INFS2200 Assignment

Roy Portas - 43560846

Task 1: Constraints

Part A

```
select * from USER_CONSTRAINTS;
```

Output:

```
OWNER
------------------------------------------------------------------------------------------------------------------------
SEARCH_CONDITION
--------------------------------------------------------------------------------
R_OWNER
------------------------------------------------------------------------------------------------------------------------
VALIDATED     GENERATED      BAD RELY LAST_CHAN INDEX_OWNER                    INDEX_NAME
------------- -------------- --- ---- --------- ------------------------------ ------------------------------
S4356084


VALIDATED     USER NAME               19/OCT/16 S4356084                       PK_BIRD_ID


OWNER
------------------------------------------------------------------------------------------------------------------------
SEARCH_CONDITION
--------------------------------------------------------------------------------
R_OWNER
------------------------------------------------------------------------------------------------------------------------
VALIDATED     GENERATED      BAD RELY LAST_CHAN INDEX_OWNER                    INDEX_NAME
------------- -------------- --- ---- --------- ------------------------------ ------------------------------
S4356084


VALIDATED     USER NAME               19/OCT/16 S4356084                       PK_ORGANISATION_ID


OWNER
------------------------------------------------------------------------------------------------------------------------
SEARCH_CONDITION
--------------------------------------------------------------------------------
R_OWNER
------------------------------------------------------------------------------------------------------------------------
VALIDATED     GENERATED      BAD RELY LAST_CHAN INDEX_OWNER                    INDEX_NAME
------------- -------------- --- ---- --------- ------------------------------ ------------------------------
S4356084


VALIDATED     USER NAME               19/OCT/16 S4356084                       PK_SPOTTER_ID
```

Part B

```
alter table SPOTTERS
add constraint FK_ORG_ID_TO_ORG_ID
foreign key (organisation_id) references ORGANISATIONS (organisation_id);

alter table SIGHTINGS
add constraint PK_SIGHTING_ID
PRIMARY KEY (sighting_id);

alter table SIGHTINGS
add constraint FK_SPOTTER_ID_TO_SPOTTER_ID
foreign key (spotter_id) references SPOTTERS (spotter_id);

alter table SIGHTINGS
add constraint FK_BIRD_ID_TO_BIRD_ID
foreign key (bird_id) references BIRDS (bird_id);

alter table ORGANISATIONS
modify ORGANISATION_NAME
constraint NN_ORGANISATION_NAME NOT NULL;

alter table SPOTTERS
modify SPOTTER_NAME
constraint NN_SPOTTER_NAME NOT NULL;

alter table SIGHTINGS
add constraint CK_SIGHTING_DATE
check (SIGHTING_DATE <= TO_DATE('2016-12-31', 'YYYY-MM-DD'));
```

Output:

```
Table altered.


Table altered.


Table altered.


Table altered.


Table altered.


Table altered.


Table altered.
```

Task 2: Triggers

Part A

```
create sequence SEQ_SIGHTINGS
start with 300000
increment by 1;

create or replace trigger TR_SIGHTING_ID
before insert on "SIGHTINGS"
for each row
begin
    select "SEQ_SIGHTINGS".NEXTVAL into :NEW.sighting_id from DUAL;
end;
/
```

Output:

```
Sequence created.

Trigger created.
```

Part B

```
create or replace trigger TR_SIGHTING_DESC
before insert on "SIGHTINGS"
for each row
begin
    if :NEW.latitude < -28.4 then
        /* Its less than the middle latitude, thus south */
        if :NEW.longitude < 151.25 then
            /* Its less than the middle longitude */
            select CONCAT(CONCAT('A bird of the species ', BIRD_NAME),
                          ' was spotted in the south-west part of the observation area' )
            into :NEW.DESCRIPTION from DUAL
            inner join BIRDS
            on BIRDS.BIRD_ID = :NEW.BIRD_ID;
        else
            /* Its greater than the middle longitude */
            select CONCAT(CONCAT('A bird of the species ', BIRD_NAME),
                          ' was spotted in the south-east part of the observation area' )
            into :NEW.DESCRIPTION from DUAL
            inner join BIRDS
            on BIRDS.BIRD_ID = :NEW.BIRD_ID;
        end if;
    else
        /* Its greater than the middle latitude */
        if :NEW.longitude < 151.25 then
            /* Its less than the middle longitude */
            select CONCAT(CONCAT('A bird of the species ', BIRD_NAME),
                          ' was spotted in the north-west part of the observation area' )
            into :NEW.DESCRIPTION from DUAL
            inner join BIRDS
            on BIRDS.BIRD_ID = :NEW.BIRD_ID;
        else
            /* Its greater than the middle longitude */
            select CONCAT(CONCAT('A bird of the species ', BIRD_NAME),
```

```
                        ' was spotted in the north-east part of the observation area' )
            into :NEW.DESCRIPTION from DUAL
            inner join BIRDS
            on BIRDS.BIRD_ID = :NEW.BIRD_ID;
        end if;
    end if;

end;
/
```

Output:

```
Trigger created.
```

Part C

```
INSERT INTO sightings (spotter_id, bird_id, latitude,
longitude, sighting_date)
VALUES (2457, 901, -28.0, 152, '09-MAR-2016');
INSERT INTO sightings (spotter_id, bird_id, latitude,
longitude, sighting_date)
VALUES (1024, 512, -25.6, 153, '09-MAR-2016');
```

Output:

```
1 row created.


1 row created.
```

Part D

```
select * from sightings where sighting_date = '09-MAR-2016';
```

Output:

```
SIGHTING_ID SPOTTER_ID    BIRD_ID   LATITUDE  LONGITUDE SIGHTING_
----------- ---------- ---------- ---------- ---------- ---------
DESCRIPTION
--------------------------------------------------------------------------------
     300000       2457        901        -28        152 09/MAR/16
A bird of the species Australian pied cormorant was spotted in the north-east part of the observation area

     300001       1024        512      -25.6        153 09/MAR/16
A bird of the species Mrs. Humes pheasant was spotted in the north-east part of the observation area
```

Task 3: Views

Part A

```
create or replace view V_ORGANISATION_BIRD_COUNT as select org.ORGANISATION_NAME, count(*) "bird_count"
from ORGANISATIONS org
inner join SPOTTERS sp
    on org.ORGANISATION_ID = sp.ORGANISATION_ID
inner join SIGHTINGS si
```

```
    on sp.SPOTTER_ID = si.SPOTTER_ID
group by ORGANISATION_NAME;
```

Output:

```
View created.
```

Part B

```
create materialized view MV_ORGANISATION_BIRD_COUNT as
select org.ORGANISATION_NAME, count(*) "bird_count"
from ORGANISATIONS org
inner join SPOTTERS sp
    on org.ORGANISATION_ID = sp.ORGANISATION_ID
inner join SIGHTINGS si
    on sp.SPOTTER_ID = si.SPOTTER_ID
group by ORGANISATION_NAME;
```

Output:

```
Materialized view created.
```

Part C

```
SELECT * FROM V_ORGANISATION_BIRD_COUNT;
```

```
ORGANISATION_NAME                                                  bird_count
------------------------------------------------------------------ ----------
Greenpeace                                                              33901
Department of Environmental Sciences                                    34457
Environmental Protection Agency                                         33195
Peoples Association for the Conservation of the Environment             34885
National Bird Observatory                                               32469
Royal Society for the Protection of Birds                               32899
National Bird Spotting Association                                      32792
Highlands Bird Watching Society                                         33294

8 rows selected.

Elapsed: 00:00:00.12
```

```
SELECT * FROM MV_ORGANISATION_BIRD_COUNT;
```

```
ORGANISATION_NAME                                                  bird_count
------------------------------------------------------------------ ----------
Greenpeace                                                              33901
Department of Environmental Sciences                                    34457
Environmental Protection Agency                                         33195
Peoples Association for the Conservation of the Environment             34885
National Bird Observatory                                               32469
Royal Society for the Protection of Birds                               32899
National Bird Spotting Association                                      32792
Highlands Bird Watching Society                                         33294

8 rows selected.

Elapsed: 00:00:00.05
```

Task 4: Function Based Indexes

Part A

```
select SIGHTING_ID, sqrt(power((LATITUDE + -28), 2) + power((LONGITUDE + 151), 2))
as DISTANCE from SIGHTINGS;
```

```
     265843 306.643935
     265844 308.192986
     265845 306.452793
     265846 307.701141
     265847 307.710867
     265848 308.670027
     265849 306.562374
     265850 308.556821
     265851 308.068268
     265852 308.683945
     265853 306.170567

SIGHTING_ID   DISTANCE
---------- ----------
     265854 307.420503
     265855 307.958362
     265856 306.923612
     265857 305.963061
     265858 308.229412
     265859 308.153449
     265860 308.259124
     265861 308.242701
     265862 308.333024
     265863 307.033918
     263764 308.669053

SIGHTING_ID   DISTANCE
---------- ----------
     263765 305.911499
     263766 308.560455
     263767  307.44016
     263768 307.821969
     263769  308.05148
     263770  306.18204
     263771 306.527573
     263772 306.803138
     263773 307.494552

267892 rows selected.

Elapsed: 00:01:23.05
```

Part B

```
create index IDX_HEADQUARTERS_DISTANCE on
SIGHTINGS(sqrt(power((LATITUDE + -28), 2) + power((LONGITUDE + 151), 2)));
```

Part C

```
select SIGHTING_ID, sqrt(power((LATITUDE + -28), 2) + power((LONGITUDE + 151), 2))
as DISTANCE from SIGHTINGS;
```

```
     265851 308.068268
     265852 308.683945
     265853 306.170567

SIGHTING_ID   DISTANCE
---------- ----------
     265854 307.420503
     265855 307.958362
     265856 306.923612
     265857 305.963061
     265858 308.229412
     265859 308.153449
     265860 308.259124
     265861 308.242701
     265862 308.333024
     265863 307.033918
     263764 308.669053

SIGHTING_ID   DISTANCE
---------- ----------
     263765 305.911499
     263766 308.560455
     263767  307.44016
     263768 307.821969
     263769  308.05148
     263770  306.18204
     263771 306.527573
     263772 306.803138
     263773 307.494552

267892 rows selected.

Elapsed: 00:01:09.38
```

The index will be indexing the queries, so when the database goes to calculate the distance, it will first look up the equation in the index, and return the precomputed value if found.

We don't get massive performance boosts because a lot of the distances are unique. However if there was many duplicates, such as birds at the exact same position, there would be more noticable improvments.

Task 5: Execution Plan and Analysis

Part A

```sql
explain plan for select SIGHTING_ID, SPOTTER_NAME, SIGHTING_DATE
from SIGHTINGS
inner join SPOTTERS
    on SPOTTERS.SPOTTER_ID = SIGHTINGS.SPOTTER_ID
where SIGHTINGS.SPOTTER_ID = 1255;

SELECT PLAN_TABLE_OUTPUT FROM TABLE (DBMS_XPLAN.DISPLAY);
```

```
PLAN_TABLE_OUTPUT
--------------------------------------------------------------------------------------------------
Plan hash value: 4071757951

--------------------------------------------------------------------------------------------------
| Id  | Operation                     | Name          | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |               |    82 |  6150 |  1402   (1)| 00:00:17 |
|   1 |  NESTED LOOPS                 |               |    82 |  6150 |  1402   (1)| 00:00:17 |
|   2 |   TABLE ACCESS BY INDEX ROWID| SPOTTERS      |     1 |    40 |     0   (0)| 00:00:01 |
|*  3 |    INDEX UNIQUE SCAN          | PK_SPOTTER_ID |     1 |       |     0   (0)| 00:00:01 |
|*  4 |   TABLE ACCESS FULL           | SIGHTINGS     |    82 |  2870 |  1402   (1)| 00:00:17 |
--------------------------------------------------------------------------------------------------

PLAN_TABLE_OUTPUT
--------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   3 - access("SPOTTERS"."SPOTTER_ID"=1255)
   4 - filter("SIGHTINGS"."SPOTTER_ID"=1255)

Note
-----
   - dynamic sampling used for this statement (level=2)

21 rows selected.

Elapsed: 00:00:00.59
```

The query plan can be described as a series of steps:

1. Run a index scan on the `SPOTTER_ID` in the `SPOTTERS` table to evaluate the where clause
2. Rows are located by the `ROWID` index in the `SPOTTERS` table and the the entire `SIGHTINGS` table is read
3. The `SPOTTERS` table becomes the outer loop and the `SIGHTINGS` table becomes the inner loop, it then joins the tables with a nested loop
4. Apply the select statement on the result

Part B

```
alter table SIGHTINGS
drop constraint FK_SPOTTER_ID_TO_SPOTTER_ID;

alter table SPOTTERS
drop constraint PK_SPOTTER_ID;

explain plan for select SIGHTING_ID, SPOTTER_NAME, SIGHTING_DATE
from SIGHTINGS
inner join SPOTTERS
    on SPOTTERS.SPOTTER_ID = SIGHTINGS.SPOTTER_ID
where SIGHTINGS.SPOTTER_ID = 1255;

SELECT PLAN_TABLE_OUTPUT FROM TABLE (DBMS_XPLAN.DISPLAY);
```