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PreCAT

Module – Operating System Concepts

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Operating System – Page Fault

- If page is present in main memory its page table entry is valid.
- If page is not present in main memory, its page table entry is not valid.
- This is possible due to one of the following reasons:
 - Page address is not valid (dangling pointer).
 - Page is on disk/swapped out.
- If CPU requests a page that is not present in main memory (i.e. page table entry valid bit=0), then "page fault" occurs.
- Then OS's page fault exception handler is invoked, which handles page faults as follows:
 1. Check virtual address due to which page fault occurred. If it is not valid (i.e. dangling pointer), terminate the process. (Validity fault).
 2. Check if read-write operation is permitted on the address. If not, terminate the process. (Protection fault).
 3. If virtual address is valid (i.e. page is swapped out), then locate one empty frame in the RAM.
 4. If page is on swap device or hard disk, swap in the page in that frame.
 5. Update page table entry i.e. add new frame address and make entry valid.
 6. Restart the instruction for which page fault occurred.



Operating System – Page Replacement Algorithms

- While handling page fault if no empty frame found (step 3), then some page of any process need to be swapped out. This page is called as "victim" page.
- The algorithm used to decide the victim page is called as "page replacement algorithm".
- There are three important page replacement algorithms: FIFO, Optimal, LRU
- FIFO
 - The page brought in memory first, will be swapped out first.
 - Sometimes in this algorithm, if number of frames are increased, number of page faults also increase.
 - This abnormal behavior is called as "Belady's Anomaly".
- OPTIMAL
 - The page not required in near future is swapped out.
 - This algorithm gives minimum number of page faults.
 - This algorithm is not practically implementable.



Operating System – Page Replacement Algorithms

- LRU
 - The page which not used for longer duration will be swapped out.
 - This algorithm is used in most OS like Linux, Windows, ...
 - LRU mechanism is implemented using "stack based approach" or "counter based approach".
 - This makes algorithm implementation slower.
 - Approximate LRU algorithm close to LRU, however is much faster.
- Thrashing
 - If number of programs are running in comparatively smaller RAM, a lot of system time will be spent into page swapping (paging) activity.
 - Due to this overall system performance is reduced.
 - The problem can be solved by increasing RAM size in the machine



Operating System – File Systems

- File = Data (Data blocks) + Metadata (Inode (FCB))
- File System is way of organizing files (data and metadata) on the disk.
- File System = Boot block/Boot sector + Super block/Volume control block + Inode list/Master file table + Data blocks
- Boot block/Boot sector
 - Programs required for booting the system.
 - Bootstrap program, Bootloader.
- Super block/Volume control block
 - Information about the partition.
 - Partition label, partition size, Number of data blocks, Number of free data blocks, Information of free data blocks.
- Inode list/Master file table
 - Metadata of files in FCB/inodes.
- Data blocks
 - Data of the files





Thank you!

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