Project Report

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Outline :

Commands used to create the database :

```
>>CREATE DATABASE `Chinook`;



>>USE `Chinook`;



>>CREATE TABLE `Album`
(
    `AlbumId` INT NOT NULL,
    `Title` NVARCHAR(160) NOT NULL,
    `ArtistId` INT NOT NULL,
    CONSTRAINT `PK_Album` PRIMARY KEY  (`AlbumId`)
);

>>CREATE TABLE `Artist`
(
    `ArtistId` INT NOT NULL,
    `Name` NVARCHAR(120),
    CONSTRAINT `PK_Artist` PRIMARY KEY  (`ArtistId`)
);

>>CREATE TABLE `Customer`
(
    `CustomerId` INT NOT NULL,
    `FirstName` NVARCHAR(40) NOT NULL,
    `LastName` NVARCHAR(20) NOT NULL,
    `Company` NVARCHAR(80),
    `Address` NVARCHAR(70),
    `City` NVARCHAR(40),
    `State` NVARCHAR(40),
    `Country` NVARCHAR(40),
    `PostalCode` NVARCHAR(10),
    `Phone` NVARCHAR(24),
    `Fax` NVARCHAR(24),
    `Email` NVARCHAR(60) NOT NULL,
    `SupportRepId` INT,
    CONSTRAINT `PK_Customer` PRIMARY KEY  (`CustomerId`)
```

```
);

>>CREATE TABLE `Employee`
(
    `EmployeeId` INT NOT NULL,
    `LastName` NVARCHAR(20) NOT NULL,
    `FirstName` NVARCHAR(20) NOT NULL,
    `Title` NVARCHAR(30),
    `ReportsTo` INT,
    `BirthDate` DATETIME,
    `HireDate` DATETIME,
    `Address` NVARCHAR(70),
    `City` NVARCHAR(40),
    `State` NVARCHAR(40),
    `Country` NVARCHAR(40),
    `PostalCode` NVARCHAR(10),
    `Phone` NVARCHAR(24),
    `Fax` NVARCHAR(24),
    `Email` NVARCHAR(60),
    CONSTRAINT `PK_Employee` PRIMARY KEY  (`EmployeeId`)
);

>>CREATE TABLE `Genre`
(
    `GenreId` INT NOT NULL,
    `Name` NVARCHAR(120),
    CONSTRAINT `PK_Genre` PRIMARY KEY  (`GenreId`)
);

>>CREATE TABLE `Invoice`
(
    `InvoiceId` INT NOT NULL,
    `CustomerId` INT NOT NULL,
    `InvoiceDate` DATETIME NOT NULL,
    `BillingAddress` NVARCHAR(70),
    `BillingCity` NVARCHAR(40),
    `BillingState` NVARCHAR(40),
    `BillingCountry` NVARCHAR(40),
    `BillingPostalCode` NVARCHAR(10),
    `Total` NUMERIC(10,2) NOT NULL,
    CONSTRAINT `PK_Invoice` PRIMARY KEY  (`InvoiceId`)
);

>>CREATE TABLE `InvoiceLine`
(
```

```
    `InvoiceLineId` INT NOT NULL,
    `InvoiceId` INT NOT NULL,
    `TrackId` INT NOT NULL,
    `UnitPrice` NUMERIC(10,2) NOT NULL,
    `Quantity` INT NOT NULL,
    CONSTRAINT `PK_InvoiceLine` PRIMARY KEY  (`InvoiceLineId`)
);

>>CREATE TABLE `MediaType`
(
    `MediaTypeId` INT NOT NULL,
    `Name` NVARCHAR(120),
    CONSTRAINT `PK_MediaType` PRIMARY KEY  (`MediaTypeId`)
);

>>CREATE TABLE `Playlist`
(
    `PlaylistId` INT NOT NULL,
    `Name` NVARCHAR(120),
    CONSTRAINT `PK_Playlist` PRIMARY KEY  (`PlaylistId`)
);

>>CREATE TABLE `PlaylistTrack`
(
    `PlaylistId` INT NOT NULL,
    `TrackId` INT NOT NULL,
    CONSTRAINT `PK_PlaylistTrack` PRIMARY KEY  (`PlaylistId`, `TrackId`)
);

>>CREATE TABLE `Track`
(
    `TrackId` INT NOT NULL,
    `Name` NVARCHAR(200) NOT NULL,
    `AlbumId` INT,
    `MediaTypeId` INT NOT NULL,
    `GenreId` INT,
    `Composer` NVARCHAR(220),
    `Milliseconds` INT NOT NULL,
    `Bytes` INT,
    `UnitPrice` NUMERIC(10,2) NOT NULL,
    CONSTRAINT `PK_Track` PRIMARY KEY  (`TrackId`)
);
```

Various Tables Descriptions :

```
mysql> show tables;
+-------------------+
| Tables_in_chinook |
+-------------------+
| album             |
| artist            |
| customer          |
| employee          |
| genre             |
| invoice           |
| invoiceline       |
| mediatype         |
| playlist          |
| playlisttrack     |
| track             |
+-------------------+

mysql> desc album;
+----------+--------------+------+-----+---------+-------+
| Field    | Type         | Null | Key | Default | Extra |
+----------+--------------+------+-----+---------+-------+
| AlbumId  | int(11)      | NO   | PRI | NULL    |       |
| Title    | varchar(160) | NO   |     | NULL    |       |
| ArtistId | int(11)      | NO   | MUL | NULL    |       |
+----------+--------------+------+-----+---------+-------+

mysql> desc artist;
+----------+--------------+------+-----+---------+-------+
| Field    | Type         | Null | Key | Default | Extra |
+----------+--------------+------+-----+---------+-------+
| ArtistId | int(11)      | NO   | PRI | NULL    |       |
| Name     | varchar(120) | YES  |     | NULL    |       |
+----------+--------------+------+-----+---------+-------+

mysql> desc customer;
+-------------+-------------+------+-----+---------+-------+
| Field       | Type        | Null | Key | Default | Extra |
+-------------+-------------+------+-----+---------+-------+
| CustomerId  | int(11)     | NO   | PRI | NULL    |       |
| FirstName   | varchar(40) | NO   |     | NULL    |       |
| LastName    | varchar(20) | NO   |     | NULL    |       |
| Company     | varchar(80) | YES  |     | NULL    |       |
| Address     | varchar(70) | YES  |     | NULL    |       |
| City        | varchar(40) | YES  |     | NULL    |       |
```

```
| State        | varchar(40) | YES  |     | NULL    |       |
| Country      | varchar(40) | YES  |     | NULL    |       |
| PostalCode   | varchar(10) | YES  |     | NULL    |       |
| Phone        | varchar(24) | YES  |     | NULL    |       |
| Fax          | varchar(24) | YES  |     | NULL    |       |
| Email        | varchar(60) | NO   |     | NULL    |       |
| SupportRepId | int(11)     | YES  | MUL | NULL    |       |
+--------------+-------------+------+-----+---------+-------+


mysql> desc employee;
+------------+-------------+------+-----+---------+-------+
| Field      | Type        | Null | Key | Default | Extra |
+------------+-------------+------+-----+---------+-------+
| EmployeeId | int(11)     | NO   | PRI | NULL    |       |
| LastName   | varchar(20) | NO   |     | NULL    |       |
| FirstName  | varchar(20) | NO   |     | NULL    |       |
| Title      | varchar(30) | YES  |     | NULL    |       |
| ReportsTo  | int(11)     | YES  | MUL | NULL    |       |
| BirthDate  | datetime    | YES  |     | NULL    |       |
| HireDate   | datetime    | YES  |     | NULL    |       |
| Address    | varchar(70) | YES  |     | NULL    |       |
| City       | varchar(40) | YES  |     | NULL    |       |
| State      | varchar(40) | YES  |     | NULL    |       |
| Country    | varchar(40) | YES  |     | NULL    |       |
| PostalCode | varchar(10) | YES  |     | NULL    |       |
| Phone      | varchar(24) | YES  |     | NULL    |       |
| Fax        | varchar(24) | YES  |     | NULL    |       |
| Email      | varchar(60) | YES  |     | NULL    |       |
+------------+-------------+------+-----+---------+-------+

mysql> desc genre;
+---------+--------------+------+-----+---------+-------+
| Field   | Type         | Null | Key | Default | Extra |
+---------+--------------+------+-----+---------+-------+
| GenreId | int(11)      | NO   | PRI | NULL    |       |
| Name    | varchar(120) | YES  |     | NULL    |       |
+---------+--------------+------+-----+---------+-------+

mysql> desc invoice;
+-------------------+--------------+------+-----+---------+-------+
| Field             | Type         | Null | Key | Default | Extra |
+-------------------+--------------+------+-----+---------+-------+
| InvoiceId         | int(11)      | NO   | PRI | NULL    |       |
| CustomerId        | int(11)      | NO   | MUL | NULL    |       |
```

```
| InvoiceDate      | datetime     | NO   |     | NULL    |       |
| BillingAddress   | varchar(70)  | YES  |     | NULL    |       |
| BillingCity      | varchar(40)  | YES  |     | NULL    |       |
| BillingState     | varchar(40)  | YES  |     | NULL    |       |
| BillingCountry   | varchar(40)  | YES  |     | NULL    |       |
| BillingPostalCode| varchar(10)  | YES  |     | NULL    |       |
| Total            | decimal(10,2)| NO   |     | NULL    |       |
+------------------+--------------+------+-----+---------+-------+

mysql> desc invoiceline;
+--------------+--------------+------+-----+---------+-------+
| Field        | Type         | Null | Key | Default | Extra |
+--------------+--------------+------+-----+---------+-------+
| InvoiceLineId| int(11)      | NO   | PRI | NULL    |       |
| InvoiceId    | int(11)      | NO   | MUL | NULL    |       |
| TrackId      | int(11)      | NO   | MUL | NULL    |       |
| UnitPrice    | decimal(10,2)| NO   |     | NULL    |       |
| Quantity     | int(11)      | NO   |     | NULL    |       |
+--------------+--------------+------+-----+---------+-------+

mysql> desc mediatype;
+-------------+--------------+------+-----+---------+-------+
| Field       | Type         | Null | Key | Default | Extra |
+-------------+--------------+------+-----+---------+-------+
| MediaTypeId | int(11)      | NO   | PRI | NULL    |       |
| Name        | varchar(120) | YES  |     | NULL    |       |
+-------------+--------------+------+-----+---------+-------+

mysql> desc playlist;
+------------+--------------+------+-----+---------+-------+
| Field      | Type         | Null | Key | Default | Extra |
+------------+--------------+------+-----+---------+-------+
| PlaylistId | int(11)      | NO   | PRI | NULL    |       |
| Name       | varchar(120) | YES  |     | NULL    |       |
+------------+--------------+------+-----+---------+-------+

mysql> desc playlisttrack;
+------------+---------+------+-----+---------+-------+
| Field      | Type    | Null | Key | Default | Extra |
+------------+---------+------+-----+---------+-------+
| PlaylistId | int(11) | NO   | PRI | NULL    |       |
| TrackId    | int(11) | NO   | PRI | NULL    |       |
+------------+---------+------+-----+---------+-------+

mysql> desc track;
```

```
+-------------+--------------+------+-----+---------+-------+
| Field       | Type         | Null | Key | Default | Extra |
+-------------+--------------+------+-----+---------+-------+
| TrackId     | int(11)      | NO   | PRI | NULL    |       |
| Name        | varchar(200) | NO   |     | NULL    |       |
| AlbumId     | int(11)      | YES  | MUL | NULL    |       |
| MediaTypeId | int(11)      | NO   | MUL | NULL    |       |
| GenreId     | int(11)      | YES  | MUL | NULL    |       |
| Composer    | varchar(220) | YES  |     | NULL    |       |
| Milliseconds| int(11)      | NO   |     | NULL    |       |
| Bytes       | int(11)      | YES  |     | NULL    |       |
| UnitPrice   | decimal(10,2)| NO   |     | NULL    |       |
+-------------+--------------+------+-----+---------+-------+
```

No. of entries in the tables :

```
Album - 347
Artist - 275
Genre - 25
Track - 3503
Employee - 8
Mediatype - 5
Customer - 59
Invoice - 412
Invoiceline - 2240
Playlist - 18
Playlisttrack 8715
```

Queries Run on the database :

1. SALES OF AN ARTIST(name):

    >>SELECT COUNT(invoicelineid) FROM invoiceline INNER JOIN (SELECT
    trackid FROM track INNER JOIN (SELECT albumid FROM album INNER JOIN
    artist ON album.artistid = artist.artistid AND
    artist.Name="Metallica") as A ON track.albumid=A.albumid) as T ON
    invoiceline.trackid = T.trackid

2. NO. OF TRACKS A CUSTOMER BOUGHT:

    >>SELECT COUNT(invoicelineid) FROM invoiceline INNER JOIN (SELECT
    invoiceid FROM customer INNER JOIN invoice ON
    customer.customerid=invoice.customerid AND
    customer.firstname="Martha" AND customer.lastname="Silk") as I ON
    invoiceline.invoiceid=I.invoiceid

3. Name of media types with a customer:

    SELECT name FROM mediatype INNER JOIN (SELECT DISTINCT mediatypeid
```

```
       FROM track INNER JOIN (SELECT trackid FROM invoiceline INNER JOIN  (
       SELECT invoicelineid FROM invoiceline INNER JOIN( SELECT invoiceid
       FROM invoice INNER JOIN customer ON
       invoice.customerid=customer.customerid AND
       customer.firstname="Frank" AND customer.lastname="Ralston" ) as I ON
       invoiceline.invoiceid=I.invoiceid ) as L ON
       invoiceline.invoicelineid= L.invoicelineid ) as T ON
       track.trackid=T.trackid ) as M ON
       mediatype.mediatypeid=M.mediatypeid
```

Profiling :

```
WITHOUT - INDEXING;

 1 | 0.07709550 | SELECT  COUNT( invoicelineid ) FROM invoiceline INNER
JOIN (SELECT trackid FROM track INNER JOIN (SELECT albumid FROM album
INNER JOIN artist ON album.artistid = artist.artistid AND
artist.Name="Metallica" ) as A ON  track.albumid=A.albumid ) as T ON
invoiceline.trackid = T.trackid

mysql> SHOW PROFILE CPU FOR QUERY 1;
+----------------------+----------+----------+------------+
| Status               | Duration | CPU_user | CPU_system |
+----------------------+----------+----------+------------+
| starting             | 0.000116 | 0.000000 |   0.000000 |
| checking permissions | 0.000004 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| Opening tables       | 0.000034 | 0.000000 |   0.000000 |
| init                 | 0.000053 | 0.000000 |   0.000000 |
| System lock          | 0.000011 | 0.000000 |   0.000000 |
| optimizing           | 0.000016 | 0.000000 |   0.000000 |
| statistics           | 0.000040 | 0.000000 |   0.000000 |
| preparing            | 0.000019 | 0.000000 |   0.000000 |
| executing            | 0.000001 | 0.000000 |   0.000000 |
| Sending data         | 0.076667 | 0.000000 |   0.000000 |
| end                  | 0.000008 | 0.000000 |   0.000000 |
| query end            | 0.000009 | 0.000000 |   0.000000 |
| closing tables       | 0.000009 | 0.000000 |   0.000000 |
| freeing items        | 0.000053 | 0.000000 |   0.000000 |
| cleaning up          | 0.000052 | 0.000000 |   0.000000 |
```

```
+---------------------+----------+----------+------------+

 2 | 0.02054400 | SELECT COUNT(invoicelineid) FROM invoiceline INNER JOIN
(SELECT invoiceid FROM customer INNER JOIN invoice ON
customer.customerid=invoice.customerid AND customer.firstname="Martha" AND
customer.lastname="Silk" ) as I ON invoiceline.invoiceid=I.invoiceid

mysql> SHOW PROFILE CPU FOR QUERY 2;
+---------------------+----------+----------+------------+
| Status              | Duration | CPU_user | CPU_system |
+---------------------+----------+----------+------------+
| starting            | 0.000090 | 0.000000 |   0.000000 |
| checking permissions | 0.000004 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| Opening tables      | 0.000023 | 0.000000 |   0.000000 |
| init                | 0.000040 | 0.000000 |   0.000000 |
| System lock         | 0.000007 | 0.000000 |   0.000000 |
| optimizing          | 0.000015 | 0.000000 |   0.000000 |
| statistics          | 0.000031 | 0.000000 |   0.000000 |
| preparing           | 0.000017 | 0.000000 |   0.000000 |
| executing           | 0.000001 | 0.000000 |   0.000000 |
| Sending data        | 0.020223 | 0.000000 |   0.000000 |
| end                 | 0.000008 | 0.000000 |   0.000000 |
| query end           | 0.000009 | 0.000000 |   0.000000 |
| closing tables      | 0.000007 | 0.000000 |   0.000000 |
| freeing items       | 0.000052 | 0.000000 |   0.000000 |
| cleaning up         | 0.000013 | 0.000000 |   0.000000 |
+---------------------+----------+----------+------------+

 3 | 0.01704725 | SELECT name FROM mediatype INNER JOIN (SELECT DISTINCT
mediatypeid FROM track INNER JOIN (SELECT trackid FROM invoiceline INNER
JOIN  ( SELECT invoicelineid FROM invoiceline INNER JOIN( SELECT invoiceid
FROM invoice INNER JOIN customer ON invoice.customerid=customer.customerid
AND customer.firstname

mysql> SHOW PROFILE CPU FOR QUERY 3;
+---------------------+----------+----------+------------+
| Status              | Duration | CPU_user | CPU_system |
+---------------------+----------+----------+------------+
| starting            | 0.000095 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
```

```
| checking permissions | 0.000004 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
| Opening tables       | 0.000802 | 0.000000 |   0.000000 |
| init                 | 0.000061 | 0.000000 |   0.000000 |
| System lock          | 0.000008 | 0.000000 |   0.000000 |
| optimizing           | 0.000002 | 0.000000 |   0.000000 |
| optimizing           | 0.000011 | 0.000000 |   0.000000 |
| statistics           | 0.000044 | 0.000000 |   0.000000 |
| preparing            | 0.000018 | 0.000000 |   0.000000 |
| Creating tmp table   | 0.000032 | 0.000000 |   0.000000 |
| statistics           | 0.000019 | 0.000000 |   0.000000 |
| preparing            | 0.000004 | 0.000000 |   0.000000 |
| executing            | 0.000008 | 0.000000 |   0.000000 |
| Sending data         | 0.014777 | 0.000000 |   0.000000 |
| executing            | 0.000011 | 0.000000 |   0.000000 |
| Sending data         | 0.000733 | 0.000000 |   0.000000 |
| end                  | 0.000033 | 0.000000 |   0.000000 |
| query end            | 0.000019 | 0.000000 |   0.000000 |
| removing tmp table   | 0.000026 | 0.000000 |   0.000000 |
| query end            | 0.000005 | 0.000000 |   0.000000 |
| closing tables       | 0.000005 | 0.000000 |   0.000000 |
| removing tmp table   | 0.000021 | 0.000000 |   0.000000 |
| closing tables       | 0.000027 | 0.000000 |   0.000000 |
| freeing items        | 0.000208 | 0.000000 |   0.000000 |
| cleaning up          | 0.000069 | 0.000000 |   0.000000 |
+----------------------+----------+----------+------------+
```

AFTER INDEXING
 only after primary key indexing

1 | 0.06887925 | SELECT COUNT(invoicelineid) FROM invoiceline INNER
JOIN (SELECT trackid FROM track INNER JOIN (SELECT albumid FROM album
INNER JOIN artist ON album.artistid = artist.artistid AND
artist.Name="Metallica") as A ON track.albumid=A.albumid) as T ON
invoiceline.trackid = T.trackid

```
mysql> show profile cpu for query 8;
+----------------------+----------+----------+------------+
| Status               | Duration | CPU_user | CPU_system |
+----------------------+----------+----------+------------+
| starting             | 0.000151 | 0.000000 |   0.000000 |
| checking permissions | 0.000006 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000004 | 0.000000 |   0.000000 |
```

```
| Opening tables        | 0.003125 | 0.000000 |    0.000000 |
| init                  | 0.000065 | 0.000000 |    0.000000 |
| System lock           | 0.000012 | 0.000000 |    0.000000 |
| optimizing            | 0.000019 | 0.000000 |    0.000000 |
| statistics            | 0.000053 | 0.000000 |    0.000000 |
| preparing             | 0.000019 | 0.000000 |    0.000000 |
| executing             | 0.000002 | 0.000000 |    0.000000 |
| Sending data          | 0.065264 | 0.000000 |    0.000000 |
| end                   | 0.000014 | 0.000000 |    0.000000 |
| query end             | 0.000017 | 0.000000 |    0.000000 |
| closing tables        | 0.000015 | 0.000000 |    0.000000 |
| freeing items         | 0.000086 | 0.000000 |    0.000000 |
| cleaning up           | 0.000027 | 0.000000 |    0.000000 |
+---------------------+----------+----------+-------------+
```

9 | 0.06550075 | SELECT COUNT(invoicelineid) FROM invoiceline INNER JOIN (SELECT invoiceid FROM customer INNER JOIN invoice ON customer.customerid=invoice.customerid AND customer.firstname="Martha" AND customer.lastname="Silk") as I ON invoiceline.invoiceid=I.invoiceid

```
mysql> show profile cpu for query 9;
+---------------------+----------+----------+-------------+
| Status              | Duration | CPU_user | CPU_system  |
+---------------------+----------+----------+-------------+
| starting            | 0.000080 | 0.000000 |    0.000000 |
| checking permissions | 0.000003 | 0.000000 |    0.000000 |
| checking permissions | 0.000001 | 0.000000 |    0.000000 |
| checking permissions | 0.000004 | 0.000000 |    0.000000 |
| Opening tables      | 0.002368 | 0.000000 |    0.000000 |
| init                | 0.000040 | 0.000000 |    0.000000 |
| System lock         | 0.000007 | 0.000000 |    0.000000 |
| optimizing          | 0.000013 | 0.000000 |    0.000000 |
| statistics          | 0.000029 | 0.000000 |    0.000000 |
| preparing           | 0.000017 | 0.000000 |    0.000000 |
| executing           | 0.000002 | 0.000000 |    0.000000 |
| Sending data        | 0.062794 | 0.000000 |    0.000000 |
| end                 | 0.000012 | 0.000000 |    0.000000 |
| query end           | 0.000011 | 0.000000 |    0.000000 |
| closing tables      | 0.000012 | 0.000000 |    0.000000 |
| freeing items       | 0.000081 | 0.000000 |    0.000000 |
| cleaning up         | 0.000026 | 0.000000 |    0.000000 |
+---------------------+----------+----------+-------------+
```

10 | 0.04470550 | SELECT name FROM mediatype INNER JOIN (SELECT DISTINCT mediatypeid FROM track INNER JOIN (SELECT trackid FROM invoiceline INNER

JOIN (SELECT invoicelineid FROM invoiceline INNER JOIN(SELECT invoiceid
FROM invoice INNER JOIN customer ON invoice.customerid=customer.customerid
AND customer.firstname |

mysql> show profile cpu for query 10;
+----------------------+----------+----------+------------+
| Status | Duration | CPU_user | CPU_system |
+----------------------+----------+----------+------------+
starting	0.000117	0.000000	0.000000
checking permissions	0.000003	0.000000	0.000000
checking permissions	0.000002	0.000000	0.000000
checking permissions	0.000001	0.000000	0.000000
checking permissions	0.000001	0.000000	0.000000
checking permissions	0.000001	0.000000	0.000000
checking permissions	0.000003	0.000000	0.000000
Opening tables	0.000931	0.000000	0.000000
init	0.000082	0.015625	0.000000
System lock	0.000017	0.000000	0.000000
optimizing	0.000003	0.000000	0.000000
optimizing	0.000017	0.000000	0.000000
statistics	0.000078	0.000000	0.000000
preparing	0.000026	0.000000	0.000000
Creating tmp table	0.000027	0.000000	0.000000
statistics	0.000025	0.000000	0.000000
preparing	0.000013	0.000000	0.000000
executing	0.000015	0.000000	0.000000
Sending data	0.000069	0.000000	0.000000
executing	0.000004	0.000000	0.000000
Sending data	0.043124	0.000000	0.000000
end	0.000007	0.000000	0.000000
query end	0.000009	0.000000	0.000000
removing tmp table	0.000030	0.000000	0.000000
query end	0.000004	0.000000	0.000000
closing tables	0.000003	0.000000	0.000000
removing tmp table	0.000010	0.000000	0.000000
closing tables	0.000009	0.000000	0.000000
freeing items	0.000059	0.000000	0.000000
cleaning up	0.000018	0.000000	0.000000
+----------------------+----------+----------+------------+

AFTER INDEXING ON FOREIGNKEY

                                        |
| 21 | 0.00084000 | SELECT COUNT(invoicelineid) FROM invoiceline
INNER JOIN (SELECT trackid FROM track INNER JOIN (SELECT albumid FROM

album INNER JOIN artist ON album.artistid = artist.artistid AND
artist.Name="Metallica") as A ON track.albumid=A.albumid) as T ON
invoiceline.trackid = T.trackid

```
mysql> show profile cpu for query 21;
+----------------------+----------+----------+------------+
| Status               | Duration | CPU_user | CPU_system |
+----------------------+----------+----------+------------+
| starting             | 0.000101 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| Opening tables       | 0.000027 | 0.000000 |   0.000000 |
| init                 | 0.000053 | 0.000000 |   0.000000 |
| System lock          | 0.000009 | 0.000000 |   0.000000 |
| optimizing           | 0.000018 | 0.000000 |   0.000000 |
| statistics           | 0.000050 | 0.000000 |   0.000000 |
| preparing            | 0.000020 | 0.000000 |   0.000000 |
| executing            | 0.000002 | 0.000000 |   0.000000 |
| Sending data         | 0.000487 | 0.000000 |   0.000000 |
| end                  | 0.000003 | 0.000000 |   0.000000 |
| query end            | 0.000006 | 0.000000 |   0.000000 |
| closing tables       | 0.000006 | 0.000000 |   0.000000 |
| freeing items        | 0.000036 | 0.000000 |   0.000000 |
| cleaning up          | 0.000014 | 0.000000 |   0.000000 |
+----------------------+----------+----------+------------+
```

22 | 0.00046400 | SELECT COUNT(invoicelineid) FROM invoiceline INNER JOIN
(SELECT invoiceid FROM customer INNER JOIN invoice ON
customer.customerid=invoice.customerid AND customer.firstname="Martha" AND
customer.lastname="Silk") as I ON invoiceline.invoiceid=I.invoiceid

```
mysql> show profile cpu for query 22;
+----------------------+----------+----------+------------+
| Status               | Duration | CPU_user | CPU_system |
+----------------------+----------+----------+------------+
| starting             | 0.000082 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| Opening tables       | 0.000027 | 0.000000 |   0.000000 |
| init                 | 0.000034 | 0.000000 |   0.000000 |
| System lock          | 0.000007 | 0.000000 |   0.000000 |
| optimizing           | 0.000014 | 0.000000 |   0.000000 |
```

```
| statistics          | 0.000037 | 0.000000 |   0.000000 |
| preparing           | 0.000020 | 0.000000 |   0.000000 |
| executing           | 0.000001 | 0.000000 |   0.000000 |
| Sending data        | 0.000166 | 0.000000 |   0.000000 |
| end                 | 0.000003 | 0.000000 |   0.000000 |
| query end           | 0.000007 | 0.000000 |   0.000000 |
| closing tables      | 0.000006 | 0.000000 |   0.000000 |
| freeing items       | 0.000036 | 0.000000 |   0.000000 |
| cleaning up         | 0.000017 | 0.000000 |   0.000000 |
+---------------------+----------+----------+------------+
```

 23 | 0.00175350 | SELECT name FROM mediatype INNER JOIN (SELECT DISTINCT
mediatypeid FROM track INNER JOIN (SELECT trackid FROM invoiceline INNER
JOIN (SELECT invoicelineid FROM invoiceline INNER JOIN(SELECT invoiceid
FROM invoice INNER JOIN customer ON invoice.customerid=customer.customerid
AND customer.firstname |

```
mysql> show profile cpu for query 23;
+---------------------+----------+----------+------------+
| Status              | Duration | CPU_user | CPU_system |
+---------------------+----------+----------+------------+
| starting            | 0.000130 | 0.000000 |   0.000000 |
| checking permissions | 0.000005 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000002 | 0.000000 |   0.000000 |
| checking permissions | 0.000001 | 0.000000 |   0.000000 |
| checking permissions | 0.000003 | 0.000000 |   0.000000 |
| Opening tables      | 0.000858 | 0.000000 |   0.000000 |
| init                | 0.000081 | 0.000000 |   0.000000 |
| System lock         | 0.000012 | 0.000000 |   0.000000 |
| optimizing          | 0.000002 | 0.000000 |   0.000000 |
| optimizing          | 0.000017 | 0.000000 |   0.000000 |
| statistics          | 0.000055 | 0.000000 |   0.000000 |
| preparing           | 0.000016 | 0.000000 |   0.000000 |
| Creating tmp table  | 0.000016 | 0.000000 |   0.000000 |
| statistics          | 0.000017 | 0.000000 |   0.000000 |
| preparing           | 0.000004 | 0.000000 |   0.000000 |
| executing           | 0.000009 | 0.000000 |   0.000000 |
| Sending data        | 0.000044 | 0.000000 |   0.000000 |
| executing           | 0.000002 | 0.000000 |   0.000000 |
| Sending data        | 0.000381 | 0.000000 |   0.000000 |
| end                 | 0.000003 | 0.000000 |   0.000000 |
| query end           | 0.000009 | 0.000000 |   0.000000 |
| removing tmp table  | 0.000006 | 0.000000 |   0.000000 |
```

```
| query end            | 0.000002 | 0.000000 |   0.000000 |
| closing tables       | 0.000002 | 0.000000 |   0.000000 |
| removing tmp table   | 0.000006 | 0.000000 |   0.000000 |
| closing tables       | 0.000006 | 0.000000 |   0.000000 |
| freeing items        | 0.000048 | 0.000000 |   0.000000 |
| cleaning up          | 0.000015 | 0.000000 |   0.000000 |
+----------------------+----------+----------+------------+
```

Statements to create indexing on foreign keys:

CREATE INDEX `IFK_AlbumArtistId` ON `Album` (`ArtistId`);

CREATE INDEX `IFK_CustomerSupportRepId` ON `Customer` (`SupportRepId`);

CREATE INDEX `IFK_EmployeeReportsTo` ON `Employee` (`ReportsTo`);

CREATE INDEX `IFK_InvoiceCustomerId` ON `Invoice` (`CustomerId`);

CREATE INDEX `IFK_InvoiceLineInvoiceId` ON `InvoiceLine` (`InvoiceId`);

CREATE INDEX `IFK_InvoiceLineTrackId` ON `InvoiceLine` (`TrackId`);

CREATE INDEX `IFK_PlaylistTrackTrackId` ON `PlaylistTrack` (`TrackId`);

CREATE INDEX `IFK_TrackAlbumId` ON `Track` (`AlbumId`);

CREATE INDEX `IFK_TrackGenreId` ON `Track` (`GenreId`);

CREATE INDEX `IFK_TrackMediaTypeId` ON `Track` (`MediaTypeId`);

Stored Procedures:
1. Procedure_01 :

```
>>DELIMITER $$
mysql> CREATE PROCEDURE sales_artist(IN artist_name
VARCHAR(60), OUT sales INT)
    -> BEGIN
    -> SELECT  COUNT( invoicelineid ) FROM invoiceline INNER
JOIN (SELECT trackid FROM track INNER JOIN (SELECT albumid
FROM album INNER JOIN artist ON album.artistid =
artist.artistid AND artist.Name=artist_name ) as A ON
track.albumid=A.albumid ) as T ON invoiceline.trackid =
```

```
                T.trackid;
                     -> END
                     -> $$
        mysql> show profile cpu for query 1;
```

```
+--------------------------+----------+----------+------------+
| Status                   | Duration | CPU_user | CPU_system |
+--------------------------+----------+----------+------------+
| continuing inside routine | 0.000007 | 0.000000 |   0.000000 |
| checking permissions     | 0.000003 | 0.000000 |   0.000000 |
| checking permissions     | 0.000001 | 0.000000 |   0.000000 |
| checking permissions     | 0.000001 | 0.000000 |   0.000000 |
| checking permissions     | 0.000002 | 0.000000 |   0.000000 |
| Opening tables           | 0.000020 | 0.000000 |   0.000000 |
| init                     | 0.000041 | 0.000000 |   0.000000 |
| System lock              | 0.000008 | 0.000000 |   0.000000 |
| optimizing               | 0.000018 | 0.000000 |   0.000000 |
| statistics               | 0.000044 | 0.000000 |   0.000000 |
| preparing                | 0.000017 | 0.000000 |   0.000000 |
| executing                | 0.000002 | 0.000000 |   0.000000 |
| Sending data             | 0.000410 | 0.000000 |   0.000000 |
| end                      | 0.000002 | 0.000000 |   0.000000 |
| query end                | 0.000005 | 0.000000 |   0.000000 |
| closing tables           | 0.000059 | 0.000000 |   0.000000 |
+--------------------------+----------+----------+------------+
```

```
2. mysql> DELIMITER $$
mysql> CREATE PROCEDURE track_bought(IN first_name VARCHAR(20),IN
last_name VARCHAR(20), OUT tracks INT)
    -> BEGIN
    -> SELECT COUNT(invoicelineid) FROM invoiceline INNER JOIN (SELECT
invoiceid FROM customer INNER JOIN invoice ON
customer.customerid=invoice.customerid AND customer.firstname=first_name
AND customer.lastname=last_name ) as I ON
invoiceline.invoiceid=I.invoiceid;
    -> END
    -> $$
mysql> show profile cpu for query 2;
```

```
+--------------------------+----------+----------+------------+
| Status                   | Duration | CPU_user | CPU_system |
+--------------------------+----------+----------+------------+
| continuing inside routine | 0.000008 | 0.000000 |   0.000000 |
| checking permissions     | 0.000002 | 0.000000 |   0.000000 |
| checking permissions     | 0.000001 | 0.000000 |   0.000000 |
| checking permissions     | 0.000002 | 0.000000 |   0.000000 |
| Opening tables           | 0.000016 | 0.000000 |   0.000000 |
```

```
| init                      | 0.000022 | 0.000000 |    0.000000 |
| System lock               | 0.000006 | 0.000000 |    0.000000 |
| optimizing                | 0.000014 | 0.000000 |    0.000000 |
| statistics                | 0.000025 | 0.000000 |    0.000000 |
| preparing                 | 0.000015 | 0.000000 |    0.000000 |
| executing                 | 0.000001 | 0.000000 |    0.000000 |
| Sending data              | 0.000097 | 0.000000 |    0.000000 |
| end                       | 0.000002 | 0.000000 |    0.000000 |
| query end                 | 0.000004 | 0.000000 |    0.000000 |
| closing tables            | 0.000058 | 0.000000 |    0.000000 |
+---------------------------+----------+----------+------------+
```

We use information_schema to see no of stored procedures .
>>select * from DatabaseName.information_schema.routines where routine_type = 'PROCEDURE'

This will return all stored procedures.

Indexing :

We can change the given index to hash indexing .

First we have to drop indexing on any field and then run this command :

>>ALTER TABLE my_table ENGINE = MEMORY;

But we use varchar datatype in almost every table so it is not possible to change indexing for our case as many constraints fail .