PERCONA
Performance Consulting Experts

The MySQL Query Cache

Baron Schwartz

Percona Inc

The Roadmap

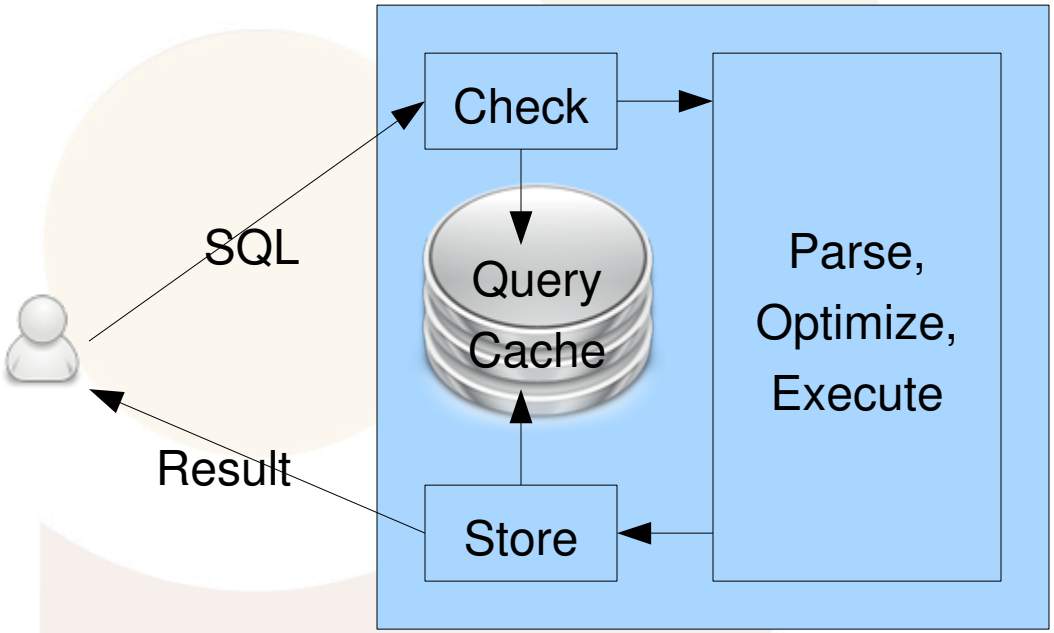
- How it works
- What it isn't
- Myths
- How it uses memory
- Monitoring and status
- Configuration
- Trivia (how it works with InnoDB)

What is the Query Cache?

- Caches the result of a SELECT statement
  - The raw bytes
- When there's a hit, just resends the result
- Does not cache execution plans

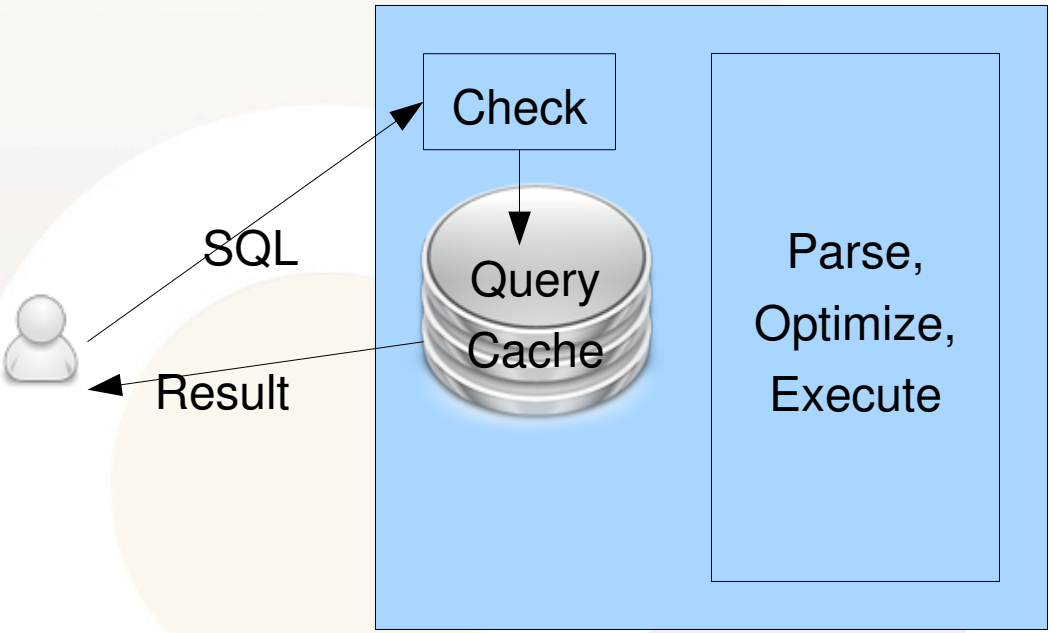
How it Works

- It's a big hash table
- The hash key is the query text, current database, relevant character sets, etc etc.
  - It's case-sensitive, whitespace-sensitive



If there's a cache hit

- There's no parsing, optimizing, etc etc



Not all queries are cacheable

- Temp tables
- User variables
- Non-deterministic functions such as RAND() and NOW()
- Column-level privileges
- LOCK IN SHARE MODE/FOR UPDATE
- User-defined functions

Query Cache Myths

- “MySQL might serve from the cache if the query contains SQL_NO_CACHE and a previous query without it was inserted”
  - False: the query won't match the previous query
- “MySQL doesn't check the query cache if the query contains CURRENT_DATE”
  - False: MySQL checks the cache before it parses the query
  - Enabling the query cache adds overhead to all SELECT queries

Query Cache Overhead

- Each SELECT has extra overhead
  - Must check the cache for a hit
  - If it's cacheable and not in the cache, must store the result
- Each UPDATE, INSERT, etc has extra overhead
  - Must check for cached queries to invalidate

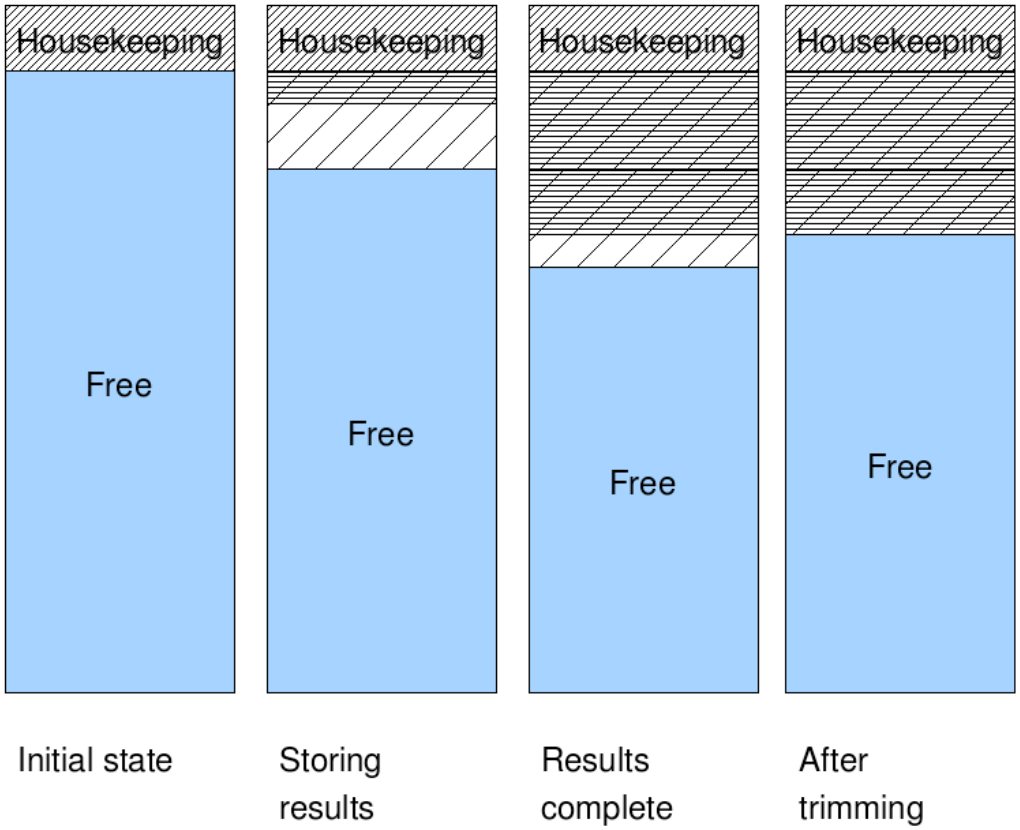
Memory Usage

- The query cache is completely in-memory
- MySQL allocates one big chunk of memory for it
- MySQL manages its own memory – no malloc()
- Internally, it is structured into “blocks”
  - Hold that thought! These are not traditional blocks
  - Variable-sized blocks, not 4K or 16K or whatever
  - Initially, the entire cache's memory is one big block
  - Blocks can be of several types: free, table list, cache result, etc

Storing Results

- “Allocate” a block for results
  - must be at least query_cache_min_res_unit bytes
  - finding an existing free block can take some time
- Store results as they're sent
  - Server does not know in advance how big the entire result will be
  - If bigger than query_cache_limit, abort
- When block is full, allocate another
- When done, trim the last block to size

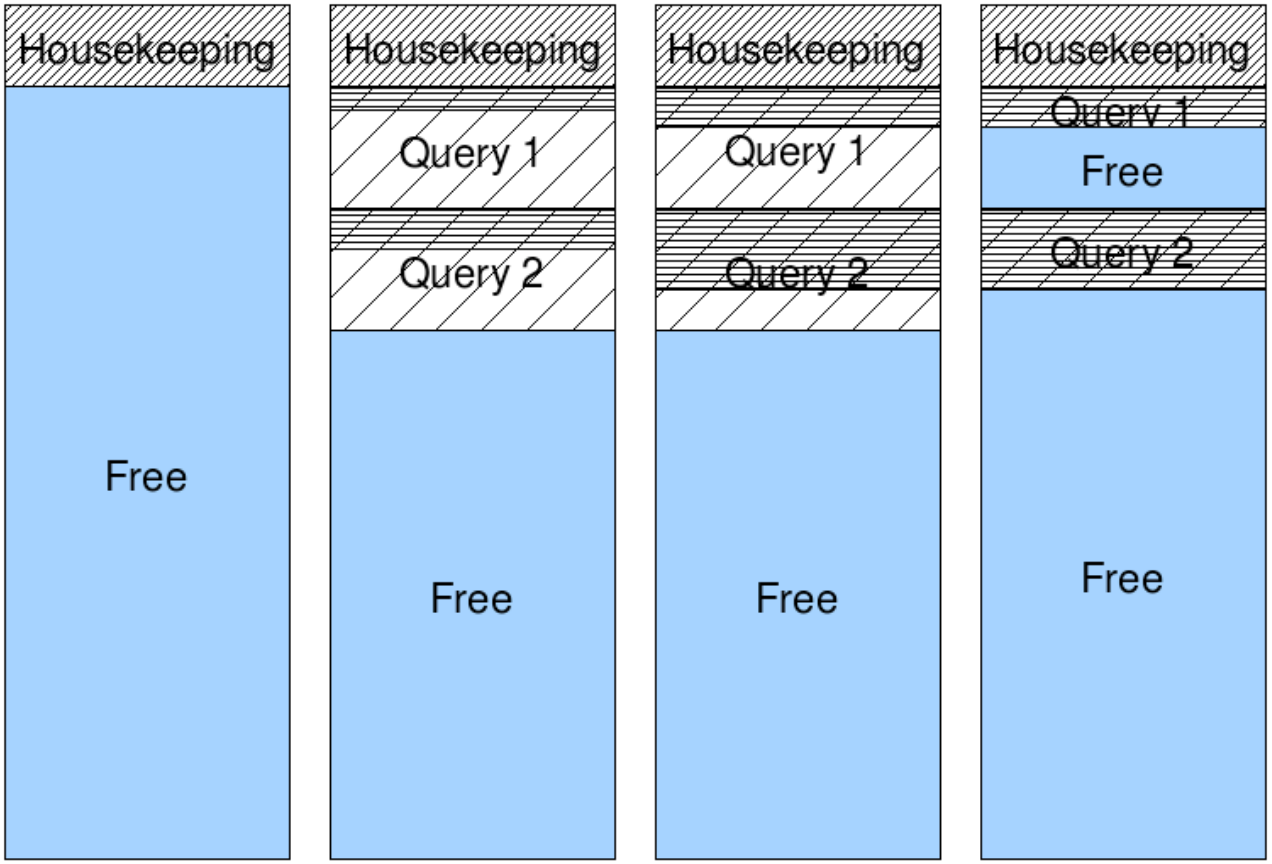
Storing Results



Fragmentation

- Happens because of trimming
- Happens because of invalidations
- Is a problem because you get blocks that are too small to use, so memory is wasted
- If Qcache_lowmem_prunes is increasing and you have lots of free memory, suspect fragmentation

Fragmentation



PERCONA
Performance Consulting Experts

Monitoring and Status

```
mysql> show global status like 'qcache%';
+-------------------------+----------+
| Variable_name           | Value    |
+-------------------------+----------+
| Qcache_free_blocks      | 11       |
| Qcache_free_memory      | 16715152 |
| Qcache_hits             | 49422    |
| Qcache_inserts          | 8072     |
| Qcache_lowmem_prunes    | 0        |
| Qcache_not_cached       | 17404    |
| Qcache_queries_in_cache | 32       |
| Qcache_total_blocks     | 82       |
+-------------------------+----------+
```

Monitoring and Status

- Qcache_total_blocks
  - total number of variable-sized blocks in cache
- Qcache_free_blocks
  - number of blocks of type FREE
  - worst-case: Qcache_total_blocks / 2
- Qcache_free_memory
  - total bytes in FREE blocks

Monitoring and Status

- Qcache_hits
  - queries that were returned from the cache
  - hit rate: `Qcache_hits/(Qcache_hits+Com_select)`
- Qcache_inserts
  - queries that were stored into the cache
- Qcache_lowmem_prunes
  - number of cached results discarded to make room for new results
  - fragmentation can cause this to grow

Monitoring and Status

- Qcache_not_cached
  - queries that were uncacheable
  - had non-deterministic function
  - were bigger than query_cache_limit
- Qcache_queries_in_cache
  - total number of queries in the cache
- Qcache_invalidations [doesn't exist]
  - but you can calculate it:
    Qcache_inserts - Qcache_queries_in_cache

Avoiding Fragmentation

- You can avoid fragmentation with the block size
  - try setting it close to the average result size
  - (query_cache_size – Qcache_free_memory) / Qcache_queries_in_cache
- You might not be able to pick a good size
  - you have a blend of large and small queries
  - some queries cause a lot of churn
  - you can set the query_cache_type to DEMAND and use SQL_CACHE to select queries that are good to cache

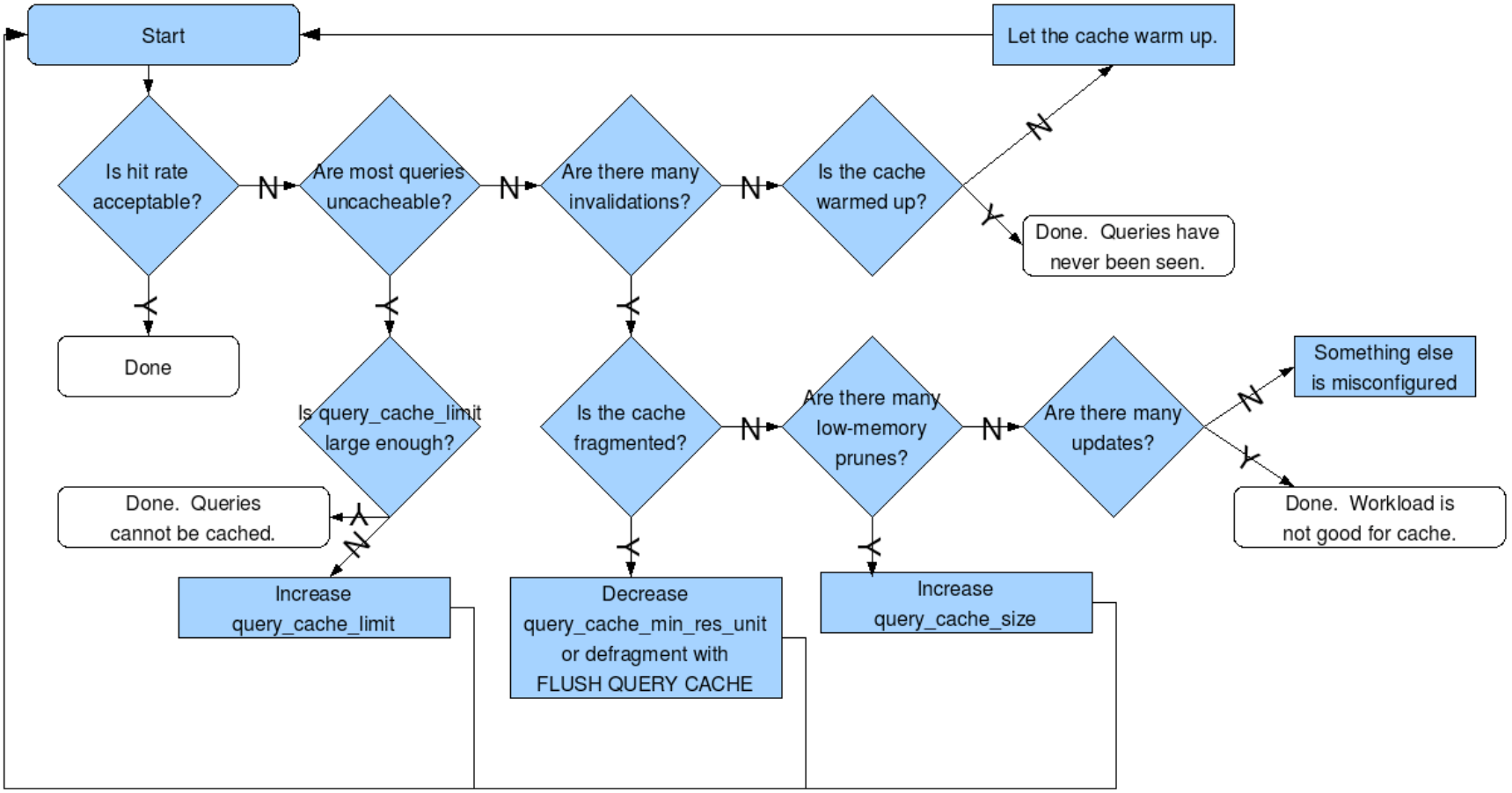
Defragmenting

- Use FLUSH QUERY CACHE
- It doesn't flush the cache, it compacts it
- It locks the whole cache
  - effectively locks the whole server

Tuning

```
mysql> show global variables like 'query_cache%';
+------------------------------+----------+
| Variable_name                | Value    |
+------------------------------+----------+
| query_cache_limit            | 1048576  |
| query_cache_min_res_unit     | 4096     |
| query_cache_size             | 16777216 |
| query_cache_type             | ON       |
| query_cache_wlock_invalidate | OFF      |
+------------------------------+----------+
```

Tuning the Query Cache



InnoDB and the Query Cache

- InnoDB works with the query cache
  - for some value of “works”
- InnoDB tells the server whether a table is cacheable
  - Both for storing results, and for reading results
- Two factors determine this:
  - Your Transaction ID
  - Whether there are locks on the table
  - This is a rough heuristic

InnoDB and the Query Cache

- If there are locks on a table, it's not cacheable
- If the table's transaction counter is > yours, you can't access that table in the cache
  - Each table's transaction counter is updated when a txn with locks on the table commits
  - It is updated to the system's transaction ID, not the txn ID of the txn with locks
  - Thus, if you modify a table, you can never read/write it again till you start a new transaction

Optimizations

- Many small tables instead of one big table
- Batched writes (fewer invalidations)
- Don't make it too big or it stalls—256 MB is plenty
- Consider disabling it entirely