22C:060 Computer Organization

Sample solution: Assignment 4

Chapter 5, problem 11(a)

000-100	Address 1	Address 2
3	4	4

Encoding of 5 2-address instructions

101-111	0000-1110	Address 2
3	4	4

Encoding of (3x15) = 45 1-address instructions

101-111	1111	0000-1111
3	4	4

So we can have up to 3x16 = 48 0-address instructions (we need only 32)

Chapter 5, problem 13

Mode	**Value loaded into AC**
Immediate	1000
Direct	M[1000]=1400
Indirect	M[M[1000]]=1300
Indexed	M[1000+200] = 1000

Chapter 5, problem 18

Number of bits in the opcode = $\lceil \log_2 150 \rceil = 8$

Number of bits left for the address part = 24-8 = 16

Maximum allowable size of the memory = $2^{16} = 65,536$

Largest unsigned number that can be accommodated in one word of the memory = $2^{24} - 1$

Chapter 6, problem 1

(a) Number of blocks in the main memory $=2^{20} / 16 = 2^{16}$

(b)

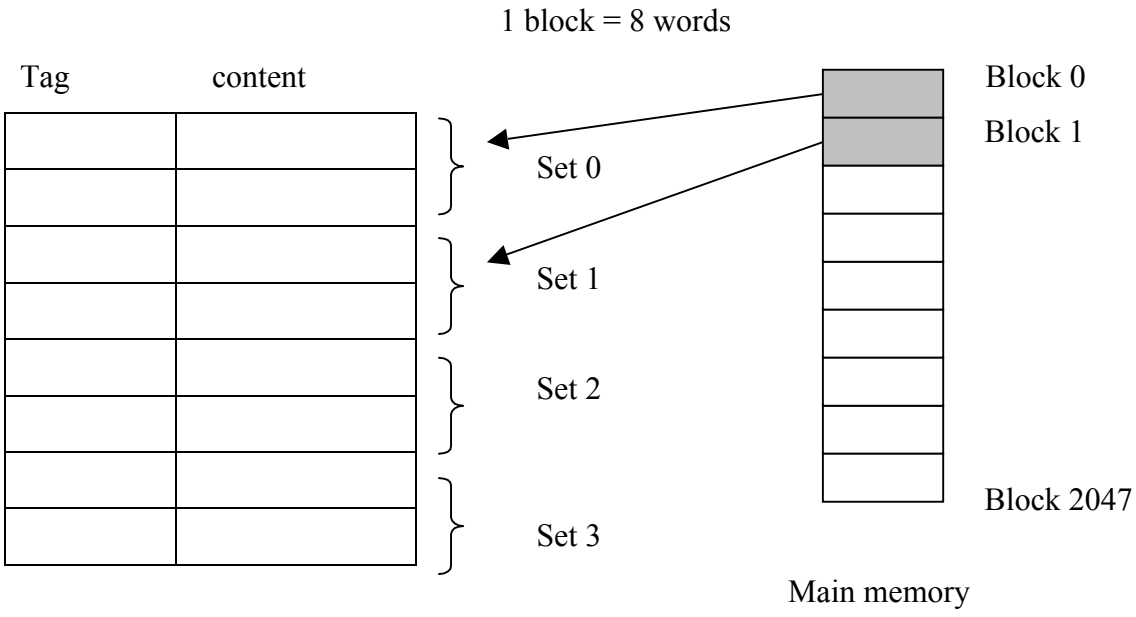
tag	block	word
11	5	4

(c)

0000 1011 101	1 0110	0011
tag	block	word

So, the block number is 10110.

Chapter 6, problem 6



(a) $2048 = 2^{11}$ blocks, and it contains $2^{14} = 16384$ so the address has 14 bits

tag	Set #	Word # in block
9	2	3

Address	M-block	C-block	Hit or miss
8-15	1	2	1 miss, then 7 hits
16-23	2	4	1 miss, then 7 hits
24-31	3	6	1 miss, then 7 hits
32-39	4	0	1 miss, then 7 hits
40-47	5	3	1 miss, then 7 hits
48-51	6	5	1 miss, then 3 hits

Initially, the cache contents are arbitrary. So the first access leads to a cache miss. After that, each M-block is mapped into a separate C-block, so there is no further conflict, and all the remaining accesses for the next two iterations will lead to a hit. Therefore the hit ratio is (38 + 44 + 44) / (44 + 44 + 44) = 95.5%