CS698L Assignment-1

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September 9, 2019

Problem 1

$$t + s + b = 32$$

$b = 6$ because block size is 64B

Here B(block size) is 64B and C(cache size) is 256KB and we use A as an acronym for associativity. Total number of lines are $\frac{C}{B}$, and $s = \log_2(\frac{C}{B \times A})$.

(i) direct-mapped

Here A is 1

(a) 2^{12}

(b) $b = 6$

(c) $s = 12$

(d) $t = 14$

(ii) 4-way set-associative

Here A is 4

(a) 2^{12}

(b) $b = 6$

(c) $s = 10$

(d) $t = 16$

(iii) fully-associative

Here A is $\frac{C}{B}$

(a) 2^{12}

(b) $b = 6$

(c) $s = 0$

(d) $t = 26$

Problem 2

$$\text{Total Size of Cache} = 256KB$$

$$\text{Total Size of A} = 128KB$$

Stride = 1

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{8} = 2^{12}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{12}$$

Stride = 4

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{4 \times 2} = 2^{12}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{12}$$

Stride = 16

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{16 \times 1} = 2^{11}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{11}$$

Stride = 32

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{32 \times 1} = 2^{10}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{10}$$

Stride = 2K

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{2^{11} \times 1} = 2^{4}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{4}$$

Stride = 8K

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{2^{13} \times 1} = 2^{2}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{2}$$

Stride = 32K

For $it = 0$ the number of misses will be $\frac{32 \times 2^{10}}{2^{15} \times 1} = 2^{0}$ and for the rest of the iterations all the data will be in the cache.

$$\text{Total Number of Misses} = 2^{0}$$

Problem 3

$$\text{Total Size of Cache} = 64K\ Words$$

$$\text{Block Size} = 8\ Words \Rightarrow B = 8$$

$$\text{Total Size of Arrays} = 512 \times 512\ Words \Rightarrow N = 512$$

ijk Form

Direct Mapped

	A	B	C
i	N	N	N
k	$\frac{N}{B}$	N	1
j	1	$\frac{N}{B}$	$\frac{N}{B}$

Fully Associative

	A	B	C
i	N	N	N
k	$\frac{N}{B}$	N	1
j	1	$\frac{N}{B}$	$\frac{N}{B}$

Table 1: ijk Form

Direct Mapped	Fully Associative
• $Miss[i][B] = N$ because total number of cache lines are less than the amount required to fill all the rows in the cache. • $Miss[k][C] = 1$ because total number of cache lines across all the sets are large enough to store all the elements of a row.	• $Miss[i][B] = N$ because total number of cache lines are less than the amount required to fill all the rows in the cache. • $Miss[k][C] = 1$ because total number of cache lines in the single set are large enough to store all the elements of a row.

jik Form

Direct Mapped

	A	B	C
j	N	N	N
i	N	N	N
k	$\frac{N}{B}$	N	1

Fully Associative

	A	B	C
j	N	$\frac{N}{B}$	$\frac{N}{B}$
i	N	1	N
k	$\frac{N}{B}$	N	1

Table 2: jik Form

Direct Mapped	Fully Associative
• $Miss[i][B] = N$ and $Miss[j][B] = N$ because total number of rows that can fit in the cache are 128 which is less than 512 so the data of initial rows will be overwritten(example: B[0] will be overwritten by B[128]). • $Miss[j][A] = N$ because total number of cache lines are less than the amount required to fill all the rows in the cache.	• $Miss[i][B] = 1$ and $Miss[j][B] = \frac{N}{B}$ because the cache is fully associative so all the rows can stay together in the single set without overwriting each other, until the next set of columns are fetched. • $Miss[j][C] = \frac{N}{B}$ because the cache is fully associative so all the rows from i^{th} loop can stay together in the single set without overwriting each other, until the next set of columns are fetched.

Problem 4

Total Size of Cache = $16MB$

Block Size = $32B \Rightarrow B = 32$

Total Size of Arrays = 4096×4096 $Words \Rightarrow N = 4096 \times 8$

	A	X
k	N	N
j	N	$\frac{N}{B}$
i	N	1

- $Miss[j][A] = N$ and $Miss[k][A] = N$ because after every 512 iterations a new row will overwrite the previous row present in the cache(example: A[0] will be overwritten by A[512]).