

Virtual memory

Virtual memory - realisation of very large memory systems

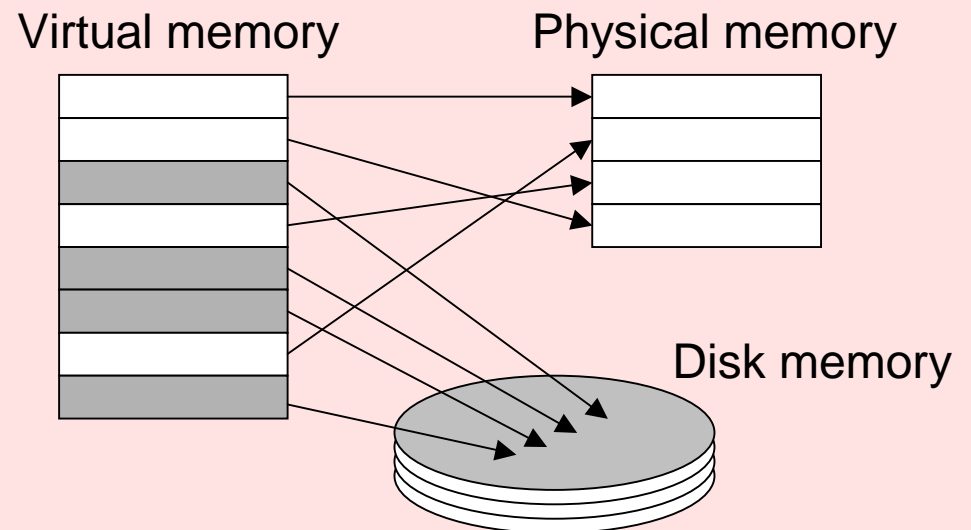
Idea: physical memory system (DRAM) acts as a 'cache' for large data storage (magnetic disks)

- ✓ Efficient physical memory sharing in multitasking systems
- ✓ Programs can use memory larger than physical

Virtual memory takes away from programmers a burden of allocation of memory for programs

Using fixed-size block simplify the memory allocation process (no need for contiguous block)

<u>Cache</u>	<u>Virtual memory</u>
line	page
cache miss	page fault



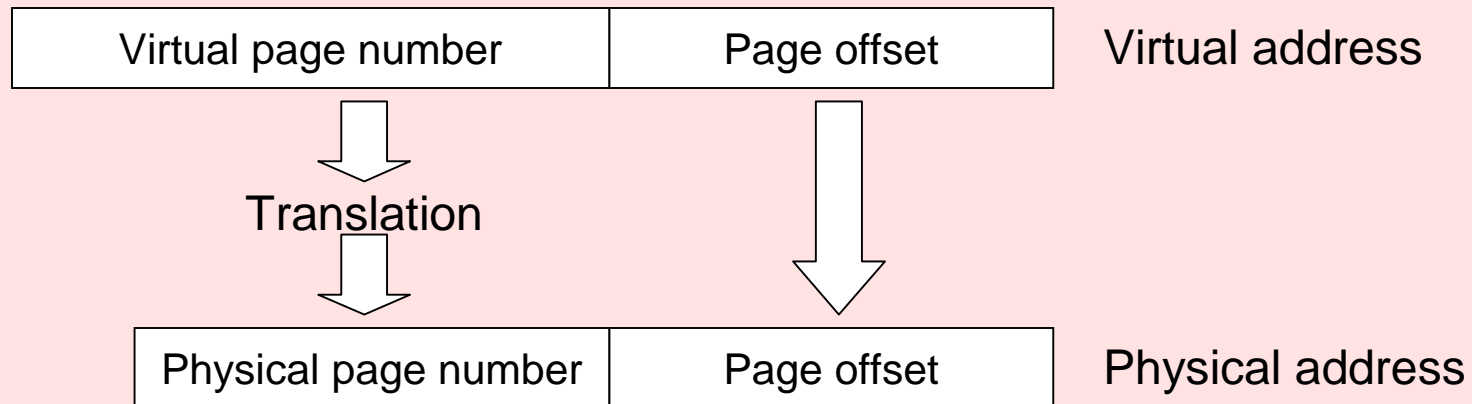
Virtual memory

Virtual memory rules

- ✓ Pages large enough to compensate for high access time
4KB - 64KB
- ✓ Any method reducing page faults is attractive -
fully associative solutions are preferred
- ✓ Page faults can be handled by software, advanced algorithms
for pages replacement are feasible
- ✓ Writes are managed using write-back, write-through
cannot be used

Virtual memory

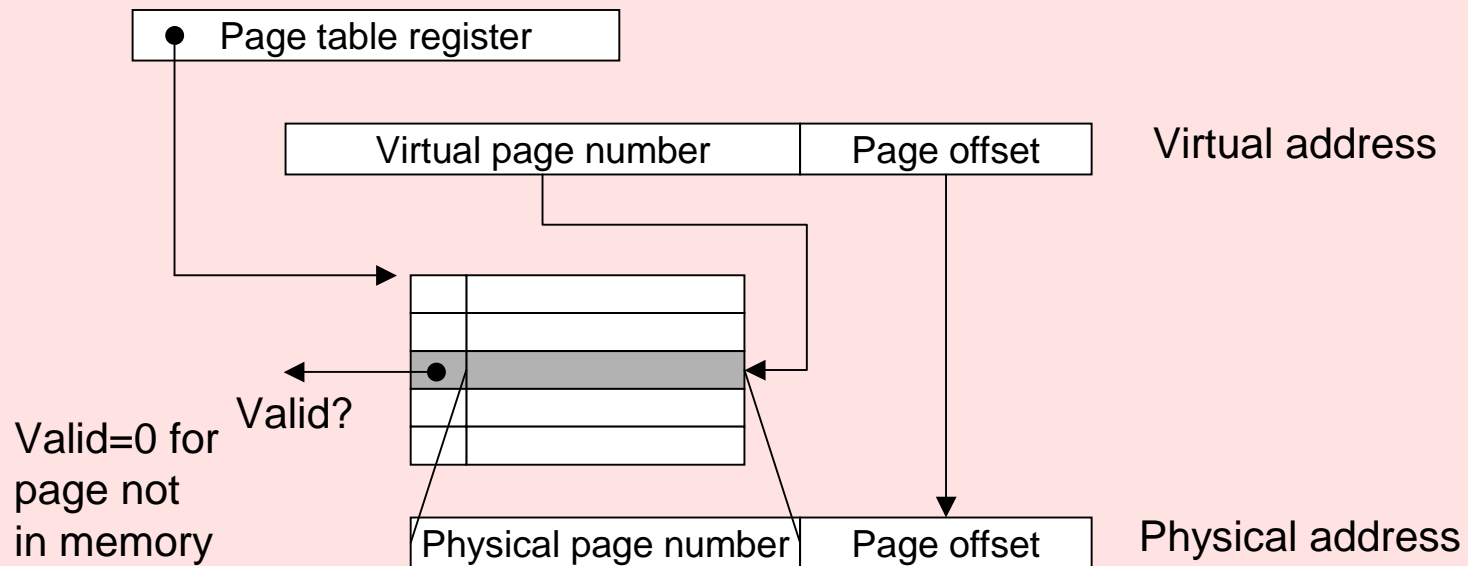
Address translation (memory mapping)



- ✓ Translation for fully associative placement would require a long search through all the pages
- ✓ In practice, pages are located by *page tables* containing indexed physical page address for a each program
- ✓ Current page table is selected by a page table register, associated with the given program

Virtual memory

Address translation



- ✓ Page table, page table register, program counter + registers: state of the program (process)
- ✓ In multitasking systems, the processor is used by one processes, while other are saved in memory waiting for their turn

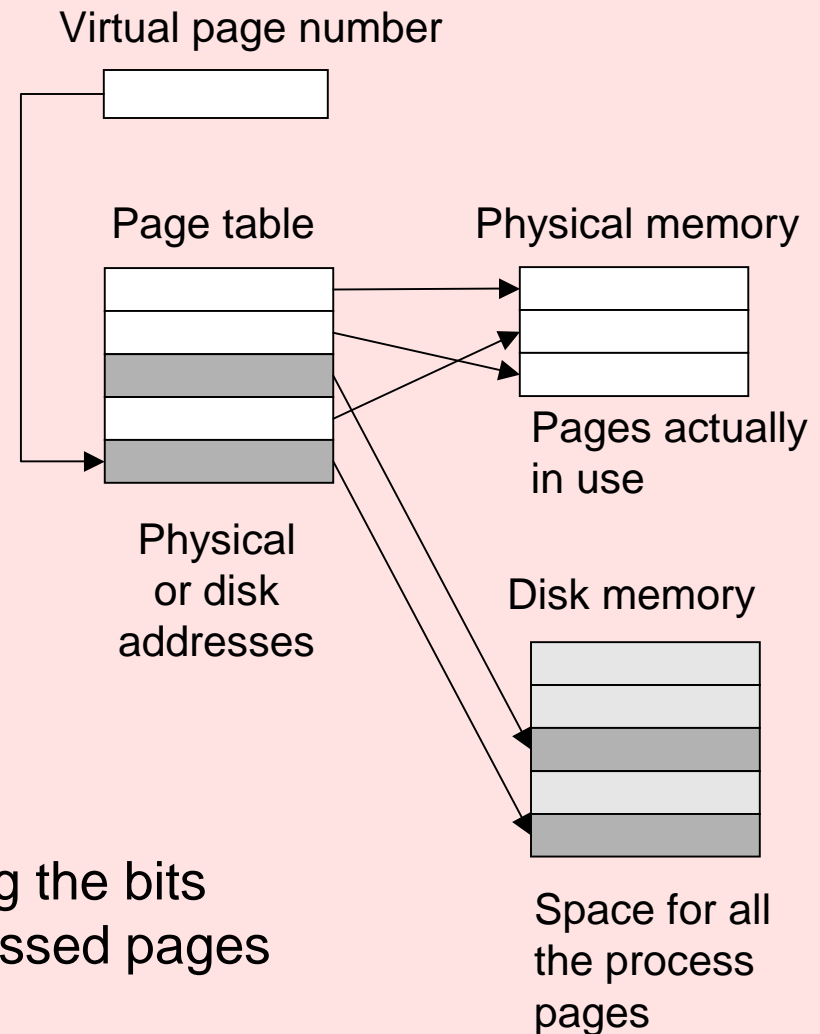
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Page faults

- ✓ Page fault requires the loading (and writing) a new page from disk
- ✓ Penalty for page fault is very high, thus it is important to remove the page which will not be used in near future
- ✓ Even very advanced software algorithms for finding pages to replace pay off

Approximated LRU method:

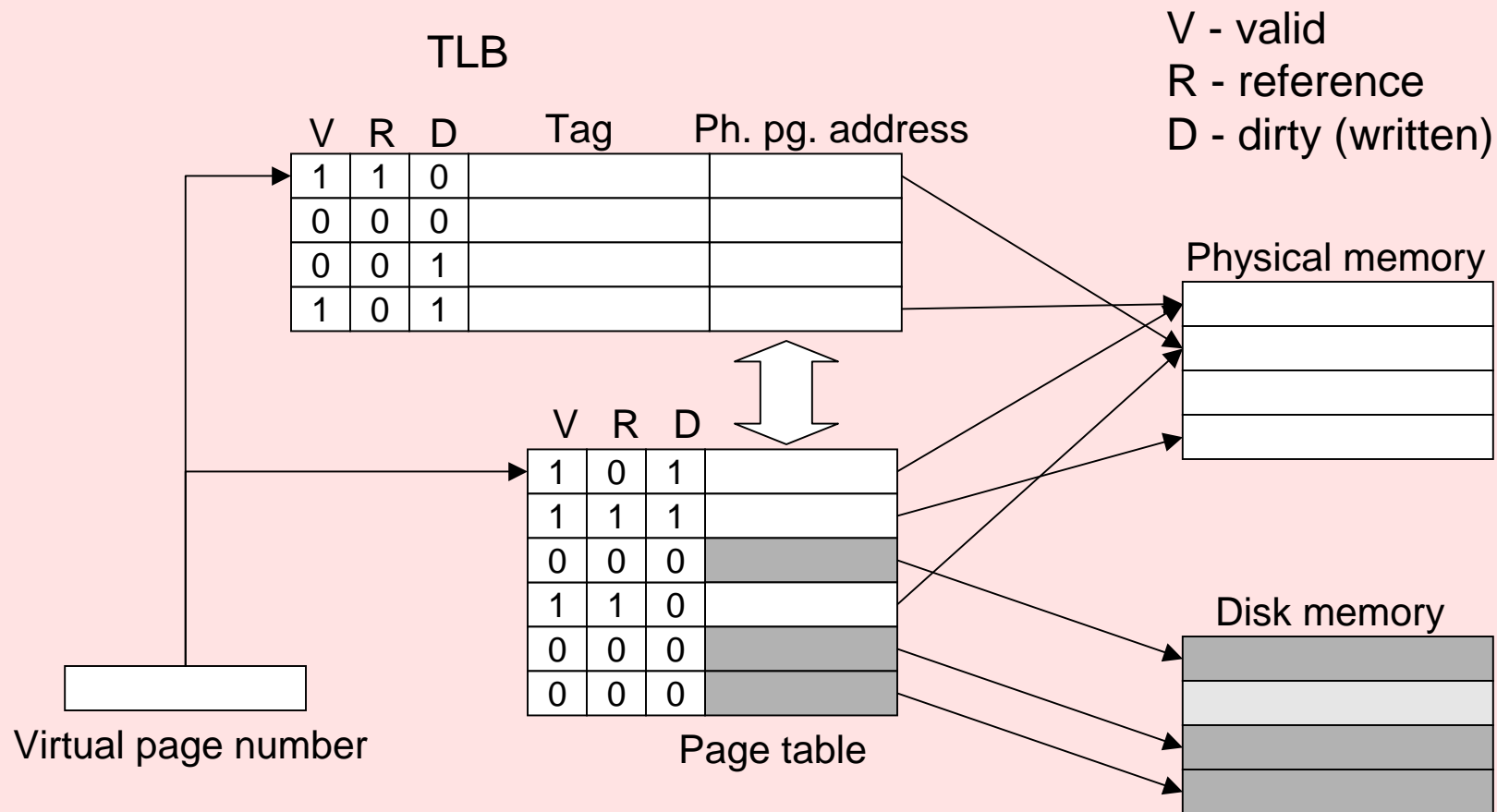
use of reference bit for a page and periodical reading and clearing the bits in order to get information on accessed pages



Virtual memory

Fast address translation

Translation lookaside buffer (TLB) - dedicated cache memory to keep track of recently used translations



V - valid
R - reference
D - dirty (written)

Virtual memory

Virtual memory, TLB and cache

