

# MySQL执行计划解读

胡中泉

# 纲要

- MySQL 执行计划调用方式
- 执行计划包含的信息
- 执行计划显示内容解读
- MySQL 执行计划的局限
- Q&A

# 通过执行计划可以了解什么

```
mysql> explain
-> select d1.col2, t2.col1
-> from (select col2, col3
->       from t1
->       where col1 in ('ab','ac')) d1, t2
-> where d1.col2 = t2.col1
-> group by d1.col2, t2.col1
-> order by t2.id;
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	PRIMARY	<derived2>	ALL	NULL	NULL	NULL	NULL	286	Using temporary; Using filesort
1	PRIMARY	t2	ref	idx_col1_col2	idx_col1_col2	195	d1.col2	45	Using where; Using index
2	DERIVED	t1	range	idx_col1_col2_col3	idx_col1_col2_col3	13	NULL	285	Using where; Using index

```
3 rows in set (0.00 sec)
```

# MySQL执行计划调用方式

- **EXPLAIN SELECT .....**

变体:

- **1. EXPLAIN EXTENDED SELECT .....**

将执行计划“反编译”成SELECT语句，运行SHOW WARNINGS可得到被MySQL优化器优化后的查询语句

- **2. EXPLAIN PARTITIONS SELECT .....**

用于分区表的EXPLAIN

# 执行计划包含的信息

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
----	-------------	-------	------	---------------	-----	---------	-----	------	-------

## 1. id:

包含一组数字，表示查询中执行select子句或操作表的顺序

e.g.

```
mysql> explain select t2.*  
-> from t1, t2, t3  
-> where t1.id = t2.id and t1.id = t3.id  
-> and t1.other_column = '';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t1	ref	PRIMARY,idx_t1	idx_t1	92	const	1	Using where
1	SIMPLE	t3	eq_ref	PRIMARY	PRIMARY	4	test.t1.ID	1	Using index
1	SIMPLE	t2	eq_ref	PRIMARY	PRIMARY	4	test.t1.ID	1	

```
3 rows in set (0.00 sec)|
```

id相同，执行顺序由上至下

e.g.

```
mysql> explain SELECT t2.*
-> FROM t2
-> WHERE id = (SELECT id
->             FROM t1
->             WHERE id = (SELECT t3.id
->                         FROM t3
->                         WHERE t3.other_column = ''));
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	PRIMARY	t2	const	PRIMARY	PRIMARY	4	const	1	
2	SUBQUERY	t1	const	PRIMARY	PRIMARY	4		1	Using index
3	SUBQUERY	t3	ALL	NULL	NULL	NULL	NULL	1	Using where

3 rows in set (0.00 sec)

如果是子查询，id的序号会递增，id值越大优先级越高，越先被执行

e.g.

```
mysql> explain select t2.* from (  
  -> select t3.id  
  -> from t3  
  -> where t3.other_column = '') s1, t2  
  -> where s1.id = t2.id;
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	PRIMARY	<derived2>	system	NULL	NULL	NULL	NULL	1	
1	PRIMARY	t2	const	PRIMARY	PRIMARY	4	const	1	
2	DERIVED	t3	ALL	NULL	NULL	NULL	NULL	1	Using where

```
3 rows in set (0.00 sec)
```

id如果相同，可以认为是一组，从上往下顺序执行；在所有组中，id值越大，优先级越高，越先执行

## 2. select\_type

表示查询中每个select子句的类型（简单 OR 复杂）

id	select_type
1	SIMPLE
2	PRIMARY
3	SUBQUERY
4	DERIVED
5	UNION
6	UNION RESULT

- SIMPLE**: 查询中不包含子查询或者UNION
- 查询中若包含任何复杂的子部分，最外层查询则被标记为：**PRIMARY**
- 在**SELECT**或**WHERE**列表中包含了子查询，该子查询被标记为：**SUBQUERY**
- 在**FROM**列表中包含的子查询被标记为：**DERIVED**（衍生）
- 若第二个**SELECT**出现在**UNION**之后，则被标记为**UNION**；若**UNION**包含在**FROM**子句的子查询中，外层**SELECT**将被标记为：**DERIVED**
- 从**UNION**表获取结果的**SELECT**被标记为：**UNION RESULT**



e.g.

```
mysql> explain select d1.name, (select id from t3) d2
-> from (select id, name from t1 where other_column = '') d1
-> union
-> (select name, id from t2);
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	PRIMARY	<derived3>	system	NULL	NULL	NULL	NULL	1	
3	DERIVED	t1	ALL	NULL	NULL	NULL	NULL	1	Using where
2	SUBQUERY	t3	index	NULL	PRIMARY	4	NULL	1	Using index
4	UNION	t2	ALL	NULL	NULL	NULL	NULL	1	
NULL	UNION RESULT	<union1,4>	ALL	NULL	NULL	NULL	NULL	NULL	

5 rows in set (0.01 sec)

第一行：**id**列为1，表示第一个**select**，**select\_type**列的**primary**表示该查询为外层查询，**table**列被标记为<derived3>，表示查询结果来自一个衍生表，其中3代表该查询衍生自第三个**select**查询，即**id**为3的**select**。

第二行：**id**为3，表示该查询的执行次序为2（4→3），是整个查询中第三个**select**的一部分。因查询包含在**from**中，所以为**derived**。

第三行：**select**列表中的子查询，**select\_type**为**subquery**，为整个查询中的第二个**select**。

第四行：**select\_type**为**union**，说明第四个**select**是**union**里的第二个**select**，最先执行。

第五行：代表从**union**的临时表中读取行的阶段，**table**列的<union1,4>表示用第一个和第四个**select**的结果进行**union**操作。

### 3. type

表示MySQL在表中找到所需行的方式，又称“访问类型”，常见类型如下：

```
+-----+-----+-----+-----+-----+-----+-----+
| ALL  | index | range | ref  | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+-----+
```

由左至右，由最差到最好

e.g.

```
+-----+-----+-----+-----+-----+-----+-----+
| ALL | index | range | ref | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+-----+
```

a. ALL: Full Table Scan, MySQL将遍历全表以找到匹配的行

```
mysql> explain select * from t1 where column_without_index = '';
+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | t1 | ALL | NULL | NULL | NULL | NULL | 516 | Using where |
+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```

```
+-----+-----+-----+-----+-----+-----+-----+
| ALL | index | range | ref | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+-----+
```

b. index: Full Index Scan, index与ALL区别为index类型只遍历索引树

```
mysql> explain select id from t1;
+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | t1 | index | NULL | PRIMARY | 4 | NULL | 516 | Using index |
+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```



## TIPS:

### range访问类型的不同形式的索引访问性能差异

```
mysql> explain select id from t1 where col1 in ('ac','ab','aa') and col2 = 'ac';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t1	range	idx_col1_col2	idx_col1_col2	388	NULL	3	

```
1 row in set (0.00 sec)
```

```
mysql> explain select id from t1 where col1 > 'aa' and col2 = 'ac';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t1	range	idx_col1_col2	idx_col1_col2	194	NULL	299	

```
1 row in set (0.00 sec)
```

```

+-----+-----+-----+-----+-----+-----+
| ALL | index | range | ref | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+

```

d. **ref**: 非唯一性索引扫描，返回匹配某个单独值的所有行。常见于使用非唯一索引即唯一索引的非唯一前缀进行的查找

e.g.

```

mysql> create index idx_col1_col2 on t1(col1,col2);
Query OK, 1000 rows affected (0.15 sec)
Records: 1000 Duplicates: 0 Warnings: 0

```

```

mysql> select count(distinct col1) from t1;

```

```

+-----+
| count(distinct col1) |
+-----+
|                7 |
+-----+

```

```

1 row in set (0.00 sec)

```

```

mysql> explain select * from t1 where col1 = 'ac';

```

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | t1 | ref | idx_col1_col2 | idx_col1_col2 | 194 | const | 284 | |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

```

1 row in set (0.00 sec)

```

e.g.

```
mysql> explain select * from t1, t2 WHERE t1.col1 = t2.col1;
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t2	ALL	NULL	NULL	NULL	NULL	639	
1	SIMPLE	t1	ref	idx_col1_col2	idx_col1_col2	195	shared.t2.col1	45	

```
2 rows in set (0.00 sec)
```

```
mysql> explain select * from t1, t2 WHERE t1.col1 = t2.col1 AND t1.col2 = 'ac';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t2	ALL	NULL	NULL	NULL	NULL	639	
1	SIMPLE	t1	ref	idx_col1_col2	idx_col1_col2	390	shared.t2.col1,const	45	

```
2 rows in set (0.00 sec)
```

```

+-----+-----+-----+-----+-----+-----+
| ALL  | index | range | ref | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+

```

e. `eq_ref`: 唯一性索引扫描，对于每个索引键，表中只有一条记录与之匹配。常见于主键或唯一索引扫描

e.g.

```
mysql> explain select * from t1, t2 where t1.id = t2.id;
```

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type   | possible_keys | key       | key_len | ref           | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1  | SIMPLE      | t2    | ALL    | PRIMARY       | NULL     | NULL    | NULL         | 639  |       |
| 1  | SIMPLE      | t1    | eq_ref | PRIMARY       | PRIMARY  | 4       | shared.t2.ID | 1    |       |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

```
2 rows in set (0.00 sec)
```



```

+-----+-----+-----+-----+-----+-----+-----+
| ALL | index | range | ref | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+-----+

```

f. `const`、`system`: 当MySQL对查询某部分进行优化，并转换为一个常量时，使用这些类型访问。如将主键置于`where`列表中，MySQL就能将该查询转换为一个常量

e.g.

```

mysql> explain select * from (select * from t1 where id = 1) d1;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table      | type   | possible_keys | key      | key_len | ref  | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY     | <derived2> | system | NULL          | NULL    | NULL    | NULL | 1    |      |
| 2 | DERIVED     | t1         | const  | PRIMARY      | PRIMARY | 4       |      | 1    |      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.00 sec)

```

**TIPS:** `system`是`const`类型的特例，当查询的表只有一行的情况下，使用`system`

```

+-----+-----+-----+-----+-----+-----+-----+
| ALL  | index | range | ref  | eq_ref | const, system | NULL |
+-----+-----+-----+-----+-----+-----+-----+

```

g. NULL: MySQL在优化过程中分解语句，执行时甚至不用访问表或索引

e.g.

```
mysql> explain extended select * from t1 where id = (select min(id) from t2);
```

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type  | possible_keys | key       | key_len | ref  | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1  | PRIMARY    | t1    | const | PRIMARY      | PRIMARY  | 4       | const | 1    | 100.00 |      |
| 2  | SUBQUERY   | NULL  | NULL  | NULL         | NULL     | NULL    | NULL | NULL | NULL    |      |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

```
2 rows in set, 1 warning (0.00 sec)
```

```
mysql> show warnings;
```

```

+-----+-----+-----+
| Level | Code | Message |
+-----+-----+-----+
| Note  | 1003 | select '1' AS `ID`,`hu` AS `col1`,`dba` AS `col2` from `shared`.`t1` where 1 |
+-----+-----+-----+

```

```
1 row in set (0.00 sec)
```



## 6. key\_len

表示索引中使用的字节数，可通过该列计算查询中使用的索引的长度

```
mysql> desc t1;
+-----+-----+-----+-----+-----+-----+
| Field | Type   | Null | Key | Default | Extra           |
+-----+-----+-----+-----+-----+-----+
| ID    | int(11)| NO   | PRI | NULL    | auto_increment |
| col1  | char(4)| YES  | MUL | NULL    |                 |
| col2  | char(4)| YES  |     | NULL    |                 |
+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)
```

```
mysql> explain select * from t1 where col1 = 'ab';
+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key           | key_len | ref | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE      | t1    | ref  | idx_col1_col2 | idx_col1_col2 | 13      | const | 143 |       |
+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```

```
mysql> explain select * from t1 where col1 = 'ab' and col2 = 'ac';
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | type | possible_keys | key           | key_len | ref           | rows | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE      | t1    | ref  | idx_col1_col2 | idx_col1_col2 | 26      | const,const | 1    |       |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.01 sec)
```

**TIPS:** `key_len`显示的价值为索引字段的最大可能长度，并非实际使用长度，即`key_len`是根据表定义计算而得，不是通过表内检索出的

## 7. ref

表示上述表的连接匹配条件，即哪些列或常量被用于查找索引列上的值

```
mysql> explain select * from t1, t2 where t1.col1 = t2.col1 and t1.col2 = 'ac';
+----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | ... | table | type | possible_keys | key          | key_len | ref          | rows |
+----+-----+-----+-----+-----+-----+-----+-----+-----+
|  1 | ... | t2    | ALL  | NULL          | NULL        | NULL    | NULL        |  640 |
|  1 | ... | t1    | ref  | idx_col1_col2 | idx_col1_col2 | 26      | shared.t2.col1,const |  82 |
+----+-----+-----+-----+-----+-----+-----+-----+-----+
2 rows in set (0.01 sec)
```

本例中，由key\_len可知t1表的idx\_col1\_col2被充分使用，col1匹配t2表的col1，col2匹配了一个常量，即 'ac'

## 8. rows

表示MySQL根据表统计信息及索引选用情况，估算的找到所需的记录所需要读取的行数

```
mysql> explain select * from t1, t2 where t1.id = t2.id and t2.col1 = 'ac';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t2	ALL	PRIMARY	NULL	NULL	NULL	640	Using where
1	SIMPLE	t1	eq_ref	PRIMARY	PRIMARY	4	shared.t2.ID	1	

```
2 rows in set (0.00 sec)
```

```
mysql> create index idx_col1_col2 on t2(col1,col2);
```

```
Query OK, 1001 rows affected (0.17 sec)
```

```
Records: 1001 Duplicates: 0 Warnings: 0
```

```
mysql> explain select * from t1, t2 where t1.id = t2.id and t2.col1 = 'ac';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	t2	ref	PRIMARY,idx_col1_col2	idx_col1_col2	195	const	142	
1	SIMPLE	t1	eq_ref	PRIMARY	PRIMARY	4	shared.t2.ID	1	

```
2 rows in set (0.00 sec)
```

## 9. Extra

包含不适合在其他列中显示但十分重要的额外信息

### a. Using index

该值表示相应的select操作中使用了覆盖索引（Covering Index）

```
mysql> explain select col2 from t1 where col1 = 'ab';
+----+-----+-----+-----+-----+-----+-----+-----+
| id |...| possible_keys | key          | key_len | ref  | rows | Extra          |
+----+-----+-----+-----+-----+-----+-----+-----+
|  1 |...| idx_col1_col2 | idx_col1_col2 | 13      | const | 143 | Using where; Using index |
+----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```



## TIPS: 覆盖索引 (Covering Index)

MySQL可以利用索引返回select列表中的字段，而不必根据索引再次读取数据文件

包含所有满足查询需要的数据的索引称为 **覆盖索引 (Covering Index)**

注意:

如果要使用覆盖索引，一定要注意select列表中只取出需要的列，不可select \*，因为如果将所有字段一起做索引会导致索引文件过大，查询性能下降

## b. Using where

表示MySQL服务器在存储引擎受到记录后进行“后过滤”（Post-filter），如果查询未能使用索引，Using where的作用只是提醒我们MySQL将用where子句来过滤结果集

```
mysql> explain extended select t1.col2 from t1, t2 where t1.col1 = 'ab' and t1.id= t2.id ;
+-----+-----+-----+-----+-----+-----+-----+
| id |.....| key          | key_len | ref          | rows | filtered | Extra          |
+-----+-----+-----+-----+-----+-----+-----+
| 1 |.....| idx_col1_col2 | 13      | const       | 143  | 100.00  | Using where; Using index |
| 1 |.....| PRIMARY      | 4       | shared.t1.ID | 1    | 100.00  | Using index    |
+-----+-----+-----+-----+-----+-----+
2 rows in set, 1 warning (0.00 sec)
```

### c. Using temporary

表示MySQL需要使用临时表来存储结果集，常见于排序和分组查询

```
mysql> explain select col1 from t1 where col1 in ('ac','ab','aa') group by col2\G
***** 1. row *****
      id: 1
  select_type: SIMPLE
        table: t1
         type: range
possible_keys: idx_col1_col2
          key: idx_col1_col2
       key_len: 13
         ref: NULL
        rows: 569
   Extra: Using where; Using index; Using temporary; Using filesort
1 row in set (0.00 sec)
```

```
mysql> explain select col1 from t1 where col1 in ('ac', 'ab') group by col1, col2\G
***** 1. row *****
      id: 1
  select_type: SIMPLE
        table: t1
         type: range
possible_keys: idx_col1_col2_col3
          key: idx_col1_col2_col3
       key_len: 26
         ref: NULL
        rows: 4
   Extra: Using where; Using index for group-by
1 row in set (0.00 sec)
```

## d. Using filesort

MySQL中无法利用索引完成的排序操作称为“文件排序”

```
mysql> explain select col1 from t1 where col1 = 'ac' order by col3\G
***** 1. row *****
      id: 1
    select_type: SIMPLE
      table: t1
      type: ref
possible_keys: idx_col1_col2_col3
      key: idx_col1_col2_col3
     key_len: 13
      ref: const
     rows: 142
  Extra: Using where; Using index; Using filesort
1 row in set (0.00 sec)
```

```
mysql> explain select col1 from t1 where col1 = 'ac' order by col2, col3\G
***** 1. row *****
      id: 1
    select_type: SIMPLE
      table: t1
      type: ref
possible_keys: idx_col1_col2_col3
      key: idx_col1_col2_col3
     key_len: 13
      ref: const
     rows: 142
  Extra: Using where; Using index
1 row in set (0.00 sec)
```

```
mysql> explain
-> select d1.col2, t2.col1
-> from (select col2, col3
->       from t1
->       where col1 in ('ab','ac')) d1, t2
-> where d1.col2 = t2.col1
-> group by d1.col2, t2.col1
-> order by t2.id;
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	PRIMARY	<derived2>	ALL	NULL	NULL	NULL	NULL	286	Using temporary; Using filesort
1	PRIMARY	t2	ref	idx_col1_col2	idx_col1_col2	195	d1.col2	45	Using where; Using index
2	DERIVED	t1	range	idx_col1_col2_col3	idx_col1_col2_col3	13	NULL	285	Using where; Using index

3 rows in set (0.00 sec)

```
mysql> desc t1;
```

Field	Type	Null	Key	Default	Extra
ID	int(11)	NO	PRI	NULL	auto_increment
col1	char(4)	YES	MUL	NULL	
col2	char(4)	YES		NULL	
col3	char(4)	YES		NULL	

4 rows in set (0.00 sec)

```
mysql> desc t2;
```

Field	Type	Null	Key	Default	Extra
ID	int(11)	NO	PRI	NULL	auto_increment
col1	varchar(64)	YES	MUL	NULL	
col2	varchar(64)	YES		NULL	

3 rows in set (0.00 sec)

```
mysql> select count(*) from t1 where col1 = 'ac';
```

```
-----+
| count(*) |
+-----+
|      143 |
+-----+
```

1 row in set (0.00 sec)

```
mysql> select count(*) from t1 where col1 = 'ab';
```

```
-----+
| count(*) |
+-----+
|      143 |
+-----+
```

1 row in set (0.01 sec)

# MySQL执行计划的局限

- **EXPLAIN**不会告诉你关于触发器、存储过程的信息或用户自定义函数对查询的影响情况
- **EXPLAIN**不考虑各种Cache
- **EXPLAIN**不能显示MySQL在执行查询时所作的优化工作
- 部分统计信息是估算的，并非精确值
- **EXPALIN**只能解释**SELECT**操作，其他操作要重写为**SELECT**后查看执行计划
- .....

Q&A

谢谢