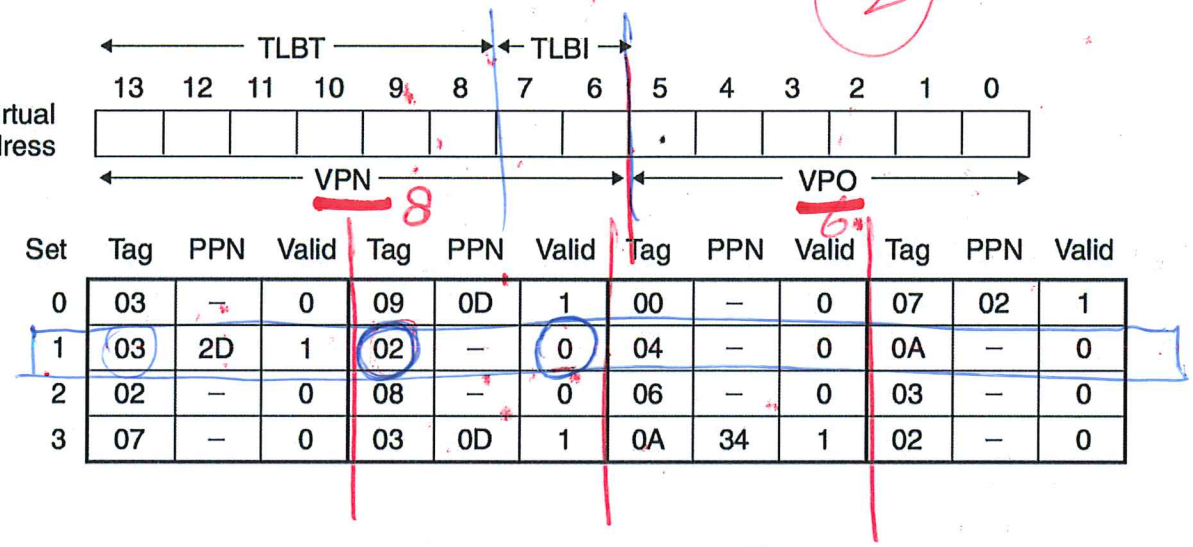
In-Class Problem Walkthrough

Will be solved in class on April 20, 2016

Consider the following memory system snapshot,

Figure A. TLB: Four sets, 16 entries, four-way set associative



Set	Tag	PPN	Valid	Tag	PPN	Valid	Tag	PPN	Valid	Tag	PPN	Valid
0	03	–	0	09	0D	1	00	–	0	07	02	1
1	03	2D	1	02	–	0	04	–	0	0A	–	0
2	02	–	0	08	–	0	06	–	0	03	–	0
3	07	–	0	03	0D	1	0A	34	1	02	–	0

Figure B. Page table: Only the first 16 PTEs are shown

VPN	PPN	Valid
00	28	1
01	—	0
02	33	1
03	02	1
04	—	0
05	16	1
06	—	0
07	—	0

VPN	PPN	Valid
08	13	1
09	17	1
0A	09	1
0B	–	0
0C	–	0
0D	2D	1
0E	11	1
0F	0D	1

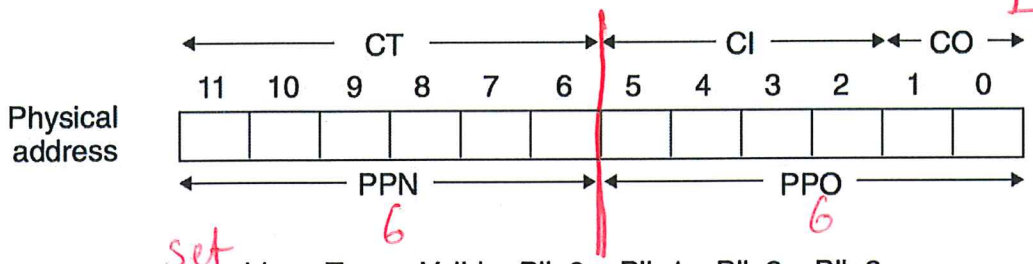
0000 1001

0x 0 9

Main memory = 2^{12} bytes = $2^2 \times 2^{10}$ = 4 KB

2^6 bytes { 1 page } 2^6 pages

Figure C. Cache: Sixteen Sets, 4 byte blocks, direct mapped



set

Idx	Tag	Valid	Blk 0	Blk 1	Blk 2	Blk 3
0	19	1	99	11	23	11
1	15	0	—	—	—	—
2	1B	1	00	02	04	08
3	36	0	—	—	—	—
4	32	1	43	6D	8F	09
5	0D	1	36	72	F0	1D
6	31	0	—	—	—	—
7	16	1	11	C2	DF	03
8	24	1	3A	00	51	89
9	2D	0	—	—	—	—
A	2D	1	93	15	DA	3B
B	0B	0	—	—	—	—
C	12	0	—	—	—	—
D	16	1	04	96	34	15
E	13	1	83	77	1B	D3
F	14	0	—	—	—	—

17 X

L1 cache

Block offset = 2 bits

set index = 4 bits

Tag = 6 bits

Show how the memory system described above translates a virtual address into a physical address and accesses the cache.

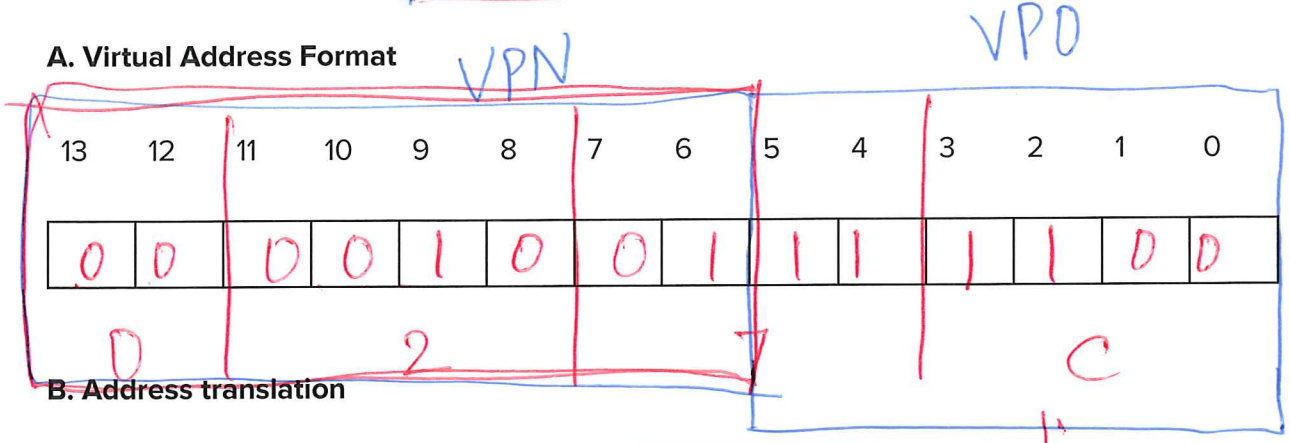
For the given virtual address, indicate the TLB entry accessed, the physical address, and the cache byte value returned. Indicate whether the TLB misses, whether a page fault occurs, and whether a cache miss occurs. If there is a cache miss, enter "–" for "Cache Byte returned." If there is a page fault, enter "–" for "PPN" and leave parts C and D blank.

VA = ~~0x272~~ 0x027C

PA = 0x5FC.

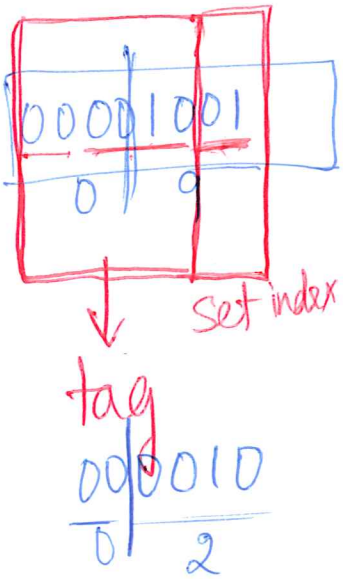
Given Virtual Address: **0x027c**

A. Virtual Address Format



B. Address translation

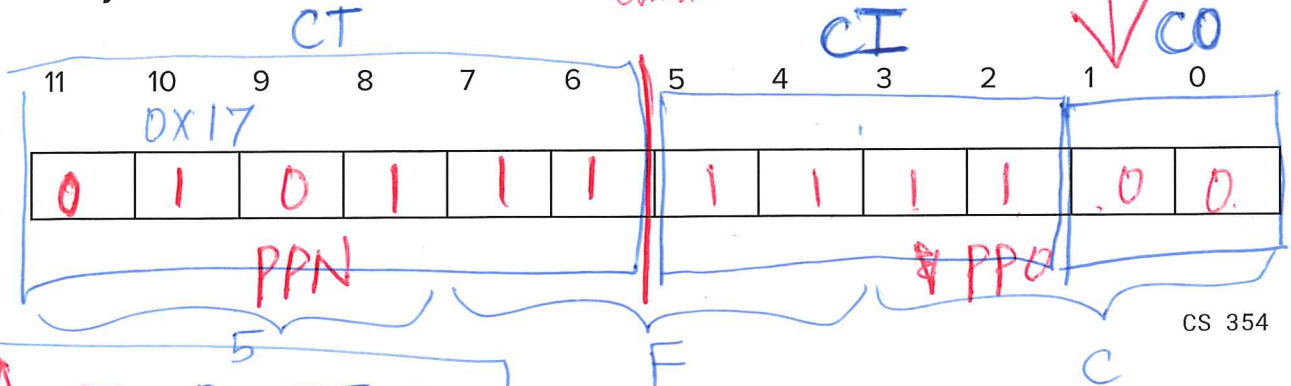
Parameter	Value
VPN	0x09
TLB Index	0x01 (00 0x1
TLB tag	0x02
TLB Hit? (Y/N)	N
Page Fault? (Y/N)	N
PPN	0x17



(PA) PPN + PPO = PA

combine

C. Physical Address Format



PA = 0x5FC

D. Physical Memory Reference

Parameter	Value
Byte Offset	0x00
Cache Index (Set)	0x0F
Cache tag	0x17
Cache Hit? (Y/N)	N
Cache byte returned	—