Cache Simulator Project Report

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• A brief description of the implementation of the simulator

This cache simulator is to simulate set associative caches with different replacement policy. This simulator reads memory one by one, and simulates their accesses to cache. The simulator would take command-line parameter of memory trace file name, with optional choice of cache line size, cache size, associativity, and replacement policy including LRU, Second Chance, FIFO and LIFO, then read these memory addresses line by line and simulate their accesses to cache. By default, this simulator is configured with an LRU write-back cache of 1 MB with 16-ways. The parser.py handles reading in cache sequence from the file. The sim.py is the main program reads optional configuration and take the tag bits from sequence, determine if cache hit or cache miss in cache.py, with different kind of replacement policy.

• A description of your experiments and the experiment results with figures and/or tables

We extensively tested our cache implementation with many different parameters. The testing serves both as a comparison between different caching techniques and as a sanity check on the correctness of our implementation. The testing simulates the memory accesses from many memory traces obtained, some obtained from real applications while others are synthetic. We test different cache sizes, cache line sizes, n-way associativity and replacement policies.

1KB_64B: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
32 KB	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
256 KB	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
1 MB	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
4 MB	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%

1KB_64B: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
64 Bytes	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
128 Bytes	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
512 Bytes	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%
1024 Bytes	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%	3.12%

4MB_4: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%
32 KB	6.25%	6.25%	6.25%	6.23%	6.25%	6.25%	6.25%	6.23%	6.25%	6.25%	6.25%	6.22%	6.25%	6.25%	6.25%	6.22%
256 KB	6.25%	6.25%	6.25%	6.12%	6.25%	6.25%	6.25%	6.05%	6.25%	6.25%	6.25%	6.02%	6.25%	6.25%	6.25%	6.01%
1 MB	6.25%	6.25%	6.25%	5.73%	6.25%	6.25%	6.25%	5.47%	6.25%	6.25%	6.25%	5.34%	6.25%	6.25%	6.25%	5.27%
4 MB	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%

4MB_4: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	25.0%	25.0%	25.0%	22.92%	25.0%	25.0%	25.0%	21.88%	25.0%	25.0%	25.0%	21.35%	25.0%	25.0%	25.0%	21.09%
64 Bytes	6.25%	6.25%	6.25%	5.73%	6.25%	6.25%	6.25%	5.47%	6.25%	6.25%	6.25%	5.34%	6.25%	6.25%	6.25%	5.27%
128 Bytes	3.12%	3.12%	3.12%	2.86%	3.12%	3.12%	3.12%	2.73%	3.12%	3.12%	3.12%	2.67%	3.12%	3.12%	3.12%	2.64%
512 Bytes	0.78%	0.78%	0.78%	0.72%	0.78%	0.78%	0.78%	0.68%	0.78%	0.78%	0.78%	0.67%	0.78%	0.78%	0.78%	0.66%
1024 Bytes	0.39%	0.39%	0.39%	0.36%	0.39%	0.39%	0.39%	0.34%	0.39%	0.39%	0.39%	0.33%	0.39%	0.39%	0.39%	0.33%

32MB_4B: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%
32 KB	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%
256 KB	6.25%	6.25%	6.25%	6.23%	6.25%	6.25%	6.25%	6.23%	6.25%	6.25%	6.25%	6.22%	6.25%	6.25%	6.25%	6.22%
1 MB	6.25%	6.25%	6.25%	6.18%	6.25%	6.25%	6.25%	6.15%	6.25%	6.25%	6.25%	6.14%	6.25%	6.25%	6.25%	6.13%
4 MB	6.25%	6.25%	6.25%	5.99%	6.25%	6.25%	6.25%	5.86%	6.25%	6.25%	6.25%	5.79%	6.25%	6.25%	6.25%	5.76%

32MB_4B: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	25.0%	25.0%	25.0%	24.74%	25.0%	25.0%	25.0%	24.61%	25.0%	25.0%	25.0%	24.54%	25.0%	25.0%	25.0%	24.51%
64 Bytes	6.25%	6.25%	6.25%	6.18%	6.25%	6.25%	6.25%	6.15%	6.25%	6.25%	6.25%	6.14%	6.25%	6.25%	6.25%	6.13%
128 Bytes	3.12%	3.12%	3.12%	3.09%	3.12%	3.12%	3.12%	3.08%	3.12%	3.12%	3.12%	3.07%	3.12%	3.12%	3.12%	3.06%
512 Bytes	0.78%	0.78%	0.78%	0.77%	0.78%	0.78%	0.78%	0.77%	0.78%	0.78%	0.78%	0.77%	0.78%	0.78%	0.78%	0.77%
1024 Bytes	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.38%	0.39%	0.39%	0.39%	0.38%	0.39%	0.39%	0.39%	0.38%

bw_mem: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%
32 KB	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%
256 KB	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.57%	1.56%	1.57%	1.57%	1.57%	1.56%
1 MB	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%
4 MB	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%

bw_mem.traces: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%	6.25%
64 Bytes	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%	1.56%
128 Bytes	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%	0.78%
512 Bytes	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
1024 Bytes	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

ls: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	17.3%	18.43%	18.43%	28.8%	16.25%	16.93%	17.38%	37.46%	15.97%	16.52%	17.25%	50.3%	16.18%	16.71%	17.18%	62.8%
32 KB	2.52%	2.66%	2.66%	4.33%	2.24%	2.34%	2.43%	4.4%	2.19%	2.28%	2.41%	5.41%	2.17%	2.22%	2.39%	7.09%
256 KB	1.65%	1.69%	1.69%	1.75%	1.61%	1.63%	1.63%	1.74%	1.6%	1.61%	1.62%	1.86%	1.59%	1.61%	1.61%	1.85%
1 MB	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%
4 MB	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%

ls.traces: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%
64 Bytes	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%	1.59%
128 Bytes	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
512 Bytes	0.28%	0.28%	0.28%	0.28%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%	0.27%
1024 Bytes	0.16%	0.16%	0.16%	0.17%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%	0.16%

gcc: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	13.15%	13.9%	13.9%	25.43%	11.94%	12.6%	13.06%	35.67%	11.46%	12.02%	12.74%	47.78%	11.34%	11.87%	12.83%	60.61%
32 KB	2.06%	2.16%	2.16%	3.15%	1.94%	2.02%	2.08%	3.8%	1.91%	1.97%	2.07%	5.91%	1.89%	1.93%	2.04%	7.93%
256 KB	1.34%	1.36%	1.36%	1.4%	1.31%	1.33%	1.34%	1.4%	1.3%	1.32%	1.32%	1.47%	1.29%	1.31%	1.32%	1.54%
1 MB	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%
4 MB	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%

gcc.traces: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%	4.6%
64 Bytes	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%	1.29%
128 Bytes	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%
512 Bytes	0.22%	0.22%	0.22%	0.23%	0.21%	0.22%	0.22%	0.22%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%	0.21%
1024 Bytes	0.13%	0.13%	0.13%	0.16%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%

native_dgemm: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	56.44%	58.75%	58.75%	61.55%	56.44%	56.45%	58.0%	66.69%	56.44%	56.44%	56.44%	77.21%	56.44%	56.44%	56.44%	99.31%
32 KB	50.27%	50.27%	50.27%	49.23%	50.27%	50.27%	50.27%	48.61%	50.27%	50.27%	50.27%	48.5%	50.27%	50.27%	50.27%	49.15%
256 KB	50.25%	50.26%	50.26%	38.36%	50.25%	50.25%	50.25%	32.24%	50.25%	50.25%	50.25%	29.2%	50.25%	50.25%	50.25%	27.72%
1 MB	0.87%	0.88%	0.88%	0.93%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
4 MB	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%

native_dgemm.traces: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	3.48%	3.51%	3.51%	3.54%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%	3.48%
64 Bytes	0.87%	0.88%	0.88%	0.93%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%	0.87%
128 Bytes	0.43%	0.44%	0.44%	0.49%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%	0.43%
512 Bytes	0.11%	0.11%	0.11%	0.16%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%	0.11%
1024 Bytes	0.05%	0.06%	0.06%	0.11%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%

native_dgemm_full: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	55.48%	57.74%	57.74%	60.82%	55.47%	55.48%	57.0%	66.15%	55.47%	55.47%	55.47%	76.81%	55.47%	55.47%	55.47%	98.12%
32 KB	49.4%	49.4%	49.4%	49.56%	49.4%	49.4%	49.4%	49.73%	49.4%	49.4%	49.4%	50.06%	49.39%	49.4%	49.4%	51.1%
256 KB	49.38%	49.38%	49.38%	49.4%	49.38%	49.38%	49.38%	49.4%	49.37%	49.38%	49.38%	49.43%	49.37%	49.37%	49.37%	49.49%
1 MB	0.13%	0.15%	0.15%	0.64%	0.13%	0.15%	0.17%	24.95%	0.13%	0.15%	0.17%	25.6%	0.13%	0.15%	0.17%	21.0%
4 MB	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%	0.08%

native_dgemm_full: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	0.5%	0.6%	0.6%	1.11%	0.51%	0.6%	0.69%	23.76%	0.51%	0.6%	0.68%	23.95%	0.51%	0.6%	0.67%	19.78%
64 Bytes	0.13%	0.15%	0.15%	0.64%	0.13%	0.15%	0.17%	24.95%	0.13%	0.15%	0.17%	25.6%	0.13%	0.15%	0.17%	21%
128 Bytes	0.06%	0.08%	0.08%	0.57%	0.06%	0.08%	0.09%	25.86%	0.07%	0.08%	0.09%	26.85%	0.07%	0.08%	0.09%	21.99%
512 Bytes	0.02%	0.02%	0.02%	0.55%	0.02%	0.02%	0.02%	29.23%	0.02%	0.02%	0.02%	30.8%	0.02%	0.02%	0.02%	25.35%
1024 Bytes	0.01%	0.01%	0.01%	0.58%	0.01%	0.01%	0.01%	30.68%	0.01%	0.01%	0.01%	32.66%	0.01%	0.01%	0.01%	27.68%

openblas_dgemm: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	62.75%	62.84%	62.84%	67.19%	61.72%	61.8%	61.85%	79.71%	61.76%	61.85%	61.95%	81.49%	61.78%	61.8%	61.93%	83.08%
32 KB	18.43%	19.45%	19.45%	17.94%	13.44%	21.47%	22.2%	19.81%	16.33%	23.11%	23.16%	16.2%	22.13%	25.05%	25.01%	14.38%
256 KB	8.34%	9.12%	9.12%	7.75%	8.3%	8.39%	9.08%	7.43%	8.3%	8.37%	9.06%	7.71%	8.3%	8.35%	9.1%	7.98%
1 MB	4.03%	4.08%	4.08%	3.38%	5.17%	4.95%	5.04%	3.41%	6.57%	6.19%	6.34%	3.32%	8.06%	7.97%	8.01%	3.13%
4 MB	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%

openblas_dgemm: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	7.39%	7.54%	7.54%	6.61%	8.93%	8.76%	9.0%	6.35%	10.54%	10.15%	10.43%	6.17%	14.06%	13.52%	13.78%	6.09%
64 Bytes	4.03%	4.08%	4.08%	3.38%	5.17%	4.95%	5.04%	3.41%	6.57%	6.19%	6.34%	3.32%	8.06%	7.91%	8.01%	3.13%
128 Bytes	2.03%	2.05%	2.05%	1.71%	2.61%	2.49%	2.54%	1.73%	3.31%	3.11%3	3.19%	1.69%	4.04%	3.96%	4.01%	1.6%
512 Bytes	0.54%	0.53%	0.53%	0.46%	0.68%	0.65%	0.66%	0.48%	0.86%	0.8%	0.82%	0.49%	1.02%	1.0%	1.02%	0.49%
1024 Bytes	0.28%	0.28%	0.28%	0.24%	0.36%	0.36%	034%	0.27%	0.45%	0.45%	0.42%	0.28%	0.52%	0.51%	0.52%	0.3%

openblas_dgemm_full: (line size=64B)

Cache size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
1 KB	51.49%	51.66%	51.66%	56.7%	50.65%	50.75%	50.88%	68.36%	50.39%	50.48%	50.64%	72.74%	50.41%	50.43%	50.63%	75.65%
32 KB	15.52%	16.39%	16.39%	26.03%	11.58%	18.05%	18.58%	30.88%	13.83%	19.21%	19.33%	33.95%	18.42%	20.76%	20.83%	38.64%
256 KB	7.54%	8.17%	8.17%	9.36%	7.5%	7.53%	8.13%	11.09%	7.5%	7.51%	8.13%	14.38%	7.5%	7.51%	8.15%	25.99%
1 MB	3.02%	3.15%	3.15%	7.92%	4.26%	4.16%	4.32%	8.35%	5.66%	5.41%	5.71%	9.3%	7.2%	6.83%	7.11%	11.02%
4 MB	0.88%	0.93%	0.93%	1.4%	0.94%	0.94%	0.93%	2.17%	0.96%	0.95%	0.97%	7.7%	0.98%	0.96%	0.98%	8.12%

openblas_dgemm_full: (cache size=1MB)

Line size	2-ways				4-ways				8-ways				16-ways			
	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO	LRU	SC	FIFO	LIFO
16 Bytes	6.98%	7.29%	7.29%	17.52%	8.69%	8.7%	9.0%	18.15%	10.48%	10.46%	10.79%	19.67%	13.71%	13.64%	13.98%	22.24%
64 Bytes	3.02%	3.15%	3.15%	7.92%	4.26%	4.16%	4.32%	8.35%	5.66%	5.41%	5.71%	9.3%	7.2%	6.83%	7.11%	11.08%
128 Bytes	1.53%	1.59%	1.59%	4.02%	2.15%	2.09%	2.18%	4.28%	2.86%	2.72%	2.87%	4.85%	3.61%	3.42%	3.56%	3.91%
512 Bytes	0.4%	0.42%	0.42%	1.17%	0.57%	0.55%	0.57%	1.35%	0.76%	0.71%	0.75%	1.7%	0.93%	0.87%	0.92%	2.37%
1024 Bytes	0.22%	0.22%	0.22%	0.72%	0.3%	0.29%	0.3%	0.9%	0.41%	0.37%	0.4%	1.27%	0.48%	0.45%	0.48%	1.96%

• Individual contribution summary

Many thanks to Bilal contributed the key part of the simulator program, including implements different types of replacement policies and the structure of cache. Zhongxiu handled the parsing sequence from file, tested the correctness of program and did the experiments for all memory trace files. Trung Dinh built shell, tested program and corrected results in experiments for all line size cases that are less than 1MB.