

**Homework 3****Question 1**

16 bit addresses virtual and physical – page/frame size is 256 bytes ( $2^8$ )

1) **8 bit page number** and **8 bit offset**

2) **256 pages** because of 8 bit page number

3) **1024 bytes** (256 entries x 4 bytes per entry)

4)

Page Number	Valid Bit	Frame Number
0	1	100
1	1	101
2	1	102
3-252	0	N/A
253	1	5
254	1	6
255	1	7

5)

- a) 0x01CC → Page 1 → Frame 101 → **0x65CC**  
 b) 0x02FF → Page 2 → Frame 102 → **0x66FF**  
 c) 0x0301 → Page 3 → Invalid → **Page Fault**  
 d) 0xFF01 → Page 255 → Frame 7 → **0x0701**

6) **Level 1 Directory (Frame 8)**

L1 Index	Frame Number (Notes)
0	9 Pages 0-15
1-14	0 – Invalid Pages 16-239, all invalid
15	10 Pages 240-255

**Level 2 table for L1 = 0 (Frame 9)**

L2 Index	Valid Bit	Frame Number	Page Number
0	1	100	0
1	1	101	1
2	1	102	2
3-15	0	0	3-15

**Level 2 table for L1 = 15 (Frame 10)**

L2 Index	Valid Bit	Frame Number	Page Number
0-12	0	0	240-252
13	1	5	253
14	1	6	254
15	1	7	255

7) 3 Frames \* 256 bytes/frame = **768 bytes**

8)

- a) 0x01CC → L1[0] → Frame 9 valid → L2[1] → Frame 101 → **0x65CC**  
 b) 0x02FF → L1[0] → Frame 9 valid → L2[2] → Frame 102 → **0x66FF**  
 c) 0x0301 → L1[0] → Frame 9 valid → L2[3] → Invalid → **Page Fault**  
 d) 0xFF01 → L1[15] → Frame 10 valid → L2[15] → Frame 7 → **0x0701**

## Q2

### Homework 3

#### Question 2

##### FIFO Algorithm

		4	2	3	4	1	3	2	4	5	4	3	2
Frame 1		4	4	4	4	1	1	1	1	1	1	3	2
Frame 2	-		2	2	2	2	2	2	4	4	4	4	4
Frame 3	-	-		3	3	3	3	3	3	5	5	5	5
Page Faults?	Y	Y	Y	N	Y(4)	N	N	Y(2)	Y(3)	N	Y(1)	Y(3)	

##### Optimal Algorithm

		4	2	3	4	1	3	2	4	5	4	3	2
Frame 1		4	4	4	4	4	4	4	4	4	4	4	4
Frame 2	-		2	2	2	2	2	2	2	2	2	3	3
Frame 3	-	-		3	3	1	1	1	1	5	5	5	2
Page Faults?	Y	Y	Y	N	Y(3)	Y(3)	N	N	Y(1)	N	Y(2)	Y(5)	

##### Last Recently Used Algorithm

		4	2	3	4	1	3	2	4	5	4	3	2
Frame 1		4	4	4	4	1	1	1	4	4	4	4	4
Frame 2	-		2	2	2	2	2	2	2	2	2	3	3
Frame 3	-	-		3	3	3	3	3	3	5	5	5	2
Page Faults?	Y	Y	Y	N	Y(4)	N	N	Y(1)	Y(3)	N	Y(2)	Y(5)	

### Q3

#### Homework 3

Question 3	Disk Speed 6000RPM	Avg Seek Time 0.005s	Avg Transfer Speed $10^8$ B/s	Sector Size 512 Bytes	
1)	0.005s seek +	0.005s latency +	$10^6/10^8$ s transfer = $10^6$ bytes/0.02 sec =	<b>0.02 seconds</b> <b>50 MB/sec</b>	access time throughput
2)	0.005s seek +	0.005s latency +	$10^8/10^8$ s transfer = $10^8$ bytes/1.01 sec =	<b>1.01 seconds</b> <b>99.01 MB/sec</b>	access time throughput