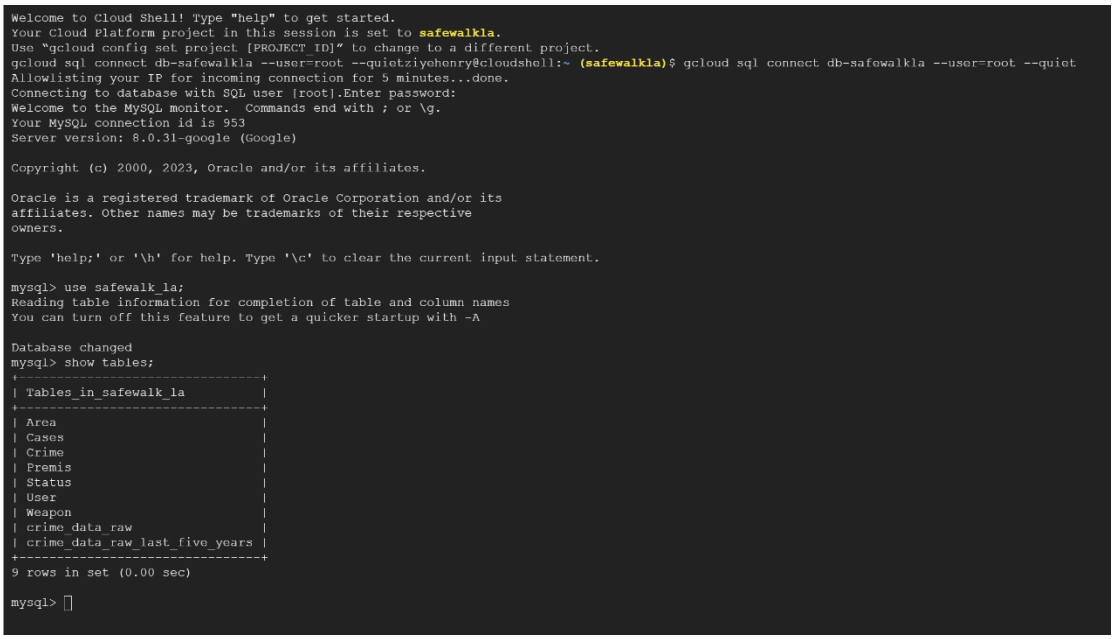
Team 042 – 411Go

Database Design & Implementation

Part 1:

1. Database implementation:



2. DDL used to create tables:

```
CREATE TABLE User (
    UserId CHAR(15) PRIMARY KEY,
    UserName VARCHAR(25),
    Email VARCHAR(50),
    PhoneNumber VARCHAR(20),
    Password VARCHAR(50)
);

CREATE TABLE Crime (
    CrimeCode INT PRIMARY KEY,
    CrimeCodeDesc VARCHAR(255),
    CrimeCode1 INT,
    CrimeCode2 INT,
    CrimeCode3 INT
);

CREATE TABLE Area (
    AreaCode INT PRIMARY KEY,
    AreaName VARCHAR(50)
```

```
);



CREATE TABLE Premis (
    PremisCode INT PRIMARY KEY,
    PremisDesc VARCHAR(255)
);

CREATE TABLE Weapon (
    WeaponUsedCode INT PRIMARY KEY,
    WeaponDesc VARCHAR(255)
);

CREATE TABLE Status (
    StatusCode VARCHAR(255) PRIMARY KEY,
    StatusDesc VARCHAR(255)
);

CREATE TABLE Cases (
    DR_NO INT PRIMARY KEY,
    DateReported VARCHAR(22),
    DateOccurred VARCHAR(22),
    TimeOccurred INT,
    RptDistNo INT,
    CrimeCode INT,
    CrimeCodeDesc VARCHAR(255),
    MOCode VARCHAR(255),
    VictimSex CHAR,
    VictimAge INT,
    VictimDescent VARCHAR(2),
    Status VARCHAR(255),
    WeaponUsed INT,
    Location VARCHAR(255),
    LAT DOUBLE,
    LON DOUBLE,
    AreaCode INT,
    FOREIGN KEY (CrimeCode) REFERENCES Crime (CrimeCode),
    FOREIGN KEY (Status) REFERENCES Status (StatusCode),
    FOREIGN KEY (WeaponUsed) REFERENCES Weapon
(WeaponUsedCode),
    FROEIGN KEY (AreaCode) REFERENECES Area (AreaCode)
);
```

3. Count of rows for three tables:
   # of rows for Cases:

```
mysql> select count(*) from Cases;
+----------+
| count(*) |
+----------+
|   317854 |
+----------+
1 row in set (0.05 sec)
```

   # of rows for Premis:

```
mysql> select count(*) from Premis;
+----------+
| count(*) |
+----------+
|     1121 |
+----------+
1 row in set (0.01 sec)
```

   # of rows for Area:

```
mysql> select count(*) from Area;
+----------+
| count(*) |
+----------+
|     1045 |
+----------+
1 row in set (0.00 sec)
```

4. Advanced Queries:
   Query 1:

```
mysql> select CrimeCodeDesc, count(1) CrimeTypeCnt
    -> from (
    -> select c.DR_NO, w.CrimeCode, w.CrimeCodeDesc
    -> from safewalk_la.Cases c
    -> left join safewalk_la.Crime w
    -> on c.CrimeCode = w.CrimeCode
    -> ) it
    -> group by CrimeCode
    -> LIMIT 15;
+-----------------------------------------------+--------------+
| CrimeCodeDesc                                 | CrimeTypeCnt |
+-----------------------------------------------+--------------+
| CRIMINAL HOMICIDE                             |          591 |
| MANSLAUGHTER, NEGLIGENT                       |            4 |
| RAPE, FORCIBLE                                |         1297 |
| RAPE, ATTEMPTED                               |          112 |
| ROBBERY                                       |        11158 |
| ATTEMPTED ROBBERY                             |         1799 |
| ASSAULT WITH DEADLY WEAPON, AGGRAVATED ASSAULT|        19341 |
| ASSAULT WITH DEADLY WEAPON ON POLICE OFFICER  |          531 |
| CHILD ABUSE (PHYSICAL) - AGGRAVATED ASSAULT   |          222 |
| INTIMATE PARTNER - AGGRAVATED ASSAULT         |         4704 |
| CHILD NEGLECT (SEE 300 W.I.C.)                |          424 |
| SHOTS FIRED AT MOVING VEHICLE, TRAIN OR AIRCRAFT |        185 |
| SHOTS FIRED AT INHABITED DWELLING             |          665 |
| BURGLARY                                      |        19954 |
| BURGLARY, ATTEMPTED                           |         1416 |
+-----------------------------------------------+--------------+
15 rows in set (2.09 sec)

mysql>
```

Query 2:

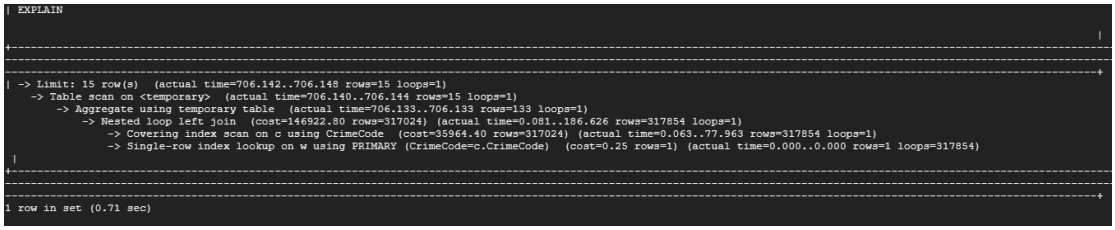
```
mysql> SELECT WeaponDesc  WeaponName, count(1) WeaponUsedCnt from( se
lect c.DR_NO, w.WeaponUsedCode WeaponID, WeaponDesc from safewalk_la.
Cases c left join safewalk_la.Weapon w on c.WeaponUsed=w.WeaponUsedCo
de ) it group by WeaponID LIMIT 15;
+----------------------------------+---------------+
| WeaponName                       | WeaponUsedCnt |
+----------------------------------+---------------+
|                                  |        201377 |
| REVOLVER                         |           520 |
| HAND GUN                         |          6910 |
| RIFLE                            |           178 |
| SHOTGUN                          |           140 |
| SAWED OFF RIFLE/SHOTGUN          |            14 |
| UNKNOWN FIREARM                  |          2397 |
| OTHER FIREARM                    |           280 |
| AUTOMATIC WEAPON/SUB-MACHINE GUN |             8 |
| SEMI-AUTOMATIC PISTOL            |          2553 |
| SEMI-AUTOMATIC RIFLE             |            15 |
| STARTER PISTOL/REVOLVER          |            11 |
| TOY GUN                          |            65 |
| SIMULATED GUN                    |           418 |
| AIR PISTOL/REVOLVER/RIFLE/BB GUN |           701 |
+----------------------------------+---------------+
15 rows in set (0.78 sec)
```

Part 2: Indexing

1.0

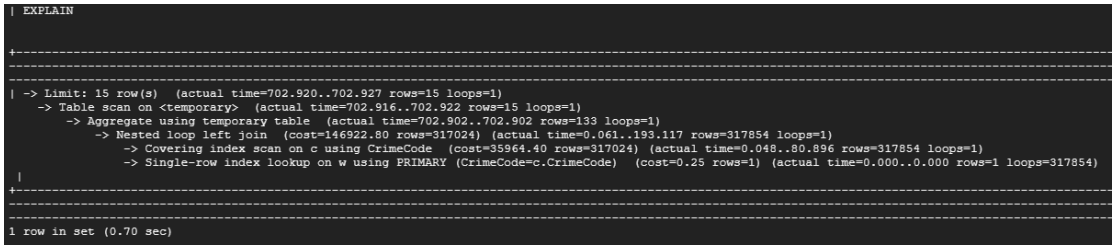
Code:

```
EXPLAIN ANALYZE
# Find most frequent crime type in all cases
select CrimeCodeDesc, count(1) CrimeTypeCnt
from (
	select c.DR_NO, w.CrimeCode, w.CrimeCodeDesc
	from safewalk_la.Cases c
	left join safewalk_la.Crime w
	on c.CrimeCode = w.CrimeCode
) it
group by CrimeCode
LIMIT 15;
```



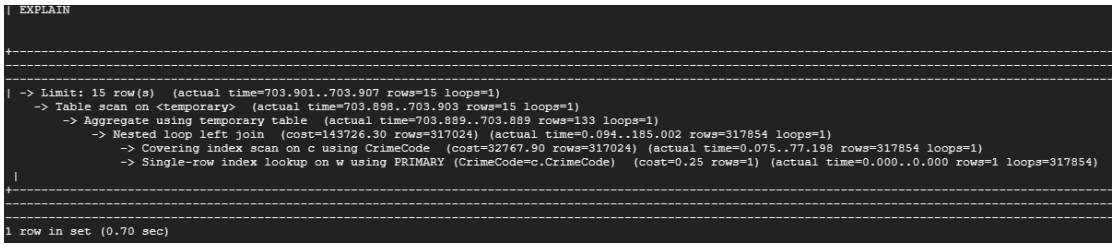
1.1

```
CREATE INDEX CrimeDesc_idx ON Crime (CrimeCodeDesc);
SHOW INDEX FROM Crime;
EXPLAIN ANALYZE ...;
DROP INDEX CrimeDesc_idx ON Crime;
```



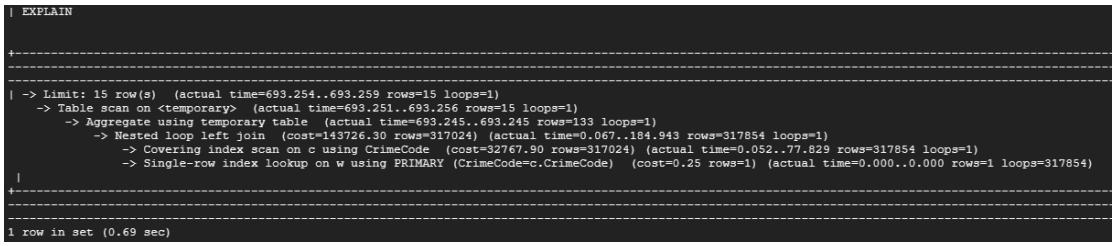
1.2

```
CREATE INDEX DateOccurred_idx ON Cases (DateOccurred);
SHOW INDEX FROM Cases;
EXPLAIN ANALYZE ...;
# DROP INDEX DateOccurred_idx ON Cases;
```



1.3

CREATE INDEX CrimeDesc_idx ON Crime (CrimeCodeDesc);
SHOW INDEX FROM Crime;
EXPLAIN ANALYZE ...;
DROP INDEX CrimeDesc_idx ON Crime;
DROP INDEX DateOccurred_idx ON Cases;



Analyze:

There's no significant difference improvement between those different ways of indexing. The reason may be that the selecting process only use CrimeCode which is the primary key of Crime table, so using Crime.CrimeCodeDesc and Cases.DateOccurred can't help with the speed of sorting results.

2.0

Code:

```
EXPLAIN ANALYZE
# Find most frequent weapon used in all cases
select WeaponDesc WeaponName, count(1) WeaponUsedCnt
from (
	select c.DR_NO, w.WeaponUsedCode WeaponID, WeaponDesc
	from safewalk_la.Cases c
	left join safewalk_la.Weapon w
	on c.WeaponUsed = w.WeaponUsedCode
) it
group by WeaponID
LIMIT 15;
```

---> 0.53 sec

```
mysql> EXPLAIN ANALYZE
    -> # Find most frequent weapon used in all cases
    -> select WeaponDesc WeaponName, count(1) WeaponUsedCnt
    -> from (
    ->     select c.DR_NO, w.WeaponUsedCode WeaponID, WeaponDesc
    ->     from safewalk_la.Cases c
    ->     left join safewalk_la.Weapon w
    ->     on c.WeaponUsed = w.WeaponUsedCode
    -> ) it
    -> group by WeaponID
    -> LIMIT 15;
+------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
| EXPLAIN


+------------------------------------------------------------------------------------------------
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------------------------------------------------------------------------------------------------
| -> Limit: 15 row(s)  (actual time=524.534..524.542 rows=15 loops=1)
    -> Table scan on <temporary>  (actual time=524.531..524.538 rows=15 loops=1)
        -> Aggregate using temporary table  (actual time=524.528..524.528 rows=79 loops=1)
            -> Nested loop left join  (cost=143726.30 rows=317024) (actual time=0.062..258.319 rows=317854 loops=1)
                -> Covering index scan on c using WeaponUsed  (cost=32767.90 rows=317024) (actual time=0.047..101.489 rows=317854 loops=1)
                -> Single-row index lookup on w using PRIMARY (WeaponUsedCode=c.WeaponUsed)  (cost=0.25 rows=1) (actual time=0.000..0.000 rows=1 loops=317854)
 |
+------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
1 row in set (0.53 sec)
```

2.1

First add index to WeaponUsedCode

CREATE INDEX WeaponID_idx ON Weapon (WeaponUsedCode);

SHOW INDEX FROM Weapon;

EXPLAIN ANALYZE ...;

DROP INDEX WeaponID_idx ON Weapon;

EXPLAIN ANALYZE ...;

---> 0.53 sec

```
------------------------------------------------------------------------------------------------
| EXPLAIN


+------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
| -> Limit: 15 row(s)  (actual time=524.534..524.542 rows=15 loops=1)
    -> Table scan on <temporary>  (actual time=524.531..524.538 rows=15 loops=1)
        -> Aggregate using temporary table  (actual time=524.528..524.528 rows=79 loops=1)
            -> Nested loop left join  (cost=143726.30 rows=317024) (actual time=0.062..258.319 rows=317854 loops=1)
                -> Covering index scan on c using WeaponUsed  (cost=32767.90 rows=317024) (actual time=0.047..101.489 rows=317854 loops=1)
                -> Single-row index lookup on w using PRIMARY (WeaponUsedCode=c.WeaponUsed)  (cost=0.25 rows=1) (actual time=0.000..0.000 rows=1 loops=317854)
 |
+------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
1 row in set (0.53 sec)
```

2.2

Then add index to Cases.DateReported, now two idx in total

CREATE INDEX DateReported_idx ON Cases (DateReported);

SHOW INDEX FROM Cases;

EXPLAIN ANALYZE ...;

---> 0.47 sec

```
------------------------------------------------------------------------------------------------
| EXPLAIN


+------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
| -> Limit: 15 row(s)  (actual time=458.722..458.730 rows=15 loops=1)
    -> Table scan on <temporary>  (actual time=458.719..458.727 rows=15 loops=1)
        -> Aggregate using temporary table  (actual time=458.715..458.715 rows=79 loops=1)
            -> Nested loop left join  (cost=143726.30 rows=317024) (actual time=0.131..192.673 rows=317854 loops=1)
                -> Covering index scan on c using Case_weapon_idx  (cost=32767.90 rows=317024) (actual time=0.107..85.598 rows=317854 loops=1)
                -> Single-row index lookup on w using PRIMARY (WeaponUsedCode=c.WeaponUsed)  (cost=0.25 rows=1) (actual time=0.000..0.000 rows=1 loops=317854)
 |
+------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------------
1 row in set (0.47 sec)
```

DROP INDEX DateReported_idx ON Cases;

2.3

Use another Case idx to replace the DateReported_idx, try it

CREATE INDEX Case_weapon_idx ON Cases (WeaponUsed);

SHOW INDEX FROM Cases;

---> 0.43 sec

DROP INDEX Case_weapon_idx ON Cases;

```
| EXPLAIN

+--------------------------------------------------------------------------------------------------------------------------------------
--------------------------------------------------------------------------------------------------------------------------------------
--------------------------------------------------------------------------------------------------------------------------------------
| -> Limit: 15 row(s)  (actual time=422.460..422.470 rows=15 loops=1)
    -> Table scan on <temporary>  (actual time=422.458..422.466 rows=15 loops=1)
        -> Aggregate using temporary table  (actual time=422.453..422.453 rows=79 loops=1)
            -> Nested loop left join  (cost=143726.30 rows=317024) (actual time=0.082..178.400 rows=317854 loops=1)
                -> Covering index scan on c using Case_weapon_idx  (cost=32767.90 rows=317024) (actual time=0.065..77.826 rows=317854 loops=1)
                -> Single-row index lookup on w using PRIMARY (WeaponUsedCode=c.WeaponUsed)  (cost=0.25 rows=1) (actual time=0.000..0.000 rows=1 loops=317854)
 |
+--------------------------------------------------------------------------------------------------------------------------------------
--------------------------------------------------------------------------------------------------------------------------------------
--------------------------------------------------------------------------------------------------------------------------------------
1 row in set (0.43 sec)
```

Analyze:

2.1 use the same parameter as primary so it won’t affect the processing speed. 2.2 used Cases.DateOccurr but its not quite relevant to the parameters used in query process so the improvement is limited. The main improvement appears as using Case_weapon_idx, which is exactly the parameter used in advance query.