

Quiz #3 (Module 5) - Answers

COMP.3080 – Operating Systems

Fall 2019 – Dr. Wilkes

1. **(multiple choice)** (2 points) Which of the following terms is used to refer to an address generated by a CPU?
 - a. Logical address
 - b. Physical address
 - c. Post relocation register address
 - d. Memory Management Unit (MMU) generated address
 - e. None of the above
2. **(multiple choice)** (2 points) Which of the following types of page table has one page entry for each physical page frame of memory?
 - a. Clustered
 - b. Forward-mapped
 - c. Hashed
 - d. Inverted
 - e. None of the above
3. **(true/false)** (1 point) **Belady's anomaly** refers to the observation that as the number of physical page frames increases, the page-fault rate will decrease or stay the same for all page replacement algorithms.
(The page-fault rate may actually increase.)
4. **(true/false)** (1 point) In a system with a page size of 32 KB, 15 bits must be used to represent the page offset in the logical address.
(page size of 32 KB = 2^{15} bytes \rightarrow offset = $0 \dots 2^{15}-1$)
5. **(short answer)** (4 points total) Assume a system has a TLB hit ratio of 98%. It requires 10 nanoseconds to access the TLB, and 100 nanoseconds to access main memory. What is the effective memory access time in nanoseconds for this system? **Show your work.**
$$\begin{aligned} \text{EAT} &= (\text{hit ratio}) * (\text{total memory access time for a hit in the TLB}) \\ &\quad + (\text{miss ratio}) * (\text{total memory access time for a miss}) \\ &= 0.98 * (10 \text{ nsec} + 100 \text{ nsec}) + (1 - 0.98) * (10 \text{ nsec} + 2 * 100 \text{ nsec}) \\ &= 0.98 * (110 \text{ nsec}) + 0.02 * (210 \text{ nsec}) \\ &= 107.8 + 4.2 \text{ nsec} \\ &= 112 \text{ nsec} \end{aligned}$$