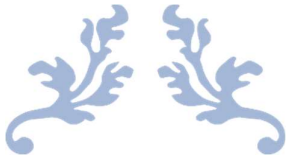

DATABASE DESIGN AND IMPLEMENTATION ASSIGNMENT

Object-Relational Databases - 42901

OCTOBER 14, 2019

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Introduction

The main objective of the report is to design and implement the Online Music Database(OMDB) using the Oracle SQL Developer. OMDB stores the information of variety of music albums. It is like a online music store where the people can buy the albums as they wish.

The music is available for different formats, genre, artists, duration, cost, tracks etc. The database was populated with different songs considering all these factors. The users can fetch the data inserted based on different formats of the album (vinyl, compact disc(CD) and MP3), duration(of the album in minutes), genre(like Jazz, metal, rock, pop, classical), release date, reviews, price etc. Usually the albums in vinyl format are costlier compared to CD's and MP3 and all the data is fed into the database corresponding to the format of the albums. The data organised in the database is represented in Entity-Relationship Diagram(ERD) using Oracle Data Modeler which is then converted to Relational Model.

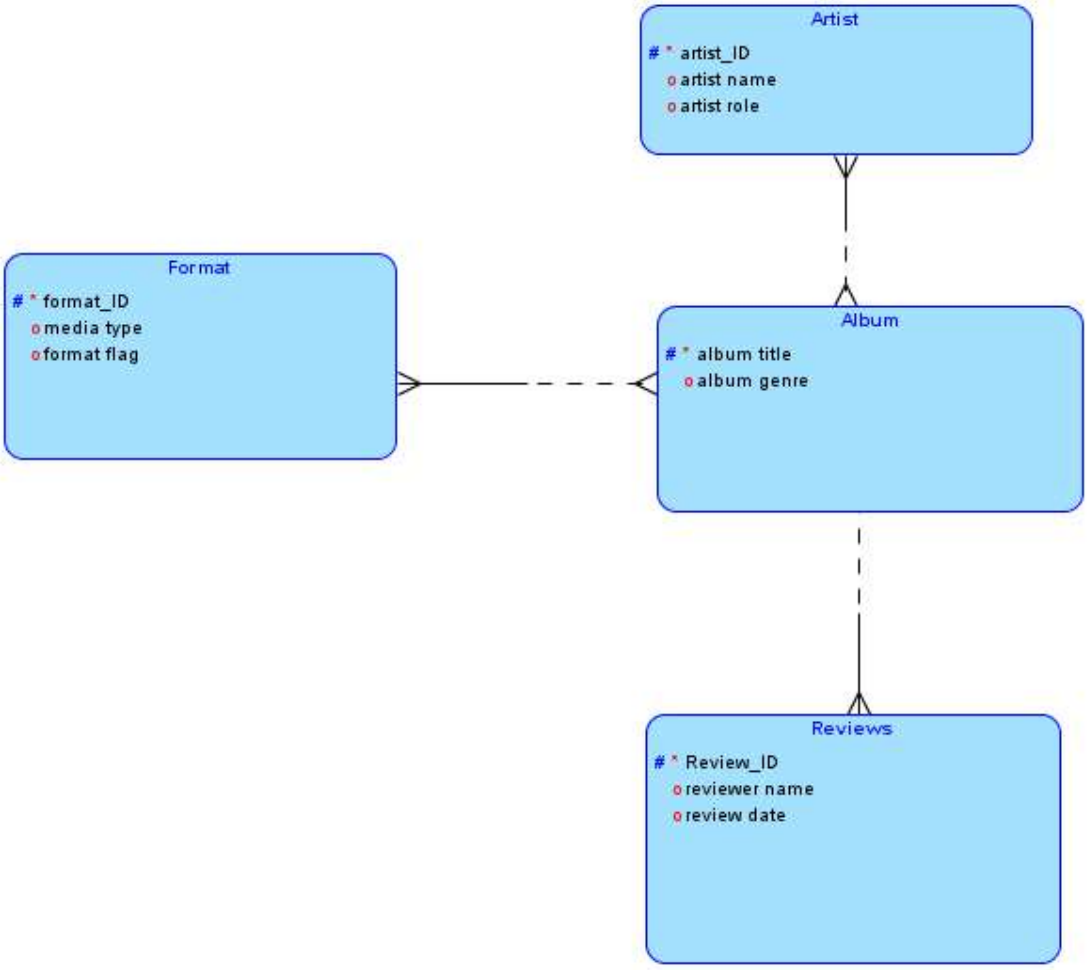
SQL queries are written to populate the database with the provided albums data and SQL script. After this stage the database is filled with a valid and retrievable albums data. The following sections are outputs to the queries asked and appendix containing the code.

Entity Relationship Model and Relational Design

The ERD is modelled based on the music database requirements. The entities, attributes, identifiers and their cardinalities are all represented, according to Barker notations. The results of the scenario described are given below:

1. The entities used below are artist, album, format and reviews.
2. IDs were created for artist, as names can be similar and so can roles.
3. IDs were created for format as mediatype can be repetitive.
4. IDs for review were created since no suitable identifier could be found.
5. Depending on whether unique values are present in each of these enitites, we can choose appropriate identifiers.
6. Album enitity has album title as the identifier and primary key.
7. For all the above, we use new unique ID's in the case no unique ID's are present inherently.
8. Album entity has the title and genre the album belongs to. It is the main entity through which all other are related.
9. Format entity has the media types of the albums. An album can have different media types such as vinyl, audio CD and mp3, and a media type can belong to many albums.
10. The review entity is related to Album as, a title can have many reviews. Since using the ID for the enitity, there is only one side to the relationship cardinality. A title can or cannot have a review.
11. Artist shows that, a title can have many artists collaborating on it. The artists can also work on other album titles. There is a many to many relationship cardinality.

We see the logical model of the scenario in the form of the ER-diagram below. The relationships are given w.r.t the transactions occuring between the entities.

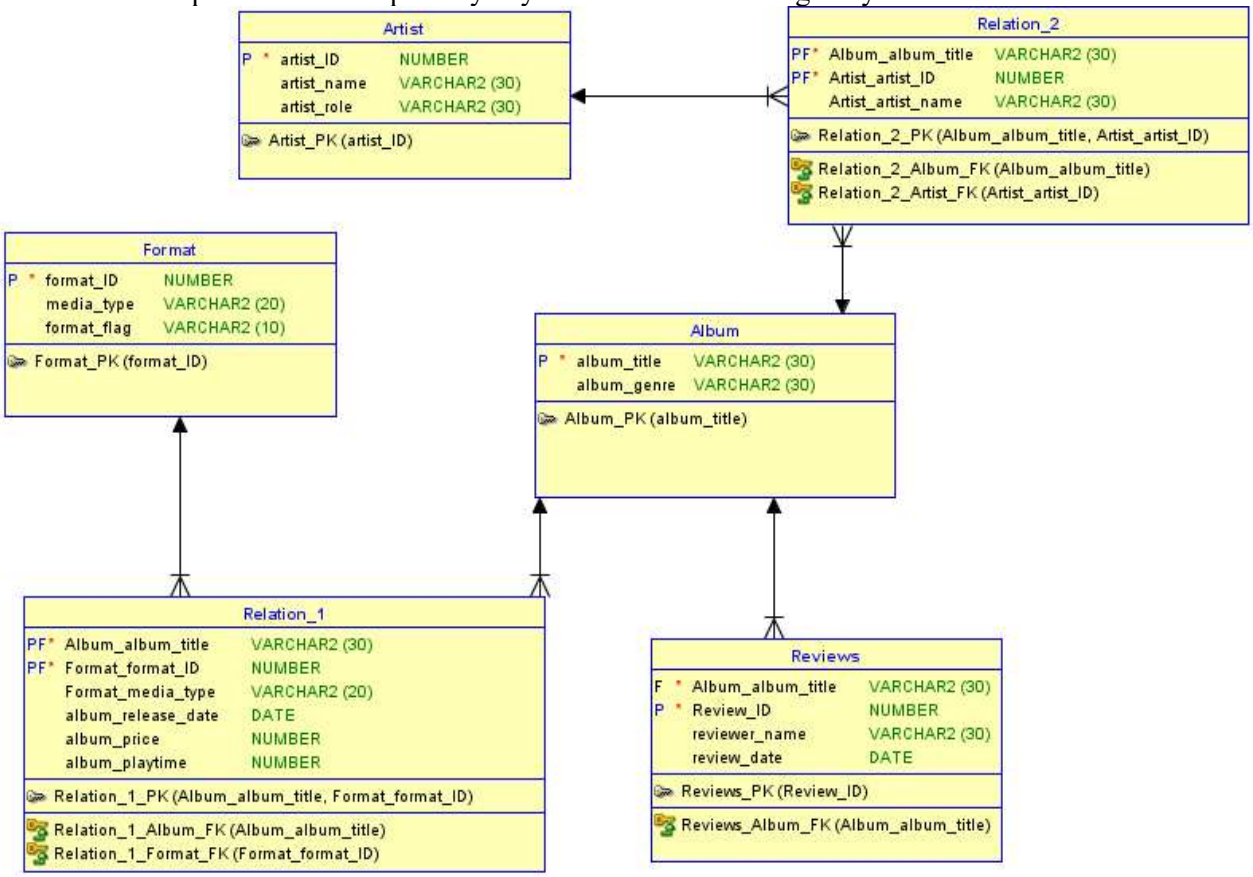


Relational Model

We convert the logical model of the ERD into a relational model and its corresponding tables. The entities in both ERD model and Relational mode are typed. We have further ensured that the model follows Boyce Codd Normal Form.
Key Points:

1. We use association tables to show how the entities are related, especially in a many to many relationships.

2. The relationships shown in association tables tell us how the transaction will work and also if the model adheres to BCNF.
3. In the relation between Artist and Album types, we can see that the unique ID of each artist is related to the particular album title they worked on. In the relation between Album and Format types, we see that they are related through the album title and format ID, which is unique and simple. There are many attributes that work between the Album and Format types to make a transaction possible. They could be attributes like release date, album price etc.,
4. The reviews table is unique in a way that it forms a nested table within the Album type. It is seen that it only depends on Album entity and hence there exists a single relationship direction. The primary key of Album is the foreign key of Review table.



OMDB Object-Relational Implementation

After analysing the given data in the form of an ERD and relational model, the object relational model is also considered.

Insert statements are used to populate the Online Music Database with the data provided in OMDB.text file. Appropriate queries are used to call and view the required data.

Appendix

```
-- create OMDB --
-----------------
-- drop tables --
drop table albums
/
drop type disk_type
/
drop type mp3_type
/
drop type album_type
/
drop type artist_array_type
/
drop type artist_type
/
drop type review_table_type
/
drop type review_type
/
-- create types --
create or replace type artist_type as object
(artistName     varchar(50),
 artistRole     varchar(25))
/
create type artist_array_type
as varray(5) of artist_type
/
create or replace type review_type as object
(reviewerName          varchar(25),
 reviewDate    date,
 reviewText    varchar(250),
 reviewScore   number)
/
create or replace type review_table_type as table of review_type
/
create or replace type album_type as object
(albumTitle             varchar(50),
 albumPlaytime                  number(3), -- minutes
 albumReleaseDate    date,
 albumGenre             varchar(15),
 albumPrice             number(9,2),
 albumTracks            number(2),
 albumArtists           artist_array_type,
 albumReviews                   review_table_type,
member function discountPrice return number,
```

```
member function containsText (pString1 varchar2, pString2 varchar2) return integer)
not instantiable not final
/
create or replace type disk_type under album_type
( mediaType             varchar(10),
 diskNum                        number(2), -- number of disks
 diskUsedPrice                  number(9,2),
 diskDeliveryCost       number(9,2),
overriding member function discountPrice return number)
/
create or replace type mp3_type under album_type
(downloadSize           number, -- size in MB
 overriding member function discountPrice return number)
/
-- create tables --
create table albums of album_type
object id system generated
nested table albumReviews store as store_reviews
/

insert into albums
values(disk_type('The Essential Bob Dylan',99,'8-Jul-2016','Pop',37.00,32,
artist_array_type(
artist_type('Bob Dylan','Composer'),
artist_type('Bob Dylan','Vocals')),
review_table_type(
review_type('Shawn','24-Jul-2018', 'Wife loved it!',5),
review_type('Reuben','2-Aug-2019', 'Great compilation of some of his most known songs',5)),
'Vinyl', 2,'',11.00))
/
insert into albums
values(disk_type('Sketches of Spain',45,'8-Mar-2011','Jazz',14.99,6,
artist_array_type(
artist_type('Miles Davis','Composer'),
artist_type('Miles Davis','Musician')),
review_table_type(
review_type('Frederick','16-Sep-2016', 'Recommend listening while viewing a sunset.',5),
review_type('Juliet','12-Mar-2018','Early days of The Great Miles--no lover of jazz should be
without this album.',5)),
'Vinyl',1 ,16.29,7.00))
/
insert into albums
values(disk_type('Bob Dylans Greatest Hits',45,'31-Jan-2017','Pop Rock',29.87,10,
artist_array_type(
artist_type('Bob Dylan','Composer'),
artist_type('Bob Dylan','Vocals')),
review_table_type(
review_type('Kandy','16-Mar-2015', 'Early Dylan in all his glory.',5),
review_type('Stewart','18-Feb-2013', 'Captures Bob Dylan transformation from a folk song
Composer to a rock legend',4)),
```

```
'Vinyl',1 ,'',11.00))
/
insert into albums
values(disk_type('Harvest (2009 Remaster)',44,'21-Jun-2009','Rock Country',28.50,10,
artist_array_type(
artist_type('Neil Young','Composer'),
artist_type('Neil Young','Vocals')),
review_table_type(
review_type('John','18-Feb-2019', 'I absolutely LOVE this CD!',5),
review_type('Stewart','18-Feb-2013', 'Sounds good on vinyl!',5)),
'Vinyl',1 ,14.99,11.00))
/
insert into albums
values(disk_type('Kind Of Blue (Legacy Edition)',155,'20-Jan-2009','Jazz',19.99,21,
artist_array_type(
artist_type('Miles Davis','Composer'),
artist_type('Miles Davis','Musician')),
review_table_type(
review_type('Laurence','10-Sep-2014', 'Very very special recording.',5)),
'Vinyl',3 ,16.99,10.00))
/
insert into albums
values(disk_type('Harvest (2009 Remaster)',44,'21-Jun-2009','Rock Country',10.50,10,
artist_array_type(
artist_type('Neil Young','Composer'),
artist_type('Neil Young','Vocals')),
review_table_type(
review_type('John','18-Feb-2019', 'I absolutely LOVE this CD!',5),
review_type('Anthony','16-Aug-2019', 'Neil Youngs signature album.',4)),
'Audio CD',1 ,4.99,11.00))
/
insert into albums
values(disk_type('The Essential Bob Dylan',99,'8-Jul-2016','Pop',26.17,32,
artist_array_type(
artist_type('Bob Dylan','Composer'),
artist_type('Bob Dylan','Vocals')),
review_table_type(
review_type('Christopher','24-Jun-2016', 'This is a terrific album.',5),
review_type('Cauley','2-Aug-2015', 'There can only be one Bob Dylan. God blessed him with
the gift of verse.',5)),
'Audio CD',2 ,'',7.00))
/
insert into albums
values(disk_type('Bob Dylans Greatest Hits',50,'1-Jun-1999','Pop Rock',20.81,10,
artist_array_type(
artist_type('Bob Dylan','Composer'),
artist_type('Bob Dylan','Vocals')),
review_table_type(
review_type('Kandy','16-Mar-2015', 'Early Dylan in all his glory.',5),
```

```
review_type('Stewart','18-Feb-2013', 'Captures Bob Dylan transformation from a folk song composer to a rock legend.',4)),
'Audio CD ',1 ,'',7.00))
/
insert into albums
values(disk_type('Kind Of Blue (Legacy Edition)',155,'20-Jan-2009','Jazz',19.99,21,
artist_array_type(
artist_type('Miles Davis','Composer'),
artist_type('Miles Davis','Musician')),
review_table_type(
review_type('Amy','17-Apr-2018', 'Poor quality sound compared to the vinyl record.',2)),
'Audio CD',3 ,16.99,10.00))
/
insert into albums
values(disk_type('Sketches of Spain',45,'20-Jan-2009','Jazz',3.11,6,
artist_array_type(
artist_type('Miles Davis','Composer'),
artist_type('Miles Davis','Musician')),
review_table_type(
review_type('Sara','3-Oct-2016', 'Another Must Have! One of Miles finest works.',5),
review_type('Douglas','14-Jun-2014', 'You might like it, but I admit it seems like a difficult listen.',5)),
'Audio CD',1 ,6.41,7.00))
/
insert into albums
values(disk_type('Gustav Mahler Symphony No. 9',45,'12-Oct-2017','Classical',23.10,5,
artist_array_type(
artist_type('David Zinman','Conductor'),
artist_type('Gustav Mahler','Composer'),
artist_type('Tonhalle Orchestra','Orchestra')),
review_table_type(
review_type('Lindon','3-Dec-2010', 'This is an uneventful but fine recording.',3),
review_type('Prescott','24-Aug-2013', 'This is truly a spellbinding record.',5)),
'Audio CD',1,15.20,7.00))
/
insert into albums
values(mp3_type('Bob Dylans Greatest Hits',55,'1-Jan-2019','Pop Rock',5.98,10,
artist_array_type(
artist_type('Bob Dylan','Composer'),
artist_type('Bob Dylan','Vocals')),
review_table_type(
review_type('Mandy','16-Mar-2019', 'Fantastic music!',5)),
60))
/
insert into albums
values(mp3_type('Best of Neil Young',153,'21-Feb-2019','Pop Rock',17.50,35,
artist_array_type(
artist_type('Neil Young','Composer'),
artist_type('Neil Young','Vocals')),
review_table_type(
```

```
review_type('John','16-Apr-2019', 'Great artist and great music.',5)),
165))
/
insert into albums
values(mp3_type('Harvest (2009 Remaster)',44,'21-Jun-2009','Rock Country',9.49,10,
artist_array_type(
artist_type('Neil Young','Composer'),
artist_type('Neil Young','Vocals')),
review_table_type(
review_type('John','16-Apr-2019', 'Great artist and great music.',5)),
52))
/
insert into albums
values(mp3_type('Sketches of Spain',45,'16-Aug-2013','Jazz',24.99,6,
artist_array_type(
artist_type('Miles Davis','Composer'),
artist_type('Miles Davis','Musician')),
review_table_type(
review_type('Douglas','14-Jun-2014', 'You might like it but I admit it seems like a difficult listen.',5)),
51))
/
insert into albums
values(mp3_type('B.B. King Greatest Hits',114,'16-Jul-2013','Rock Blues',11.49,24,
artist_array_type(
artist_type('B.B. King','Vocals'),
artist_type('B.B. King','Guitar')),
review_table_type(
review_type('David','18-May-2015', 'I highly recommend this album to anyone who want to see what BB King is all about.',4)),
125))
/
insert into albums
values(mp3_type('The Essential Bob Dylan',99,'8-Jul-2016','Pop',16.00,32,
artist_array_type(
artist_type('Bob Dylan','Composer'),
artist_type('Bob Dylan','Vocals')),
review_table_type(
review_type('Christopher','24-Jun-2016', 'This is a terrific album.',5),
review_type('Cauley','2-Apr-2015', 'There can only be one Bob Dylan. God blessed him with the gift of verse',5)),
112))
/
insert into albums
values(mp3_type('Other Peoples Lives',42,'15-Feb-2019','Rock Dance',9.49,10,
artist_array_type(
artist_type('Stats','Composer'),
artist_type('Stats','Vocals')),
review_table_type(
review_type('George','17-Sep-2019', 'Good dancing music.',3)),
```

45))

/

```
Table ALBUMS dropped.

Type DISK_TYPE dropped.

Type MP3_TYPE dropped.

Type ALBUM_TYPE dropped.

Type ARTIST_ARRAY_TYPE dropped.

Type ARTIST_TYPE dropped.

Type REVIEW_TABLE_TYPE dropped.

Type REVIEW_TYPE dropped.
```

```
Type ARTIST_TYPE compiled

Type ARTIST_ARRAY_TYPE compiled

Type REVIEW_TYPE compiled

Type REVIEW_TABLE_TYPE compiled

Type ALBUM_TYPE compiled

Type DISK_TYPE compiled

Type MP3_TYPE compiled

Table ALBUMS created.
```

Queries and Results

Q1 Give album title, album release date and album price of all Neil Young's albums released after
1st January 2015.

Worksheet | Query Builder

```
240
241  select distinct a.albumtitle,a.albumreleasedate,a.albumprice
242  from albums a, table(a.albumartists) v
243  where v.artistname =('Neil Young') and
244  a.albumreleasedate>('1-Jan-2015');
245
```

	ALBUMTITLE	ALBUMRELEASEDATE	ALBUMPRICE
1	Best of Neil Young	21-02-19	17.5

Q2 Give album title and artist name for albums released only in MP3 format. Order by album title.

Worksheet | Query Builder

```
248  select distinct a.albumtitle, v.artistname
249  from albums a, table(a.albumartists) v
250  where value(a) IS OF (mp3_type) order by a.albumtitle;
251
```

	ALBUMTITLE	ARTISTNAME
1	B.B. King Greatest Hits	B.B. King
2	Best of Neil Young	Neil Young
3	Bob Dylans Greatest Hits	Bob Dylan
4	Harvest (2009 Remaster)	Neil Young
5	Other Peoples Lives	Stats
6	Sketches of Spain	Miles Davis
7	The Essential Bob Dylan	Bob Dylan

Q3 Give lowest rated MP3 album (i.e. album with the lowest average review score). Show album
title and the average score. Exclude albums with only one review.

Worksheet | Query Builder

```
255 select a.albumtitle as albumtitle, min(v.reviewscore) as rev
256 from albums a,table(a.albumreviews) v
257 where value(a)is of (mp3_type)
258
259 and v.reviewscore=(select avg(reviewscore)
260 from table(a.albumreviews)
261 where value(a) is of (mp3_type))
262
263 group by albumtitle having count(*)>1;
```

	ALBUMTITLE	REV
1	The Essential Bob Dylan	5

Q4 Are there any albums released on all media, i.e. on MP3, audio CD and vinyl? Show album title and order by album title.

Worksheet | Query Builder

```
267 select distinct a.albumtitle
268 from albums a, albums b,albums c
269 where treat (value(a) as disk_type).mediatype='Vinyl'
270 and treat (value(b) as disk_type).mediatype='Audio CD'
271 and value(c) is of (mp3_type)
272 and a.albumtitle=c.albumtitle
273 order by a.albumtitle;
```

	ALBUMTITLE
1	Bob Dylans Greatest Hits
2	Harvest (2009 Remaster)
3	Sketches of Spain
4	The Essential Bob Dylan

Q5. Implement the method discountPrice() that returns a discounted price using the following business rule:

a. for audio CDs released more than one year ago the discount is 20%
b. for vinyl records released more than one year ago the discount is 15%
c. for MP3 downloads released more than two years ago the discount is 10%

```
create or replace type body album_type as
member function discountPrice return number is
begin
    return albumPrice;
end discountPrice;
end;

/

create or replace type body disk_type as
overriding member function discountPrice return number is
price number;
begin
    if mediaType = 'Vinyl' and (sysdate - albumreleasedate) > 365  THEN
        price:= albumPrice*0.85;
    ELSIF mediaType = 'Audio CD' and (sysdate - albumreleasedate) > 365 THEN
        price:= albumPrice*0.8;
    ELSE
        price:= albumPrice;
    end if;
    return price;
end discountPrice;
end;

/

create or replace type body mp3_type as
overriding member function discountPrice return number is
price number;
begin
    if (sysdate - albumreleasedate) > 730  THEN
        price:= albumPrice*0.9;
    else
        price:= albumPrice;
    end if;
    return price;
end discountPrice;
end;

/

select k.albumTitle albumTitle,
k.albumReleaseDate albumReleaseDate,
k.albumPrice albumPrice,
k.discountPrice() discountPrice
from albums k
```

	ALBUMTITLE	ALBUMRELEASEDATE	ALBUMPRICE	DISCOUNTPRICE
1	The Essential Bob Dylan	08-07-16	37	31.45
2	Sketches of Spain	08-03-11	14.99	12.7415
3	Bob Dylans Greatest Hits	31-01-17	29.87	25.3895
4	Harvest (2009 Remaster)	21-06-09	28.5	24.225
5	Kind Of Blue (Legacy Edition)	20-01-09	19.99	16.9915
6	Harvest (2009 Remaster)	21-06-09	10.5	8.4
7	The Essential Bob Dylan	08-07-16	26.17	20.936
8	Bob Dylans Greatest Hits	01-06-99	20.81	20.81
9	Kind Of Blue (Legacy Edition)	20-01-09	19.99	15.992
10	Sketches of Spain	20-01-09	3.11	2.488
11	Gustav Mahler Symphony No. 9	12-10-17	23.1	18.48
12	Bob Dylans Greatest Hits	01-01-19	5.98	5.98
13	Best of Neil Young	21-02-19	17.5	17.5
14	Harvest (2009 Remaster)	21-06-09	9.49	8.541
15	Sketches of Spain	16-08-13	24.99	22.491
16	B.B. King Greatest Hits	16-07-13	11.49	10.341
17	The Essential Bob Dylan	08-07-16	16	14.4
18	Other Peoples Lives	15-02-19	9.49	9.49

Q6. Create a view all_albums that includes the columns: album title, media type ('MP3', 'Vinyl',
'Audio CD'), album price, and discount (album price – discount price). Use this view to find the album that received the largest discount; show all view columns.

```
create view all_albums(albumtitle,mediatype,albumprice,discount)as
select distinct l.albumTitle , treat (value(l) as disk_type).mediatype,
l.albumPrice ,l.albumprice-l.discountPrice() as discount
from albums l where treat (value(l) as disk_type).mediatype='Vinyl'

union

select distinct m.albumTitle , treat (value(m) as disk_type).mediatype,
m.albumPrice ,m.albumprice-m.discountPrice() as discount
from albums m where treat (value(m) as disk_type).mediatype='Audio CD'

union

select distinct n.albumTitle, 'mp3',
n.albumPrice ,n.albumprice-n.discountPrice() as discount
from albums n
where value(n) is of (mp3_type);

select * from all_albums where
discount=(select max(discount) from all_albums);
```

Result of highest discount received

	ALBUMTITLE	MEDIATYPE	ALBUMPRICE	DISCOUNT
1	The Essential Bob Dylan	Vinyl	37	5.55

All view columns

	ALBUMTITLE	MEDIATYPE	ALBUMPRICE	DISCOUNT
1	B.B. King Greatest Hits	mp3	11.49	1.149
2	Best of Neil Young	mp3	17.5	0
3	Bob Dylans Greatest Hits	Vinyl	29.87	4.4805
4	Bob Dylans Greatest Hits	mp3	5.98	0
5	Gustav Mahler Symphony No. 9	Audio CD	23.1	4.62
6	Harvest (2009 Remaster)	Audio CD	10.5	2.1
7	Harvest (2009 Remaster)	Vinyl	28.5	4.275
8	Harvest (2009 Remaster)	mp3	9.49	0.949
9	Kind Of Blue (Legacy Edition)	Audio CD	19.99	3.998
10	Kind Of Blue (Legacy Edition)	Vinyl	19.99	2.9985
11	Other Peoples Lives	mp3	9.49	0
12	Sketches of Spain	Audio CD	3.11	0.622
13	Sketches of Spain	Vinyl	14.99	2.2485
14	Sketches of Spain	mp3	24.99	2.499
15	The Essential Bob Dylan	Audio CD	26.17	5.234
16	The Essential Bob Dylan	Vinyl	37	5.55
17	The Essential Bob Dylan	mp3	16	1.6

Q7. Now, modify the view all_albums to also include the column album used price for disks; set
album used price to zero for MP3 albums. Use this view to find the most expensive used album; show all view columns.

```
create view all_albums(albumtitle,mediatype,albumprice,discount,usedprice)as
select distinct l.albumTitle , treat (value(l) as disk_type).mediatype,
l.albumPrice ,l.albumprice-l.discountPrice() as discount,
treat (value(l) as disk_type).diskusedprice
from albums l where treat (value(l) as disk_type).mediatype='Vinyl'

union

select distinct m.albumTitle , treat (value(m) as disk_type).mediatype,
m.albumPrice ,m.albumprice-m.discountPrice() as discount,
treat (value(m) as disk_type).diskusedprice
from albums m where treat (value(m) as disk_type).mediatype='Audio CD'

union

select distinct n.albumTitle, 'mp3',
n.albumPrice ,n.albumprice-n.discountPrice() as discount,0.0
from albums n
where value(n) is of (mp3_type);
select albumtitle,mediatype,albumprice,discount,usedprice
from all_albums where
usedprice= (select max(usedprice) from all_albums);
```

	ALBUMTITLE	MEDIATYPE	ALBUMPRICE	DISCOUNT	USEDPRICE
1	Kind Of Blue (Legacy Edition)	Audio CD	19.99	3.998	16.99
2	Kind Of Blue (Legacy Edition)	Vinyl	19.99	2.9985	16.99

Q8. Implement the method containsText (pString1, pString2) that returns 1 if pString1 contains pString2, and 0 if it does not. Use this method to find albums with reviews that contain the word 'Great'. Show album title, review text, review score. Note that the signature of the containsText method is included in the original OMDB script.

```
create or replace type body album_type as
member function discountPrice return number is
begin
    return albumPrice;
end discountPrice;
-------This part of the code needs to be modified as per the solution for Question 8--
member function containsText (pString1 varchar2, pString2 varchar2) return integer is
Comparison integer;
begin
    Comparison:=INSTR(pString1,pString2);

    if Comparison>0 then
        Comparison:=1;
    else
        Comparison:=0;
    end if;
    return Comparison;
end containsText;
end;
/
select a.albumtitle,v.reviewtext,v.reviewscore, a.containstext(v.reviewtext,'Great') as Great
from albums a, table(a.albumreviews) v

where a.containstext(v.reviewtext,'Great')=1;
```

	ALBUMTITLE	REVIEWTEXT	REVIEWSCORE	GREAT
1	The Essential Bob Dylan	Great compilation of some of his most known songs	5	1
2	Sketches of Spain	Early days of The Great Miles--no lover of jazz should be without this album.	5	1
3	Best of Neil Young	Great artist and great music.	5	1
4	Harvest (2009 Remaster)	Great artist and great music.	5	1

Discussion

The relational model is the basis for relational design while object relational model is the basis for object oriented programming. The relational model stores data in rows and columns in the form of tables. Every row is represented in the form of entity and has a primary key. In object relational model, the data is stored in the form objects.

There is a standard way to request data in all the relation database. Object relational model was designed for complex data and hence is not easy to fetch data. Relational model can fetch data only in one form and data can be retrieved easily, which is not the case for object relational model and it can fetch many forms of data.

The above implementation would have been easier if the implementation was done in relation model. It would have been easier to use the join command perform the operation than creating the view and tables to perform similar operation.

Summary

The design and implementation of Online Music Database using object relation design is completed keeping in mind its complexity and performance. All the queries are written and executed as simple as possible.