

Programming Project 1

Part 1. Direct-mapped cache

Given a cache size of 32KB, Cache Block size or (Cache line size) of 64 bytes. Considered way size as 1 (Associativity; 1-way = Direct-mapped)

Taking inputs from trace_for_students 5 input files

- 1) hw2_q4_memoryaddr
- 2) trace.hpcg
- 3) trace.stream
- 4) trace.stream_10
- 5) trace_stream_20

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1301327	1059918	0	4
Cache Misses	5	198673	2174137	10	16
Hit rate	0.58	0.87	0.33	0.00	0.20
Miss rate	0.42	0.13	0.67	1.00	0.80

Part 2. Fully associative and n-way set associative cache

Requirement: 1

2-way set associative

Given a fixed cache size of 32KB, Cache line size of 16 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	3	1271808	1047858	0	3
Cache Misses	9	228192	2186197	10	17
Hit rate	0.25	0.85	0.32	0.00	0.15
Miss rate	0.75	0.15	0.68	1.00	0.85

Given a fixed cache size of 32KB, Cache line size of 32 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	5	1281437	1062413	0	4
Cache Misses	7	218563	2171642	10	16
Hit rate	0.42	0.85	0.33	0.00	0.20
Miss rate	0.58	0.15	0.67	1.00	0.80

Given a fixed cache size of 32KB, Cache line size of 128 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1342187	1059458	0	4
Cache Misses	5	157813	2174597	10	16
Hit rate	0.58	0.89	0.33	0.00	0.20
Miss rate	0.42	0.11	0.67	1.00	0.80

4-way set associative

Given a fixed cache size of 32KB, Cache line size of 16 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	3	1289868	1025484	0	3
Cache Misses	9	210132	2208571	10	17
Hit rate	0.25	0.86	0.32	0.00	0.15
Miss rate	0.75	0.14	0.68	1.00	0.85

Given a fixed cache size of 32KB, Cache line size of 32 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
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Cache Hits	5	1286982	1038836	0	4
Cache Misses	7	213018	2195219	10	16
Hit rate	0.42	0.86	0.32	0.00	0.20
Miss rate	0.58	0.14	0.68	1.00	0.80

Given a fixed cache size of 32KB, Cache line size of 128 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1349911	1062156	0	4
Cache Misses	5	150089	2171899	10	16
Hit rate	0.58	0.90	0.33	0.00	0.20
Miss rate	0.42	0.10	0.67	1.00	0.80

8-way set associative

Given a fixed cache size of 32KB, Cache line size of 16 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	3	1289037	995316	0	3
Cache Misses	9	210963	2238739	10	17
Hit rate	0.25	0.86	0.31	0.00	0.15
Miss rate	0.75	0.14	0.69	1.00	0.85

Given a fixed cache size of 32KB, Cache line size of 32 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	5	1299827	1007736	0	4
Cache Misses	7	200173	2226319	10	16

Hit rate	0.42	0.87	0.31	0.00	0.20
Miss rate	0.58	0.13	0.69	1.00	0.80

Given a fixed cache size of 32KB, Cache line size of 128 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1314693	832383	0	4
Cache Misses	5	185307	2401672	10	16
Hit rate	0.58	0.88	0.26	0.00	0.20
Miss rate	0.42	0.12	0.74	1.00	0.80

Fully-associative

Given a fixed cache size of 32KB, Cache line size of 16 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	3	1288376	1054410	0	3
Cache Misses	9	211624	2179645	10	17
Hit rate	0.25	0.86	0.33	0.00	0.15
Miss rate	0.75	0.14	0.67	1.00	0.85

Given a fixed cache size of 32KB, Cache line size of 32 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	5	1299217	1069034	0	4
Cache Misses	7	200783	2165021	10	16
Hit rate	0.42	0.87	0.33	0.00	0.20
Miss rate	0.58	0.13	0.67	1.00	0.80

Given a fixed cache size of 32KB, Cache line size of 128 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1370205	1078646	0	4
Cache Misses	5	129795	2155409	10	16
Hit rate	0.58	0.91	0.33	0.00	0.20
Miss rate	0.42	0.09	0.67	1.00	0.80

Requirement: 2

2-way set associative

Given fixed Cache line size of 64 bytes, cache size of 16KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1253252	1005525	0	4
Cache Misses	5	246748	2228530	10	16
Hit rate	0.58	0.84	0.31	0.00	0.20
Miss rate	0.42	0.16	0.69	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 32KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1263404	1044121	0	4
Cache Misses	5	236596	2189934	10	16
Hit rate	0.58	0.84	0.32	0.00	0.20
Miss rate	0.42	0.16	0.68	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 64KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1317776	1070141	0	4
Cache Misses	5	182224	2163914	10	16
Hit rate	0.58	0.88	0.33	0.00	0.20
Miss rate	0.42	0.12	0.67	1.00	0.80

4-way set associative

Given fixed Cache line size of 64 bytes, cache size of 16KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1268375	1037579	0	4
Cache Misses	5	231625	2196476	10	16
Hit rate	0.58	0.85	0.32	0.00	0.20
Miss rate	0.42	0.15	0.68	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 32KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1303876	1061904	0	4
Cache Misses	5	196124	2172151	10	16
Hit rate	0.58	0.87	0.33	0.00	0.20
Miss rate	0.42	0.13	0.67	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 64KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
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Cache Hits	7	1316810	1070051	0	4
Cache Misses	5	183190	2164004	10	16
Hit rate	0.58	0.88	0.33	0.00	0.20
Miss rate	0.42	0.12	0.67	1.00	0.80

8-way set associative

Given fixed Cache line size of 64 bytes, cache size of 16KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1294828	1059753	0	4
Cache Misses	5	205172	2174302	10	16
Hit rate	0.58	0.86	0.33	0.00	0.20
Miss rate	0.42	0.14	0.67	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 32KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1303328	1060222	0	4
Cache Misses	5	196672	2173833	10	16
Hit rate	0.58	0.87	0.33	0.00	0.20
Miss rate	0.42	0.13	0.67	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 64KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1317301	1070083	0	4

Cache Misses	5	182699	2163972	10	16
Hit rate	0.58	0.88	0.33	0.00	0.20
Miss rate	0.42	0.12	0.67	1.00	0.80

Fully-associative

Given fixed Cache line size of 64 bytes, cache size of 16KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1313703	1074180	0	4
Cache Misses	5	186297	2159875	10	16
Hit rate	0.58	0.88	0.33	0.00	0.20
Miss rate	0.42	0.12	0.67	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 32KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1321405	1075779	0	4
Cache Misses	5	178595	2158276	10	16
Hit rate	0.58	0.88	0.33	0.00	0.20
Miss rate	0.42	0.12	0.67	1.00	0.80

Given fixed Cache line size of 64 bytes, cache size of 64KB

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache Hits	7	1325114	1076618	0	4

Cache Misses	5	174886	2157437	10	16
Hit rate	0.58	0.88	0.33	0.00	0.20
Miss rate	0.42	0.12	0.67	1.00	0.80

Part 3. Two-level cache simulation

L1 is a 2-way set associative, Cache size of 64KB, Cache line size of 64 bytes.

L2 is a 8-way set associative, Cache size of 1MB, Cache line size of 64 bytes.

Output	hw2_q4_memoryaddr	trace.hpcg	trace.stream	trace.stream_10	trace_stream_20
Cache L1 Hits	0	1192529	930829	0	0
Cache L1 Misses	12	307471	2303226	10	20
Cache L1 Hit Rate	0.000000	0.795019	0.287821	0.000000	0.000000
Cache L1 Miss Rate	1.000000	0.204981	0.712179	1.000000	1.000000
Cache L2 Hits	3	13321	9226	0	3
Cache L2 Misses	9	11461	1402	10	17
Cache L2 Hit Rate	0.250000	0.537527	0.868084	0.000000	0.150000
Cache L2 Miss Rate	0.750000	0.462473	0.131916	1.000000	0.850000