MSiA-413 Data Management and Information Processing

Homework 5: Advanced SQL Queries and Data Creation

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Instructions

You should submit this homework assignment via Canvas. Acceptable formats are word files, text files, and pdf files. Paper submissions are not allowed and they will receive an automatic zero.

As explained during lecture and in the syllabus, assignments are done in groups. The groups have been created and assigned (randomly) by the instructors. Each group needs to submit only one assignment (i.e., there is no need for both partners to submit individually the same homework assignment).

Each group can submit solutions multiple times (for example, you may discover an error in your earlier submission and choose to submit a new solution set). We will grade only the last submission and ignore earlier ones.

Make sure you submit your solutions before the deadline. The policies governing academic integrity, tardiness and penalties are detailed in the syllabus.

Due Date: Tuesday November 27, 11:59 pm

EntertainmentAgency.sqlite Database (60 points)

1) **(5 points)** Find the EntertainerID of the entertainers that have no engagements. You **must** use EXCEPT for full credit.

```
SELECT EntertainerID
FROM Entertainers
EXCEPT
SELECT EntertainerID
FROM Engagements;
```

```
1009
```

2) **(10 points)** Find the EntertainerID **and stage name** of the entertainers that have no engagements. Your answer must be a single query with no subqueries. You **must not** directly use the result of question (1) above.

```
SELECT Entertainers.EntertainerID
, EntStageName
FROM Entertainers
LEFT JOIN Engagements Entertainers.entertainerID = Engagements.entertainerID
WHERE EngagementNumber is null;
```

```
"1009"      "Katherine Ehrlich"
```

3) **(10 points)** For all customers that have less than 10 engagements, list the customer ID, full name (i.e., a string containing the customer's first name followed by the last name with a space in between), and number of engagements, in ascending order of number of engagements. Your answer must be a single query with no subqueries.

```
SELECT Customers.CustomerID
, CustFirstName || " " || CustLastName as CustFullName
, count(Engagements.CustomerID) as EngCount
FROM Customers
NATURAL JOIN Engagements
GROUP BY Customers.CustomerID
HAVING EngCount < 10
ORDER BY EngCount asc;
```

```
"10013"    "Estella Pundt"        "6"
"10003"    "Peter Brehm"          "7"
"10007"    "Liz Keyser"           "7"
"10012"    "Kerry Patterson" "7"
"10015"    "Carol Viescas"        "7"
"10001"    "Doris Hartwig"        "8"
"10005"    "Elizabeth Hallmark"    "8"
"10009"    "Sarah Thompson"  "8"
"10006"    "Matt Berg"      "9"
```

4) **(5 points)** Using a single query, identify the members that have not been assigned a gender and update their gender to male. The updated table will be used to answer later questions in this homework.

```
UPDATE Members
SET Gender="M"
WHERE Gender is Null;
```

5) **(10 points)** Using the updated database/table from question (4), find the number of male and female members (separate counts for each gender) for each entertainer. The output table should have the columns EntertainerID, Gender, and GenderCount. The query **must** use the UNION operator.

```
SELECT EntertainerID
, count(Gender)
, Gender
FROM Members
NATURAL JOIN Entertainer_Members
WHERE Gender = "M"
GROUP BY EntertainerID
UNION
SELECT EntertainerID
, count(Gender)
, Gender
FROM Members
NATURAL JOIN Entertainer_Members
WHERE Gender = "F"
GROUP BY EntertainerID;
```

```
"1001"	"3"	"F"
"1002"	"1"	"F"
"1002"	"1"	"M"
"1003"	"1"	"F"
"1003"	"5"	"M"
"1004"	"1"	"M"
"1005"	"1"	"F"
"1005"	"2"	"M"
"1006"	"1"	"F"
"1006"	"3"	"M"
"1007"	"2"	"M"
"1007"	"3"	"F"
"1008"	"1"	"F"
"1008"	"4"	"M"
"1009"	"1"	"F"
"1010"	"4"	"F"
"1011"	"1"	"F"
"1012"	"1"	"F"
"1013"	"2"	"F"
"1013"	"2"	"M"
```

6) **(10 points)** Write a query to answer question (5) above, but this time the query **must not** use a set operation and it **must** use a natural join. *Hint:* GROUP BY can take multiple columns as arguments.

```
SELECT EntertainerID
, count(Gender)
, Gender
FROM Members
NATURAL JOIN Entertainer_Members
GROUP BY 1,3;
```

```
"1001"	"3"	"F"
"1002"	"1"	"F"
"1002"	"1"	"M"
"1003"	"1"	"F"
"1003"	"5"	"M"
"1004"	"1"	"M"
"1005"	"1"	"F"
"1005"	"2"	"M"
"1006"	"1"	"F"
"1006"	"3"	"M"
"1007"	"2"	"M"
"1007"	"3"	"F"
"1008"	"1"	"F"
"1008"	"4"	"M"
"1009"	"1"	"F"
"1010"	"4"	"F"
```

```
"1011"    "1"   "F"
"1012"    "1"   "F"
"1013"    "2"   "F"
"1013"    "2"   "M"
```

7) **(10 points)** You want to classify each entertainer as follows:
   - Super Band (if it has more than 10 engagements)
   - Regular Band (if it has more than 7 but no more than 10 engagements)
   - Support Band (if it has at least one engagement, but no more than 7), and
   - Amateur Band (if it has no engagements)

   Write the query that makes this classification and returns the class of the entertainer, the entertainer's stage name, and the number of engagements, with the entertainers appearing in descending rank (i.e., super bands first, followed by regular bands, then support bands, and amateurs at the bottom). Your answer must be a single query with no subqueries.

```
SELECT
CASE WHEN EngagementNumber is null THEN 0
      ELSE count(distinct EngagementNumber)
      END AS EngCount
,Entertainers.EntertainerID
, EntStageName
, CASE WHEN count(distinct EngagementNumber) > 10 THEN "Super Band"
      WHEN count(distinct EngagementNumber) BETWEEN 8 AND 10 THEN "Regular Band"
      WHEN count(distinct EngagementNumber) BETWEEN 1 AND 7 THEN "Support Band"
      ELSE "Amateur Band"
      END AS Class
FROM Entertainers
LEFT JOIN Engagements ON Entertainers.EntertainerID =Engagements.EntertainerID
GROUP BY 2
ORDER BY EngCount desc;
```

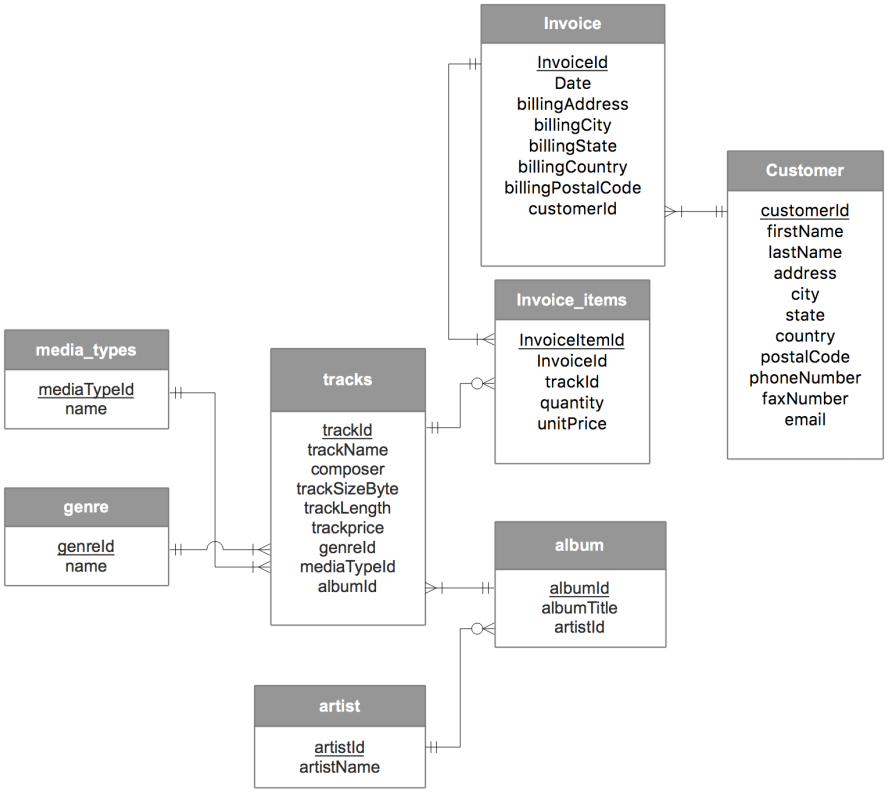
```
"15"    "1008"  "Country Feeling"           "Super Band"
"11"    "1001"  "Carol Peacock Trio"        "Super Band"
"11"    "1013"  "Caroline Coie Cuartet"     "Super Band"
"10"    "1003"  "JV & the Deep Six"         "Regular Band"
"10"    "1006"  "Modern Dance"              "Regular Band"
"9"     "1004"  "Jim Glynn"                 "Regular Band"
"9"     "1010"  "Saturday Revue"            "Regular Band"
"8"     "1007"  "Coldwater Cattle Company"  "Regular Band"
"8"     "1011"  "Julia Schnebly"            "Regular Band"
"7"     "1002"  "Topazz"                    "Support Band"
"7"     "1005"  "Jazz Persuasion"           "Support Band"
"6"     "1012"  "Susan McLain"              "Support Band"
"0"     "1009"  "Katherine Ehrlich"         "Amateur Band"
```

Online Music Store Database (40 points + 50 bonus points)

8) **(30 points)**. The `hw5_original.csv` file is a database of an on-line music store in a comma-separated file format. In order to remove redundancy and inefficiencies, we normalized it according to the following rules:
   a. Artist names, customer last names and invoice IDs are unique
   b. Each artist can have zero or more albums
   c. Each album is made by exactly one artist
   d. Each track appears in exactly one album. Note that some tracks with the same name from the same composer may appear in different albums; in that case, however, they have different lengths, so they are considered different tracks (i.e., the tuple <trackName, trackLength> is unique for each track)
   e. Each album has at least one track

f. Each track belongs to exactly one genre
g. Each genre is represented by at least one track
h. Each track is stored in exactly one media type
i. Each media type is used by at least one track
j. Each invoice item is for exactly one track and part of exactly one invoice
k. Each invoice has at least one invoice item
l. Some tracks may have never been sold (so there are no invoices for them)
m. Each invoice is issued to exactly one customer
n. The following columns always have a value: album title, customer first and last name, customer email, track name, track price, track length, invoice date, invoice item unit price, and invoice item quantity.

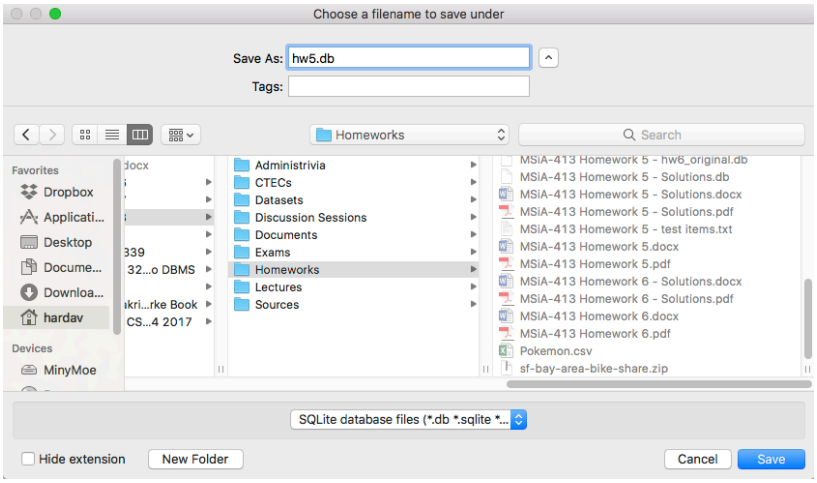
The corresponding normalized database diagram is given below:



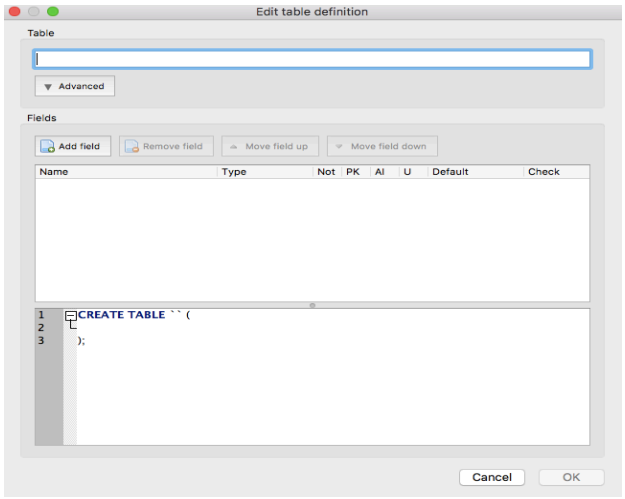
We now want to create a SQLite database that implements the normalized database. The first step is to create a new database with just one table that has the same data as the CSV file. Here is how to do that:

(0 points) Part A: Creating a new database and importing a CSV file

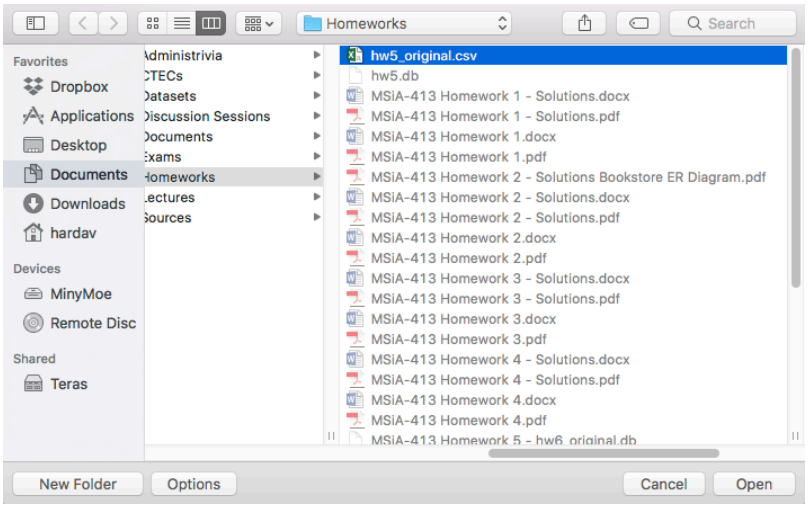
Start DB Browser for SQLite. Create a new database (`File → New Database`). A window will pop up like the one below. Specify a name and path to your new database file and click "save" to create the file.



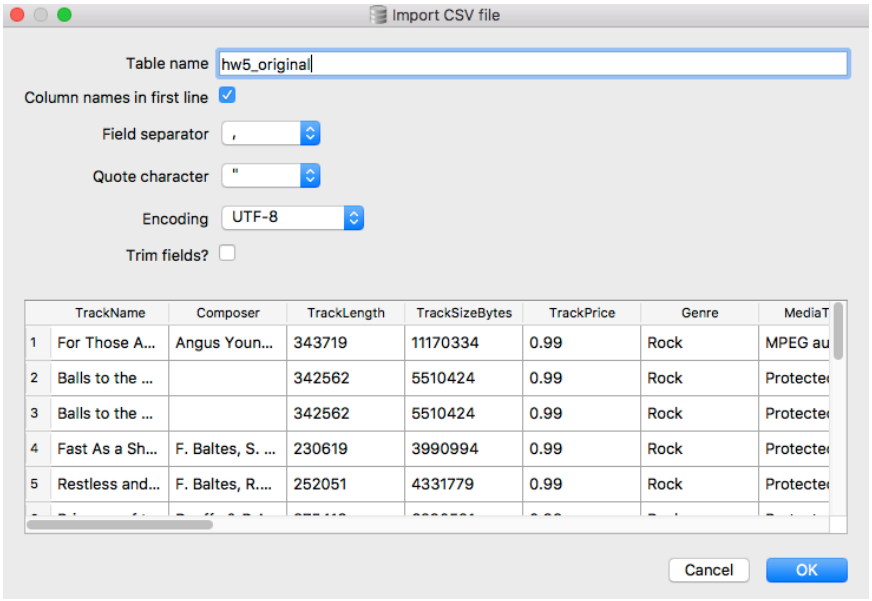
Then, another window will pop up like the one below that asks for a table definition. Click cancel.



Then, create and populate one table with the data from the `hw5_original.csv` file. The easiest way to do this is to use `File` → `Import` → `Table from CSV file`. Select the `hw5_original.csv` file and click open.



Then, a window will pop up in which you specify how the CSV data will be imported. Make sure "`Column names in first line`" is checked and the UTF-8 encoding is selected, as in the snapshot below.



This process automatically creates a single table (with the default name `hw5_original`) with as many columns as the CSV file, and with the column names extracted from the first line of the CSV file. Now, it is time to create the tables of the normalized database and populate them with data.

(30 points) Part B: Creating the normalized database

With the single-table database above as the starting point, create the database tables that follow the normalized database diagram shown earlier. Then, issue SQL queries against the original table you created (`hw5_original`) to populate these tables with data. Include in your answer:

- All the SQL commands that you used to create the tables and populate the data.
- The resulting SQLite database (submit it as a separate file through canvas). Remember to click "`Write Changes`" to save your data and tables. Please do not drop the `hw5_original` table (the initial table you created when uploading the data from the CSV file). Please leave it in your database for debugging and grading purposes.

Please note that:

- In the SQL command that creates a table you must explicitly specify the primary and foreign keys and any `UNIQUE` and `NOT NULL` constraints.
- When you import a row from a CSV file into a table, an empty column may have as a value the empty string. An empty string is different than a NULL string. This means that if you want to check whether a field has a value, you may need to compare against the empty string and not against a NULL value (i.e., instead of writing `WHERE customerLastName IS NOT NULL` you may need to write `WHERE customerLastName != ""`).

As a starting point, below are the SQL commands to create the table for media types. Use these SQL statements as the first statements in your answer, and proceed with creating and populating the remaining tables. We assume that the imported data from the CSV file were stored in a table with name `hw5_original`.

```
drop table if exists media_types;
create table media_types (
      mediaTypeId integer not null primary key autoincrement,
      mediaName nvarchar(20)
);
insert into media_types (mediaName)
select distinct mediaType from hw5_original;
```

9) **(10 points)** Find the best-selling artist and how much customers spent in buying this artist's songs, based on the normalized database that you created and populated in the previous question (8).

10) **(50 bonus points)** Instead of creating and loading the database through the GUI as explained in Problem (8) Part A, write your own program to do it. Your program can be written in any language (e.g., C, C++, Java, Python, Pearl). Your program should open the CSV file, interface with the SQLite database, and issue SQL commands to the database to create and populate the `hw5_original` table with data from the CSV file.

There are several tutorials online on the programming interfaces supported by SQLite. For example, at the bottom of http://www.sqlitetutorial.net/ you can find tutorials for SQLite interfaces with Python, Java, PHP and node.js. Similarly, at the bottom of the left pane at https://www.tutorialspoint.com/sqlite/ you can find tutorials of SQLite interfacing with C, C++, Java, Python, Pearl, and PHP. There are many other tutorials online that expand the choices to other programming languages (e.g., R, Matlab, ML, etc). Feel free to find a tutorial that best fits your needs and utilize it.

To receive full credit in this bonus problem you must submit with your answer a tarball with your program's source code modules, and instructions on how to install the necessary libraries, how to compile it and how to run it. You must also provide pointers to the tutorial(s) or any other online sources you used.

Because of the complexity of the bonus problem and the free choice of programming languages we give you, **we will not be able to provide TA/instructor support for the bonus problem**. Remember this is a bonus problem, not a required one. You can get full credit without answering Problem (10).

Question 8b:

Answers provided in `create_populate_musicstore.sql` file

Question 9:

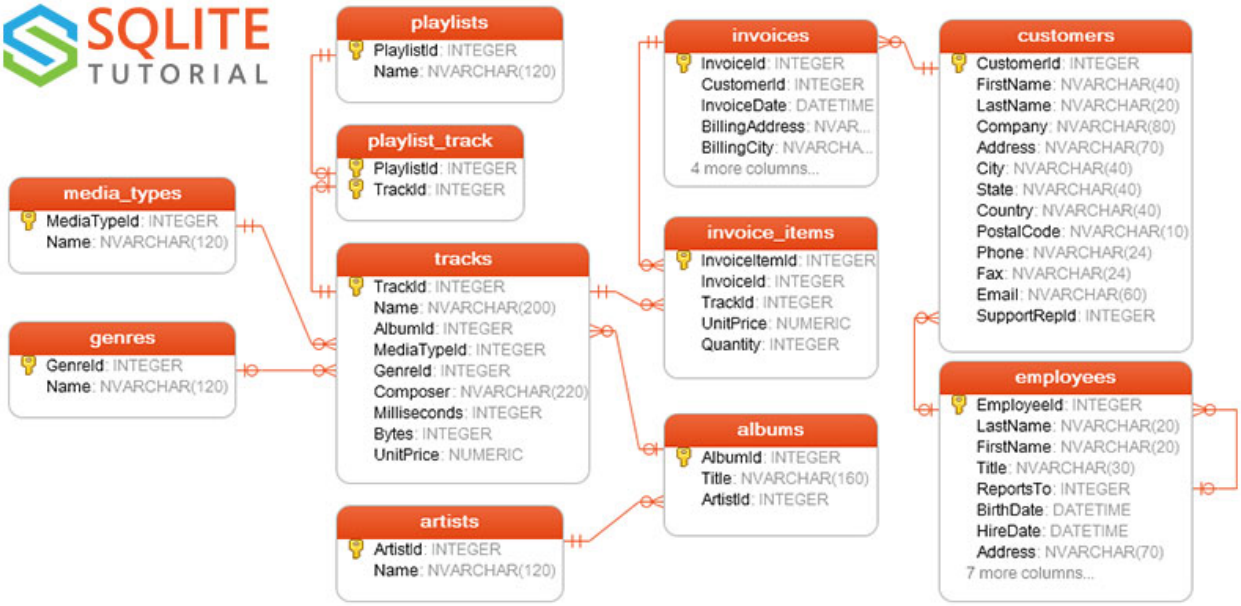
```
SELECT a2.artistName, round(SUM(i.quantity * i.unitPrice), 2) netBread
FROM invoice_item i
JOIN track t on i.trackID = t.trackID
JOIN album a on t.albumID = a.albumID
JOIN artist a2 on a.artistID = a2.artistID
GROUP BY a2.artistID
ORDER BY netBread DESC
LIMIT 3;
```

```
Iron Maiden|138.6
U2|105.93
Metallica|90.09
```

Reference: creating a CSV dataset through sqlite3

This part is written as a reference of how I created the dataset and stored it in a CSV file for problems 8-10. It is not needed to solve this homework, but it is given here for your perusal and future reference.

- **I took the database from http://www.sqlitetutorial.net/sqlite-sample-database/**



- **Then, I joined these tables together into a single result table using the following commands on SQLite's command line interface (`sqlite3`):**

```
sqlite> .open hw5_original.db
sqlite> .headers on
sqlite> .mode csv
sqlite> .output hw5_original.csv
sqlite> select tracks.Name as TrackName,
          tracks.composer,
          tracks.milliseconds as TrackLength,
          tracks.bytes as TrackSizeBytes,
          tracks.unitPrice as TrackPrice,
          genres.name as Genre,
          media_types.name as MediaType,
          albums.Title as AlbumTitle,
          artists.Name as ArtistName,
          invoice_items.Quantity as InvoiceItemQuantity,
          invoice_items.UnitPrice as InvoiceItemUnitPrice,
          invoices.invoiceId,
          invoices.InvoiceDate,
          invoices.BillingAddress as InvoiceBillingAddress,
          invoices.BillingCity as InvoiceBillingCity,
          invoices.BillingState as InvoiceBillingState,
          invoices.BillingCountry as InvoiceBillingCountry,
          invoices.BillingPostalCode as InvoiceBillingPostalCode,
          customers.FirstName as CustomerFirstName,
          customers.LastName as CustomerLastName,
          customers.Address as CustomerAddress,
          customers.City as CustomerCity,
          customers.State as CustomerState,
          customers.Country as CustomerCountry,
          customers.PostalCode as CustomerPostalCode,
          customers.Phone as CustomerPhone,
          customers.Fax as CustomerFax,
          customers.Email as CustomerEmail
        from tracks
          left join invoice_items on tracks.TrackId = invoice_items.TrackId
```

```
left join media_types on media_types.MediaTypeId = tracks.MediaTypeId
left join genres on genres.GenreId = tracks.GenreId
left join albums on albums.AlbumId = tracks.AlbumId
left join artists on artists.ArtistId = albums.ArtistId
left join invoices on invoice_items.InvoiceId = invoices.InvoiceId
left join customers on invoices.CustomerId = customers.CustomerId;
```

- Then, I exported the resulting table as a CSV file with name `hw5_original.csv`.

Contents of create_populate_musicstore.sql for convenience

```sql
--================================--
---------- MEDIA TYPE ----------
--================================--
DROP TABLE IF EXISTS media_type;
CREATE TABLE media_type (
  mediaTypeID integer not null primary key autoincrement,
  mediaName text not null
);

INSERT INTO media_type (mediaName)
SELECT DISTINCT MediaType
FROM hw5_original;


--================================--
------------ GENRE -------------
--================================--
DROP TABLE IF EXISTS genre;
CREATE TABLE genre (
  genreID integer primary key autoincrement,
  name text not null
);

INSERT INTO genre (name)
SELECT DISTINCT Genre
FROM hw5_original;


--================================--
------------ ARTIST -------------
--================================--
DROP TABLE IF EXISTS artist;
CREATE TABLE artist (
  artistID integer primary key autoincrement,
  artistName text not null unique
);

INSERT INTO artist (artistName)
SELECT DISTINCT ArtistName
FROM hw5_original;


--================================--
------------ ALBUM -------------
--================================--
DROP TABLE IF EXISTS album;
CREATE TABLE album (
  albumID integer primary key autoincrement,
  albumTitle text not null,
  artistID integer not null references artist (artistID)
);
```

```sql
INSERT INTO album (albumTitle, artistID)
SELECT AlbumTitle, artistID
FROM hw5_original o
JOIN artist ON o.artistName = artist.artistName
GROUP BY o.AlbumTitle;


--============================--
------------ TRACK ------------
--============================--
DROP TABLE IF EXISTS track;
CREATE TABLE track (
  trackID integer primary key autoincrement,
  trackName text not null,
  composer text,
  trackSizeBytes integer,
  trackLength integer not null,
  trackPrice real not null,
  genreID integer not null references genre (genreID),
  mediaTypeID integer not null references media_type (mediaTypeID),
  albumID integer references album (albumID),
  UNIQUE (trackName, trackLength)
);

INSERT INTO track (trackName, composer, trackSizeBytes, trackLength, trackPrice, genreID,
mediaTypeID, albumID)
SELECT o.TrackName, o.Composer, o.TrackSizeBytes, o.TrackLength, o.TrackPrice, g.genreID,
m.mediaTypeID, a.albumID
FROM hw5_original o
JOIN genre g ON g.name = o.Genre
JOIN media_type m ON m.mediaName = o.MediaType
JOIN album a ON a.albumTitle = o.AlbumTitle
GROUP BY TrackName, TrackLength;


--============================--
----------- CUSTOMER -----------
--============================--
DROP TABLE IF EXISTS customer;
CREATE TABLE customer (
  customerID integer primary key autoincrement,
  firstName text not null,
  lastName text not null unique,
  address text,
  city text,
  state text,
  country text,
  postalCode integer,
  phoneNumber integer,
  faxNumber integer,
  email text not null
);
```

```sql
INSERT INTO customer (firstName, lastName, address, city, state, country, postalCode, phoneNumber,
faxNumber, email)
SELECT CustomerFirstName, CustomerLastName, CustomerAddress, CustomerCity, CustomerState,
       CustomerCity, CustomerPostalCode, CustomerPhone, CustomerFax, CustomerEmail
FROM hw5_original
GROUP BY CustomerEmail
HAVING CustomerFirstName NOT NULL;


--==============================--
------------ INVOICE ------------
--==============================--
DROP TABLE IF EXISTS invoice;
CREATE TABLE invoice (
  invoiceID integer primary key autoincrement,
  date date not null default current_date,
  billingAddress text,
  billingCity text,
  billingState text,
  billingCountry text,
  billingPostalCode integer,
  customerID integer not null references customer (customerID)
);

INSERT INTO invoice
SELECT InvoiceId, InvoiceDate, InvoiceBillingAddress, InvoiceBillingCity, InvoiceBillingState,
InvoiceBillingCountry, InvoiceBillingPostalCode, c.customerID
FROM hw5_original o
JOIN customer c ON c.lastName = o.CustomerLastName
GROUP BY InvoiceId;


--==============================--
--------- INVOICE_ITEM ---------
--==============================--
DROP TABLE IF EXISTS invoice_item;
CREATE TABLE invoice_item (
  invoiceItemID integer primary key autoincrement,
  invoiceID integer not null references invoice (invoiceID),
  trackID integer not null references track (trackID),
  quantity integer not null,
  unitPrice numeric not null
);

INSERT INTO invoice_item (invoiceID, trackID, quantity, unitPrice)
SELECT o.InvoiceId, t.trackID, o.InvoiceItemQuantity, o.InvoiceItemUnitPrice
FROM hw5_original o
JOIN track t ON (t.trackName, t.trackLength) = (o.TrackName, o.TrackLength)
WHERE o.InvoiceId NOT NULL
ORDER BY o.TrackName;
```