Bilkent University
CS 224 - Section 1 - Preliminary Report - Lab 6

Mehmet Akif Şahin - 22203673

29 April 2024

Problem 1

No.	Cache Size (KB)	N Way Cache	Word Size in Bits	Block Size (no. of words)	No. of Sets	Tag Size in Bits	Index Size (Set No.) in bits	Word Block Offset Size in Bits	Byte Offset Size in bits	Block Replacement Policy Needed (Yes/No)
1	128	1	32	4	2^{13}	15	13	2	2	No
2	128	4	32	16	2^{9}	17	9	4	2	Yes
3	128	Full	32	16	1	26	0	4	2	Yes
4	256	2	64	8	2^{11}	15	11	3	3	Yes
5	256	4	64	32	2^{8}	16	8	5	3	Yes
6	256	Full	16	16	1	27	0	4	1	Yes

Problem 2

Memory Address Accessed (hex)	Set No.	Hit (Yes/No)
00 00 20 24	0	No
00 00 20 42	0	No
00 00 20 68	1	No
00 00 20 04	0	No
00 00 20 0C	1	No
00 00 20 4C	1	No

Problem 3

Memory Address Accessed (hex)	Set No.	Hit (Yes/No)
00 00 00 2C	1	No
00 00 00 48	1	No
00 00 00 44	0	No
00 00 00 0C	1	No
00 00 00 04	0	No
00 00 00 0C	1	Yes

Problem 4

a) Physical memory size is 4 GB's so $log_2(4 \cdot 2^{30}) = 32$ bits of address is minimum.

- Words contain 2 bytes so $log_2(2) = 1$ bit is required for addressing bytes.
- Blocks contain 32 words so $log_2(32) = 5$ bits are required to determine blocks.
- This is a 2-set cache so $log_2(2) = 1$ bit is required for selecting set.
- Rest $32 - 1 - 5 - 1 = 25$ bits are tag bits.

So the address structure is:

$$\text{tag (25 bit)} — \text{set (1 bit)} — \text{block (5 bit)} — \text{byte (1 bit)}$$

b) Size of a block in terms of bits is 542 bits.

- 64 bytes per block $64 \cdot 8 = 512$ bits are data.
- 25 tag bits.
- 1 dirty bit.
- 1 valid bit.
- $log_2(8\ sets) = 3$ age bits for LRU block replacement.

c) Set size is 4336 bits, SRAM size is 8672 bits.

- $8\frac{blocks}{set} \cdot 542\frac{bits}{block} = 4336\frac{bits}{set}$
- $2\ sets \cdot 4336\frac{bits}{set} = 8672\ bits$ total

d) If random replacement is used then there will be no age bits used in blocks.

$$3\frac{bits}{block} \cdot 8\frac{blocks}{set} \cdot 2\ sets = 48\ bits$$

The SRAM would be 48 bits smaller if random replacement is used.