OPERATING SYSTEM

MEMORYBOOK

CHAPTER **V**

ONLINE WEBINAR | MEMORY MANAGEMENT

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MEMORY

MANAGEMENT

Memory Management is the process of controlling and coordinating computer memory

Virtual memory is a feature of an operating system that enables a computer to be able to compensate shortages of physical memory by transferring pages of data from random access memory to disk storage

offset describes the location of a piece of data compared to another location

Memory mapping is the translation between the logical address space and the physical memory.

Paging is a storage mechanism that allows OS to retrieve processes from the secondary storage into the main memory

Memory Addressable which addresses memory in 8-bit units but can fetch and store it 16 bits at a time

KB	
MB	
GB	

Frames main memory is divided into small fixed-size blocks of physical memory

virtual pages is a fixed-length contiguous block of virtual memory

No of Frames	**No of Pages**
Page Map Table Size	**No of Entries in Page Map Table**

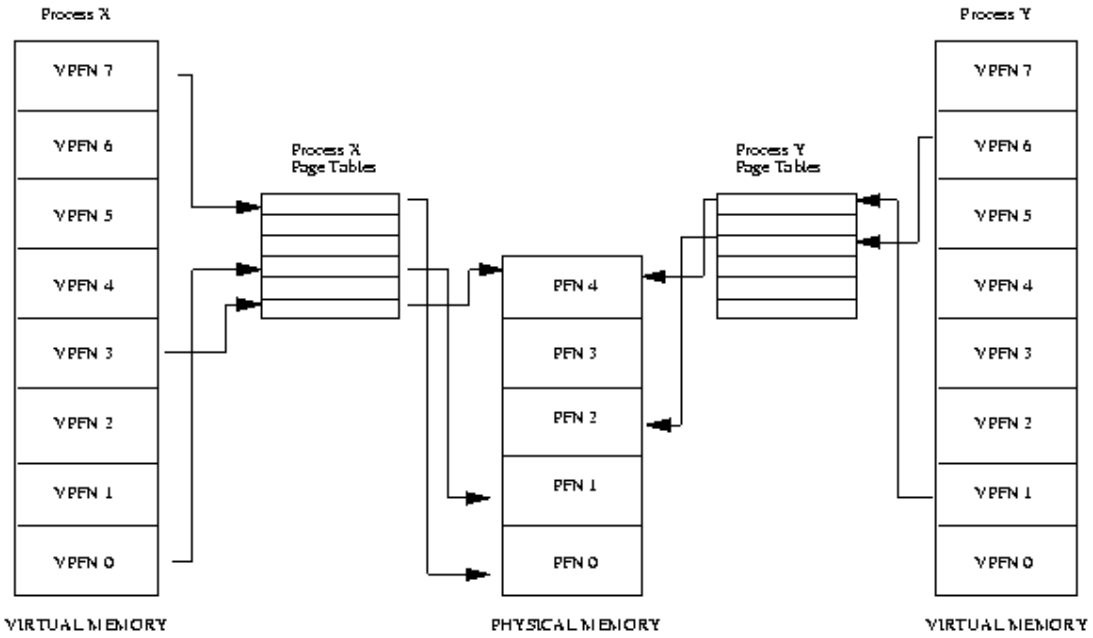

Figure 1:Memory Mapping

FWC 2021

1. Compute the Virtual Page Number and Offset for a 4-KB page and for an 8-KB page for the decimal virtual address: **2000**

	Page Number	**Offset**
4KB		
8KB		

2. Consider the logical address space of **256 Pages** with a **4KB page size**, mapped on to a physical memory of **64 frames**.

    i. How many bits are required in the logical address?

    ii. How many bits are required in the physical address?

AL 2016

1. An embedded system uses 16 bit wide address bus to access its byte addressable main memory.
   What is the maximum usable size of its main memory? Show your computation clearly

AL 2013

1. If a computer system is byte addressable and uses 32-Bit addresses to access any byte in its memory, what is the maximum usable size of its memory in Giga Byte (GB)? Show all your working clearly.

AL 2019

1. Assume that a **32 KB program** is run on a computer having **32 KB of physical memory**. That page size of the **system is 4 KB**. The page table of this process at a particular time is shown on the table below.

Note:

- Only a few selected filed of each page table entry is shown
- The ***frame number*** is indicated in binary
- The Virtual addresses on page 0 are from 0 to 4095 and on page 1 are from 4096 to 8191 and so on.
- The *present/absent* bit indicates the validity of the entry. If this bit is 1, the entry is valid and can be used. If it is 0, then relevant virtual page is not in physical memory.

Page Number	Frame Number	Present / Absent
0	110	1
1	001	1
2	010	1
3	100	1
4	011	1
5	000	0
6	000	0
7	101	1

i. Assume this program requires accessing virtual address **8200**. To which physical address will it get transformed to?
ii. Write down **one** advantage that the use of page tables brings with respect to program sizes compared to the size of physical memory
iii. Give **one** reason as to why a particular page of a process could be absent in physical memory

AL 2020

1. Assume that we have a computer that can use 16-bit virtual address from 0 up to 64KB Assume further that this computer has only 32KB of physical memory and that the page size in the computer is 4 KB

    a. The above 16-bit virtual address is made up of the bits of the page number followed by offset bits. How many bits in the address are required to store a page number in this computer?
    b. User runs a particular program have a size of 32 KB on this computer. A few selected fields of the page table of that process at a particular time are shown in the figure below

Note
The frame number is indicated in binary

The virtual address on page 0 are from 0 to 4095 and on page 1 are from 4096 to 8191 and so on

The **present/absent** bit indicates the validity of the entry. If this bit is 1, the entry is valid and can be used. If it is 0, then the relevant virtual page is not in physical memory

Page Number	Frame Number	Present / Absent
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7	101	1

    c. Assume that there was a request from the **virtual address 0001 0000 0000 0000** Due to the set of tasks that the operating system initiated to fulfill that request, the present/absent bit of the page number 6 in the above page table changed 1 to 0.
    What is the likely 15-bit physical address that the virtual address **0001 0000 0000 0000** will be mapped to?

FWC 2019

1. A Computer System is byte addressable. It contains **64MB** size of physical memory space and uses **4GB** of logical memory space. Size of a page is **4KB**
    Calculate the followings
    a. Number of pages
    b. Number of Frames
    c. Number of entries required for page table

2. Consider the following virtual memory address
    0101110000000111100

    What is the page and displacement (offset) of this address

3. Assume a 20^{20} byte memory. What are the lowest and highest addresses if memory is byte addressable?

4. Consider a machine with 64 MB Physical Memory and a 32-bit Virtual address Space. If the page size is 4KB,

   a. How many bits are required to store the frame number?
   b. What is the approximate size of the page table?

5. A Paging system has the following parameter: 8 GB of physical memory, Page size of 4KB, 2^{20} pages in logical address space.
   a. How many bits are in a logical address?
   b. How many bytes are in a frame?
   c. How many bits are in the physical address specifying the frame number
   d. How many entries in the page table?
   e. How many bits in each page table entry?

6. Consider the page table shown below for a system with 12-bit virtual and physical addresses with 256-byte page

Page Number	Frame Number
0	**-**
1	**-**
2	**2**
3	**A**
4	**6**
5	**-**
6	**7**
7	**3**
8	**-**
9	**5**

   The list of free page frames is D, E, F (that Is D is at the head of the list, E is second, F is at last). Convert the following virtual address to their equivalent physical address in hexadecimal.

7. Consider the following page table in demand paging system. Assume the page size of 256-byte. Assume the usage of decimal values.

Page Number	Frame Number
44	**v**
11	**v**
2	**i**
3	**v**
1	**i**

   Check whether the virtual address given below would generate a page fault? If it does not generate page fault, identify the physical address

   a. 777
   b. 555
   c. 333

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