Indian Statistical Institute

M.Tech.(CS), 2022-2023

Class Test 1 (March 31, 2023)

Subject: Operating Systems, Syllabus: Memory

Total: 10 marks Duration: 1 hour

Answer all the questions

1. Let there be a process for which the base and limit registers hold the values x and y, respectively. Suppose the process is getting accessed in main memory through logical address space. Then for which of the following addresses it will NOT get a *trap* signal?

   (A) from x to $x+y$ (B) from x to $x+y+1$ (C) from x to $x+y-1$

   (D) from $x+1$ to $x+y$ (E) from $x+1$ to $x+y+1$ (F) from $x+1$ to $x+y-1$

2. Consider the following statements.

   - S1: During compilation, absolute code is bound to actual physical addresses.
   - S2: During loading, relocatable code is bound to relative addresses.
   - S3: During execution, absolute code and relocatable code are bound together.

   Which of the following statements is(are) correct?

   (A) S1 only (B) S2 only (C) S3 only

   (D) S1 and S3 only (E) S2 and S3 only (F) S1, S2 and S3

3. Suppose 3 processes, labeled as p_1, p_2 and p_3, have arrived in the ready queue. Memory partitions are to be dynamically allocated to them. The memory requirements of p_1, p_2 and p_3 are x kb, y kb and z kb, respectively. The list of free blocks, numbered as per their ordering in the memory, is as follows.

Block Number	1	2	3
Free Space	x kb	y kb	z kb

   Let the free blocks are searched in the above list from left to right and allocated using the strategies first fit, best fit and worst fit. If allocations for all the strategies are exactly the same, then which of the following condition(s) necessarily hold(s)?

   (A) $x < y <$ z (B) $x > y >$ z (C) $x < y$ and $y > z$

   (D) $x > y$ and $y < z$ (E) $x = y = z$ (F) None of the above

4. Consider an implementation of paging that accommodates the page number and offset number of the logical address in x and y number of bits, respectively. Then which of the following statements is(are) correct?

   (A) The page size is 2^y (B) The size of logical address space is $2^{(x+y)}$

   (C) The maximum offset number is $2^{(y-1)}$ (D) The maximum page number is $2^{(x-1)}$

5. Let the *hit ratio* of finding a page in the TLB (stands for Translation Look-aside Buffer) be 0.5. Suppose it takes x ns ($x > 0$) time to access the entire page table present in the memory, but y ns ($0 < y < x$) time to access a page in the TLB. Consider that a page table lookup takes only one memory access. If the use of TLB decreases the effective memory-access time by a factor of 2, then which of the following condition(s) necessarily hold(s)?.

   (A) $y = x/2$ (B) $y = x/5$ (C) $y = \sqrt{x}$

   (D) $y \leq x/2$ (E) $y \leq x/5$ (F) Such y does not exist

6. Which of the following page table implementation has the least amount of space requirement?

   (A) Inverted page table (B) Hierarchical page table

   (C) Hashed page table (D) Simple page table

7. Suppose the rate at which data can be transferred between the *main memory* and *backing store* is x Mbps. Let there be a process, acquiring y Kb of main memory, which is required to be swapped with another process of the same size. If both the operational times involved in swapping-in and swapping-out a process are ϵ, then what will be the total swapping time involved during the context switch?

   (A) $2 * (y/x - \epsilon)$ ms (B) $2 * (y/x + \epsilon)$ ms (C) $2 * (y/x)$ ms

   (D) $2 * (x/y - \epsilon)$ ms (E) $2 * (x/y + \epsilon)$ ms (F) $2 * (x/y)$ ms

8. Which of the following manage(s) the accommodation of physical memory space during a fork() call?

   (A) pure demand paging (B) special demand paging (C) copy-on-read

   (D) copy-on-write (E) page replacement (F) None of the above

9. Suppose a memory management unit employs the FIFO (stands for first-in first-out) page replacement algorithm within the page-fault service to choose a victim frame. Consider a scenario when the arrived reference string, following the order in which pages were requested, is as follows.

   $$\{1, 2, 3, 4, x, y\},$$

   If changing the frame size from 3 to 4 for the aforementioned case does not cause Belady's anomaly to happen, then which of the following condition(s) necessarily hold(s)?

   (A) $x = y$ (B) $x > y$ (C) $x < y$

   (D) $x \geq y$ (E) $x \leq y$ (F) Such x, y do not exist

10. Which of the following page replacement strategies suffer(s) from Belady's anomaly?

    (A) Only FIFO (B) Only LRU (C) Only optimal

    (D) Both FIFO and LRU (E) Both FIFO and optimal (F) FIFO, LRU and optimal