

Assignment 3 - Embedded SQL, JDBC

Due: Wed Nov 20 at 11:59PM. Work individually on this assignment [Late submissions: see syllabus for policy].

Artist DB Browser: A Java Application

For this assignment, you are tasked with implementing a Java application that retrieves and displays information about artists. Before you begin, read these general instructions:

1. **You may not use standard input or output.** Doing so even once will result in the autotester terminating, causing you to receive zero credit.
2. Be sure to **close all unused statements and result sets.**
3. **The database, username, and password must be passed as parameters, never “hard-coded”.** We will use the `connectDB()` and `disconnectDB()` methods to connect to the database with our own credentials. Our test code will use these to connect to a database. You should **not** call these in the other methods we ask you to implement; you can assume that they will be called before and after, respectively, any other method calls.
4. All of your code must be written in `ArtistBrowser.java`. This is the only file you will submit for this assignment.
5. You may not change the method signature of any of the functions we’ve asked you to implement. However, you are encouraged to write helper functions to maintain good code quality ;-).
6. Your JDBC code should have proper exception-handling logic, and **must use *prepared SQL statements*** (for ensuring better performance and security standards).
7. As you saw in lecture and during one of the preps: to run your code, you will need to include the JDBC driver in your class path. You may wish to review the related exercises available under the JDBC folder on Canvas.
8. If your solution requires creating intermediate SQL views within a Java method, you can do that. We ask you not to drop your views at the end of each method, for this assignment.

Schema

In this assignment, we will work with a music industry database. What follows is a brief description of the meaning of the attributes in the schema; to fully understand this database, read these descriptions, and have a look over the actual schema definition found in `artistdb.SQL`.

- **Artist**(artist_id, name, birthdate, nationality)
A tuple in this relation represents an artist. An artist is considered a musician, a band, or a songwriter, with a given *name*. Names are stored in a single text attribute - for example, ‘Justin Timberlake’, ‘Chris Martin’, ‘Coldplay’, ‘Metallica’, ‘Guns ’n Roses’ (notice how apostrophes are represented using double quotes in SQL), etc. The birthdate for a band is the date when it was formed. A band’s nationality is considered based on where it was formed, regardless of the nationalities of its members.
- **Role**(artist_id, role)
A tuple in this relation represents whether an artist is a ‘Musician’ (solo artist), ‘Band’, or a ‘Songwriter’ (no space!). An artist can fulfill multiple roles.
- **WasInBand**(artist_id, band_id, start_year, end_year)
A tuple in this relation represents whether an artist belonged to a band, and during which timeframe. An artist can appear in different bands at different timeframes; also, an artist can belong to the same band for several distinct (non-overlapping) timeframes. An *end_year* of 2020 indicates that the artist is still an active member of this band (you can assume this is an old database dump from the year 2020).

- **Album**(album_id, title, artist_id, genre_id, year, sales)
A tuple in this relation represents that album *album_id*, with title *title*, performed by *artist_id*, belongs to genre *genre_id*, and was launched sometime during *year*, with total revenue of *sales* amount of \$. You can assume an album is only categorized as one (dominating) genre, even if there may be influences from other genres.
- **Genre**(genre_id, genre)
A tuple in this relation represents a musical genre (e.g., ‘pop’, ‘rock’, ‘heavy metal’, etc.).
- **Song**(song_id, title, songwriter_id)
A tuple in this relation represents that the song titled *title* was written by the Artist with the ID *songwriter_id*. If a band’s song was composed by multiple members, then the songwriter_id is considered the artist_id of the band.
- **BelongsToAlbum**(song_id, album_id, track_no)
A tuple in this relation represents the fact that a song *song_id* is included in the album *album_id*. A song that is the product of a collaboration between two musicians is only included in one album (the main artist’s album). A song can feature in more than one album by different artists, only if it is a cover song.
- **RecordLabel**(label_id, label_name, country)
A tuple in this relation represents a record label, and the country it is based in.
- **ProducedBy**(album_id, label_id)
A tuple in this relation represents that the album *album_id* was produced by *record_label*.
- **Collaboration**(song_id, artist1, artist2)
A tuple in this relation represents a collaboration between artists with IDs *artist1* and *artist2* on song *song_id*. Artist1 is the ‘main artist’ (the only one of the two who has this song included in their album), while Artist2 is the guest artist (for example, for the song ‘One’ by U2 featuring Mary J. Blige, U2 would be the main artist, Mary J. Blige would be the guest artist). A collaboration refers strictly to musicians and bands, and not to songwriters (a songwriter’s authorship of a song does not count in this relation, and is instead represented in the Song relation). An artist cannot collaborate with themselves.

The schema definition uses four types of integrity constraints:

- Every table has a primary key (“PRIMARY KEY”).
- Some tables use foreign key constraints (“REFERENCES”).
- Some tables define other keys (“UNIQUE”).
- Some attributes must be present (“NOT NULL”).

Your work on this assignment must work on *any* database instance that satisfies these integrity constraints, so make sure you read and understand them.

Required Java Methods

Here’s a summary of the required Java methods inside `ArtistBrowser.java`. The first two are implemented for you. For the rest, read the comments in the code carefully for additional instructions and requirements (beyond what is written here). Remember, you must not change the names and signatures of any of these core methods!

1. `connectDB`: Connect to a database with the supplied credentials.
2. `disconnectDB`: Disconnect from the database.
3. [14 points] `findArtistsInBands`: Return a list of all musicians who were part of a band at any point during a given timeframe.
4. [14 points] `findArtistsInGenre`: Return a list of all musicians and bands who released at least one album in a given genre.

5. [18 points] **findCollaborators**: Return a list of artists who collaborated with a given artist on some song. The list of artists should include both the case when an artist was a guest collaborator, as well as the main artist.
6. [18 points] **findSongwriters**: Return a list of all the songwriters that wrote songs for a given artist. Do not include the artist themselves, for artists that wrote their own music (either partially or exclusively).
7. [18 points] **findCommonAcquaintances**: Return the common acquaintances for two given artists. A common acquaintance is considered a collaborator (either as a guest or main artist), or songwriter that worked with both given artists at any point during their careers.
8. [18 points] **artistConnectivity**: We define a path between two artists P1 and P2 as a sequence of artists [P1, Q1, Q2, ..., Qn, P2] such that P1 and Q1 collaborated on some song, Q1 and Q2 collaborated on some song, ..., and Qn and P2 collaborated on some song. We say that two artists are **connected** if there exists a path [P1, P2] connecting them. For example, in the test data you are given, artists 'Z' and 'Usher' are considered *connected* even though they have not collaborated directly on any song; however, 'Z' collaborated with 'Alicia Keys' who in turn had collaborated with 'Usher', therefore there is a collaboration path connecting artists 'Z' and 'Usher'. Note that accomplishing this task in pure SQL can be quite challenging. Luckily we can utilize the power of JDBC programming to tackle this problem.

For all queries, except the connectDB, disconnectDB, and artistConnectivity, the result must be returned as an **ArrayList** of strings, as per the function signatures. Hint: You can optionally implement some of these methods without writing any additional SQL code, and while utilizing Java methods that you have already implemented in the ArtistBrowser Java class!

Getting Started: Step by Step

- Download PostgreSQL and install it on your computer, if you haven't already:
<https://www.postgresql.org/download/>
- Download all starter code in the A3 folder on Canvas.
- Execute the content of **artistdb.sql**. You can either copy its content into a pgAdmin Query Browser window and run it, or, using a terminal/shell you can use the **psql** command with **-f** flag to execute the SQL script on your computer. If you want to use the latter approach, here's an example you can follow (after modifying the file paths according to your local setup):

```
cd /Library/PostgreSQL/10/bin/      # navigate to psql binary location
./psql -U postgres -f /replace/this/with/full/path/to/your/a3/folder/artistdb.sql
```

- Implement all the missing methods in **ArtistBrowser.java**.
- Compile the Java class:
`javac ArtistBrowser.java`
- Run the Java class with the JDBC driver in the classpath (replace the colon ':' with a semicolon ';' if you're using Windows OS). Provide the two required program arguments, the DB user name and password (see the code in **main()**):

```
java -cp postgresql-42.5.0.jar: ArtistBrowser postgres postgres
```

Java Resources: You should have a basic knowledge of Java from CS171, which is a prerequisite for this course. Nevertheless, if you have Java-specific questions, feel free to consult the documentation. For your reference, the main built-in Java class that you'll need to refresh is **ArrayList**, for which you can find documentation here: <http://docs.oracle.com/javase/8/docs/api/java/util/ArrayList.html>. You can find some additional material in section 3.2 of here: http://www.vogella.com/tutorials/JavaCollections/article.html#javacollections_lists. For java.sql package questions, refer to the documentation here: <https://docs.oracle.com/javase/8/docs/api/java/sql/package-summary.html>.

Discussion and asking for clarifications: Use our course Piazza page to post questions about the assignment if you need a clarification about any of the methods. Or visit teaching staff during office hours!

Honor Code: The assignment is expected to be solved **individually** and is governed by the College Honor Code and Departmental Policy. Remember, any code you submit must be your own; otherwise you risk being investigated by the Honor Council and facing the consequences of that. We do check for code plagiarism (across student submissions and against online resources). Please remember to have the following comment included at the top of the Java file.

```
/*  
THIS CODE WAS MY OWN WORK, IT WAS WRITTEN WITHOUT CONSULTING  
CODE WRITTEN BY OTHER STUDENTS OR COPIED FROM ONLINE RESOURCES.  
_Student_Name_Here_  
*/
```