Memory Mapping

- **VM areas initialized by associating them with disk objects.**
  - Process is known as ***memory mapping***.

- **Area can be backed by (i.e., get its initial values from) :**
  - ***Regular file*** on disk (e.g., an executable object file)
    - Initial page bytes come from a section of a file
  - ***Anonymous file*** (e.g., nothing)
    - First fault will allocate a physical page full of 0's (***demand-zero page***)
    - Once the page is written to (***dirtied***), it is like any other page

- **Dirty pages are copied back and forth between memory and a special *swap file*.**

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Demand paging

- ***Key point:*** **no virtual pages are copied into physical memory until they are referenced!**
  - Known as ***demand paging***

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- **Crucial for time and space efficiency**

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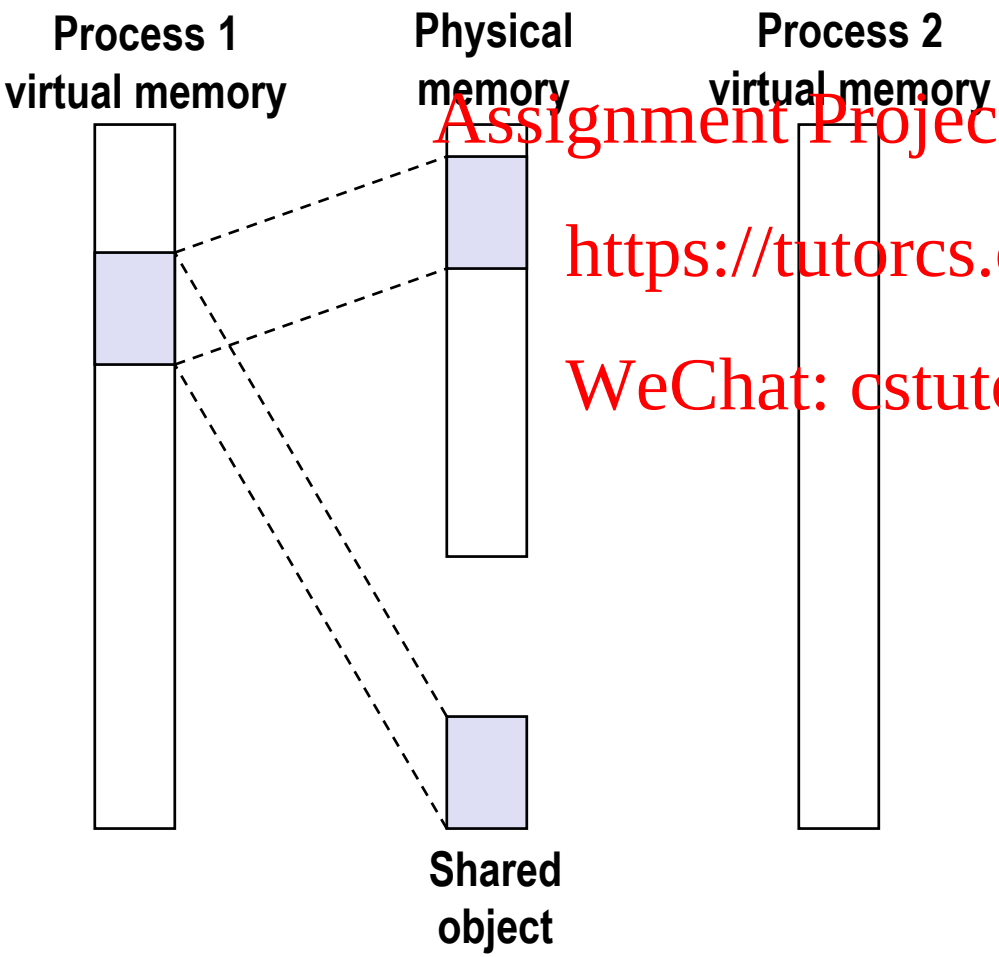
Sharing Revisited: Shared Objects



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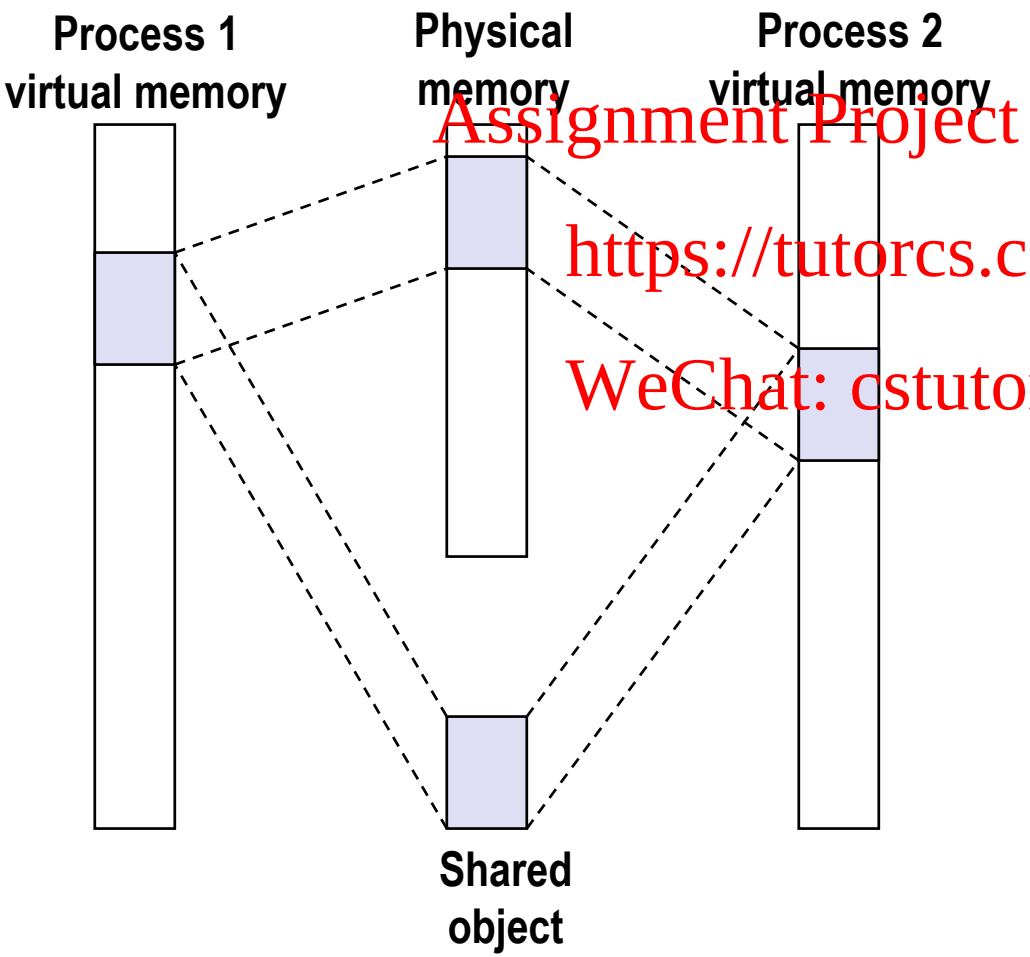
- Process 1 maps the shared object.

Sharing Revisited: Shared Objects



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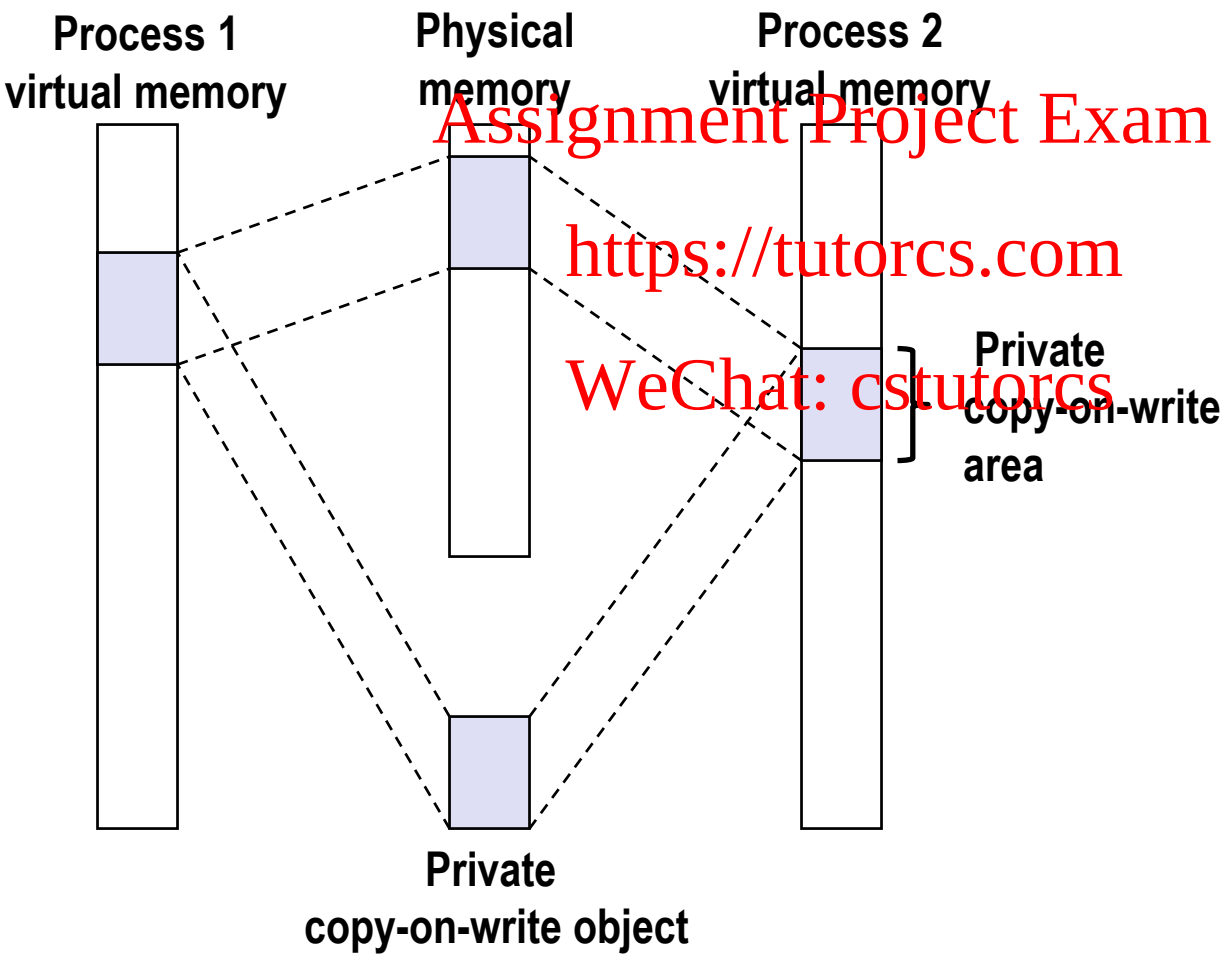
- Process 2 maps the shared object.
- Notice how the virtual addresses can be different.

Sharing Revisited: Private Copy-on-write (COW) Objects



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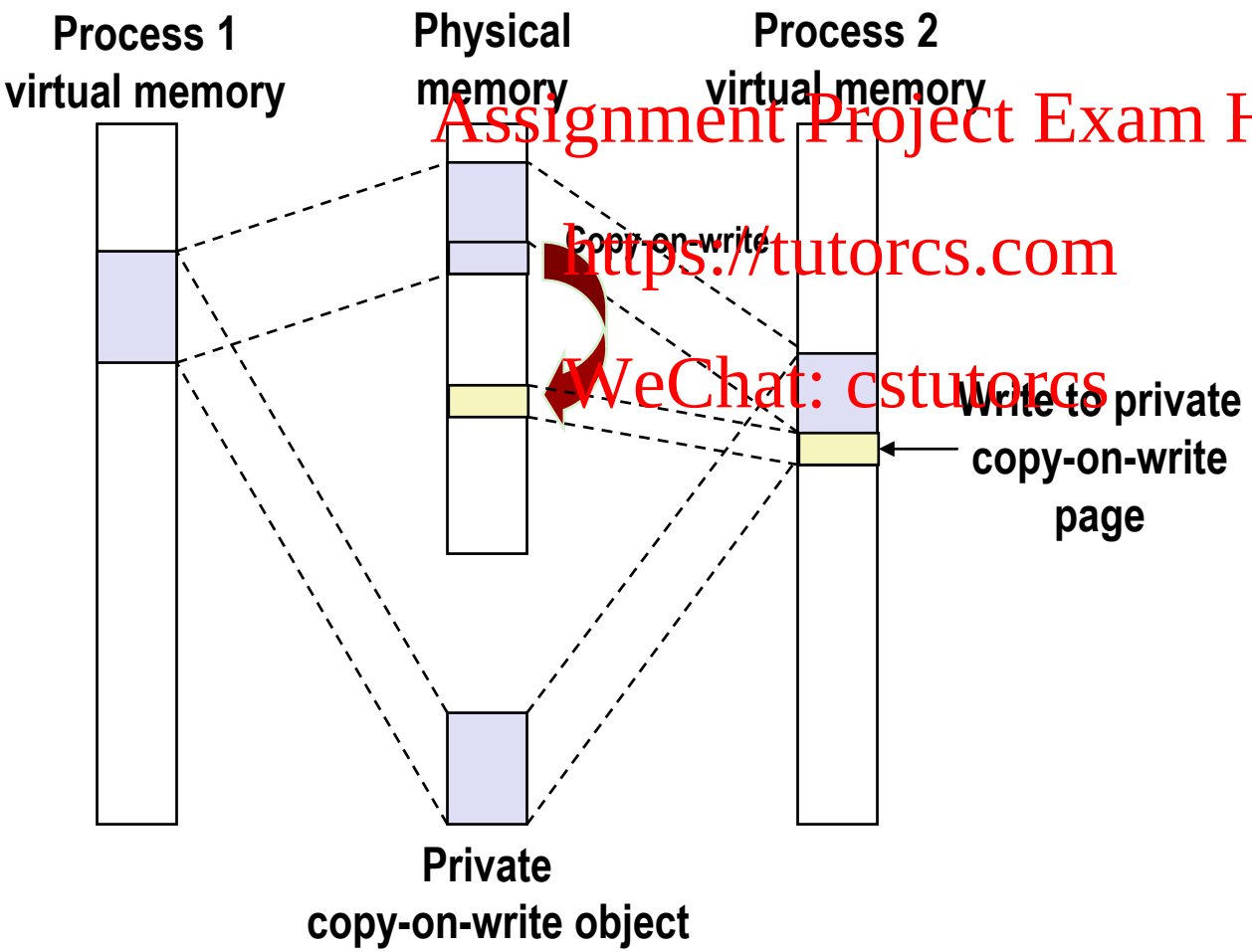
- Two processes mapping a ***private copy-on-write (COW)*** object.
- Area flagged as private copy-on-write
- PTEs in private areas are flagged as read-only

Sharing Revisited: Private Copy-on-write (COW) Objects



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- Instruction writing to private page triggers protection fault.
- Handler creates new R/W page.
- Instruction restarts upon handler return.
- Copying deferred as long as possible!