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Section 6
Lab 6

Cache Statistics

The experiment uses Mars' (version 4.5) Data Cache Simulation Tool.

The array sizes to be used will be:

1. 8x8
2. 10x10

The cache statistics (hit and miss rates) will be calculated for the following:

1. Row Major Summation
2. Column Major Summation

Stats for the two array sizes will be observed consecutively and recorded in table.

2B. a) Direct Mapped Caches

8x8 matrix (auto-initialized)

Memory Access Count: 320

Row-Major Sum Table:

	Block Size(words)				
Cache Size(bytes)	2	4	8	16	32
128	Miss Rate: 22% No. Misses: 72	Miss Rate: 12% No. Misses: 40	Miss Rate: 7% No. Misses:23	Miss Rate: 6% No. Misses: 18	Miss Rate: 7% No. Misses: 22
256	Miss Rate: 22% No. Misses: 71	Miss Rate: 12% No. Misses: 39	Miss Rate: 7% No. Misses:22	Miss Rate: 5% No. Misses: 15	Miss Rate: 5% No. Misses: 15
512	Miss Rate: 21% No. Misses: 68	Miss Rate: 12% No. Misses:37	Miss Rate: 7% No. Misses: 21	Miss Rate: 4% No. Misses: 14	Miss Rate: 4% No. Misses: 14
1024	Miss Rate: 21% No. Misses: 67	Miss Rate: 11% No. Misses:37	Miss Rate: 6% No. Misses: 20	Miss Rate: 3% No. Misses: 11	Miss Rate: 2% No. Misses: 7
2048	Miss Rate: 21% No. Misses: 67	Miss Rate: 11% No. Misses:36	Miss Rate: 6% No. Misses: 20	Miss Rate: 3% No. Misses: 11	Miss Rate: 2% No. Misses: 7

Column-Major Sum Table:

Memory Access Count: 326

	Block Size(words)				
Cache Size(bytes)	2	4	8	16	32
128	Miss Rate: 32% No. Misses: 105	Miss Rate: 28% No. Misses: 91	Miss Rate: 26% No. Misses: 85	Miss Rate: 15% No. Misses: 49	Miss Rate: 10% No. Misses: 31
256	Miss Rate: 23% No. Misses: 74	Miss Rate: 14% No. Misses: 46	Miss Rate: 11% No. Misses:36	Miss Rate: 9% No. Misses: 28	Miss Rate: 7% No. Misses: 24
512	Miss Rate: 22% No. Misses: 71	Miss Rate: =13% No. Misses:44	Miss Rate: 11% No. Misses: 35	Miss Rate: 8% No. Misses: 27	Miss Rate: 7% No. Misses: 23
1024	Miss Rate: 21% No. Misses: 67	Miss Rate: 11% No. Misses: 36	Miss Rate: 6% No. Misses: 20	Miss Rate: 4% No. Misses: 12	Miss Rate: 2% No. Misses: 8
2048	Miss Rate: 21% No. Misses: 67	Miss Rate: 11% No. Misses: 36	Miss Rate: 6% No. Misses: 20	Miss Rate: 4% No. Misses: 12	Miss Rate: 2% No. Misses: 8

10x10 matrix (auto-initialized)

Row-Major Sum Table

Memory Access Count: 360

Block Size(words)

Cache Size	2	4	8	16	32
128	Miss Rate: 25% No. Misses: 91	Miss Rate: 14% No. Misses: 52	Miss Rate: 9% No. Misses: 32	Miss Rate: 7% No. Misses: 25	Miss Rate: 8% No. Misses: 29
256	Miss Rate: 25% No. Misses: 90	Miss Rate: 14% No. Misses: 51	Miss Rate: 8% No. Misses: 30	Miss Rate: 6% No. Misses: 21	Miss Rate: 7% No. Misses: 26
512	Miss Rate: 24% No. Misses: 86	Miss Rate: 13% No. Misses: 46	Miss Rate: 7% No. Misses: 26	Miss Rate: 5% No. Misses: 17	Miss Rate: 5% No. Misses: 17
1024	Miss Rate: 24% No. Misses: 86	Miss Rate: 12% No. Misses:45	Miss Rate: 7% No. Misses: 25	Miss Rate: 4% No. Misses: 14	Miss Rate: 2% No. Misses: 9
2048	Miss Rate: 24% No. Misses:86	Miss Rate: 12% No. Misses: 45	Miss Rate: 7% No. Misses: 25	Miss Rate: 4% No. Misses: 14	Miss Rate: 2% No. Misses: 9

Column-Major Sum Table

Memory Access Count: 366

Block Size(words)

Cache Size	2	4	8	16	32
128	Miss Rate: 27% No. Misses: 98	Miss Rate: 27% No. Misses: 98	Miss Rate: 34% No. Misses: 123	Miss Rate: 23% No. Misses: 83	Miss Rate: 14% No. Misses: 51
256	Miss Rate: 26% No. Misses: 95	Miss Rate: 17% No. Misses: 64	Miss Rate: 24% No. Misses: 87	Miss Rate: 19% No. Misses: 68	Miss Rate: 12% No. Misses: 45
512	Miss Rate: 24% No. Misses: 91	Miss Rate: =14% No. Misses: 53	Miss Rate: 11% No. Misses: 40	Miss Rate: 9% No. Misses: 34	Miss Rate: 8% No. Misses: 30
1024	Miss Rate: 23% No. Misses: 85	Miss Rate: 12% No. Misses: 45	Miss Rate: 7% No. Misses: 25	Miss Rate: 4% No. Misses: 15	Miss Rate: 3% No. Misses: 10
2048	Miss Rate: 23% No. Misses: 85	Miss Rate: 12% No. Misses: 45	Miss Rate: 7% No. Misses: 25	Miss Rate: 4% No. Misses: 15	Miss Rate: 3% No. Misses: 10

Note: Each different colored line denotes cache miss rates for different sized caches, b denotes bytes.

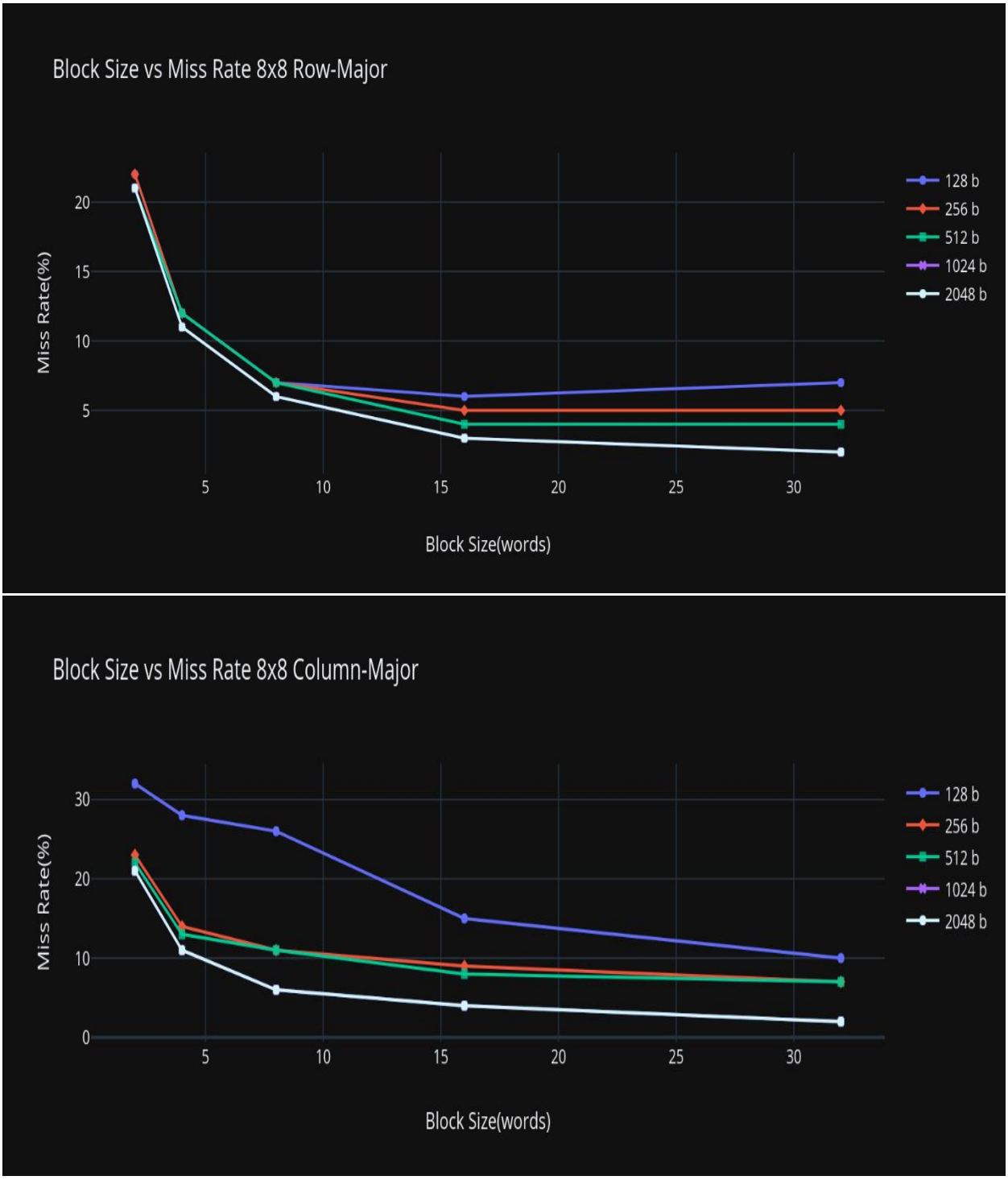
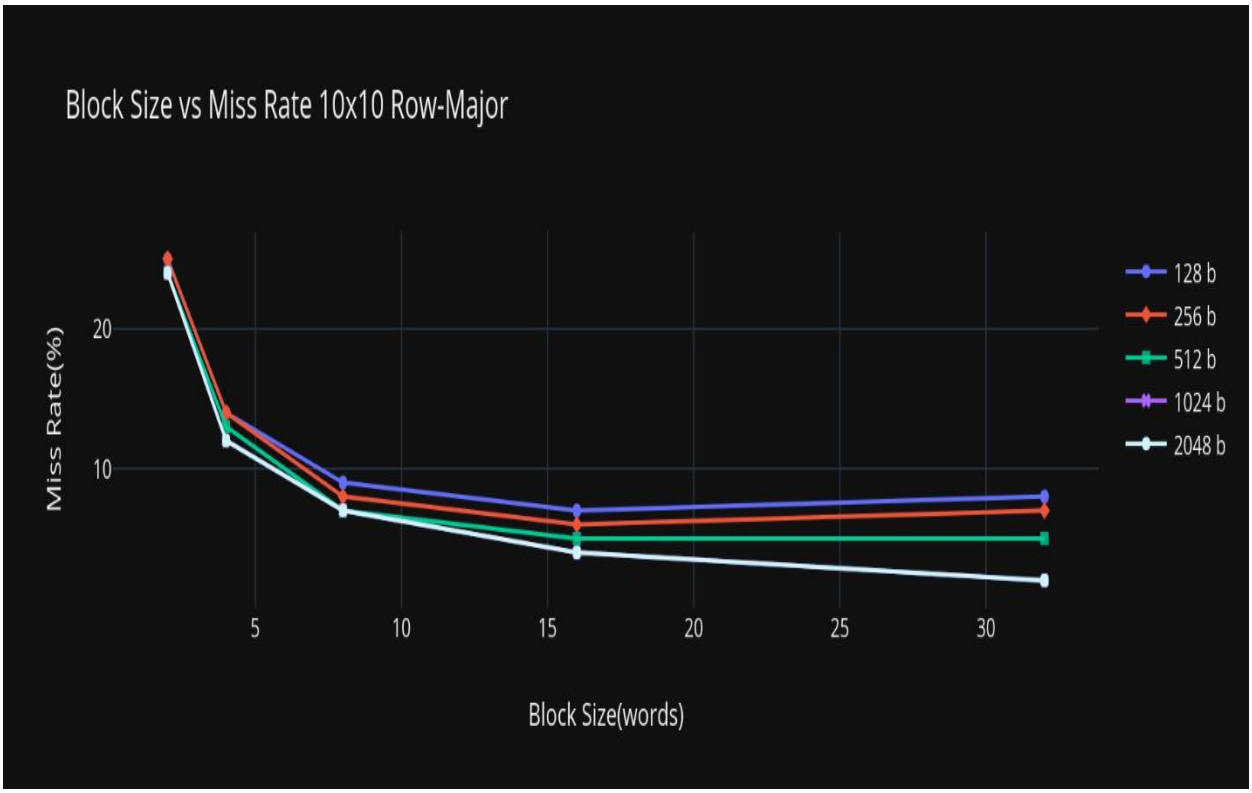


Fig 1. Cache Statistics for 8x8 Matrix



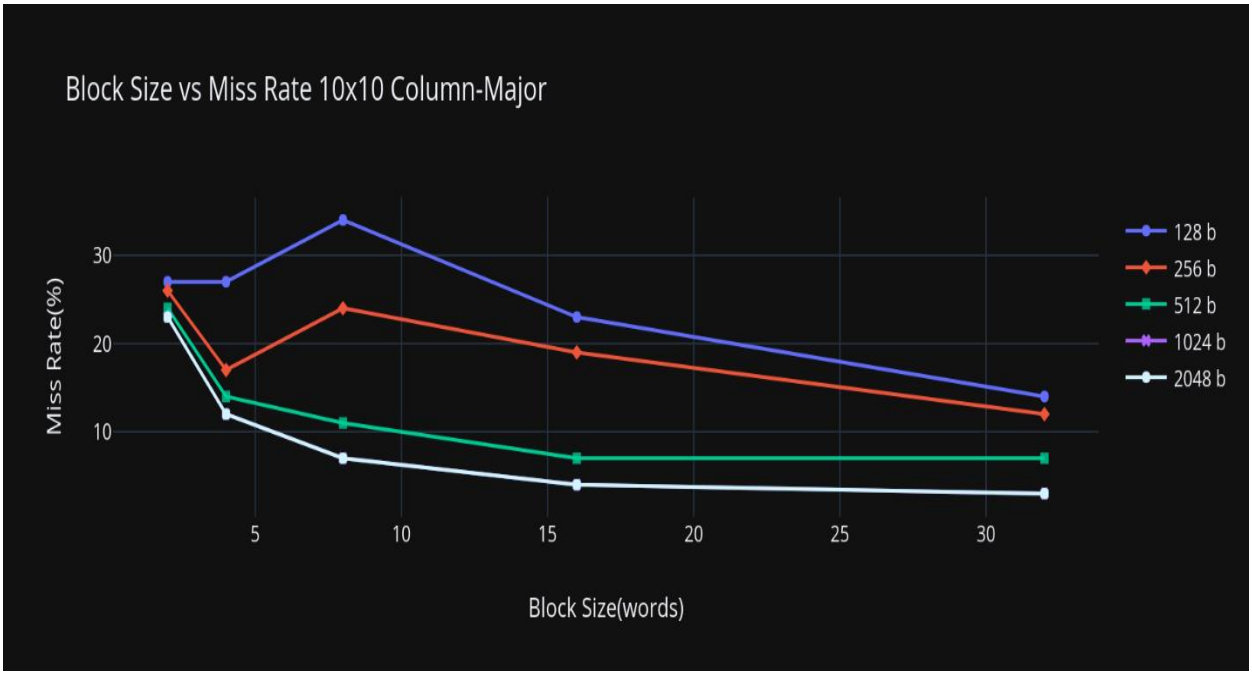


Fig 2. Cache Statistics for 10x10 Matrix

2B. b) Fully Associative Caches

It is observed that points on the:

128-byte cache have bad hit rates

256-byte cache have medium hit rates

1024-byte cache have good hit rates

From each of these parameter lines, 3 configuration pairs will be chosen

8x8 matrix

Column-Major Stats:

Bad Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(128,8)	(128,16)	(128,32)
Direct Mapped	26%	15%	10%
Fully Associative LRU	26%	15%	10%
Fully Associative Random	29%	15%	9%

Medium Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(256,8)	(256,16)	(256,32)
Direct Mapped	11%	9%	7%
Fully Associative LRU	26%	15%	10%
Fully Associative Random	24%	15%	10%

Good Hit Rate:

(cache size(bytes) , Block Size(words))

Policy	(1024,8)	(1024,16)	(1024,32)
Direct Mapped	6%	4%	2%
Fully Associative LRU	6%	4%	2%
Fully Associative Random	5%	4%	2%

Row-Major Stats:

Bad Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(128,8)	(128,16)	(128,32)
Direct Mapped	7%	6%	7%
Fully Associative LRU	7%	4%	7%
Fully Associative Random	7%	5%	7%

Medium Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(256,8)	(256,16)	(256,32)
Direct Mapped	7%	5%	5%
Fully Associative LRU	7%	4%	2%
Fully Associative Random	7%	4%	4%

Good Hit Rate:

(cache size(bytes) , Block Size(words))

Policy	(1024,8)	(1024,16)	(1024,32)
Direct Mapped	6%	3%	2%
Fully Associative LRU	6%	3%	2%
Fully Associative Random	5%	3%	2%

10x10 matrix

Column-Major Stats:

Bad Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(128,8)	(128,16)	(128,32)
Direct Mapped	34%	23%	14%
Fully Associative LRU	34%	23%	14%
Fully Associative Random	34%	23%	14%

Medium Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(256,8)	(256,16)	(256,32)
Direct Mapped	24%	19%	12%
Fully Associative LRU	34%	23%	14%
Fully Associative Random	23%	19%	12%

Good Hit Rate:

(cache size(bytes) , Block Size(words))

Policy	(1024,8)	(1024,16)	(1024,32)
Direct Mapped	7%	4%	3%
Fully Associative LRU	7%	4%	3%
Fully Associative Random	7%	4%	3%

Row-Major Stats:

Bad Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(128,8)	(128,16)	(128,32)
Direct Mapped	9%	7%	8%
Fully Associative LRU	7%	6%	8%
Fully Associative Random	8%	7%	8%

Medium Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(256,8)	(256,16)	(256,32)
Direct Mapped	8%	6%	7%
Fully Associative LRU	7%	4%	4%
Fully Associative Random	8%	5%	6%

Good Hit Rate:

(Cache Size(bytes) , Block Size(words))

Policy	(1024,8)	(1024,16)	(1024,32)
Direct Mapped	7%	4%	2%
Fully Associative LRU	7%	4%	2%
Fully Associative Random	7%	4%	3%

2B c) Fully Associative Caches

8x8 matrix

Column-Major Stats:

Point on Mid Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(256,8)
1(best)	11% 36
2	13% 43
4	17% 57
8	26% 85

Point on Good Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(1024,32)
1(best)	2% 8
2	2% 8
4	2% 8
8	2% 8

Point on Bad Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(128,8)
1(best)	26% 85
2	26% 85
4	26% 85
8	-

Row-Major Stats:

Point on Mid Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(256,8)
1 (best)	7% 22
2	7% 22
4	7% 22
8	7% 22

Point on Good Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(1024,32)
1 (best)	2% 7
2	2% 7
4	2% 7
8	2% 7

Point on Bad Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(128,8)
1 (best)	7% 22
2	7% 22
4	7% 22
8	-

10x10 matrix

Column-Major Stats:

Point on Mid Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(256,8)
1(best)	24% 87
2	25% 90
4	31% 113
8	34% 123

Point on Good Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(1024,32)
1(best)	3% 10
2	3% 10
4	3% 10
8	3% 10

Point on Bad Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(128,8)
1(best)	34% 123
2	34% 123
4	34% 123
8	-

Row-Major Stats:

Point on Mid Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(256,8)
1	8% 30
2	7% 27
4	7% 27
8 (best)	7% 27

Point on Good Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(1024,32)
1 (best)	2% 7
2	2% 7
4	2% 9
8	2% 9

Point on Bad Hit-Rate:

	Cache Size(byte), Block Size(word)
Associativity (No. of Ways)	(128,8)
1	9% 32
2	7% 27
4 (best)	7% 27
8	-