program that could execute on a machine with a 24-bit virtual address?

Q: What is the "largest" program that could execute on a machine with a 24-bit physical address?

Q: The address contained in a TLB entry <PTE> is (physical | logical).

Q: List at least 3 flags that are contained in a PTE.

Q: Define hit-ratio in a memory management context.

Q: True or False?

If a virtual page number X generates a miss in the TLB (Translation Lookaside Buffer), then the corresponding physical page number for X is guaranteed to be found in the Page Table Entry.

Q: True or False?

It is possible that page tables are stored in virtual (secondary) memory.

Q: True or False?

In a virtual memory system with paging, page size must be large enough to offset the high cost of page faults.

Q: True or False?

The Least Recently Used (LRU) page replacement strategy is based on the principle of spatial locality (locality in space) as opposed to temporal locality (locality in time).

Q: True or False?

Consider "clock policy" for page replacement, a newly arrived page (i.e. just swapped in) will not get replaced before the clock pointer makes two full rotations in the circular buffer of candidate page frames.

Q: True or False?

In a virtual memory system with paging, you can run a program whose size is larger than the size of Main Memory.

Q: How does the kernel 'know' where on disk the desired information is for a non-resident frame?

Q: Describe what demand paging means.

Q: Describe what pre-paging means.

Q. A computer system has a 36-bit virtual address space with a page size of 8K, and 4 bytes per page table entry. Answer the following.

(a) How many pages are in the virtual address space?

(b) What is the maximum size of addressable physical memory in this system?

(c) If the average process size is 8GB, compute the average size of page table for one-level, and two-level paging? Which is a better choice?