CS5541 – Computer Systems
Caches

1) Suppose we have a system with the following properties:
   The memory is byte-addressable
   Memory accesses are to 1-byte words (not 32-bit or 64-bit)
   Addresses are 12 bits wide.
   Cache organization: S=4, E=2, B=4

Cache contents (all addresses and tags are in hexadecimal):

Set index	Tag	Valid	Byte 0	Byte 1	Byte 2	Byte 3
0	00	1	40	41	42	43
	83	1	FE	97	CC	D0
1	00	1	44	45	46	47
	83	0	-	-	-	-
2	00	1	48	49	4A	4B
	40	0	-	-	-	-
3	FF	1	9A	C0	03	FF
	00	0	-	-	-	-

A) Label the following address (1 bit per box) with the following codes:

CI: Cache set index
CO: Cache block offset
CT: Cache tag

CT	CT	CT	CT	CT	CT	CT	CT	CI	CI	CO	CO
11	10	09	08	07	06	05	04	03	02	01	00

B) For each of the following addresses indicate if it will be a cache hit or miss. Carry out the following accesses in order as listed. Give the value of a read if it can be inferred from the information in the cache.

Operation	Address	Hit?	Read Value (or Unk)
Read	0x834	No	Unknown
Write	0x836	Yes	N/A
Read	0xFFD	Yes	C0

2) Suppose we have a system with the following properties:
The memory is byte-addressable
Memory accesses are to 1-byte words (not 32-bit or 64-bit)
Addresses are 13 bits wide.
Cache organization: S=8, E=4, B=4

Consider the following cache state. All tags and values are given in hexadecimal.

S	T	V	Bytes	T	V	Bytes	T	V	Bytes	T	V	Bytes
0	F0	1	ED 32 0A A2	8A	1	BF 80 1D FC	14	1	EF 09 86 2A	BC	0	25 44 6F 1A
1	BC	0	03 3E CD 38	A0	0	16 7B ED 5A	BC	1	8E 4C DF 18	E4	1	FB B7 12 02
2	BC	1	54 9E 1E FA	B6	1	DC 81 B2 14	00	0	B6 1F 7B 44	74	0	10 F5 B8 2E
3	BE	0	2F 7E 3D A8	C0	1	27 95 A4 74	C4	0	07 11 6B D8	BC	0	C7 B7 AF C2
4	7E	1	32 21 1C 2C	8A	1	22 C2 DC 34	BC	1	BA DD 37 D8	DC	0	E7 A2 39 BA
5	98	0	A9 76 2B EE	54	0	BC 91 D5 92	98	1	80 BA 9B F6	BC	1	48 16 81 0A
6	38	0	5D 4D F7 DA	BC	1	69 C2 8C 74	8A	1	A8 CE 7F DA	38	1	FA 93 EB 48
7	8A	1	04 2A 32 6A	9E	0	B1 86 56 0E	CC	1	96 30 47 F2	BC	1	F8 1D 42 30

A) What is the size of this cache in bytes?
128 bytes

B) Label the following address (1 bit per box) with the following codes:

CI: Cache set index
CO: Cache block offset
CT: Cache tag

CT	CT	CT	CT	CT	CT	CT	CT	CI	CI	CI	CO	CO
12	11	10	09	08	07	06	05	04	03	02	01	00

C) Suppose that a program references the 1-byte word at address 0x071A. Fill in the following table (if it is a miss, fill in N/A for "Cache byte returned"):

Parameter	Value
Block Offset (CO)	0x2
Set Index (CI)	0x6
Cache Tag (CT)	0x38
Cache hit? (Y/N)	Y
Cache byte returned	0xEB

D) Suppose that a program references the 1-byte word at address 0x16E8. Fill in the following table (if it is a miss, fill in N/A for “Cache byte returned”):

Parameter	Value
Block Offset (CO)	0x0
Set Index (CI)	0x2
Cache Tag (CT)	0xB7
Cache hit? (Y/N)	N
Cache byte returned	0x N/A