Computer Architecture

Cache Simulator

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- For the block addresses in the attached file, graph the total hit rate and miss rate for a cache of size 256 blocks for the following number of sets: 1, 2, 4, 8, 16, 32, 64, 128 and 256.

- Set (1)
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**233**	**Total Misses :**	**256**
Conflict Misses :	**0**	**Miss Rate :**	**51.3 %**
Cache Hits	**10**	**Hit Rate :**	**48.7 %**

- Set (2)
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**489**
Conflict Misses :	**233**	**Miss Rate :**	**98 %**
Cache Hits	**10**	**Hit Rate :**	**2 %**

- Set (4)
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**491**
Conflict Misses :	**235**	**Miss Rate :**	**98.4 %**
Cache Hits	**8**	**Hit Rate :**	**1.6 %**

- **Set (8)**
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**490**
Conflict Misses :	**234**	**Miss Rate :**	**98.2 %**
Cache Hits	**9**	**Hit Rate :**	**1.8 %**

- Set (16)
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**491**
Conflict Misses :	**235**	**Miss Rate :**	**98.4 %**
Cache Hits	**8**	**Hit Rate :**	**1.6 %**

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- Set (32)
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**491**
Conflict Misses :	**235**	**Miss Rate :**	**98.4 %**
Cache Hits	**8**	**Hit Rate :**	**1.6 %**

- Set (64)
    - **Cache Query Results:**

Compulsory Misses :	**256**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**491**
Conflict Misses :	**235**	**Miss Rate :**	**98.4 %**
Cache Hits	**8**	**Hit Rate :**	**1.6 %**

- Set (128)
    - **Cache Query Results:**

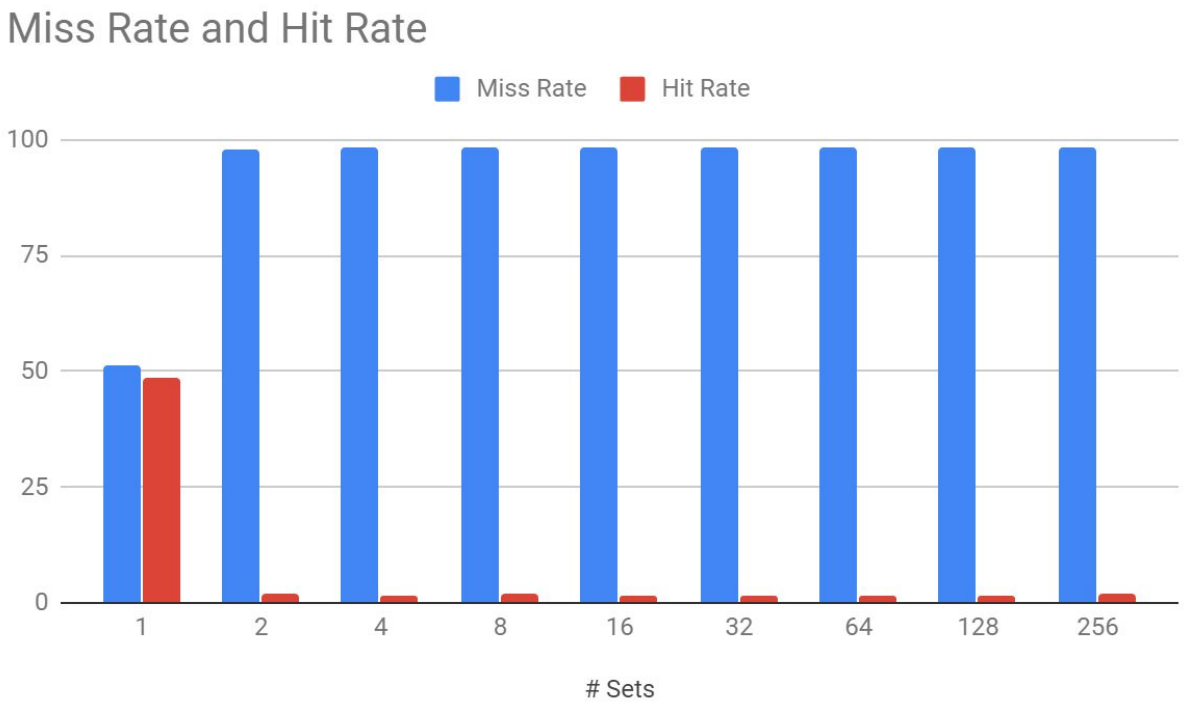
Compulsory Misses :	**242**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**491**
Conflict Misses :	**249**	**Miss Rate :**	**98.4 %**
Cache Hits	**8**	**Hit Rate :**	**1.6 %**

- Set (256)
    - **Cache Query Results:**

Compulsory Misses :	**215**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**490**
Conflict Misses :	**275**	**Miss Rate :**	**98.2 %**
Cache Hits	**9**	**Hit Rate :**	**1.8 %**

- Cache size = 256

# Sets	Miss Rate	Hit Rate
1	**51.3 %**	**48.7 %**
2	**98 %**	**2 %**
4	**98.4 %**	**1.6 %**
8	**98.2 %**	**1.8 %**
16	**98.4 %**	**1.6 %**
32	**98.4 %**	**1.6 %**
64	**98.4 %**	**1.6 %**
128	**98.4 %**	**1.6 %**
256	**98.2 %**	**1.8 %**



- Repeat the previous experiment for caches of size 128, 64, and 32 blocks

  Cache size = 128

  - Set (1)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**367**	**Total Misses :**	**128**
Conflict Misses :	**0**	**Miss Rate :**	**25.65 %**
Cache Hits	**4**	**Hit Rate :**	**74.35 %**

- Set (2)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**495**
Conflict Misses :	**367**	**Miss Rate :**	**99.2 %**
Cache Hits	**4**	**Hit Rate :**	**0.8 %**

- Set (4)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**495**
Conflict Misses :	**367**	**Miss Rate :**	**99.2 %**
Cache Hits	**4**	**Hit Rate :**	**0.8 %**

- Set(8)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**495**
Conflict Misses :	**367**	**Miss Rate :**	**99.2 %**
Cache Hits	**4**	**Hit Rate :**	**0.8 %**

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- Set (16)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**495**
Conflict Misses :	**367**	**Miss Rate :**	**99.2 %**
Cache Hits	**4**	**Hit Rate :**	**0.8 %**

- Set (32)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**496**
Conflict Misses :	**368**	**Miss Rate :**	**99.4 %**
Cache Hits	**3**	**Hit Rate :**	**0.6 %**

- Set (64)

Cache Query Results:

Compulsory Misses :	**128**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**496**
Conflict Misses :	**368**	**Miss Rate :**	**99.4 %**
Cache Hits	**3**	**Hit Rate :**	**0.6 %**

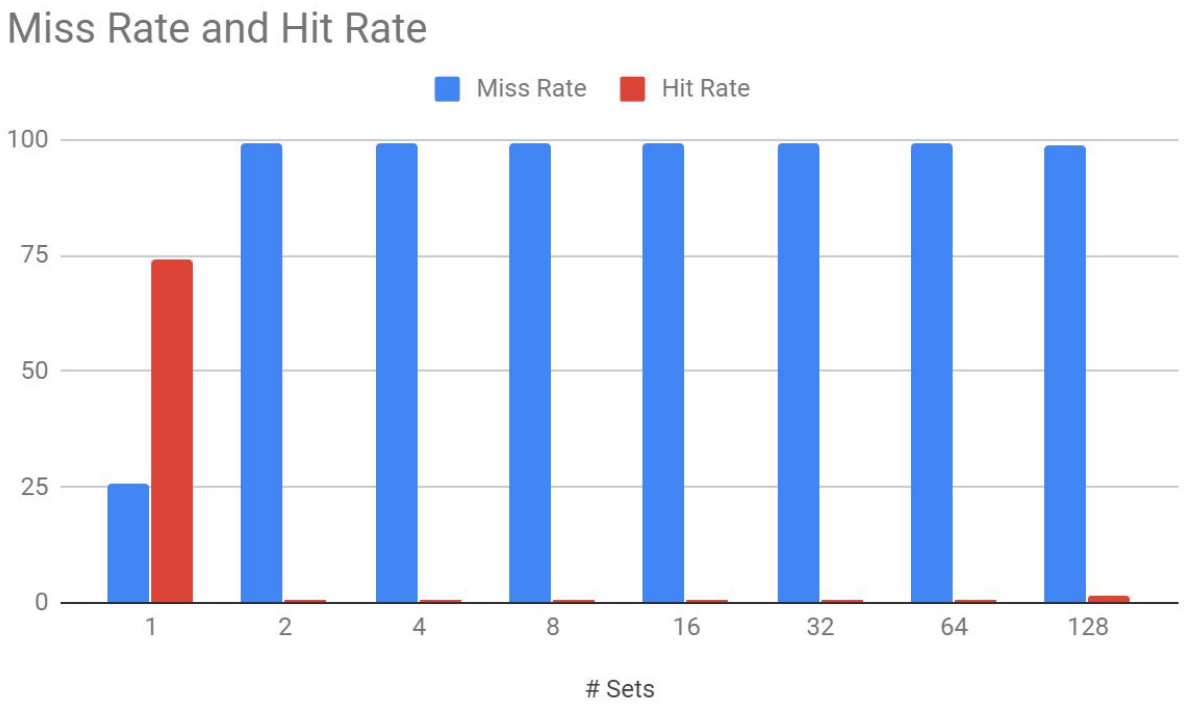
- Set (128)

Cache Query Results:

Compulsory Misses :	**125**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**492**
Conflict Misses :	**367**	**Miss Rate :**	**98.6 %**
Cache Hits	**7**	**Hit Rate :**	**1.4 %**

Comparison

# Sets	Miss Rate	Hit Rate
1	**25.65**	**74.35**
2	**99.2**	**.8**
4	**99.2**	**0.8**
8	**99.2**	**.8**
16	**99.2**	**0.8**
32	**99.4**	**.6**
64	**99.4**	**.6**
128	**98.6**	**1.4**



Cache size = 64

- Set (1)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**432**	**Total Misses :**	**64**
Conflict Misses :	**0**	**Miss Rate :**	**12.83 %**
Cache Hits	**3**	**Hit Rate :**	**87.17 %**

- Set (2)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**496**
Conflict Misses :	**432**	**Miss Rate :**	**99.4 %**
Cache Hits	**3**	**Hit Rate :**	**0.6 %**

- Set (4)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**497**
Conflict Misses :	**433**	**Miss Rate :**	**99.6 %**
Cache Hits	**2**	**Hit Rate :**	**0.4 %**

- Set(8)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**496**

Conflict Misses :	**432**	**Miss Rate :**	**99.4 %**
Cache Hits	**3**	**Hit Rate :**	**0.6 %**

- Set (16)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**497**
Conflict Misses :	**433**	**Miss Rate :**	**99.6 %**
Cache Hits	**2**	**Hit Rate :**	**0.4 %**

- Set (32)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**498**
Conflict Misses :	**434**	**Miss Rate :**	**99.8 %**
Cache Hits	**1**	**Hit Rate :**	**0.2 %**

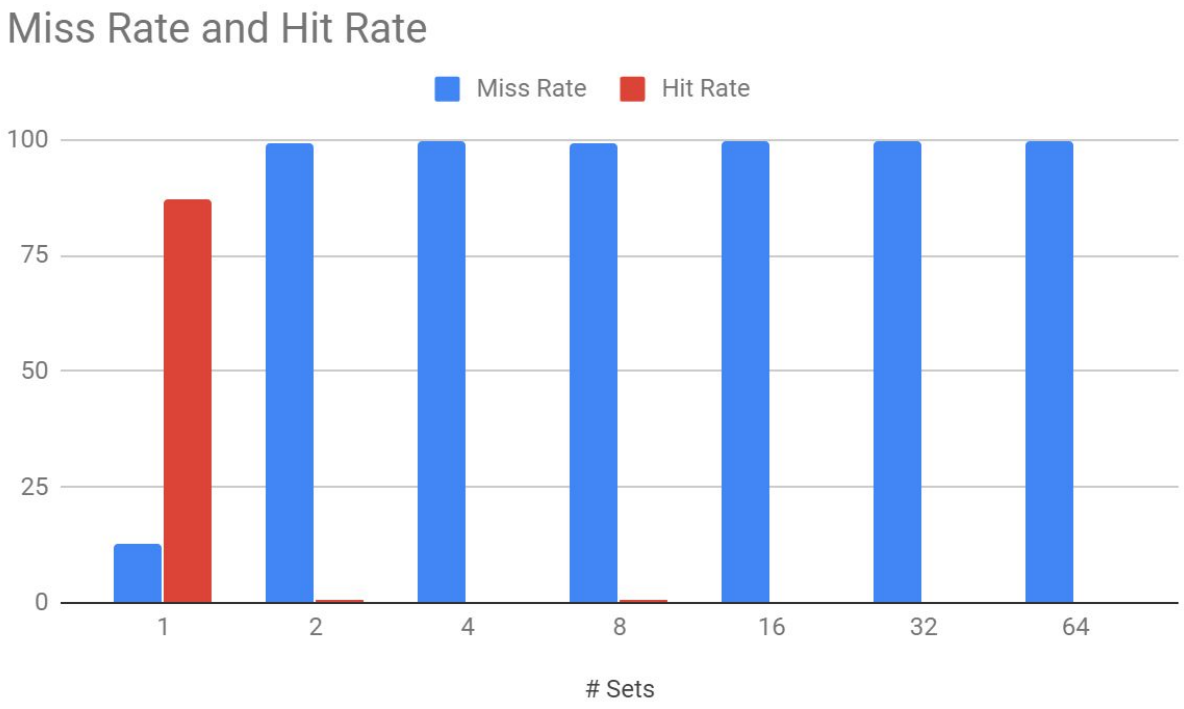
- Set (64)

Cache Query Results:

Compulsory Misses :	**64**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**497**
Conflict Misses :	**433**	**Miss Rate :**	**99.6 %**
Cache Hits	**2**	**Hit Rate :**	**0.4 %**

Comparison

# Sets	Miss Rate	Hit Rate
1	**12.83**	**87.17**
2	**99.4**	**0.6**
4	**99.6**	**0.4**
8	**99.4**	**0.6**
16	**99.6**	**0.4**
32	**99.8**	**.2**
64	**99.6**	**0.4**



Cache size = 32

- Set (1)

Cache Query Results:

Compulsory Misses :	**32**	**Total Cache Queries :**	**499**
Capacity Misses :	**466**	**Total Misses :**	**32**
Conflict Misses :	**0**	**Miss Rate :**	**6.41 %**
Cache Hits	**1**	**Hit Rate :**	**93.59 %**

- Set (2)

Cache Query Results:

Compulsory Misses :	**32**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**498**
Conflict Misses :	**466**	**Miss Rate :**	**99.8 %**
Cache Hits	**1**	**Hit Rate :**	**0.2 %**

- Set (4)

Cache Query Results:

Compulsory Misses :	**32**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**498**
Conflict Misses :	**466**	**Miss Rate :**	**99.8 %**
Cache Hits	**1**	**Hit Rate :**	**0.2 %**

- Set(8)

Cache Query Results:

Compulsory Misses :	**32**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**498**

Conflict Misses :	**466**	**Miss Rate :**	**99.8 %**
Cache Hits	**1**	**Hit Rate :**	**0.2 %**

- Set (16)

Cache Query Results:

Compulsory Misses :	**20**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**498**
Conflict Misses :	**478**	**Miss Rate :**	**99.8 %**
Cache Hits	**1**	**Hit Rate :**	**0.2 %**

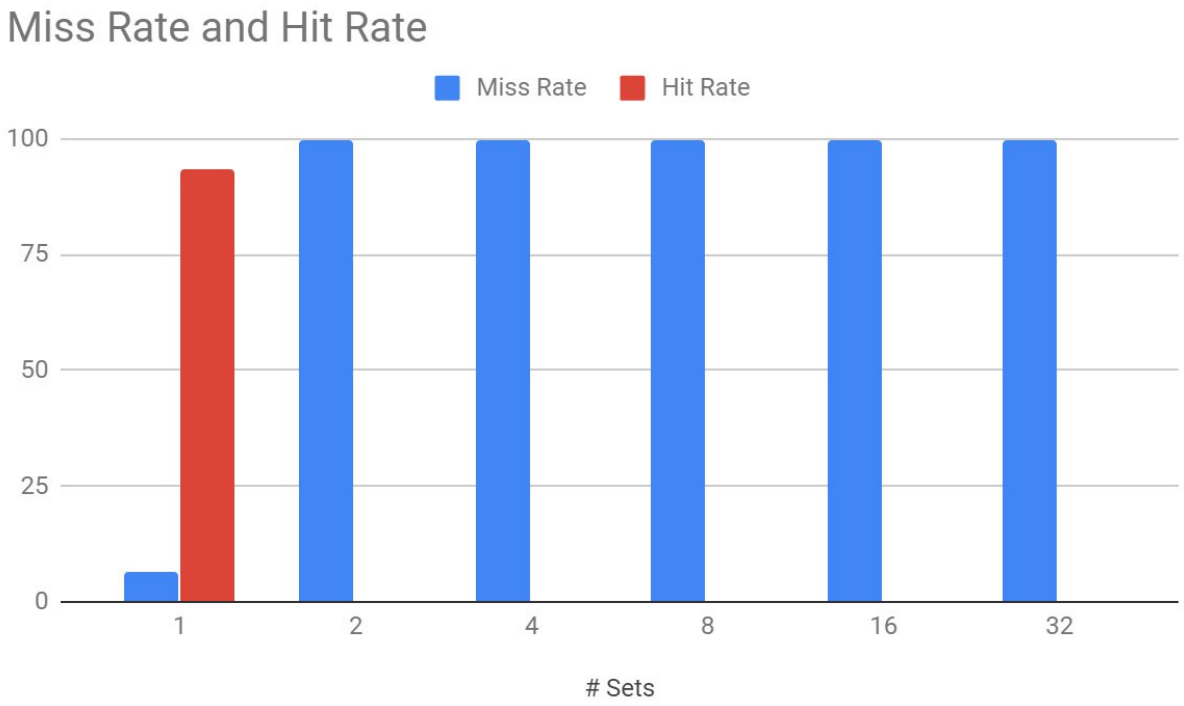
- Set (32)

Cache Query Results:

Compulsory Misses :	**20**	**Total Cache Queries :**	**499**
Capacity Misses :	**0**	**Total Misses :**	**498**
Conflict Misses :	**478**	**Miss Rate :**	**99.8 %**
Cache Hits	**1**	**Hit Rate :**	**0.2 %**

Comparison

# Sets	Miss Rate	Hit Rate
1	**6.41**	**93.59**
2	**99.8**	**0.2**
4	**99.8**	**0.2**
8	**99.8**	**0.2**
16	**99.8**	**0.2**
32	**99.8**	**.2**



- Suppose a computer has a 4-way set associative cache, and the cache size is 64 blocks, show the final cache contents and state the number of hits and misses for the following sequence of block addresses: 2, 16, 24, 32, 16, 24, 64, 48, 6

Cache Contents: LRU replacement policy;

Set#	64 Block, 4-way set-associative cache - tags shown in red			
0	24 - 00000110	64 - 00010000	48 - 00001100	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
1	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
2	02 - 00000000	16 - 00000100	32 - 00001000	06 - 00000001
	-	-	-	-
	-	-	-	-
	-	-	-	-

3	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-

Cache Query Results:

Compulsory Misses :	**7**	**Total Cache Queries :**	**9**
Capacity Misses :	**0**	**Total Misses :**	**7**
Conflict Misses :	**0**	**Miss Rate :**	**77.78 %**
Cache Hits	**2**	**Hit Rate :**	**22.22 %**

- Show the hits and misses and final cache contents for a two-way set-associative cache with one-word blocks and a total size of 16 words, Assume LRU replacement. Assume the word addresses are: 1, 4, 8, 5, 20, 17, 19, 56, 9, 11, 4, 43, 5, 6, 9, 17.

Cache Contents: LRU replacement policy;

	16 Block, 2-way set-associative cache - tags shown in red			
	04 - 0000 0010	08 - 0000 0100	20 - 0000 1010	56 - 0001 1100
	06 - 0000 0011	-	-	-
	01 - 0000 0000	05 - 0000 0010	17 - 0000 1000	19 - 0000 1001
	09 - 0000 0100	11 - 0000 0101	43 - 0001 0101	-

Cache Query Results:

Compulsory Misses :	**12**	**Total Cache Queries :**	**16**
Capacity Misses :	**0**	**Total Misses :**	**12**
Conflict Misses :	**0**	**Miss Rate :**	**75 %**

Cache Hits	**4**	**Hit Rate :**	**25 %**