Database (ICE4016)

Week 12

Index

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Index

- 인덱스는 보조 접근 경로(secondary access path)를 제공하는 디스크상의 별도의 파일
- 기본파일 내에 있는 레코드들의 물리적인 위치에 영향을 끼치지 않으면서 인덱스 필드를 기반으로 레코드들을 효율적으로 탐색할 수 있는 별도의 탐색 경로를 제공
- 기본적으로 인덱스 생성을 위해 파일의 임의의 필드를 사용할 수 있음
- 서로 다른 필드에 대한 여러 인덱스 뿐만 아니라 다중 필드에 대한 인덱스들을 동일한 파일에 생성 가능
- 인덱스 각각은 탐색 속도를 향상시키기 위해 특정 자료구조를 사용함
  - B-Tree, Hash, Bitmap 등

Week 12 practice

Index

- 100만개 데이터를 활용하여 index 유무에 따른 검색 시간 비교
  - source c:/users/dilab/million_insert_queries.sql;

```
mysql> select count(*) from employee;
+----------+
| count(*) |
+----------+
|  1000000 |
+----------+
1 row in set (0.03 sec)
```

million_insert_queries.sql

```
1   CREATE DATABASE WEEK12;
2   USE WEEK12;
3
4   CREATE TABLE EMPLOYEE (
5       Fname VARCHAR(50),
6       Minit CHAR(1),
7       Lname VARCHAR(50),
8       Ssn CHAR(9),
9       Sex CHAR(1),
10      Salary INT,
11      Dno INT
12  );
13
14  INSERT INTO EMPLOYEE (Fna
15  INSERT INTO EMPLOYEE (Fna
16  INSERT INTO EMPLOYEE (Fna
17  INSERT INTO EMPLOYEE (Fna
18  INSERT INTO EMPLOYEE (Fna
19  INSERT INTO EMPLOYEE (Fna
20  INSERT INTO EMPLOYEE (Fna
```

Week 12 practice

- CREAT INDEX IndexName ON TableName (IndexColumns);

```
mysql> CREATE INDEX employee_on_Lname_Sex_Dno ON EMPLOYEE (Lname, Sex, Dno) USING BTREE;
Query OK, 0 rows affected (5.89 sec)
Records: 0  Duplicates: 0  Warnings: 0
```

- DROP INDEX IndexName ON TableName;

```
mysql> DROP INDEX employee_on_Lname_Sex_Dno ON EMPLOYEE;
Query OK, 0 rows affected (0.01 sec)
Records: 0  Duplicates: 0  Warnings: 0
```

- SHOW INDEX FROM TableName;

```
mysql> SHOW INDEX FROM EMPLOYEE;
+----------+------------+---------------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
| Table    | Non_unique | Key_name                  | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+----------+------------+---------------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
| employee |          1 | employee_on_Fname_Minit   |            1 | Fname       | A         |         732 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Fname_Minit   |            2 | Minit       | A         |         610 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Lname_Sex_Dno |            1 | Lname       | A         |         984 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Lname_Sex_Dno |            2 | Sex         | A         |        1846 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Lname_Sex_Dno |            3 | Dno         | A         |       19956 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
+----------+------------+---------------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
5 rows in set (0.00 sec)
```

Week 12 practice

Index 적용 전

```
mysql> select count(Fname) from employee where Lname="Lee";
+--------------+
| count(Fname) |
+--------------+
|         5514 |
+--------------+
1 row in set (0.65 sec)

mysql> select count(Fname) from employee where Lname="Kim";
+--------------+
| count(Fname) |
+--------------+
|         1748 |
+--------------+
1 row in set (0.64 sec)

mysql> select count(Fname) from employee where Lname="Park";
+--------------+
| count(Fname) |
+--------------+
|          753 |
+--------------+
1 row in set (0.66 sec)

mysql> select count(Fname) from employee where Lname="Brown";
+--------------+
| count(Fname) |
+--------------+
|        12740 |
+--------------+
1 row in set (0.64 sec)
```

Index 적용 후

```
mysql> select count(Fname) from employee where Lname="Lee";
+--------------+
| count(Fname) |
+--------------+
|         5514 |
+--------------+
1 row in set (0.01 sec)

mysql> select count(Fname) from employee where Lname="Kim";
+--------------+
| count(Fname) |
+--------------+
|         1748 |
+--------------+
1 row in set (0.01 sec)

mysql> select count(Fname) from employee where Lname="Park";
+--------------+
| count(Fname) |
+--------------+
|          753 |
+--------------+
1 row in set (0.00 sec)

mysql> select count(Fname) from employee where Lname="Brown";
+--------------+
| count(Fname) |
+--------------+
|        12740 |
+--------------+
1 row in set (0.03 sec)
```

Week 12 practice

- Primary, Unique key는 자동으로 인덱스 생성됨

```
mysql> desc department;
+-------------+-------------+------+-----+---------+-------+
| Field       | Type        | Null | Key | Default | Extra |
+-------------+-------------+------+-----+---------+-------+
| Id          | int         | NO   | PRI | NULL    |       |
| Name        | varchar(45) | NO   | UNI | NULL    |       |
| Email       | varchar(45) | NO   | UNI | NULL    |       |
| PhoneNumber | varchar(45) | NO   | UNI | NULL    |       |
+-------------+-------------+------+-----+---------+-------+
4 rows in set (0.00 sec)

mysql> show index from department;
+------------+------------+--------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
| Table      | Non_unique | Key_name           | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+------------+------------+--------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
| department |          0 | PRIMARY            |            1 | Id          | A         |           4 |     NULL |   NULL |      | BTREE      |         |               | YES     | NULL       |
| department |          0 | Name_UNIQUE        |            1 | Name        | A         |           4 |     NULL |   NULL |      | BTREE      |         |               | YES     | NULL       |
| department |          0 | Email_UNIQUE       |            1 | Email       | A         |           4 |     NULL |   NULL |      | BTREE      |         |               | YES     | NULL       |
| department |          0 | PhoneNumber_UNIQUE |            1 | PhoneNumber | A         |           4 |     NULL |   NULL |      | BTREE      |         |               | YES     | NULL       |
+------------+------------+--------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
4 rows in set (0.00 sec)
```

- Primary, Unique key의 자동으로 생성된 인덱스는 삭제 불가

```
mysql> drop index PRIMARY on department;
ERROR 1064 (42000): You have an error in your SQL
```

Week 12 practice

- ALTER TABLE table_name DROP PRIMARY KEY

```
mysql> ALTER TABLE room DROP PRIMARY KEY;
Query OK, 5 rows affected (0.03 sec)
Records: 5  Duplicates: 0  Warnings: 0

mysql> desc room;
+---------------+-------------+------+-----+---------+-------+
| Field         | Type        | Null | Key | Default | Extra |
+---------------+-------------+------+-----+---------+-------+
| id            | int         | NO   |     | NULL    |       |
| Name          | varchar(45) | NO   |     | NULL    |       |
| Capacity      | int         | NO   |     | NULL    |       |
| building_Id   | int         | NO   | MUL | NULL    |       |
| Department_Id | int         | YES  | MUL | NULL    |       |
+---------------+-------------+------+-----+---------+-------+
5 rows in set (0.00 sec)
```

- Foreign key로 사용 중인 Primary key

```
mysql> ALTER TABLE department DROP PRIMARY KEY;
ERROR 1553 (HY000): Cannot drop index 'PRIMARY': needed in a foreign key constraint
```

Week 12 Assignment

○ 아래 내용에 대한 보고서 작성

- STEP 1 : 10만명 이상의 학생을 INHA_DB에 INSERT하는 쿼리문 작성 (언어 사용 제한 없음)
- STEP 2 : SHOW INDEX (Cardinality), EXPLAIN (rows, filtered) 조사

```
mysql> SHOW INDEX FROM EMPLOYEE;
+----------+------------+-------------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
| Table    | Non_unique | Key_name                | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+----------+------------+-------------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
| employee |          1 | employee_on_Lname_Sex_Dno |            1 | Lname       | A         |         984 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Lname_Sex_Dno |            2 | Sex         | A         |        1846 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Lname_Sex_Dno |            3 | Dno         | A         |       19956 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Fname_Minit   |            1 | Fname       | A         |         732 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
| employee |          1 | employee_on_Fname_Minit   |            2 | Minit       | A         |         610 |     NULL |   NULL | YES  | BTREE      |         |               | YES     | NULL       |
+----------+------------+-------------------------+--------------+-------------+-----------+-------------+----------+--------+------+------------+---------+---------------+---------+------------+
5 rows in set (0.00 sec)

mysql> explain select count(Fname) from employee where Lname="Brown" and Dno = 10;
+----+-------------+----------+------------+------+---------------------------+---------------------------+---------+-------+------+----------+-------------+
| id | select_type | table    | partitions | type | possible_keys             | key                       | key_len | ref   | rows | filtered | Extra       |
+----+-------------+----------+------------+------+---------------------------+---------------------------+---------+-------+------+----------+-------------+
|  1 | SIMPLE      | employee | NULL       | ref  | employee_on_Lname_Sex_Dno | employee_on_Lname_Sex_Dno | 203     | const | 23214 |    10.00 | Using index condition |
+----+-------------+----------+------------+------+---------------------------+---------------------------+---------+-------+------+----------+-------------+
1 row in set, 1 warning (0.00 sec)
```

- STEP 3 : 10만명 이상의 학생을 INHA_DB에 INSERT 한 뒤 5개 이상의 INDEX 적용 전후 비교 및 분석