

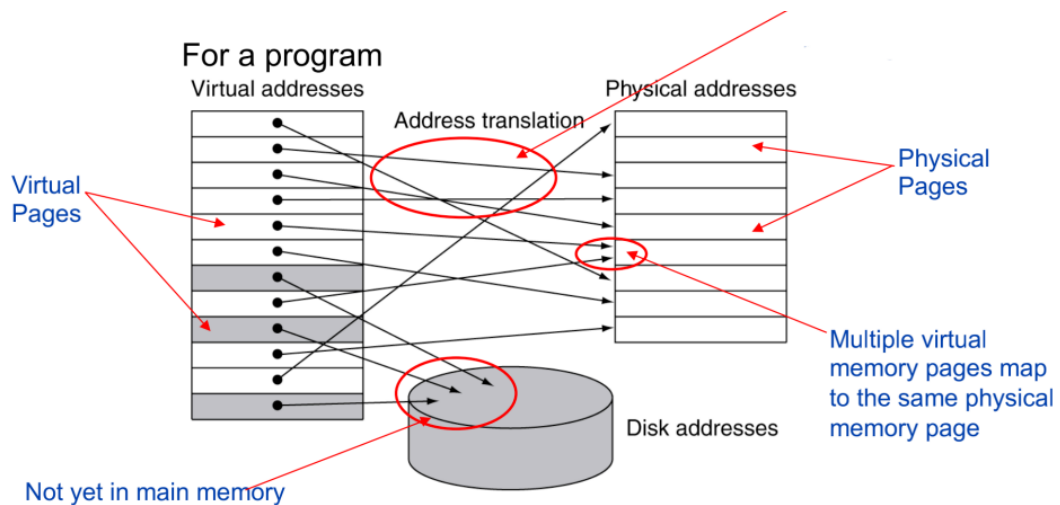
# T12-T13 Virtual Memory

## Why Virtual Memory

- Computer may have a huge program that requires memory to be much larger than cache and main memory.
- Computer may run multiple programs. They may share the main memory, but we don't want them to communicate with each other.
- CPU interacts with main memory through cache, but we don't want it be bothered by memory issues.

## What is Virtual Memory

- An imaginary, huge and fast memory from CPU's perspective – mapped to physical memory.
- Each program has a virtual memory space.
- Mapping is done by CPU or OS translating specific virtual addresses to specific physical addresses.
- If a requested page is not in main memory, it should be fetched from **swap space** in disk (but time consuming).



## Page, Page Table and Page Fault

- In virtual memory context, the data transfer unit is **page** (larger than a block).
- Use **page offset** to locate each byte in a page.
- **Page table** is used for translating **virtual page number (VPN)** into **physical page number (PPN)**. Use VPN as an index to locate the corresponding PPN.
- **Page fault**: The requested page does not exist in the main memory. Need to go to disk to fetch it.

## Translation Look-aside Buffer (TLB)

- (TLB  $\leftarrow$  page table) = (cache  $\leftarrow$  main memory)
- Located inside CPU
- Fully associative
- Tag field used as VPN

