MySQL Full-Text Search Tutorial

— by royalwzy

Personal Profile

Database technology enthusiast	Oracle 10g/11g OCM MySQL 5.6 Database Administrator MCITP/MCTS DBA(MSSQL2008) RHCE Java Programmer
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Database technology user	More than 5 years experience in database use and management Proficient in synchronizing data between heterogeneous database Skilled in designing and optimizing database Install and configure MySQL cluster and high-availability cluster environment Synchronize and merge data from Oracle to MySQL
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MySQL Full-Text Search Introduction

- Exciting feature

- Switch tables to InnoDB

yntax of Full-Text Searche

MATCH (col1,col2,...) AGAINST (expr [search_modifier])

search_modifier:

```
  {
       IN NATURAL LANGUAGE MODE
     | IN NATURAL LANGUAGE MODE WITH QUERY EXPANSION
     | IN BOOLEAN MODE
     | WITH QUERY EXPANSION
  }
```

Three Types of Full-Text Searches

- Natural Language Full-Text Searches
- Boolean Full-Text Searches
- Full-Text Searches with Query Expansion

Natural Language Full-Text Searches

- By default or with the IN NATURAL LANGUAGE MODE modifier
- MATCH() returns a relevance value
- AGAINST takes a search string and an optional modifier to search for

Example of Natural Language Full-Text Searches

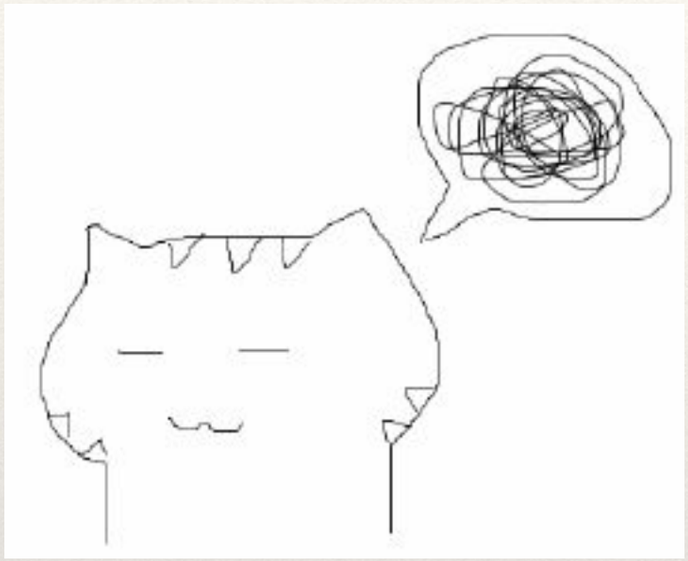
```
mysql> SELECT * FROM articles;
+----+-----------------------------+-------------------------------------+
| id | title                       | body                                |
+----+-----------------------------+-------------------------------------+
|  1 | MySQL Tutorial              | This database tutorial ...          |
|  2 | How To Use MySQL            | After you went through a ...        |
|  3 | Optimizing Your Database    | In this database tutorial ...       |
|  4 | MySQL vs. YourSQL           | When comparing databases ...        |
|  5 | MySQL Security              | When configured properly, MySQL ... |
|  6 | Database, Database, Database | database database database          |
|  7 | 1001 MySQL Tricks           | 1. Never run mysqld as root. 2. ... |
|  8 | MySQL Full-Text Indexes     | MySQL fulltext indexes use a ..     |
+----+-----------------------------+-------------------------------------+
8 rows in set (0.00 sec)
```

```
mysql> SELECT id, title, body, MATCH (title,body) AGAINST ('database' IN NATURAL LANGUAGE MODE) AS score
    -> FROM articles
    -> WHERE MATCH (title,body) AGAINST ('database' IN NATURAL LANGUAGE MODE);
+----+-----------------------------+-------------------------------------+-------------------+
| id | title                       | body                                | score             |
+----+-----------------------------+-------------------------------------+-------------------+
|  6 | Database, Database, Database | database database database          |  1.0886961221694946 |
|  3 | Optimizing Your Database    | In this database tutorial ...       | 0.362898707389831 54 |
|  1 | MySQL Tutorial              | This database tutorial ...          | 0.18144935369491577 |
+----+-----------------------------+-------------------------------------+-------------------+
3 rows in set (0.00 sec)
```

What does Last Slide Show?

- By default, performed in case-insensitive fashion(latin1->latin1_bin)
- The rows returned are automatically sorted with the highest relevance first
- Relevance is computed based on
  - The number of words in the row
  - The number of unique words in that row
  - The total number of words in the collection
  - The number of documents (rows) that contain a particular word

Boolean Full-Text Searches



What if you want to retrieve records that include word "YourSQL" and exclude word "MySQL"?

```
SELECT * FROM articles
WHERE MATCH (title,body)
      AGAINST ('+YourSQL -MySQL' IN BOOLEAN MODE);
```

Operators in Boolean Full-Text Search

- (no operator)
- +
- -
- ~
- > <
- ( )
- *
- “
- @distance

Examples Using Boolean Full-Text Operators

- 'apple banana'
- '+apple +juice'
- '+apple macintosh'
- '+apple -macintosh'
- '+apple ~macintosh'
- '+apple +(>plus <minus)'
- 'apple*'
- '"some words"'
- '"word1 word2 word3" @8'

Quizzes

- Which search string will return more results?

A:'+word +the*′
B:'+word +the'

- What is the relevancy ranking of the following three search strings in row "The Macintosh is a series of personal computers (PCs) designed, developed, and marketed by Apple Inc."

A:'+apple macintosh′
B:'+apple -macintosh′
C:'+apple ~macintosh′

How Relevancy Ranking is Calculated

- InnoDB full-text search's algorithms are based on BM25 and TF-IDF ranking algorithms
- TF-IDF(Term Frequency-Inverse Document Frequency)
- May differ from MyISAM relevancy rankings

How Relevancy Ranking is Calculated

- ${TF}
- ${IDF} = log10(${total_records} / ${matching_records})
  - total_records is the number of records in the collection
  - matching_records is the number of records that the search term appears in
- ${Ranking} = ${TF} * ${IDF} * ${IDF}

Example of Relevancy Ranking for a Single Word Search

```
mysql> SELECT * FROM articles;
+----+-----------------------------+-------------------------------------+
| id | title                       | body                                |
+----+-----------------------------+-------------------------------------+
|  1 | MySQL Tutorial              | This database tutorial ...          |
|  2 | How To Use MySQL            | After you went through a ...        |
|  3 | Optimizing Your Database    | In this database tutorial ...       |
|  4 | MySQL vs. YourSQL           | When comparing databases ...        |
|  5 | MySQL Security              | When configured properly, MySQL ... |
|  6 | Database, Database, Database | database database database         |
|  7 | 1001 MySQL Tricks           | 1. Never run mysqld as root. 2. ... |
|  8 | MySQL Full-Text Indexes     | MySQL fulltext indexes use a ..     |
+----+-----------------------------+-------------------------------------+
8 rows in set (0.00 sec)
```

```
mysql> SELECT id, title, body, MATCH (title,body) AGAINST ('database' IN BOOLEAN MODE) AS score
    -> FROM articles
    -> ORDER BY score DESC;
+----+-----------------------------+-------------------------------------+--------------------+
| id | title                       | body                                | score              |
+----+-----------------------------+-------------------------------------+--------------------+
|  6 | Database, Database, Database | database database database         |  1.0886961221694946 |
|  3 | Optimizing Your Database    | In this database tutorial ...       | 0.36289870738983154 |
|  1 | MySQL Tutorial              | This database tutorial ...          | 0.18144935369491577 |
|  2 | How To Use MySQL            | After you went through a ...        |                  0 |
|  4 | MySQL vs. YourSQL           | When comparing databases ...        |                  0 |
|  5 | MySQL Security              | When configured properly, MySQL ... |                  0 |
|  7 | 1001 MySQL Tricks           | 1. Never run mysqld as root. 2. ... |                  0 |
|  8 | MySQL Full-Text Indexes     | MySQL fulltext indexes use a ..     |                  0 |
+----+-----------------------------+-------------------------------------+--------------------+
8 rows in set (0.00 sec)
```

Example of Relevancy Ranking for a Single Word Search

- total_records:8

```
mysql> SELECT 6 * log10(8/3) * log10(8/3) AS ranking FROM dual;
+--------------------+
| ranking            |
+--------------------+
| 1.0886961646869382 |
+--------------------+
1 row in set (0.00 sec)
```

- ${Ranking}=6*log10(8/3)*log10(8/3)

Example of Relevancy Ranking for a Multiple Word Search

- The relevancy ranking value is a sum of the relevancy ranking value for each word
- ${rank} = ${TF} * ${IDF} * ${IDF} + ${TF} * ${IDF} * ${IDF}

```
mysql> SELECT id, title, body, MATCH (title,body)  AGAINST ('mysql tutorial' IN BOOLEAN MODE) AS score
    -> FROM articles
    -> ORDER BY score DESC;
+----+-----------------------------+-------------------------------------+--------------------+
| id | title                       | body                                | score              |
+----+-----------------------------+-------------------------------------+--------------------+
|  1 | MySQL Tutorial              | This database tutorial ...          |  0.7405621409416199 |
|  3 | Optimizing Your Database    | In this database tutorial ...       |  0.3624762296676636 |
|  5 | MySQL Security              | When configured properly, MySQL ... | 0.0312193762511014 94 |
|  8 | MySQL Full-Text Indexes     | MySQL fulltext indexes use a ..     | 0.0312193762511014 94 |
|  2 | How To Use MySQL            | After you went through a ...        | 0.0156096881255507 47 |
|  4 | MySQL vs. YourSQL           | When comparing databases ...        | 0.0156096881255507 47 |
|  7 | 1001 MySQL Tricks           | 1. Never run mysqld as root. 2. ... | 0.0156096881255507 47 |
|  6 | Database, Database, Database | database database database         |                  0 |
+----+-----------------------------+-------------------------------------+--------------------+
8 rows in set (0.00 sec)
```

Example of Relevancy Ranking for a Multiple Word Search

- total_records:8
- matching records:6 for "mysql" and 2 for "tutorial"

```
mysql> SELECT (1*log10(8/6)*log10(8/6)) + (2*log10(8/2)*log10(8/2)) AS ranking FROM dual;
+--------------------+
| ranking            |
+--------------------+
| 0.7405621541938004 |
+--------------------+
1 row in set (0.00 sec)
```

- ${Ranking}=(1*log10(8/6)*log10(8/6))+(2*log10(8/2)*log10(8/2))

Full-Text Searches with Query Expansion

- Full-text search supports query expansion
- It's generally useful when a search phrase is too short
- Relying on implied knowledge that the full-text search engine lacks
- Enabled by adding WITH QUERY EXPANSION or IN NATURAL LANGUAGE MODE WITH QUERY EXPANSION
- For example, a user searching for “database” may really mean that “MySQL”, “Oracle”, “DB2”, and “RDBMS”

What's is Implied Knowledge?

https://www.baidu.com/s?wd=梁思成的老婆的情人的老婆是谁%3F&rsv_spt=1&rsv_iqid=0xc068a67800004033&issp=1&f=8&rsv_b…

https://www.sogou.com/web?query=梁思成的老婆的情人的老婆是谁%3F&_asf=www.sogou.com&_ast=&w=01019900&p=400401…

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梁思成的老婆的情人的老婆是谁? 搜狗搜索 全部时间

梁思成老婆情人老婆

陆小曼
第二任妻子

张幼仪
第一任妻子

推理说明：梁思成的第一任妻子是林徽因。林徽因的前男友是徐志摩。梁思成的第一任妻子是林徽因。林徽因的前男友是徐志摩。徐志摩的第一任妻子是张幼仪。徐志摩的第二任妻子是陆小曼。

来自搜狗知识图谱 反馈

梁思成的关系图谱

亲情 友情 爱情 查看更多

Example of Query Expansion

```
mysql> SELECT * FROM articles
    -> WHERE MATCH (title,body) AGAINST ('database' IN NATURAL LANGUAGE MODE);
+----+-----------------------------+-------------------------------+
| id | title                       | body                          |
+----+-----------------------------+-------------------------------+
|  6 | Database, Database, Database | database database database    |
|  3 | Optimizing Your Database    | In this database tutorial ... |
|  1 | MySQL Tutorial              | This database tutorial ...    |
+----+-----------------------------+-------------------------------+
3 rows in set (0.00 sec)
```

```
mysql> SELECT * FROM articles
    -> WHERE MATCH (title,body) AGAINST ('database' WITH QUERY EXPANSION);
+----+-----------------------------+-----------------------------------+
| id | title                       | body                              |
+----+-----------------------------+-----------------------------------+
|  3 | Optimizing Your Database    | In this database tutorial ...     |
|  1 | MySQL Tutorial              | This database tutorial ...        |
|  6 | Database, Database, Database | database database database        |
|  5 | MySQL Security              | When configured properly, MySQL ... |
|  8 | MySQL Full-Text Indexes     | MySQL fulltext indexes use a ..   |
|  2 | How To Use MySQL            | After you went through a ...      |
|  4 | MySQL vs. YourSQL           | When comparing databases ...      |
|  7 | 1001 MySQL Tricks           | 1. Never run mysqld as root. 2. ... |
+----+-----------------------------+-----------------------------------+
8 rows in set (0.00 sec)
```

MySQL Full-Text Stopwords

- Stopwords for InnoDB Search Indexes
  - INFORMATION_SCHEMA.INNODB_FT_DEFAULT_STOPWORD table
  - innodb_ft_server_stopword_table/innodb_ft_user_stopword_table
- Stopwords for MyISAM Search Indexes
  - storage/myisam/ft_static.c
  - ft_stopword_file

Fine-Tuning MySQL Full-Text Search

```
mysql>
mysql>
mysql>
mysql> SELECT * FROM ft_myisam
    -> WHERE MATCH (title) AGAINST ('Security' IN NATURAL LANGUAGE MODE);
+----+---------------+-----------------------------------+
| id | title         | body                              |
+----+---------------+-----------------------------------+
|  5 | MySQL Security | When configured properly, MySQL ... |
+----+---------------+-----------------------------------+
1 row in set (0.00 sec)

mysql> SELECT * FROM ft_myisam;
+----+-------------------------------+-----------------------------------+
| id | title                         | body                              |
+----+-------------------------------+-----------------------------------+
|  1 | MySQL Tutorial                | This database tutorial ...        |
|  2 | How To Use MySQL              | After you went through a ...      |
|  3 | Optimizing Your Database      | In this database tutorial ...     |
|  4 | MySQL vs. YourSQL             | When comparing databases ...      |
|  5 | MySQL Security                | When configured properly, MySQL ... |
|  6 | Database, Database, Database | database database database        |
|  7 | 1001 MySQL Tricks             | 1. Never run mysqld as root. 2. ... |
|  8 | MySQL Full-Text Indexes       | MySQL fulltext indexes use a ..   |
+----+-------------------------------+-----------------------------------+
8 rows in set (0.00 sec)
```

Case Study

```
mysql> EXPLAIN SELECT COUNT(*) FROM articles
    -> WHERE MATCH (title,body)
    -> AGAINST ('database' IN NATURAL LANGUAGE MODE);
+----+-------------+-------+------+---------------+------+---------+------+------+
----------------------------+
| id | select_type | table | type | possible_keys | key  | key_len | ref  | rows |
 Extra                      |
+----+-------------+-------+------+---------------+------+---------+------+------+
----------------------------+
|  1 | SIMPLE      | NULL  | NULL | NULL          | NULL | NULL    | NULL | NULL |
 Select tables optimized away |
+----+-------------+-------+------+---------------+------+---------+------+------+
----------------------------+
1 row in set (0.00 sec)
    -> FROM articles;
+----+-------------+---------+------+---------------+------+---------+------+----
--+-------+
| id | select_type | table   | type | possible_keys | key  | key_len | ref  | row
s | Extra |
+----+-------------+---------+------+---------------+------+---------+------+----
--+-------+
|  1 | SIMPLE      | articles | ALL  | NULL          | NULL | NULL    | NULL |
6 | NULL  |
+----+-------------+---------+------+---------------+------+---------+------+----
--+-------+
1 row in set (0.00 sec)
```

Case Study

```
mysql> SELECT id, title, body, MATCH (title,body) AGAINST ('Security implications of running MySQL as root' IN NATURAL LANGUAGE MODE) AS score
    -> FROM articles
    -> WHERE MATCH (title,body) AGAINST('Security implications of running MySQL as root' IN NATURAL LANGUAGE MODE)
    -> ORDER BY MATCH (title,body) AGAINST('Security implications of running MySQL as root' IN NATURAL LANGUAGE MODE);
+----+-------------------------+-------------------------------------+-------------------+
| id | title                   | body                                | score             |
+----+-------------------------+-------------------------------------+-------------------+
|  1 | MySQL Tutorial          | This database tutorial ...          | 0.015609688125550747 |
|  2 | How To Use MySQL        | After you went through a ...        | 0.015609688125550747 |
|  4 | MySQL vs. YourSQL       | When comparing databases ...        | 0.015609688125550747 |
|  8 | MySQL Full-Text Indexes | MySQL fulltext indexes use a ..     | 0.031219376251101494 |
|  7 | 1001 MySQL Tricks       | 1. Never run mysqld as root. 2. ... |  0.8311812281608582 |
|  5 | MySQL Security          | When configured properly, MySQL ... |  0.8467909097671509 |
+----+-------------------------+-------------------------------------+-------------------+
6 rows in set (0.00 sec)
```

MySQL Full-Text Monitor

```
mysql> SHOW TABLES LIKE '%FT%';
+---------------------------------------+
| Tables_in_information_schema (%FT%) |
+---------------------------------------+
| INNODB_FT_DELETED                     |
| INNODB_FT_DEFAULT_STOPWORD            |
| INNODB_FT_INDEX_TABLE                 |
| INNODB_FT_BEING_DELETED               |
| INNODB_FT_INDEX_CACHE                 |
| INNODB_FT_CONFIG                      |
+---------------------------------------+
6 rows in set (0.00 sec)
```

- Variable:innodb_ft_aux_table

```
mysql> SET GLOBAL innodb_ft_aux_table = 'dbname/tablename';
Query OK, 0 rows affected (0.00 sec)
```

MySQL Full-Text Restrictions

- Full-text searches are supported for InnoDB and MyISAM tables only
- Full-text searches are not supported for partitioned tables
- Full-text indexes can be created only for CHAR, VARCHAR, or TEXT columns
- Ideographic languages limitations

MySQL Full-Text Restrictions

- All columns in a FULLTEXT index must use the same character set and collation.
- The MATCH() column list must match exactly the column definited in FULLTEXT index
- The argument to AGAINST() must be a string value
- Index hints are more limited for FULLTEXT searches than Non-FULLTEXT

Best Practices

- Drop FULLTEXT index before load large data sets
- InnoDB Full-Text Plugin
- InnoDB N-gram parser
- MeCab Parser

"Do NOT alter the MySQL sources unless you know what you are doing!!!"

Variables for MyISAM

- ft_boolean_syntax
- ft_max_word_len
- ft_min_word_len
- ft_query_expansion_limit
- ft_stopword_file

Variables for InnoDB

- innodb_ft_aux_table
- innodb_ft_cache_size
- innodb_ft_enable_diag_print
- innodb_ft_enable_stopword
- innodb_ft_max_token_size
- innodb_ft_min_token_size

Variables for InnoDB

- innodb_ft_num_word_optimize
- innodb_ft_result_cache_limit
- innodb_ft_server_stopword_table
- innodb_ft_sort_pll_degree
- innodb_ft_total_cache_size
- innodb_ft_user_stopword_table
- innodb_optimize_fulltext_only

Q & A