

1] (a) Main memory size = 8M

$$8M = 2^3 \times 2^{20} = 2^{23}$$

of bits needed = 23

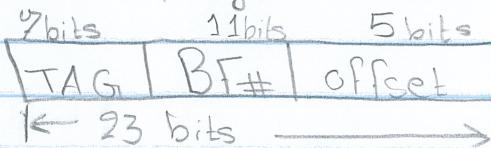
$$\text{Cache size} = 2^6 \times 2^6 = 2^{12} \text{ words}$$

$$\text{Block size} = 2^5 = 32 \text{ words}$$

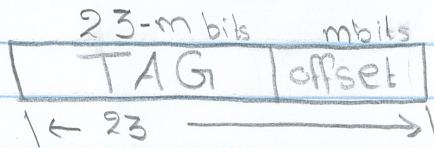
$$\text{\# of BF's in cache} = \frac{\text{Cache size}}{\text{Block size}} = \frac{2^{12}}{2^5} = 2^7$$

offset = 5

Direct Mapping Format:



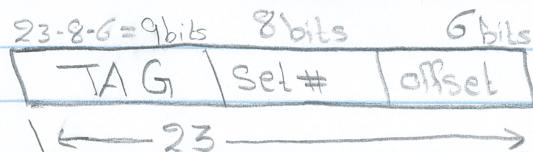
(b) BS = 2^m , offset = m



(c) BS = 64 = 2^6 , offset = 6

Set size = 4

$$\text{\# of sets} = \frac{\text{\# of BF's}}{\text{Set size}} = \frac{2^{10}}{4} = 2^8$$



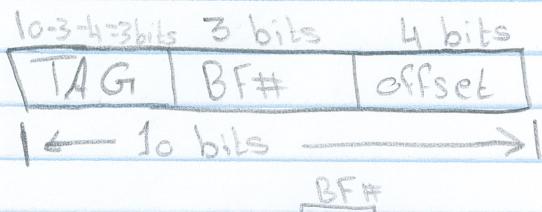
$$27 \quad BS = 16 \text{ words} = 2^4, \text{ offset} = 4$$

Main memory size = $64 = 2^6$ blocks = $16 * 64 = 1024$ words

Cache size = 8 blocks = $16 * 8 = 128$ words

Policy: Direct Mapping

$$(a) \# \text{ of BF's} = \frac{2^4}{2^4} = 2^3$$



$$(b) 0x307A = \underbrace{110}_{\text{TAG}} \underbrace{111}_{\text{BF#}} \underbrace{010}_{\text{offset}}$$

Yes, Since the TAG_i value (110) matches with the BF# (111) in the cache directory.

$$(c) 0x22C = \underbrace{1000}_{\text{TAG}} \underbrace{101}_{\text{BF#}} \underbrace{100}_{\text{offset}}$$

Yes, Since the TAG_i value (100) matches with the BF# (010) in the Cache directory.

$$(d) 0x1B9 = \underbrace{110}_{\text{TAG}} \underbrace{111}_{\text{BF#}} \underbrace{001}_{\text{offset}}$$

No, Since the TAG_i value (011) doesn't match with the BF# (011) in the Cache directory.

3] $B \cdot S = 2^4$ words, offset = 4

Mem size = 2^{10} words

CS = 2^7 words

Set size = 2

Policy: Set associative

$$(a) \# \text{ of BT's} = \frac{2^7}{2^4} = 2^3$$

$$\# \text{ of sets} = \frac{2^3}{2^1} = 2^2$$

4 bits	2 bits	4 bits
TAG	set #	offset

$$(b) 0x37A = \underbrace{1101}_{\text{TAG}} \underbrace{111010}_{\substack{\text{set \#} \\ \text{offset}}}$$

Yes, Since the TAG value matches the set # in the cache directory.

$$(c) 0x22C = \underbrace{1000}_{\text{TAG}} \underbrace{101100}_{\substack{\text{set \#} \\ \text{offset}}}$$

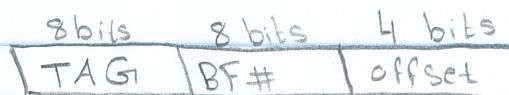
Yes, Since the TAG value matches the set # in the cache directory.

$$(d) 0x1B9 = \underbrace{0110}_{\text{TAG}} \underbrace{111001}_{\substack{\text{set \#} \\ \text{offset}}}$$

Yes, Since the TAG value matches the set # in the cache directory.

4] Mem Size = $2^0 \times 2^{20} = 2^{20}$
 $C.S = 2^2 \times 2^{10} = 2^{12}$
 $B.S = 2^4$ words, offset = 4

(a) # of BF's = $\frac{2^{12}}{2^4} = 2^8$

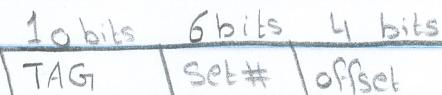


$0x949DA = \underbrace{1001}_{TAG} \underbrace{0100}_{BF\#} \underbrace{1001}_{offset} \underbrace{1101}_{BF\#} \underbrace{1010}_{offset}$

- The Cache frame should be: 10011101
- To get a hit TAG should be: 10010100

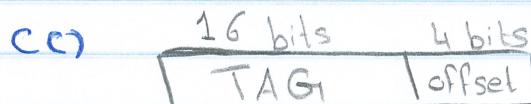
(b) ~~2^6~~ = # of sets

SS = 4



$0x949DA = \underbrace{1001}_{TAG} \underbrace{0100}_{Set\#} \underbrace{1001}_{offset} \underbrace{1101}_{Set\#} \underbrace{1010}_{offset}$

- it maps to set # 29
- There are 10 bits in each cache TAG
- $1001010010 = 0x252$



$1001010010011101 = 0x949D$

5] mem Size = $2^5 \cdot 2^{10} = 2^{15}$ words

$$C.S = 2^2 \cdot 2^{10} = 2^{12}$$
 words

$$B.S = 2^3$$
 words, offset = 3

$$\text{Policy: Fully Associative, BF\#} = \frac{2^{12}}{2^3} = 2^9$$

(a) # of HC needed = # of BFs in cache

$$\# \text{ of BFs} = \frac{2^{12}}{2^3} = 2^9$$

of HC need = 512

(b) size of TAG field = $15 - 3 = \boxed{12}$

(c) # of HC = 1

$$\text{TAG size} = 15 - 9 - 3 = \boxed{3}$$

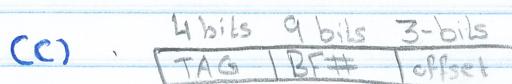
6] mem size = $2^3 \cdot 2^{10} = 2^{13}$ blocks = $2^{13} \cdot 2^3 = 2^{16}$ words

$$C.S = 2^9$$
 blocks = $2^9 \cdot 2^3 = 2^{12}$ words

$$B.S = 2^3$$
, offset = 3, BF # = 2^9

(a) There are 16-bits

(b) $0xCA49 = 1100 \underbrace{1010}_{\text{Set\#}} \underbrace{0100}_{\text{BF\#}} \underbrace{1001}_{\text{offset}}$
The offset bits = 001

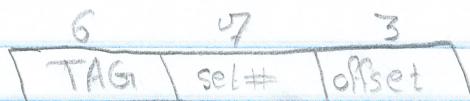


$$101001001_2 = 329_{10}$$

$$\text{width of HC} = \text{size of TAG} = 16 - 9 - 3 = \boxed{4}$$

$$\# \text{ of H.C} = 1$$

(d) S.S = 4, Set# = $\frac{2^9}{2^2} = 2^4$



$$\text{Set\#} = 1001001 = 73_{10}$$

$$\text{width} = \text{size of TAG} = 16 - 7 - 3 = \boxed{6}, \# \text{ of H.C} = \boxed{4} = \text{Set size}$$