2024 Operating Systems Assignment 6

9.17   A page-replacement algorithm should minimize the number of page faults. We can achieve this minimization by distributing heavily used pages evenly over all of memory, rather than having them compete for a small number of page frames. We can associate with each page frame a counter of the number of pages associated with that frame. Then, to replace a page, we can search for the page frame with the smallest counter.

    a. Define a page-replacement algorithm using this basic idea. Specifically address these problems:
- i.   What is the initial value of the counters?
- ii. When are counters increased?
- iii. When are counters decreased?
- iv. How is the page to be replaced selected?

    b. How many page faults occur for your algorithm for the following reference string with four page frames?

1, 2, 3, 4, 5, 3, 4, 1, 6, 7, 8, 7, 8, 9, 7, 8, 9, 5, 4, 5, 4, 2.

    c. What is the minimum number of page faults for an optimal page-replacement strategy for the reference string in part b with four page frames?

9.18   Consider a demand-paging system with a paging disk that has an average access and transfer time of 20 milliseconds. Addresses are translated through a page table in main memory, with an access time of 1 microsecond per memory access. Thus, each memory reference through the page table takes two accesses. To improve this time, we have added an associative memory that reduces access time to one memory reference if the page-table entry is in the associative memory.

    Assume that 80 percent of the accesses are in the associative memory and that, of those remaining, 10 percent (or 2 percent of the total) cause page faults. What is the effective memory access time?

9.19   What is the cause of thrashing? How does the system detect thrashing? Once it detects thrashing, what can the system do to eliminate this problem?