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CSE 351
Homework 4
05/26/13

1.
A. When reading x[1][0] after reading x[0][0], x[0][0] along with x[0][1], x[0][2], and x[0][3] will be evicted from the cache; therefore, when it will be a miss when reading x[0][1]. Consequently, miss rate is 100%.
B. If we double the cache size, we won't encounter thrashing in case 1, that is, when reading x[0][1] after reading x[1][0], we'll have a hit instead of miss since the block that contains x[0][1] isn't evicted by the block the contains x[1][0]; therefore, we'll only face cold misses in this case and the miss rate is 25%.
C. Two-way set associative cache eliminates the thrashing problem in case 1 and we'll only face cold misses in this case; therefore, the miss rate is 25%.
D. No, it won't reduce miss rate since increasing the cache size won't eliminate cold misses; in other words, we'll still encounter misses whenever we read x[0][4k] or x[1][4k] where k >= 0 and k <= 31 because the block size is still 16 bytes. So the miss rate is still 25%.
E. Yes, it'll reduce the miss rate. For instance, if we increase the block size by a multiple of 2, we'll now encounter misses whenever we read x[0][8k] or x[1][8k] where k >= 0 and k <= 15; therefore, the miss rate is reduced by a multiple of 2 because of increasing the block size.

2. Possible outputs: 243, 423, 432

3.
n = 64 and P = 4 KB: # PTEs = 2^{64} / $(4*2^{10})$ = 2^{64} / 2^{12} = 2^{52} (or 2^2 P)
n = 64 and P = 4096 KB: # PTEs = 2^{64} / $(4096*2^{10})$ = 2^{64} / 2^{22} = 2^{42} (or 2^2 T)

4. a 64-bit virtual address space and a 36-bit physical address

P	# VPN bits	# VPO bits	# PPN bits	# PPO bits
4 KB	52	12	24	12
4096 KB	42	22	14	22

5. Virtual address: 0x027c
A.

13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	1	1	1	1	1	0	0

B.

Parameter	Value
VPN	0x09
TLB index	0x1
TLB tag	0x02

TLB hit? (Y/N)	N
Page fault? (Y/N)	N
PPN	0x17

C.

11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	1	1	1	1	1	1	1	0	0

D.

Parameter	Value
Byte offset	0x0
Cache index	0xF
Cache tag	0x17
Cache hit? (Y/N)	N
Cache byte returned	---

6. Virtual address: 0x03a9

A.

13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	0	1	0	1	0	0	1

B.

Parameter	Value
VPN	0x0E
TLB index	0x2
TLB tag	0x03
TLB hit? (Y/N)	N
Page fault? (Y/N)	N
PPN	0x11

C.

11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	0	0	1	1	0	1	0	0	1

D.

Parameter	Value
Byte offset	0x1
Cache index	0xA
Cache tag	0x11
Cache hit? (Y/N)	N
Cache byte returned	---

7. Virtual address: 0x0040

A.

13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0

B.

Parameter	Value
VPN	0x01
TLB index	0x1
TLB tag	0x00
TLB hit? (Y/N)	N
Page fault? (Y/N)	Y
PPN	---

C.

11	10	9	8	7	6	5	4	3	2	1	0

D.

Parameter	Value
Byte offset	
Cache index	
Cache tag	
Cache hit? (Y/N)	
Cache byte returned	