Tutorial 2

1. Consider a logical address space of 64 pages of 1,024 words each, mapped onto a physical memory of 32 frames. a. how many bits are there in the logical address? b. how many bits are there in the physical address?

a) Logical memory = 64 pages

= 2^6 pages

size of each word = 1024 = 2^{10}

Hence total logical memory = 2^6 x 2^{10} = 2^{16}

Hence the logical address will have 16 bits.

b) Physical memory = 32 frames

= 2^5 frames

size of each word = 1024 = 2^{10}

Hence total physical size = 2^5 x 2^{10} = 2^{15}

Hence there will be 15 bits in the physical address

2. Assuming a 1-KB page size, what are the page numbers and offsets for the following address references(provided as decimal numbers):

a. 3085

b. 42095

Given page size 1KB, we can express it as $= 2^n = 1024 = 2^{10}$, so the no. of bits in offset part is $(n) = 10$.

Then we can solve this problem as follows:

Step 1: Convert logical address: Decimal to Binary.

Step 2: Split binary address to 2 parts (page no, offset), offset: n digits

Step 3: Convert offset and page no, Binary to Decimal.

(a) 3085 as Decimal

(1) Binary format = 0000001100000001101

(2) Page no. = 011 = 3

(3) Page offset: 0000001101 = 13

(b) 42095 as Decimal

(1) Binary = 1010010001101111

(2) Page no. = 101001 = 41

(3) Page offset: 0001101111 = 111

3. Consider a logical address space of 256 pages with a 4- KB page size, mapped onto a physical memory of 64 frames.
a. How many bits are required in the logical address?
b. How many bits are required in the physical address?

(a) Logical address space (size) $= 2^m$, then:

$$\text{Logical address space (size)} = \text{no. of pages} \times \text{page size}$$

$$= 256 \times 4 \text{ KB}$$

$$= 256 \times 4096$$

$$= 1048576$$

$$= 2^{20}$$

$$\therefore \quad m = 20$$

(b) Let x be the number of physical addresses, then:

$$\text{Physical address space (size)} = 2^x$$

$$= \text{no. of frames} \times \text{frame size}$$

$$= 64 \times 4 \text{ KB}$$

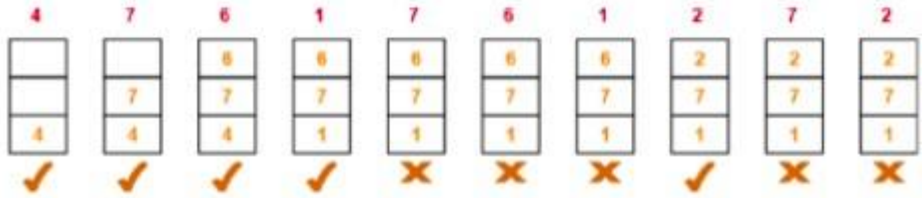
$$= 64 \times 4096$$

$$= 2^6 \times 2^{12} = 2^{18}$$

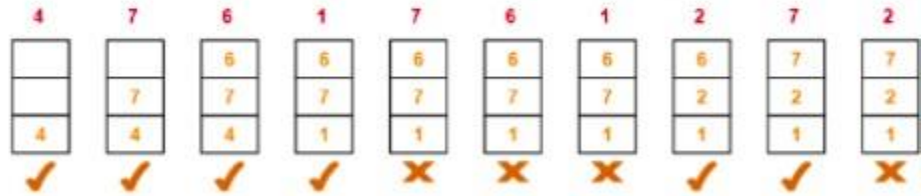
$\therefore$ The number of the required bits in the physical address is $x = 18$ bits

4. A system uses 3-page frames for storing process pages in the main memory. It uses the following page replacement algorithms as (a) Optimal page replacement policy (b) Least Recently Used (LRU) page replacement (c) First in First out (FIFO) page replacement policy. Assume that all the page frames are initially empty. What is the total number of page faults that will occur while processing the page reference string 4, 7, 6, 1, 7, 6, 1, 2, 7, 2 in each of the above cases?

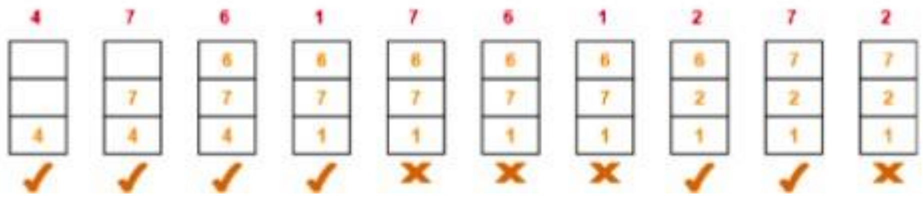
(a) Total number of page faults occurred =5



(b) Total number of page faults occurred =6



(c) Total number of page faults occurred =6



5. Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?
a. 0,430 - 219 + 430 = 649
b. 1,10 - 2300 + 10 = 2310
c. 2,500 - llegal address since size of segment 2 is 100 and the offset in logical address is 500
d. 3,400 - 1327 + 400 = 1727
e. 4,112 - Illegal address since size of segment 4 is 96 and the offset in logical address is 112