Web Design and Programming (0107558) Internet Programming (0107571)[1]

Introduction to SQL - Database

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[1] Michael Mendez. *The Missing Link: An Introduction to Web Development and Programming*. Open SUNY Textbooks 2014.

Database Example

Track	Len	Artist	Album	Genre	Rating	Count
Hells Bells	5:13	AC/DC	Who made who	Rock	5	61
Shake your foundations	3:54	AC/DC	Who made who	Rock	5	70
Chase the Ace	3:01	AC/DC	Who made who	Rock	0	56
For those about to rock	5:54	AC/DC	Who made who	Rock	5	61
Dulaman	3:43	Altan	Natural wonders	New Age	0	31
Rode across the desert	4:10	America	Greatest Hits	Easy listen	5	23
Now you are gone	3:08	America	Greatest Hits	Easy listen	5	18
Tin Man	3:30	America	Greatest Hits	Easy listen	5	23
Sister Golden Hair	3:22	America	Greatest Hits	Easy listen	5	24
Track 01	4:22	Billy Price	Danger Zone	Blues/R&B	5	26
Track 02	2:45	Billy Price	Danger Zone	Blues/R&B	5	18
Track 03	3:26	Billy Price	Danger Zone	Blues/R&B	5	22
Track 04	4:17	Billy Price	Danger Zone	Blues/R&B	5	18
Track 05	3:50	Billy Price	Danger Zone	Blues/R&B	5	21
War Pigs/Luke's Wall	7:58	Black Sabbath	Paranoid	Metal	5	25
Paranoid	2:53	Black Sabbath	Paranoid	Metal	5	22
Planet Caravan	4:35	Black Sabbath	Paranoid	Metal	5	25
Iron Man	5:59	Black Sabbath	Paranoid	Metal	5	26
Electric Funeral	4:53	Black Sabbath	Paranoid	Metal	5	22
Hnad of Doom	7:10	Black Sabbath	Paranoid	Metal	5	23
Rat Salad	2:30	Black Sabbath	Paranoid	Metal	5	31
Jack the Stripper/Fairies Wear	6:14	Black Sabbath	Paranoid	Metal	5	24
Bomb Squad (TECH)	3:28	Brent	Brent's Album		0	1
Clay techno	4:36	Brent	Brent's Album		0	2
Heavy	3:08	Brent	Brent's Album		0	1
Hi metal man	4:20	Brent	Brent's Album		0	1
Mistro	2:58	Brent	Brent's Album		0	1

Introduction to SQL

Building a Database

- Don't put the same string data in twice - use a relationship instead.
- When there is one thing in the real world there should only be one copy of that thing in the database.

Introduction to SQL

Building a Database

Questions to ask

It is clear that there should be more than one relational tables.

- What is the first table? What is the whole purpose of this application?
- What is not vertically a duplicate string data? To add to the first table.

First table

Is the track (the purpose of the database).

Title	Len	Rating	Count

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Other tables

- Album:

Title

- Artist:

Name

- Genre:

Name

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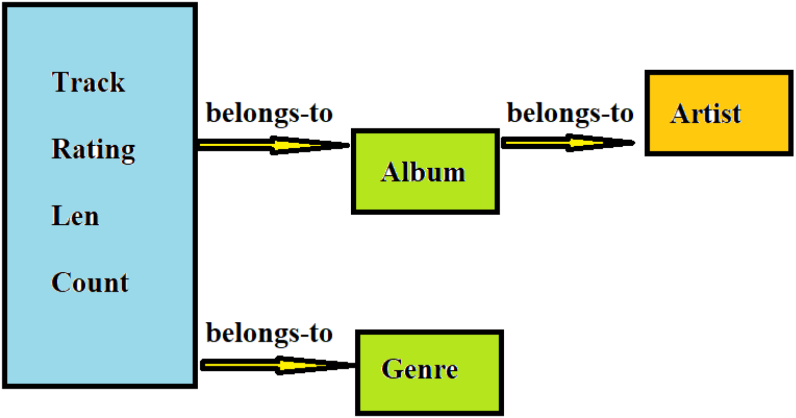
Tables



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Database normalization

Makes benefit of the underlying math that constitutes the database.

- Don't replicate data. Reference data.
- Use integers for keys and for references.
- Add a special key column for each table you reference.

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SQL basics - Logical Key, Primary Key, and Foreign key

- Primary Key: Integer auto incremented field.
  (*table name*)_id
- Foreign Key: Integer pointing to a row in another table.
  (*referenced table name*)_id
- Logical Key: What the outside world uses for lookup (email, name, ...).

Introduction to SQL

SQL basics - Logical Key, Primary Key, and Foreign key

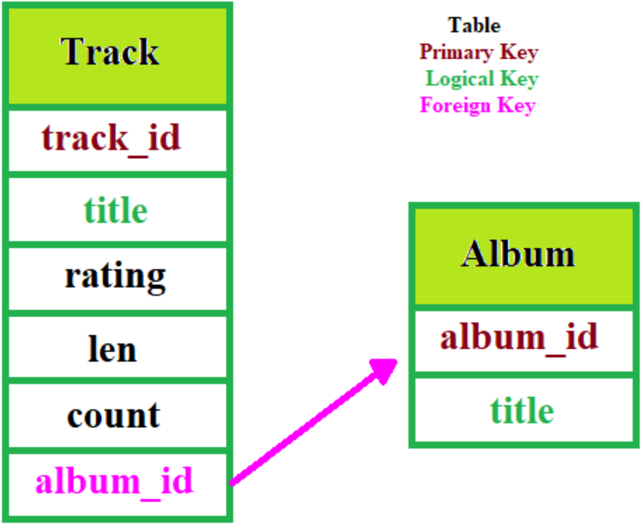

Table
Primary Key
Logical Key
Foreign Key

Track
track_id
title
rating
len
count
album_id

Album
album_id
title

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Physical Schema

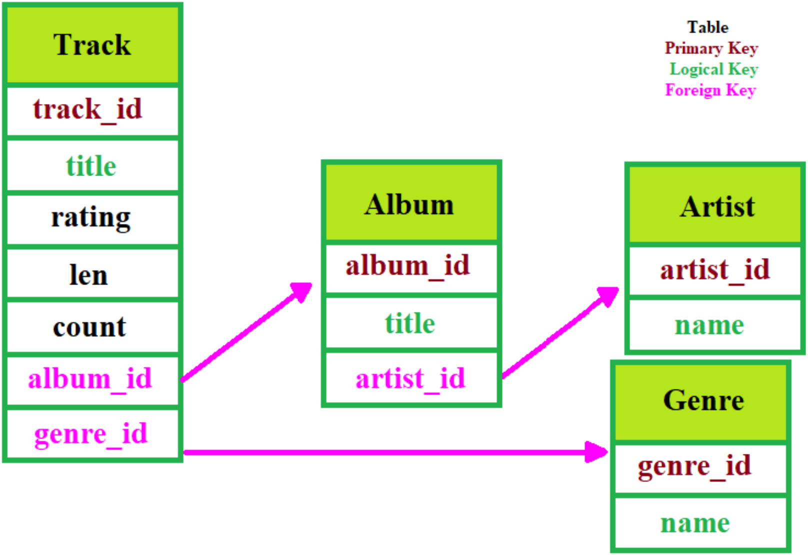

Table
Primary Key
Logical Key
Foreign Key

Track
track_id
title
rating
len
count
album_id
genre_id

Album
album_id
title
artist_id

Artist
artist_id
name

Genre
genre_id
name

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Physical Schema

```
CREATE DATABASE Music;
CREATE TABLE Artist(
    artist_id INTEGER NOT NULL AUTO_INCREMENT,
    name VARCHAR(255),
    PRIMARY KEY(artist_id)
)ENGINE=InnoDB;
CREATE TABLE Album(
    album_id INTEGER NOT NULL AUTO_INCREMENT,
    title VARCHAR(255),
    artist_id INTEGER,
    PRIMARY KEY(album_id),
    INDEX USING BTREE(title),

    CONSTRAINT FOREIGN KEY(artist_id)
      REFERENCES Artist (artist_id)
      ON DELETE CASCADE ON UPDATE CASCADE
)ENGINE=InnoDB;
```

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Physical Schema

```
CREATE TABLE Genre(
    genre_id INTEGER NOT NULL AUTO_INCREMENT,
    name VARCHAR(255),
    PRIMARY KEY(genre_id),
    INDEX USING BTREE(name)
)ENGINE=InnoDB;
CREATE TABLE Track(
    track_id INTEGER NOT NULL AUTO_INCREMENT,
    title VARCHAR(255),
    rating INTEGER,
    len INTEGER,
    count INTEGER,
    album_id INTEGER,
    genre_id INTEGER,
    PRIMARY KEY(track_id),
    INDEX USING BTREE(title),

    CONSTRAINT FOREIGN KEY(album_id) REFERENCES Album (album_id)
      ON DELETE CASCADE ON UPDATE CASCADE,
    CONSTRAINT FOREIGN KEY(genre_id) REFERENCES Genre (genre_id)
      ON DELETE CASCADE ON UPDATE CASCADE
)ENGINE=InnoDB;
```

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Insert data

- Start from leaf tables. (Artist)

  ```
  INSERT INTO Artist(name) VALUES('AC/DC');
  INSERT INTO Artist(name) VALUES('Altan');
  ```

- Then the upper tables. All children of a table should be filled with the information of an entity before adding the corresponding info into a parent table. Watch the ids.

  ```
  INSERT INTO Album(title, artist_id) VALUES('Natural Wonders', 2);
  INSERT INTO Album(title, artist_id) VALUES('Who made who', 1);
  ```

- Genre table:

  ```
  INSERT INTO Genre(name) VALUES('Rock');
  INSERT INTO Genre(name) VALUES('New Age');
  ```

- Finally Track table. Watch ids from Genre and Album tables.

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Join operation

- Join operation links data on several tables.
- It is part of the Select operation.
- Example:

```
SELECT Album.title,Artist.name FROM Album JOIN Artist
ON Album.artist_id=Artist.artist_id;
```

- Example without ON clause:

```
SELECT Track.title,Track.genre_id,Genre.genre_id,
Genre.name FROM Track JOIN Genre;
```

- JOIN operation without ON clause gives all possible combinations.

Introduction to SQL

Join operation

Complex Join operation:

```
SELECT Track.title,Artist.name,Album.title,Genre.name
FROM Track JOIN Genre JOIN Artist JOIN Album ON
Track.genre_id=Genre.genre_id AND
Track.album_id=Album.album_id AND
Album.artist_id=Artist.artist_id;
```

Introduction to SQL

Quiz - 1

- What is the primary value add of relational databases over flat files?
    - Ability to quickly convert data to HTML
    - Ability to execute JavaScript in the file
    - Ability to execute PHP code within the file
    - Ability to scan large amounts of data quickly
    - Ability to store data in a format that can be sent across a network
- Which of the following is NOT a good rule to follow when developing a database model?
    - Each "object" in the application should be modeled as one or more tables
    - Use a persons email address as their primary key
    - Never repeat string data in more than one table in a data model
    - Use integers as primary keys

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Quiz - 2

- If our user interface (i.e. like iTunes) has repeated strings on one column of the UI, how should we model this properly in a database:
    - Encode the entire row as JSON and store it in a TEXT column in the database
    - We put the string in the first row where it occurs and then NULL in all of the other rows
    - We make a table that maps the strings in the column to numbers and then use those numbers in the column
    - We put the string in the first row it occurs and then put that row number in the column all of the rest of the rows where the string occurs
    - We put the string in the last row where it occurs and put the number of that row in the column all of the rest of the rows where the string occurs

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Quiz - 3

- Which of the following is the label we give a column that the "outside world" uses to look up a particular row?
  - Primary key
  - Logical key
  - Remote key
  - Local key
  - Foreign key
- What is the label we give to a column that is an integer and used to point to a row in a different table?
  - Remote key
  - Primary key
  - Local key
  - Logical key
  - Foreign key

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Quiz - 4

- What MySQL keyword is added to primary keys in a CREATE TABLE statement to indicate that the database is to provide a value for the column when records are inserted.
  - AUTO_INCREMENT
  - INSERT_AUTO_PROVIDE
  - ASSERT_UNIQUE
  - PRIMARY
- What is the SQL keyword that reconnects rows with foreign keys with the corresponding data in the table that the foreign key points to?
  - CONSTRAINT
  - COUNT
  - CONNECT
  - APPEND
  - JOIN

Introduction to SQL

Quiz - 5

- What happens when you JOIN two tables together without an ON clause?
  - You get all of the rows of the left table in the JOIN and NULLs in all of the columns of the right table
  - Leaving out the ON clause when joining two tables is an SQL syntax error
  - The rows of the left table are connected to the rows in the right table when their primary key matches
  - You get no rows at all
  - The number of rows you get is the number of rows in the first table times the number of rows in the second table

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Quiz - 6

- What does an "ON DELETE CASCADE" clause imply in a foreign key constraint in a MySQL CREATE TABLE statement?
    - Whenever a row is deleted, it is moved into a table named "CASCADE"
    - Whenever a row is deleted from the table, the other rows are scanned to insure that the logical key is unique and any duplicates are removed
    - When a row in the parent table is deleted all the rows in a child table that point to that row via a foreign key are deleted
    - When rows in a child table are deleted, the primary key of the corresponding row in the parent table is set to NULL
- Which of the following types of tables often are created without a primary key?
    - One-to-one
    - Hash Map
    - One-to-many
    - Many-to-many
    - B-Trees

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Quiz - 7

- When might one prefer the CHAR column type over VARCHAR?
  - When the data needs to be searched using a LIKE clause
  - When the data has widely varying lengths
  - When the data is prose like a discussion comment versus a logical key
  - When the data is relatively short and almost always present
- What is the built-in MySQL function that gives you the current time in an SQL statement?
  - DATE(false)
  - NOW()
  - CURR_DATE()
  - TODAY()
- Which of the following indexes would be best for fast look up for exact key matches but not so good for prefix lookups or sorting?
  - HASH
  - BTREE
  - EXACT
  - INDEX2

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Quiz - 8

- Why is it a good idea to add "CONSTRAINT FOREIGN KEY" statements when creating database tables? (Check all that apply)
  - So that MySql knows which columns are foreign keys and which columns are just integers
  - So that prefix-based lookups perform well
  - So that you can specify default behaviors when records are deleted or updated
  - So that database modeling tools know the relationships between tables
- When you add an index to a field in a database table, how are performance and storage affected?
  - Read performance is the same, insert performance is faster and no extra storage is required
  - Read performance is faster, insert performance is slower and extra storage is required
  - Read performance is faster, insert performance is the same and no extra storage is required
  - Read performance is faster, insert performance is faster and extra storage is required