Beyond Physical Memory

Reserve some space in hard-disk to load and store the data when needed. This space is called swap space.

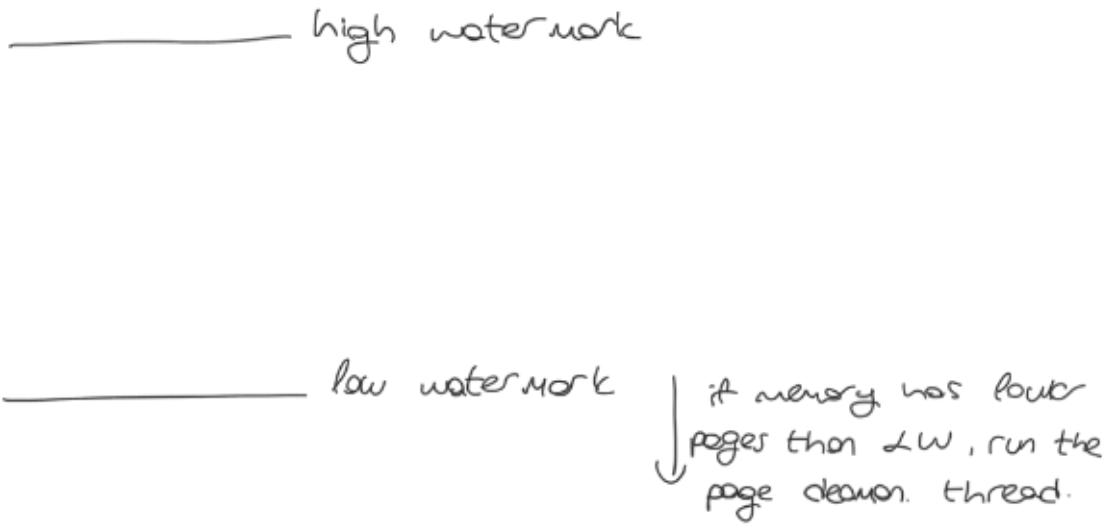
Addition of swap space allows OS to create virtual space for concurrently running programs.

if present_bit = 1 then you can find what you're looking for in memory.

if present_bit = 0 then memory does not keep that data. PAGE FAULT.

Then OS invoked to handle the page fault, and particular piece of code page-fault handler runs.

While I/O is on, the process will be in blocked state. Thus, OS will run other processes while waiting for I/O to finish.



$$AMAT = T_M + (P_{Miss} * T_D)$$

- AMAT: Average Memory Access Time
- T_M: Memory Time
- P_{Miss}: Probability of miss
- T_D: Disk Time

Optimal Replacement Policy

Evict the page that will be used furthest in the future.

Cold-start (compulsory) miss: When program firstly loaded into memory miss is inavetible.

FIFO:

Easy to implement, low hit rate.

if # of proc = 5

Hit rate (# of blocks is 3) > Hit rate (# of blocks is 4)

Random:

Easy to implement, hit rate may vary.

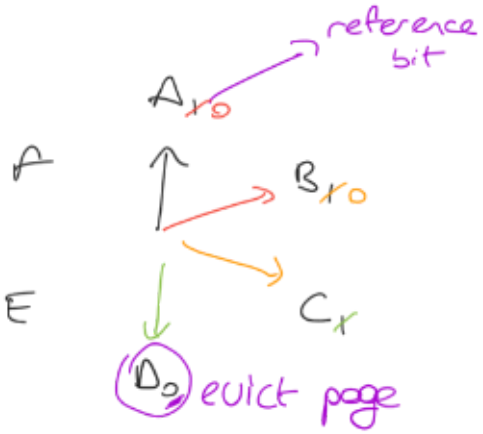
Using History: LRU

If a program accessed a page in near past, it is likely to access it in the near future.

Implementation is hard, but approximation is possible.

%80 / %20 : %80 of refferences is made upon %20 of pages.

Approximation of LRU :



OS prefers clean pages to evict.
not modified pages.

When to bring a page into memory?

Demand paging → Bring it when accessed.

Prefetching → if page i is demanded, it is wise to bring page (i+1) too.

Clustering:

Pending writes together in order to increase efficiency.

Thrashing :

When memory is oversubscribed, kill some processes.
It is sometimes better to do less work well than try to do everything at once poorly.

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