Paging in Memory Management

⇒ Main Memory:

Formulas

- Physical address space = Size of main memory
- Size of main memory = Total number of frames * Page size
- Frame size = Page size
- If the number of frames in the main memory = 2^x, then number of bits in frame number = x bits.
- If page size = 2^x bytes, then number of bits in page offset = x bits
- To represent 8 pages we need 3 bits i.e $2^3 = 8$
- If the size of main memory = 2^x Bytes, then number of bits in physical address = x bits

⇒ Page Table:

- Number of pages = Logical Address Space / Page Size
- Number of frames = Physical Address Space / Frame Size
- Size of the page table = Number of entries in page table * Page table entry size
- Number of entries in page table = Number of pages the process is divided into
- Page table entry size = Number of bits in the frame number + Number of bits used for optional fields if any

Simple Basics:

$2^2 = 4$	$2^6 = 64$	$2^{10} = 1024 = 1K$
$2^3 = 8$	$2^7 = 128$	$2^{20} = 1M$
$2^4 = 16$	$2^8 = 256$	$2^{30} = 1G$
$2^5 = 32$	$2^9 = 512$	$2^{40} = 1T$

Total word 8 words
Each word of size 16-bits.

Capacity of memory = Number of words in the memory * word size.

Capacity = 8 x 16 bits
= 8 x 2 bytes
= 16 bytes

Numerical Question No #1.

Consider a system in which logical address equal to 27 bits and the physical address requires 21 bits. The page size is 4k words. Calculate the number of pages and the number of frames?

Solution:

Logical Address = 27 bits = 2^{27}
Physical Address = 21 bits = 2^{21}
Page Size = 4K = 4×2^{10}
$= 2^2 \times 2^{10}$
$= 2^{2+10} \Rightarrow 2^{12}$

Number of pages = ?
Number of frames = ?

Number of pages = Logical Address / Page size

$$= \frac{2^{27}}{2^{12}}^{15}$$

$$= 2^{15}$$
$$= 2^5 \times 2^{10}$$
$$= 32 \times k$$
$$= 32k.$$

Number of frames = Physical Address / Frame size

$$= \frac{2^{21}}{2^{12}}^{9}$$

$$= 2^9$$
$$= 512 \text{ frames.}$$

Question No # 2.

Consider a system with logical address of 32 bits and physical address space 64 M words. The page size is 4k. Page table entry size is 2 bytes. what is the approximate size of the page.

Solution:

Page table entry size = 2 bytes.

Logical Address = 32 bits = 2^{32}

Physical Address = 64 M.

Page size = 4k.

$= 4 \times 2^{10}$

$= 2^2 \times 2^{10} \Rightarrow 2^{2+10}$

$= 2^{12}$.

Number of pages = Logical address / Pagesize

$= \frac{2^{32}}{2^{12}}$

$= 2^{20}$

Size of page table in bytes $= 2^{20} \times 2$ bytes

$= 1M \times 2$ bytes.

$= 2MB$

Question No # 3

Consider a system having a page table with 4K entries, Logical address of 29 bits. How many bits the physical address requires if the system of 512 frames.

Solution:

Number of frame = 512

Logical Address = 29 bits.

$= 2^{29}$.

Number of entries in page table = 4k.

$= 4 \times 2^{10}$

$= 2^2 \times 2^{10}$

$= 2^{12}$

Number of pages = Logical Address / Page size.

$= \frac{2^{29}}{2^{12}}$

$= 2^{17}$

$= 2^7 \times 2^{10}$

$= 128$ k.

Frame size = Page size.

Number of frames = Physical Address / Frame size

$512 = \frac{\text{Physical Address}}{2^{17}}$

$2^9 = \frac{\text{Physical Address}}{2^{17}}$

$2^9 \times 2^{17} = \text{Physical Address}$

$2^{9+17} = \text{Physical Address}$

2^{26} bits = Physical Adress.