CS224

Section No.: 02

Spring 2021

Lab No.: 6

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Experiments with Data Cache Parameters

Report for Matrix Size 50

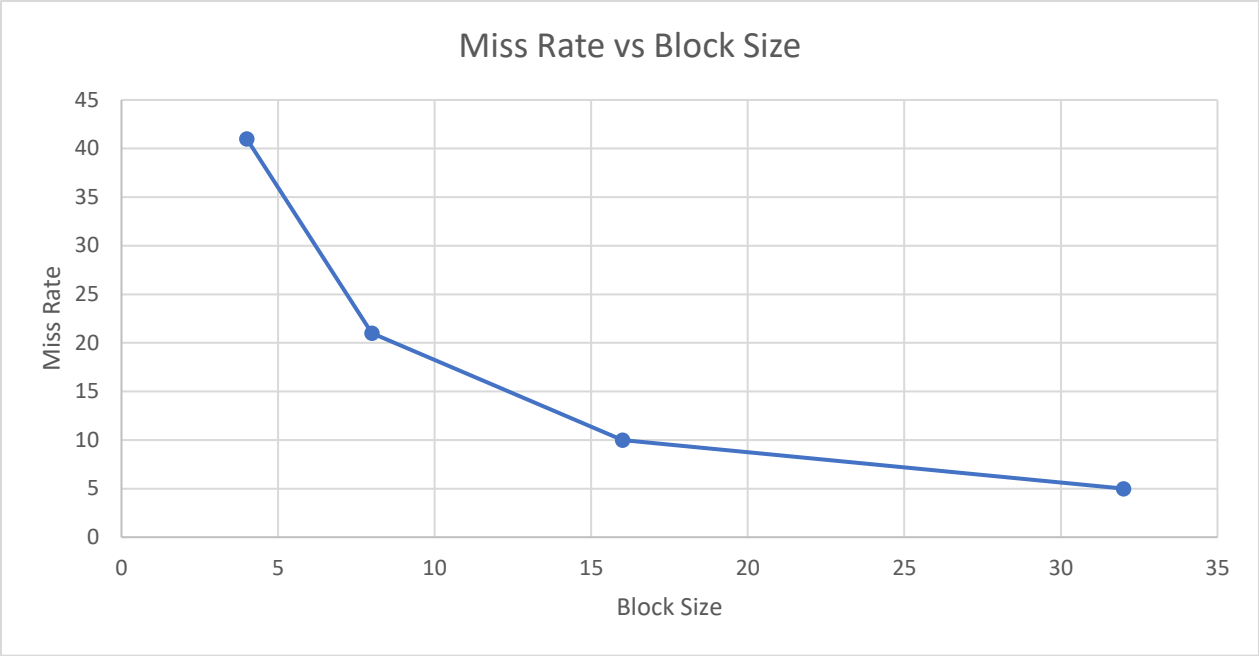
a)

Block Size / Cache Size	2	4	8	16	32
128	Miss Rate: 41% Number of misses: 2687	Miss Rate: 21% Number of misses: 1345	Miss Rate: 10% Number of misses: 674	Miss Rate: 5% Number of misses: 340	Miss Rate: 3% Number of misses: 172
256	Miss Rate: 41% Number of misses: 2687	Miss Rate: 21% Number of misses: 1345	Miss Rate: 10% Number of misses: 674	Miss Rate: 5% Number of misses: 340	Miss Rate: 3% Number of misses: 172
512	Miss Rate: 41% Number of misses: 2687	Miss Rate: 21% Number of misses: 1345	Miss Rate: 10% Number of misses: 674	Miss Rate: 5% Number of misses: 340	Miss Rate: 3% Number of misses: 172
1024	Miss Rate: 41% Number of misses: 2687	Miss Rate: 21% Number of misses: 1345	Miss Rate: 10% Number of misses: 674	Miss Rate: 5% Number of misses: 340	Miss Rate: 3% Number of misses: 172
2048	Miss Rate: 41% Number of misses: 2687	Miss Rate: 21% Number of misses: 1345	Miss Rate: 10% Number of misses: 674	Miss Rate: 5% Number of misses: 340	Miss Rate: 3% Number of misses: 172

Table 1.1: Table for row-major averaging

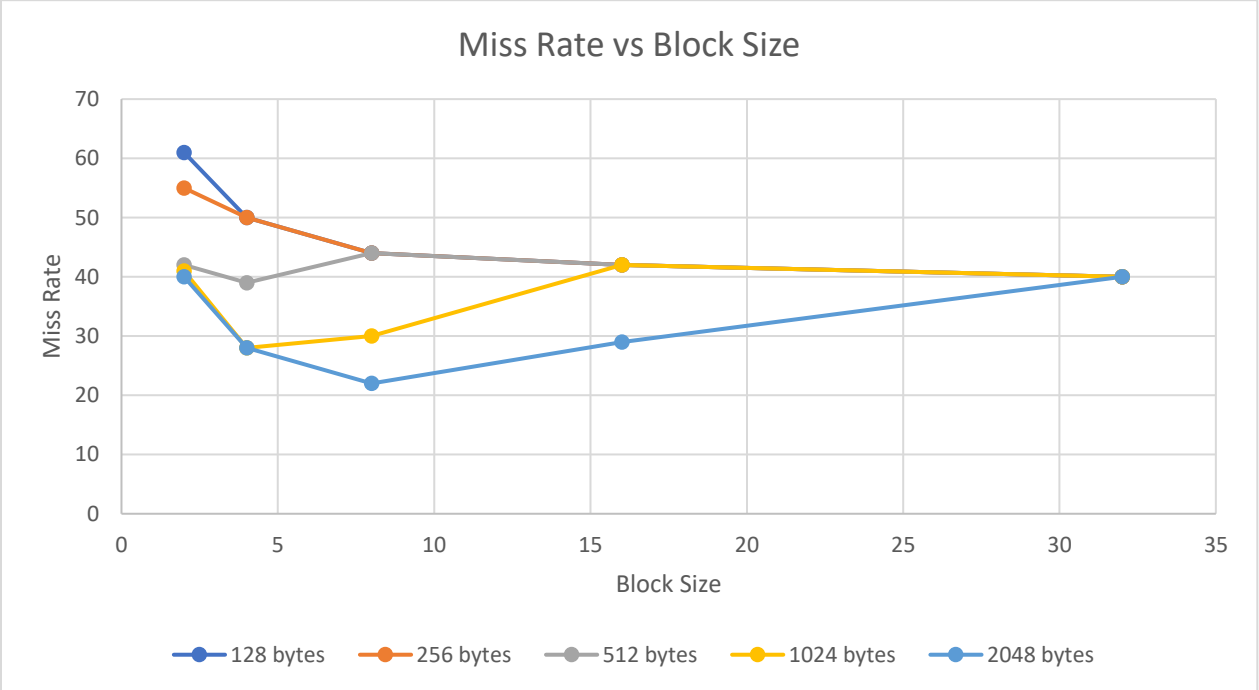
Block Size / Cache Size	2	4	8	16	32
128	Miss Rate: 61% Number of misses: 3988	Miss Rate: 50% Number of misses: 3271	Miss Rate: 44% Number of misses: 2912	Miss Rate: 42% Number of misses: 2733	Miss Rate: 40% Number of misses: 2643
256	Miss Rate: 55% Number of misses: 3649	Miss Rate: 50% Number of misses: 3271	Miss Rate: 44% Number of misses: 2912	Miss Rate: 42% Number of misses: 2733	Miss Rate: 40% Number of misses: 2643
512	Miss Rate: 42% Number of misses: 2745	Miss Rate: 39% Number of misses: 2561	Miss Rate: 44% Number of misses: 2912	Miss Rate: 42% Number of misses: 2733	Miss Rate: 40% Number of misses: 2643
1024	Miss Rate: 41% Number of misses: 2709	Miss Rate: 28% Number of misses: 1869	Miss Rate: 30% Number of misses: 1971	Miss Rate: 42% Number of misses: 2733	Miss Rate: 40% Number of misses: 2643
2048	Miss Rate: 40% Number of misses: 2658	Miss Rate: 28% Number of misses: 1823	Miss Rate: 22% Number of misses: 1429	Miss Rate: 29% Number of misses: 1883	Miss Rate: 40% Number of misses: 2643

Table1.2: Table for column-major averaging



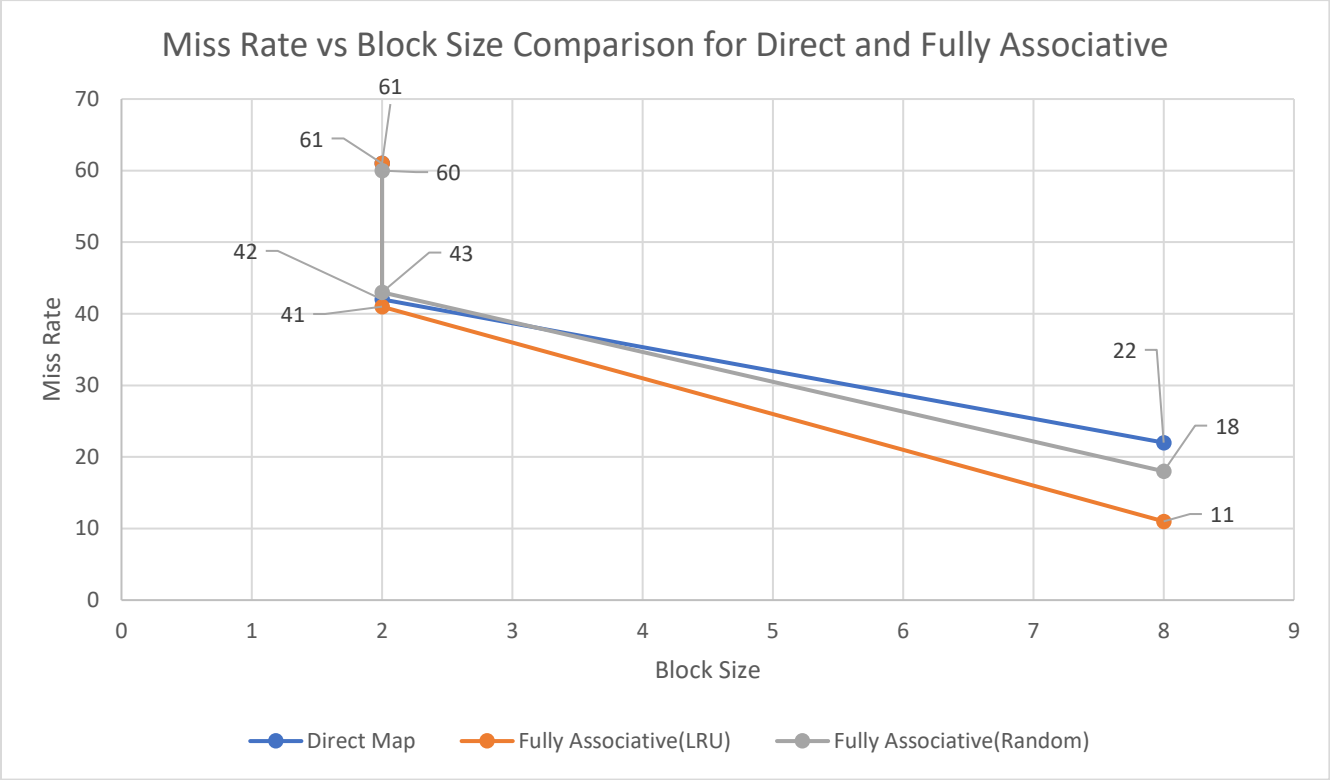
Graph for row-major averaging with matrix size of 50

- All cache sizes have the same miss rate vs block size graph for row-major averaging



Graph for column-major averaging with matrix size of 50

b)



- **Fully associative with Replacement Policy LRU:** For bad and medium parameter points it nearly makes no difference compare to direct mapping. However, for good parameter point miss rates decrease from 21% to %11.

- **Fully associative with Random Replacement Policy:** For bad parameter point it makes 1% decrease on miss rate, however for medium parameter poiint it makes 1% decrease. Moreover, for good paramter point miss rate decreases from 22% to 18%.

c)

N-way Set Associative Cache Set Size	Hit Rate (Medium) Block Size: 2 Cache Size: 512 bytes	Hit Rate (Poor) Block Size: 2 Cache Size: 128 bytes	Hit Rate (Good) Block Size: 8 Cache Size: 2048 bytes
2	hit rate: 58% miss rate: 42% number of misses: 2744	hit rate: 39% miss rate: 61% number of misses: 3988	hit rate: 85% miss rate: 15% number of misses: 957
4	hit rate: 59% miss rate: 41% number of misses: 2706	hit rate: 39% miss rate: 61% number of misses: 3988	hit rate: 88% miss rate: 12% number of misses: 777
8	hit rate: 59% miss rate: 41% number of misses: 2688	hit rate: 39% miss rate: 61% number of misses: 3988	hit rate: 89% miss rate: 11% number of misses: 712
16	hit rate: 59% miss rate: 41% number of misses: 2688	hit rate: 39% miss rate: 61% number of misses: 3988	hit rate: 89% miss rate: 11% number of misses: 712

Table1.3: Table for N-way Set Associative Cache

What set size gives the best result?

- It can be clearly seen that for higher degree of set sizes, miss rate decreases. However, after a certain degree, increasing set size makes no difference. For example, for medium and good hit rates set sizes of 8 and 16 give the same results. On the other hand, for poor hit rate all of the set sizes give the same result

How much improvement is gained as N increases each step?

- For medium hit rate %1 improvement is gained while poor hit rates gained 0% improvement. However, good hit rate gained 11% improvement compare to Direct mapping.

Report for Matrix Size 100

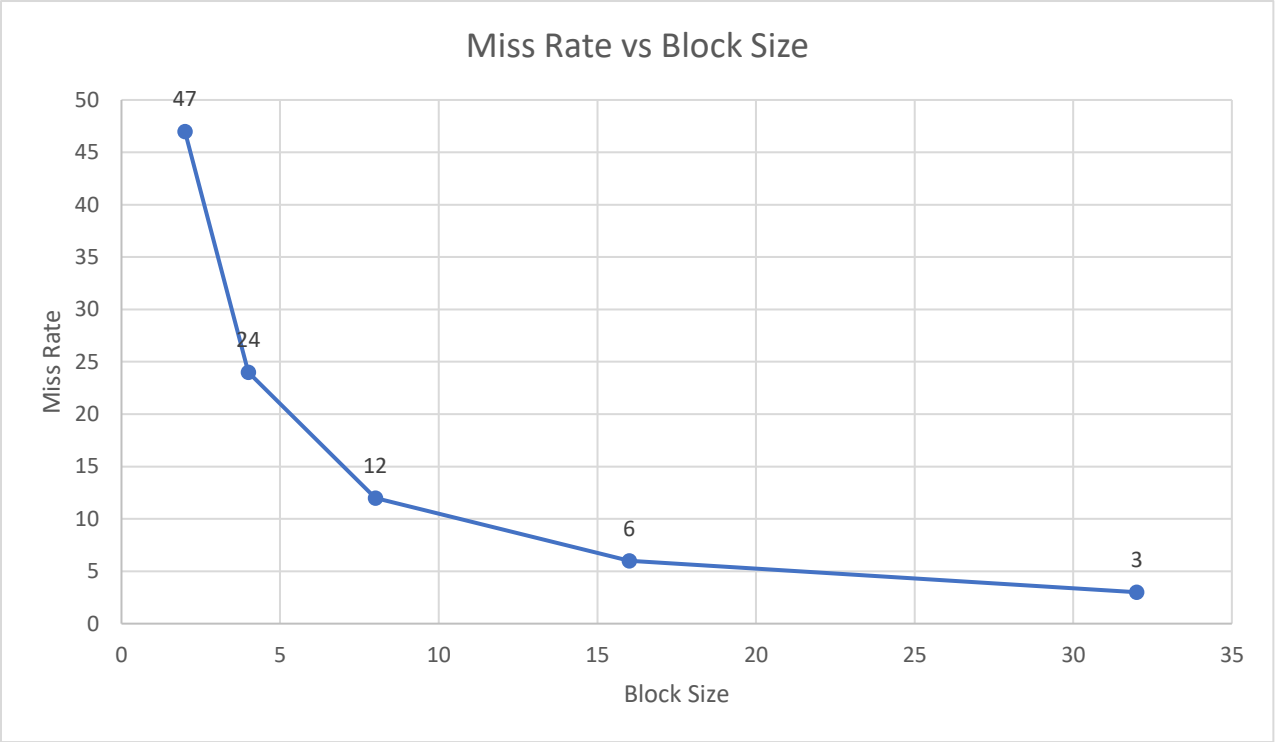
a)

Block Size / Cache Size	2	4	8	16	32
128	Miss Rate: 47% Number of misses: 10187	Miss Rate: 24% Number of misses: 5095	Miss Rate: 12% Number of misses: 2548	Miss Rate: 6% Number of misses: 1276	Miss Rate: 3% Number of misses: 640
256	Miss Rate: 47% Number of misses: 10187	Miss Rate: 24% Number of misses: 5095	Miss Rate: 12% Number of misses: 2548	Miss Rate: 6% Number of misses: 1276	Miss Rate: 3% Number of misses: 640
512	Miss Rate: 47% Number of misses: 10187	Miss Rate: 24% Number of misses: 5095	Miss Rate: 12% Number of misses: 2548	Miss Rate: 6% Number of misses: 1276	Miss Rate: 3% Number of misses: 640
1024	Miss Rate: 47% Number of misses: 10187	Miss Rate: 24% Number of misses: 5095	Miss Rate: 12% Number of misses: 2548	Miss Rate: 6% Number of misses: 1276	Miss Rate: 3% Number of misses: 640
2048	Miss Rate: 47% Number of misses: 10187	Miss Rate: 24% Number of misses: 5095	Miss Rate: 12% Number of misses: 2548	Miss Rate: 6% Number of misses: 1276	Miss Rate: 3% Number of misses: 640

Table 2.1: Table for row-major averaging

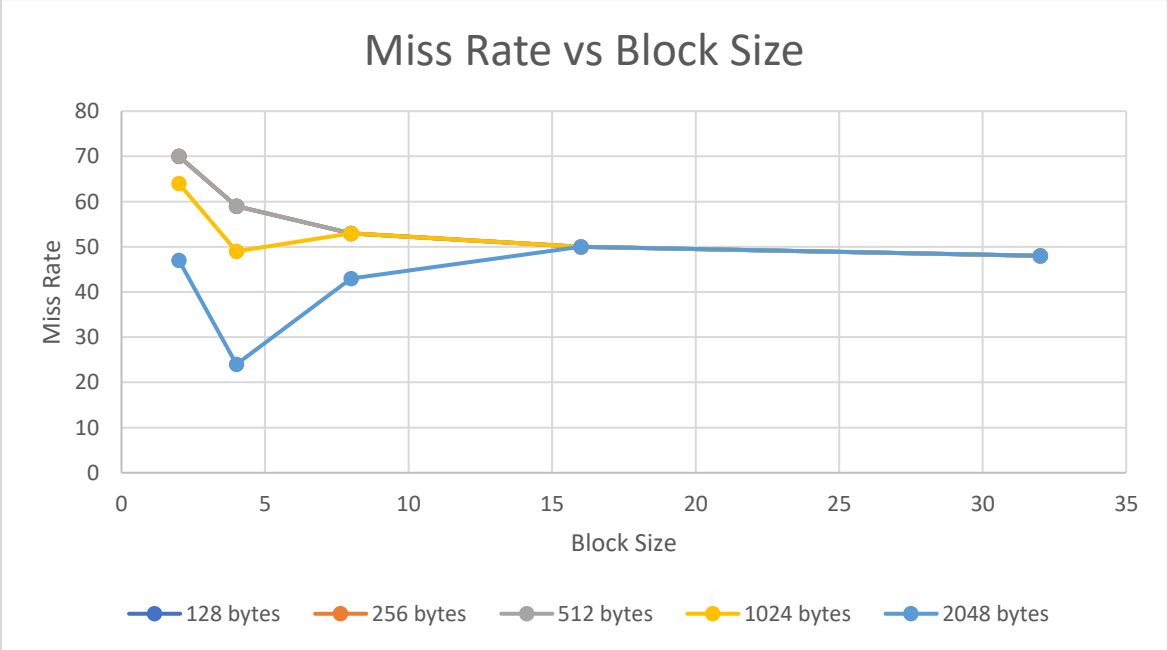
Block Size / Cache Size	2	4	8	16	32
128	Miss Rate: 70% Number of misses: 15238	Miss Rate: 59% Number of misses: 12696	Miss Rate: 53% Number of misses: 11399	Miss Rate: 50% Number of misses: 10751	Miss Rate: 48% Number of misses: 10427
256	Miss Rate: 70% Number of misses: 15238	Miss Rate: 59% Number of misses: 12696	Miss Rate: 53% Number of misses: 11399	Miss Rate: 50% Number of misses: 10751	Miss Rate: 48% Number of misses: 10427
512	Miss Rate: 70% Number of misses: 15238	Miss Rate: 59% Number of misses: 12696	Miss Rate: 53% Number of misses: 11399	Miss Rate: 50% Number of misses: 10751	Miss Rate: 48% Number of misses: 10427
1024	Miss Rate: 64% Number of misses: 13849	Miss Rate: 49% Number of misses: 10629	Miss Rate: 53% Number of misses: 11399	Miss Rate: 50% Number of misses: 10751	Miss Rate: 48% Number of misses: 10427
2048	Miss Rate: 47% Number of misses: 10237	Miss Rate: 24% Number of misses: 5225	Miss Rate: 43% Number of misses: 9335	Miss Rate: 50% Number of misses: 10751	Miss Rate: 48% Number of misses: 10427

Table2.2: Table for column-major averaging



Graph for row-major averaging with matrix size of 100

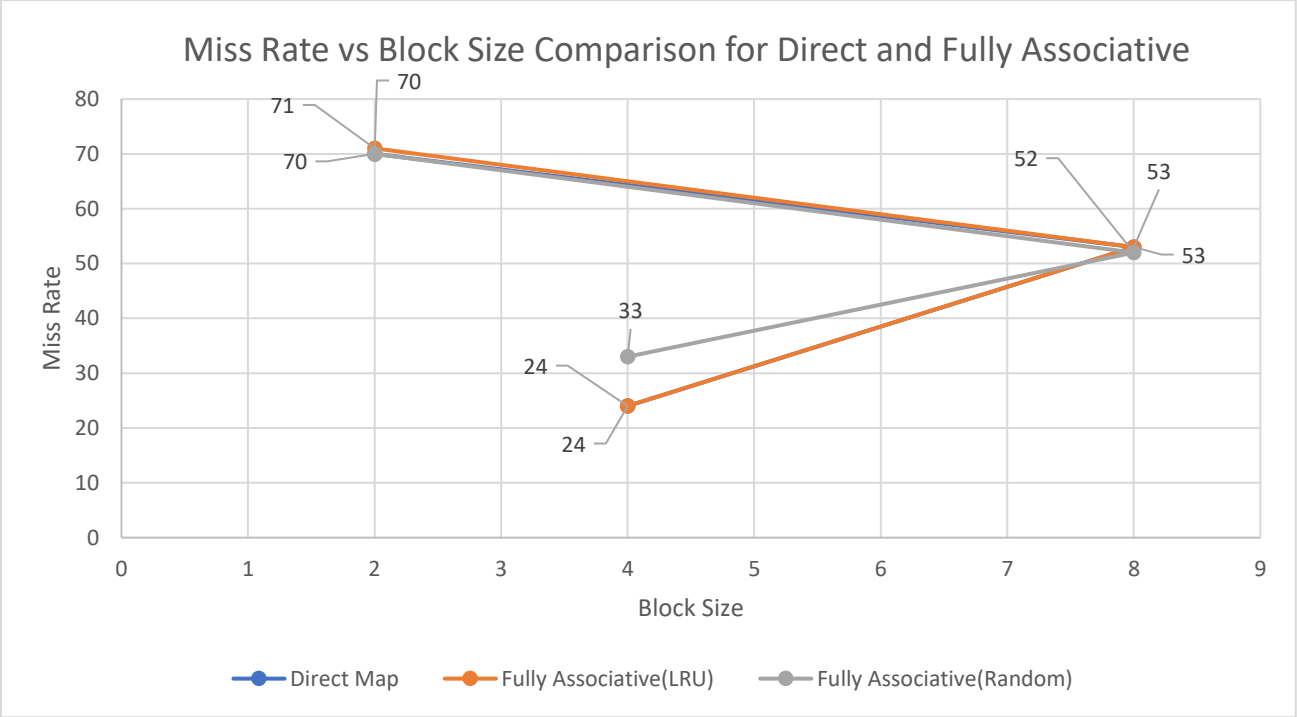
- All cache sizes have the same miss rate vs block size graph for row-major averaging



Graph for column-major averaging with matrix size of 100

- 128 bytes and 256 bytes' lines can not be seen since 512 bytes line is same with them and overlaps to them.

b)



- **Fully associative with Replacement Policy LRU:** Nearly nothing has change except 1% increase on miss rate for bad parameter point.

- **Fully associative with Random Replacement Policy:** Bad parameter point has not change. Medium parameter point's miss rate has decreased 1% percent. On the other hand, good parameter point's miss rate has increased 9% percent.

p.s.: Direct Map's line can not be seen, since Fully associative(LRU) and Fully associative(Random) overlaps with its values.. Moreover, from the graph it can be interpreted that Full Associative caches are not efficient on decreasing the miss rates, since most of the miss rates have not change and some of them has increased.

c)

N-way Set Associative Cache Set Size	Hit Rate (Medium) Block Size: 8 Cache Size: 512 bytes	Hit Rate (Poor) Block Size: 2 Cache Size: 128 bytes	Hit Rate (Good) Block Size: 4 Cache Size: 2048 bytes
2	hit rate: 47% miss rate: 53% number of misses: 11399	hit rate: 30% miss rate: 70% number of misses: 15238	hit rate: 76% miss rate: 24% number of misses: 5235
4	hit rate: 47% miss rate: 53% number of misses: 11399	hit rate: 30% miss rate: 70% number of misses: 15238	hit rate: 76% miss rate: 24% number of misses: 5144
8	hit rate: 47% miss rate: 53% number of misses: 11399	hit rate: 30% miss rate: 70% number of misses: 15238	hit rate: 76% miss rate: 24% number of misses: 5096
16	hit rate: 47% miss rate: 53% number of misses: 11399	hit rate: 29% miss rate: 71% number of misses: 15288	hit rate: 76% miss rate: 24% number of misses: 5096

Table2.3: Table for N-way Set Associative Cache

What set size gives the best result?

- For poor hit rate there is not most efficient set size, however, set size of 16 has increased the miss rate 1%. On the other hand for good hit rate, both set size of 8 and 16 have given the least number of misses. For medium hit rate nothing has changed.

How much improvement is gained as N increases each step?

- For size of 100, N-way set associative cache did not give as effficient results as size of 50's results did. For both poor and medium hit rates any positive improvement con not be gained. However, for good hit rate number of misses has decreased from 5144 to 5096, although this is not very significant improvement.