Chapter Assignment Help

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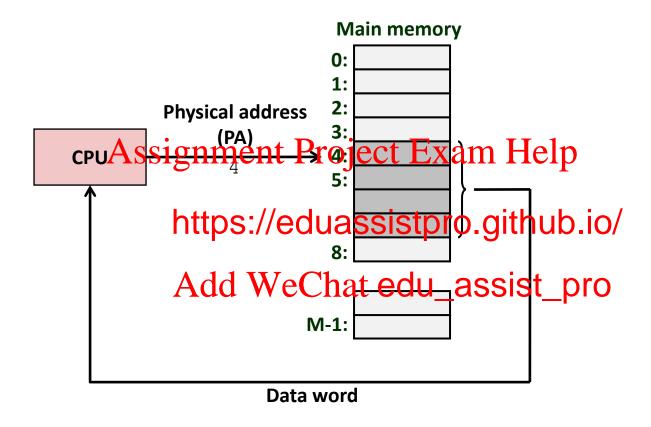
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Today

- **Address spaces**
- VM as a tool for caching
- VM as a tool for memory management Assignment Project Exam Help VM as a tool for
- Address translathttps://eduassistpro.github.io/

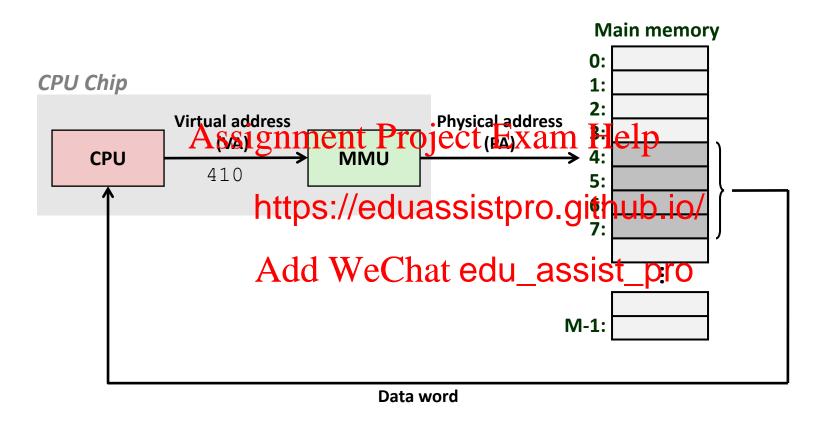
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A System Using Physical Addressing



 Used in "simple" systems like embedded microcontrollers in devices like cars, elevators, and digital picture frames

A System Using Virtual Addressing



- Used in all modern servers, desktops, and laptops
- One of the great ideas in computer science

Address Spaces

■ Linear address space: Ordered set of contiguous non-negative integer addresses:

$$\{0, 1, 2, 3 \dots \}$$

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Virtual address space: Set of N = 2ⁿ virtual addresses

{0, 1, https://eduassistpro.github.io/

■ Physical address spaced to the Part edu_assistepro

- Clean distinction between data (bytes) and their attributes (addresses)
- Each object can now have multiple addresses
- Every byte in main memory: one physical address, one (or more) virtual addresses

Why Virtual Memory (VM)?

- Uses main memory efficiently
 - Use DRAM as a cache for the parts of a virtual address space
- Simplifies memory management Exam Help
 - Each process get

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ess space

- Isolates address spaces
 - One process can't Ander few with art edu_assist_pro
 - User program cannot access privileged kernel information

VM as a Tool for Caching

- Virtual memory is an array of N contiguous bytes stored on disk.
- The contents of the array on disk are cached in *physical* memory (DRANGE Exam Help
 - https://eduassistpro.github.io/ These cache blo Virtual memory Unallocated dd WeChat edu_assist_pro VP 1 **Cached Empty** PP₀ **Uncached** PP 1 Unallocated **Empty Cached Uncached Empty** Cached PP 2m-p-1 M-1 **VP 2**^{n-p}-1 **Uncached**

Virtual pages (VPs) stored on disk

Physical pages (PPs) cached in DRAM

DRAM Cache Organization

- DRAM cache organization driven by the enormous miss penalty
 - DRAM is about 10x slower than SRAM
 - Disk is about 10,000x slower than DRAM

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- Consequences https://eduassistpro.github.jo/
 - Large page (block)

- es 4 MB
- Fully associative Add WeChat edu_assist_pro
 - Any VP can be placed in any PP
 - Requires a "large" mapping function different from CPU caches
- Highly sophisticated, expensive replacement algorithms
 - Too complicated and open-ended to be implemented in hardware
- Write-back rather than write-through