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Homework -9

Operating System

Chapter-9(Virtual Memory)

Question No:1

Under what circumstances do page faults occur? Describe the actions taken by the operating system when a page fault occurs.

Solution:

A page fault occurs when an access to a page that has not been brought into main memory takes place.
The operating system verifies the memory access, aborting the program if it is invalid. If it is valid, a 7 free frame is located and I/O is requested to read the needed page into the free frame. Upon completion of I/O, the process table and page table are updated and the instruction is restarted.

Question No:2

Consider the following page-replacement algorithms. Rank these algorithms on a five-point scale from “bad” to “perfect” according to their page-fault rate. Separate those algorithms that suffer from Belady’s anomaly from those that do not.

a. LRU replacement
b. FIFO replacement
c. Optimal replacement
d. Second-chance replacement

Solution:

Rank	Algorithm	Suffer from Belady’s anomaly
1	Optimal	No
2	LRU	No
3	Second-chance	Yes
4	FIFO	Yes

Question No:3

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.
How many page faults would occur for the following replacement algorithms, assuming three, five, and seven frames? Remember that all frames are initially empty, so your first unique pages will cost one fault each.

- LRU replacement
- FIFO replacement
- Optimal replacement

Solution:

Number of frames	LRU	FIFO	Optimal
1	20	20	20
2	18	18	15
3	15	16	11
4	10	14	8
5	8	10	7
6	7	10	7
7	7	7	7

Question No:4

Consider the parameter Δ used to define the working-set window in the working-set model. When Δ is set to a small value, what is the effect on the page-fault frequency and the number of active (non-suspended) processes currently executing in the system? What is the effect when Δ is set to a very high value?

Solution:

When Δis set to a small value

- The set of resident pages for a process might be underestimated.
- Allowing a process to be scheduled even though all of its required pages are not resident.
- This could result in a large number of page faults.

When Δis set to a large value

- This might prevent many processes from being scheduled even though their required pages are resident.
- However, once a process is scheduled, it is unlikely to generate page faults since its resident set has been overestimated.

Question No:5

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?

Solution:

If a process does not have enough pages, thrashing occurs as a high paging activity due to the high page fault rate, hence rapidly exchanging data in memory for data on disk. The continuously page fault may be more serious when OS observed a lower CPU utilization by introducing more new processes to the system. The system can detect thrashing by evaluating the level of CPU utilization as compared to the level of multiprogramming.

System does following things to eliminate this problem:

1)It can be eliminated by reducing the level of multiprogramming.

2)Thrashing can also be removed by using local replacement algorithm.