Optimizacija upita u MySQL-u

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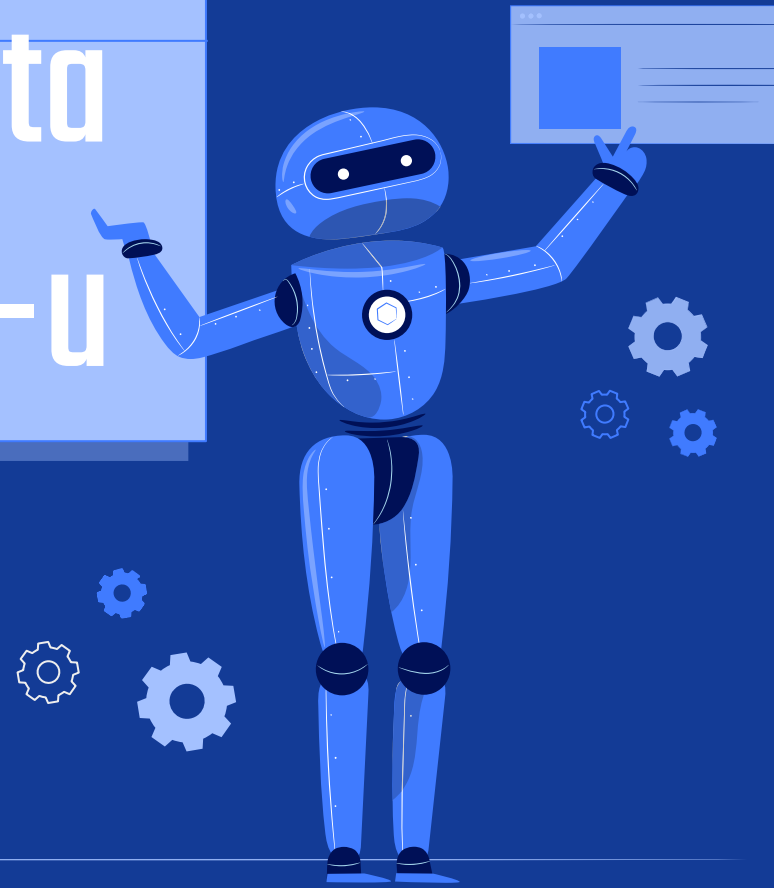

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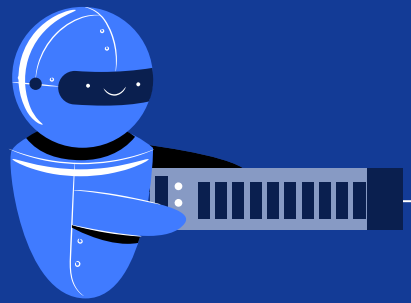
01 Uvod



01.

Šta je optimizacija upita?

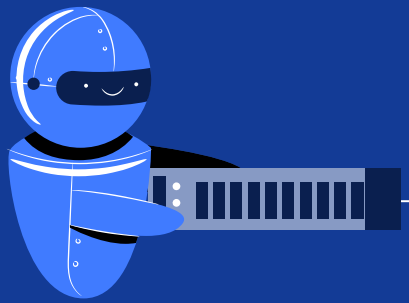
02.

Šta je plan izvršenja?

03.

Kako MySQL vrši optimizaciju upita?

02 MySQL optimizator



MySQL optimizator

- Skup rutina koje određuju optimalan plan izvršenja
- Trasa optimizatora i *EXPLAIN*
- Primarne i ostale optimizacije

```
handle_select()
  mysql_select()
    JOIN::prepare()
      setup_fields()
    JOIN::optimize()            /* optimizer is from here ... */
      optimize_cond()
      opt_sum_query()
      make_join_statistics()
        get_quick_record_count()
        choose_plan()
          /* Find the best way to access tables */
          /* as specified by the user.          */
          optimize_straight_join()
            best_access_path()
          /* Find a (sub-)optimal plan among all or subset */
          /* of all possible query plans where the user    */
          /* controls the exhaustiveness of the search.    */
          greedy_search()
            best_extension_by_limited_search()
              best_access_path()
          /* Perform an exhaustive search for an optimal plan */
          find_best()
      make_join_select()        /* ... to here */
    JOIN::exec()
```

Primarne optimizacije:

Konstantne relacije

01 Obrada tranzitivnosti

02 Uklanjanje „mrtvog “ koda

```
use sakila;
set optimizer_trace="enabled=on";
select * from payment where customer_id=staff_id and staff_id = 1;
select * from information_schema.optimizer_trace;
```

```
"steps": [
  {
    "condition_processing": {
      "condition": "WHERE",
      "original_condition": "((`payment`.`customer_id` = `payment`.`staff_id`) and (`payment`.`staff_id` = 1))",
```

```
use sakila;
set optimizer_trace="enabled=on";
select * from payment where 0=0 and customer_id=1;
select * from information_schema.optimizer_trace;
```

```
"condition_processing": {
  "condition": "WHERE",
  "original_condition": "((`payment`.`customer_id` = 1))",
```

Primarne optimizacije:

Konstantne relacije

03 Obrada IS NULL uslova

04 Konstantne tabele

```
use sakila;
create table test_null_cond (label char(1));
...
set optimizer_trace="enabled=on";
select * from test_null_cond where label="test";
select * from information_schema.optimizer_trace;
```

```
"condition_processing": {
  "condition": "WHERE",
  "original_condition": "(`test_null_cond`.`label` = 'test')",
```

```
use sakila;
set optimizer_trace="enabled=on";
explain select language.language_id, film.language_id from language, film
where language.language_id=film.language_id and language.language_id=1;
select * from information_schema.optimizer_trace;
```

```
"attaching_conditions_to_tables": {
  "original_condition": "(`film`.`language_id` = 1)",
  "attached_conditions_computation": [],
  "attached_conditions_summary": [
    {
      "table": "`film`",
      "attached": "(`film`.`language_id` = 1)"
    }
...
"rows_estimation": [
  {
    "table": "`language`",
    "rows": 1,
    "cost": 1,
    "table_type": "const",
    "empty": false
  },
```

```
explain select language.language_id, film.language_id from language, film
where language.language_id=film.language_id and language.language_id=100;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	no matching row in const table

Primarne optimizacije

Tipovi pristupa

01

Indeksi

02

Pretraga opsega (range)

```
use sakila;
set optimizer_trace="enabled=on";
select rental_duration from film where rental_duration>3;
```

```
"considered_access_paths": [
  {
    "rows_to_scan": 797,
    "access_type": "range",
    "range_details": {
      "used_index": "dur_index"
    },
    "resulting_rows": 797,
    "cost": 159.73,
    "chosen": true
```

```
use sakila;
set optimizer_trace="enabled=on";
select rental_duration from film where rental_duration>0;
```

```
"considered_access_paths": [
  {
    "rows_to_scan": 1000,
    "access_type": "scan",
    "resulting_rows": 1000,
    "cost": 103,
    "chosen": true
```

Primarne optimizacije:

Tipovi pristupa

03

Spajanje indeksa

```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • explain select * from film where language_id>1 or rental_duration>14;
4 • select * from information_schema.optimizer_trace optimizer_trace;
```


```
"chosen_range_access_summary": {
  "range_access_plan": {
    "type": "index_merge",
    "index_merge_of": [
      {
        "type": "range_scan",
        "index": "idx_fk_language_id",
        "rows": 1,
        "ranges": [
          "1 < language_id"
        ]
      },
      {
        "type": "range_scan",
        "index": "dur_index",
        "rows": 1,
        "ranges": [
          "14 < rental_duration"
        ]
      }
    ]
  },
```


```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • explain select * from film where language_id>0 and rental_duration>14;
4 • select * from information_schema.optimizer_trace optimizer_trace;
```


```
"range_scan_alternatives": [
  {
    "index": "idx_fk_language_id",
    "ranges": [
      "0 < language_id"
    ],
    "index_dives_for_eq_ranges": true,
    "rowid_ordered": false,
    "using_mrr": false,
    "index_only": false,
    "rows": 1000,
    "cost": 350.26,
    "chosen": false,
    "cause": "cost"
  },
  {
    "index": "dur_index",
    "ranges": [
      "14 < rental_duration"
    ],
    "index_dives_for_eq_ranges": true,
    "rowid_ordered": false,
    "using_mrr": false,
    "index_only": false,
    "rows": 1,
    "cost": 0.61,
    "chosen": true
  }
],
```

Primarne optimizacije

ORDER BY

Order by

- Indeksi
- filesort

```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • explain select rental_duration from film order by rental_duration;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	index	NULL	dur_index	1	NULL	1000	100.00	Using index

```
1 • use sakila;
2 • explain select rental_duration from film order by rental_duration+1;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	index	NULL	dur_index	1	NULL	1000	100.00	Using index; Using filesort

Primarne optimizacije:

GROUP BY

01 Privremene tabele i indeksi za grupisanje

02 DISTINCT u GROUP BY

```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • select distinct title from film;
4 • select * from information_schema.optimizer_trace;
```

```
{
  "optimizing_distinct_group_by_order_by": {
    "changed_distinct_to_group_by": true,
    "simplifying_group_by": {
      "original_clause": "`film`.`title`",
      "items": [
        {
          "item": "`film`.`title`"
        }
      ],
```

```
1 • use sakila;
2 • explain select rental_duration from film group by rental_duration;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	range	dur_index	dur_index	1	NULL	6	100.00	Using index for group-by

```
1 • use sakila;
2 • explain select rating from film group by rating;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	ALL	NULL	NULL	NULL	NULL	1000	100.00	Using temporary

Ostale optimizacije

- Rana i kasna obrada NULL vrednosti
- Particionisanje

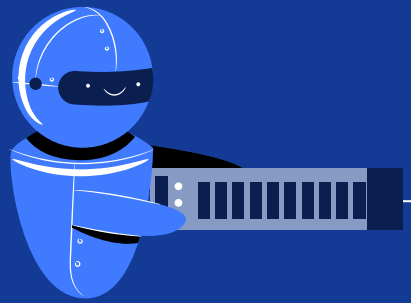
```
use sakila;
set optimizer_trace="enabled=on";
explain select staff_id, store.address_id from staff, store where staff_id=manager_staff_id;
select * from information_schema.optimizer_trace;
```

```
"ref_optimizer_key_uses": [
  {
    "table": "`staff`",
    "field": "staff_id",
    "equals": "`store`.`manager_staff_id`",
    "null_rejecting": true
  },
  {
    "table": "`store`",
    "field": "manager_staff_id",
    "equals": "`staff`.`staff_id`",
    "null_rejecting": true
  }
]
```

```
use sakila;
set optimizer_trace="enabled=on";
select * from film where film_id=5/0;
select * from information_schema.optimizer_trace;
```

```
"ref_optimizer_key_uses": [
  {
    "table": "`film`",
    "field": "film_id",
    "equals": "(5 / 0)",
    "null_rejecting": true
  }
]
```

03 Pisanje optimizovanih upita



SELECT naredbe

- Upotreba indeksa i potiskivanje indeksa
- Nametanje korišćenja indeksa optimizatoru

```
use sakila;
explain select address_id from store  where manager_staff_id<4 and address_id=4;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	store	NULL	ref	idx_unique_manager,idx_fk_address_id	idx_fk_address_id	2	const	1	100.00	Using where

```
use sakila;
explain select address_id from store use index (idx_unique_manager) where manager_staff_id<4 and address_id=4;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	store	NULL	range	idx_unique_manager	idx_unique_manager	1	NULL	2	50.00	Using index condition; Using where

```
use sakila;
explain select address_id from store force index (idx_unique_manager) where manager_staff_id<4 and address_id=4;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	store	NULL	range	idx_unique_manager	idx_unique_manager	1	NULL	2	50.00	Using index condition; Using where

```
use sakila;
explain select address_id from store ignore index (idx_unique_manager) where manager_staff_id<4 and address_id=4;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	store	NULL	ref	idx_fk_address_id	idx_fk_address_id	2	const	1	50.00	Using where

SELECT naredbe-range scan

- Džoker karakteri kod LIKE operatora
- Row constructor expressions

```
use sakila;
explain select title from film where title like "c%";
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	range	idx_title	idx_title	514	NULL	92	100.00	Using where; Using index

```
use sakila;
explain select title from film where title like "%c";
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	index	NULL	idx_title	514	NULL	1000	11.11	Using where; Using index

```
use sakila;
alter table customer add index row_const_ind (customer_id, store_id, address_id);
analyze table customer;
explain select customer_id, store_id from customer where (customer_id, store_id, address_id) in ((1, 1, 1) , (2, 2, 1));
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	customer	NULL	range	PRIMARY,idx_fk_store_id,idx_fk_address_id,ro...	row_const_ind	5	NULL	2	100.00	Using where; Using index

```
use sakila;
explain select customer_id, store_id from customer where (address_id, store_id) in ((1, 1) , (2, 2));
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	customer	NULL	range	idx_fk_store_id,idx_fk_address_id	idx_fk_address_id	2	NULL	2	100.00	Using where

SELECT naredbe-range scan

Skip scan index

```
1  use sakila;
2  CREATE TABLE test_skip_scan (col1 INT NOT NULL, col2 INT NOT NULL, PRIMARY KEY(col1, col2));
3  INSERT INTO test_skip_scan VALUES
4    (1,1), (1,2), (1,3), (1,4), (1,5),
5    (2,1), (2,2), (2,3), (2,4), (2,5);
6  INSERT INTO test_skip_scan SELECT col1, col2 + 5 FROM test_skip_scan;
7  INSERT INTO test_skip_scan SELECT col1, col2 + 10 FROM test_skip_scan;
8  INSERT INTO test_skip_scan SELECT col1, col2 + 20 FROM test_skip_scan;
9  INSERT INTO test_skip_scan SELECT col1, col2 + 40 FROM test_skip_scan;
10 ANALYZE TABLE test_skip_scan;
11 EXPLAIN SELECT col1, col2 FROM test_skip_scan WHERE col2 > 40;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_skip_scan	NULL	range	PRIMARY	PRIMARY	8	NULL	53	100.00	Using where; Using index for skip scan

SELECT naredbe – spoljašnji spoj

01 Nemogući (NULL rejected) uslovi

02 Transformacija u unutrašnji spoj

```
1  use sakila;
2  set optimizer_trace="enabled=on";
3  explain select film.film_id, category_id from film_category left join film on film_category.film_id=film.film_id
4  where language_id=1 or 0=1;
5  select * from information_schema.optimizer_trace;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film	NULL	ref	PRIMARY,idx_fk_language_id	idx_fk_language_id	1	const	1000	100.00	Using where; Using index
1	SIMPLE	film_category	NULL	ref	PRIMARY	PRIMARY	2	sakila.film.film_id	1	100.00	Using index


```
{
  "transformations_to_nested_joins": {
    "transformations": [
      "outer_join_to_inner_join",
      "JOIN_condition_to_WHERE",
      "parenthesis_removal"
    ],
```

SELECT naredbe – ORDER BY

01 Indeksi i primarni ključ

```
use sakila;
set optimizer_trace="enabled=on";
alter table inventory add index ind_film_store (film_id, store_id);
explain select inventory_id, film_id, store_id from inventory order by film_id, store_id
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	inventory	NULL	index	NULL	ind_film_store	3	NULL	4581	100.00	Using index

02 Više kolona u klauzuli

```
use sakila;
set optimizer_trace="enabled=on";
CREATE TABLE test_order_dir (
  col1 INT, col2 INT,
  INDEX idx1 (col1 ASC, col2 DESC)
);

set optimizer_trace="enabled=on";
explain select * from test_order_dir order by col1 asc, col2 desc;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_order_dir	NULL	index	NULL	idx1	10	NULL	5	100.00	Using index

```
explain select * from test_order_dir order by col1 desc, col2 asc;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_order_dir	NULL	index	NULL	idx1	10	NULL	5	100.00	Backward index scan; Using index

```
explain select * from test_order_dir order by col1 desc, col2 desc;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_order_dir	NULL	index	NULL	idx1	10	NULL	5	100.00	Using index; Using filesort

SELECT naredbe – ORDER BY

03

Korišćenje alijasa

```
1 • use sakila;
2 • explain select country_id from country order by country_id;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	country	NULL	index	NULL	PRIMARY	2	NULL	109	100.00	Using index

```
1 • use sakila;
2 • explain select country_id+1 as country_id from country order by country_id;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	country	NULL	index	NULL	PRIMARY	2	NULL	109	100.00	Using index; Using filesort

SELECT naredbe – GROUP BY

01 Slobodan indeks (loose scan index)

02 Čvrst indeks (tight scan index)

```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • alter table test_loose add index all_ind(col1, col2, col3);
4 • explain select * from test_loose where col2=1 group by col1, col3;
5
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_loose	NULL	index	all_ind	all_ind	15	NULL	5	20.00	Using where; Using index

```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • alter table test_loose add index col1(col1, col2);
4 • explain select col1, max(col2) from test_loose group by col1;
5 • select * from information_schema.optimizer_trace;
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_loose	NULL	range	col1	col1	5	NULL	2	100.00	Using index for group-by

```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • explain select min(col1), col2 from test_loose group by col2;
4 • select * from information_schema.optimizer_trace;
5
```

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	test_loose	NULL	index	col1	col1	10	NULL	5	100.00	Using index; Using temporary

SELECT naredbe – DISTINCT

01

Slično kao kog GROUP BY

02

Odbacivanje tabela koje se ne koriste kod upita s više tabela

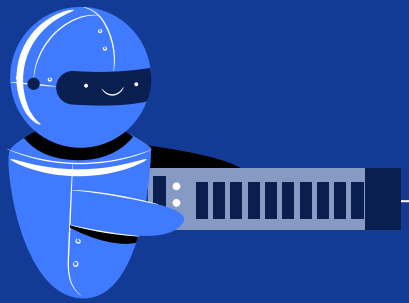
```
1 • use sakila;
2 • set optimizer_trace="enabled=on";
3 • explain select distinct title from film, film_category where film.film_id=film_category.film_id;
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	film_category	NULL	index	PRIMARY	fk_film_category_category	1	NULL	1000	100.00	Using index; Using tempo
1	SIMPLE	film	NULL	eq_ref	PRIMARY,idx_title	PRIMARY	2	sakila.film_category.film_id	1	100.00	NULL

INSERT, UPDATE i DELETE naredbe

- Učitavanje iz fajla (LOAD DATA)
- INSERT s više vrsti vrednosti
- Postavljanje veličine bulk bafera
- Odlaganje ažuriranja
- TRUNCATE umesto DELETE FROM

03 Zaključak



Zaključak

01 Optimizacija upita poboljšava performanse aplikacije.

02 MySQL optimizator vrši transformacije na osnovu kojih automatski optimizuje upite.

03 Na osnovu trase optimizatora i EXPLAIN izlaza, korisnik može da vrši optimizaciju pisanjem upitea koji imaju optimalne planove izvršenja.

Hvala na pažnji!