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Q1.

Soln. #Sets=2^{14}

T=N-S-F=32-14-6= 12b

Q2.

Soln. the location of X[4][7] when the array X is stored in

(a) column major order = 3000+67*3 = 3201
(b) row major order = 3000+87*3 = 3261

Q3.

Soln. Global miss-rate of L2 cache= 90,000/10,00,000=9%

Local miss-rate of L2 cache = 90,000/7,00,000=12.85%

Global miss-rate of L3 cache= 50,000/10,00,000=5%

Local miss-rate of L3 cache =50,000/90,000=55.55%

Q4.

Soln. No. of blocks=4

Block Size=2B=2^1 => Offset=1b

No. of sets=2

S=$\log_2 2$=1

Request	Binary	Tag	SetId	Offset
0	0000	00	0	0
1	0001	00	0	1
2	0010	00	1	0
3	0011	00	1	1
4	0100	01	0	0
5	0101	01	0	1
6	0110	01	1	0
8	1000	10	0	0
9	1001	10	0	1

11	1011	10	1	1
13	1101	11	0	1

After 1,compulsory miss

(0,1)	

After 5,compulsory miss

(0,1)	(4,5)

After 9,compulsory miss

(8,9)	(4,5)

After 3,compulsory miss

(8,9)	(4,5)
(2,3)	

After 6,compulsory miss

(8,9)	(4,5)
(2,3)	(6,7)

After 4,hit

(8,9)	(4,5)
(2,3)	(6,7)

After 11,compulsory miss

(8,9)	(4,5)
(10,11)	(6,7)

After 8,Hit

(8,9)	(4,5)
(10,11)	(6,7)

After 0,Miss

(8,9)	(0,1)
(10,11)	(6,7)

After 2,Miss

(8,9)	(0,1)
(10,11)	(2,3)

After 13,compulsory miss

(12,13)	(0,1)
(10,11)	(2,3)

After 9,Miss

(12,13)	(8,9)
(10,11)	(2,3)

1,5,9,3,6,11,13 are compulsory misses. 4 and 8 are hits. 0,2,9 are misses.

Now considering a fully associative cache of 4 blocks with block size 2B.

1	(0,1)				Compulsory Miss
5	(0,1)	(4,5)			Compulsory Miss
9	(0,1)	(4,5)	(8,9)		Compulsory Miss
3	(0,1)	(4,5)	(8,9)	(2,3)	Compulsory Miss
6	(6,7)	(4,5)	(8,9)	(2,3)	Compulsory Miss
4	(6,7)	(4,5)	(8,9)	(2,3)	Hit
11	(6,7)	(4,5)	(10,11)	(2,3)	Compulsory Miss
8	(6,7)	(4,5)	(10,11)	(8,9)	Miss
0	(0,1)	(4,5)	(10,11)	(8,9)	Miss
2	(0,1)	(2,3)	(10,11)	(8,9)	Miss
13	(0,1)	(4,5)	(12,13)	(8,9)	Compulsory Miss
9	(0,1)	(4,5)	(10,11)	(8,9)	Hit

9 is a hit in Fully associative so 9 is a conflict miss. (0,2) are misses in a 2-way associative and fully associative. So they are capacity misses.

1,5,9,3,6,11,13-Compulsory misses

0,2-Capacity misses

9-Conflict miss

Q.5

Soln. Block size=32=2^5

Offset=5=F

S=7,N=16,T=N-S-F=4

So on breaking down the address : 1011 0100 1111 0000

Offset=10000

Tag=1011

SetIndex=S=0100111=39

Ways will depend on the access pattern.

No. will be stored in set 39 and 1^{st} way.

Q6.

Soln. Address 91 in binary= 1011011

91%6=1

So starting address =91-1=90

Addresses fetched=90,91,92,93,94,95

Q7.

Soln.

(i) Optimal replacement algorithm:

7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Value to be inserted

7	7			Miss
0	0	7		Miss
1	1	0	7	Miss
2	1	0	2	Miss
0	1	0	2	Hit
3	3	0	2	Miss
0	3	0	2	Hit
4	3	4	2	Miss
2	3	4	2	Hit
3	3	4	2	Hit
0	3	0	2	Miss
3	3	0	2	Hit
2	3	0	2	Hit
1	1	0	2	Miss
2	1	0	2	Hit
0	1	0	2	Hit
1	1	0	2	Hit
7	1	0	7	Miss

0	1	0	7	Hit
1	1	0	7	Hit

Total no. of misses=9

(ii) LRU replacement algorithm:

7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Value to be inserted

7	7			miss
0	7	0		miss
1	7	0	1	miss
2	2	0	1	miss
0	2	0	1	hit
3	2	0	3	miss
0	2	0	3	hit
4	4	0	3	miss
2	4	0	2	miss
3	4	3	2	miss
0	0	3	2	miss
3	0	3	2	hit
2	0	3	2	hit
1	1	3	2	miss
2	1	3	2	hit
0	1	0	2	miss
1	1	0	2	hit
7	1	0	7	miss
0	1	0	7	hit
1	1	0	7	hit

Total no. of misses =12