Lecture 10: Modifying Data and Migrating Tables

DATA 351: Data Management with SQL

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This lecture covers how to modify data in PostgreSQL using ALTER TABLE, UPDATE, DELETE, and transactions. Building on Chapter 10 of Practical SQL, we apply these techniques to a Gen-Z pop music catalog (2015-2025) with intentional data quality issues. Students will clean a messy staging table and migrate the cleaned data into a 3NF normalized schema of artists, albums, and tracks. This is a hands-on, interactive session where students build their own SQL cleanup script to turn in.

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1 Learning Objectives

1.1 What You Will Be Able to Do

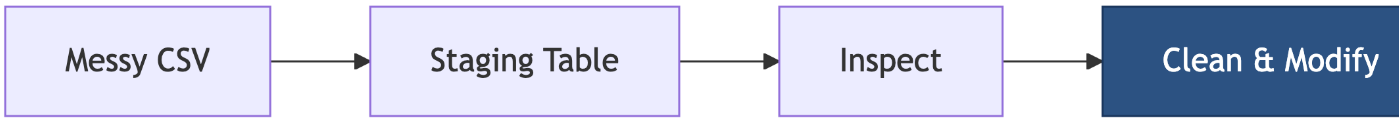
By the end of this lesson, you will be able to:

- **Recall** (Remember) the syntax and purpose of ALTER TABLE, UPDATE, DELETE, and transactions
- **Identify** (Analyze) data quality issues by interviewing a dataset using GROUP BY, count(), length(), and IS NULL
- **Apply** (Apply) UPDATE with WHERE, ALTER TABLE ADD/DROP COLUMN, and DELETE to fix data quality problems
- **Use** (Apply) transactions (START TRANSACTION, COMMIT, ROLLBACK) to safely preview and revert changes
- **Use** (Apply) the RETURNING clause to verify modifications without a separate SELECT
- **Construct** (Create) INSERT INTO … SELECT statements to migrate cleaned staging data into normalized 3NF tables
- **Produce** (Create) a complete SQL cleanup and migration script from a messy staging table

2 The Big Picture

2.1 Where We Are

We have covered inspecting data. Now we apply the full pipeline: clean, modify, and migrate.



Last time we were the data doctors running diagnostics. Today we are the surgeons. Scrub in.

2.2 Today's Agenda

Two hours, seven phases, one deliverable. No bathroom breaks. (Kidding. Mostly.)

- Phase 1: Setup and orientation (the messy data and the clean target)
- Phase 2: Interviewing the dataset (inspection review)
- Phase 3: Safety first (backups and column copies)
- Phase 4: Cleaning with UPDATE
- Phase 5: Removing bad rows with DELETE
- Phase 6: Transactions for safe surgery
- Phase 7: Migrating cleaned data into normalized tables

What you turn in: A single SQL file with all your cleanup and migration statements.

2.3 The Deliverable

By the end of class you will submit a SQL file called `cleanup.sql` that contains:

1. Your backup statement
2. All UPDATE statements that fix the data
3. All DELETE statements that remove bad rows
4. Column cleanup (DROP/RENAME) statements
5. INSERT INTO … SELECT migration statements
6. Verification queries

Start a new file now in Beekeeper or your text editor. Add your name at the top as a comment.

```sql
-- cleanup.sql
-- Name: <Your Name>
-- Date: 2026-03-10
-- DATA 351 - Lecture 10: Data Cleanup and Migration
```

3 Phase 1: Setup and Orientation

3.1 Creating the Database

If you still have `lc_music` from last time, drop it and start fresh:

```sql
DROP DATABASE IF EXISTS lc_music;
CREATE DATABASE lc_music;
```

Connect to `lc_music`, then run the setup script `music_genz_setup.sql` from the course site.

3.2 What the Script Creates

The script creates four tables:

Table	Purpose	Rows
`music_catalog_staging`	Raw messy data	48
`artists`	Normalized target (empty)	0
`albums`	Normalized target (empty)	0
`tracks`	Normalized target (empty)	0

Verify:

```sql
SELECT count(*) FROM music_catalog_staging;
-- Should return 48
```

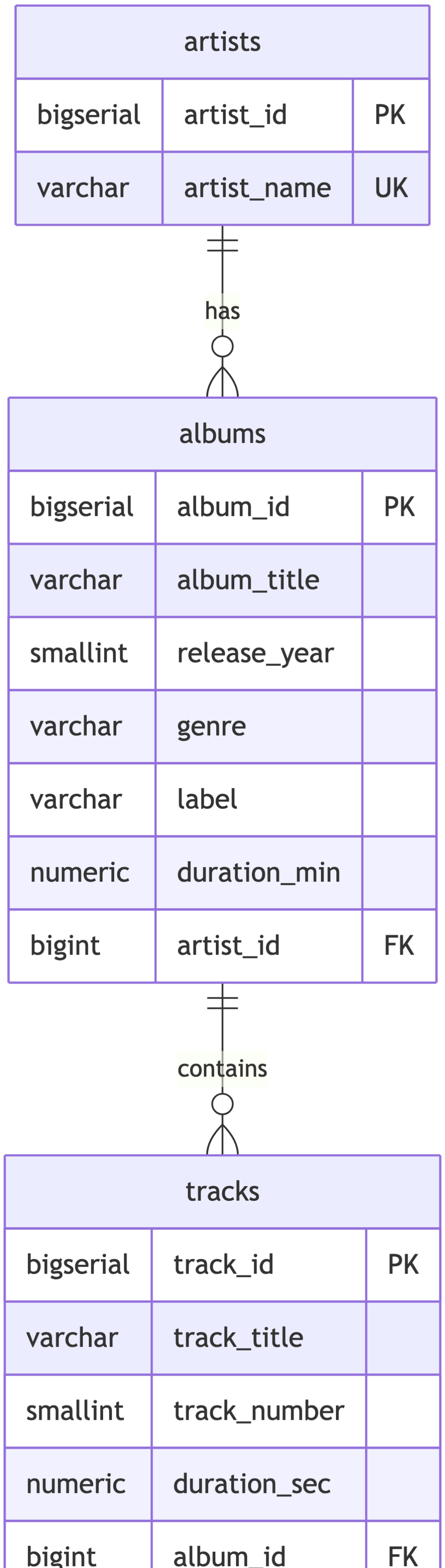
3.3 The Staging Table Schema

```sql
SELECT column_name, data_type
FROM information_schema.columns
WHERE table_name = 'music_catalog_staging'
ORDER BY ordinal_position;
```

Column	Type
catalog_id	varchar(20)
artist_name	varchar(200)
album_title	varchar(200)
release_year	smallint
genre	varchar(50)
label	varchar(100)
duration_min	numeric(5,1)
track_title	varchar(200)
track_number	smallint
track_duration_sec	numeric(6,1)

One flat table. No constraints. No keys. Just raw imported data. A crime scene, basically.

3.4 The Target: 3NF Normalized Design



The target tables have constraints: CHECK on year ranges, positive durations, UNIQUE on artist name and album-artist combos. Dirty data will be **rejected** if we try to insert it as-is. The constraints are bouncers, and our data is not on the list.

3.5 Why We Cannot Just Insert

Try this and watch it fail:

```sql
INSERT INTO artists (artist_name)
SELECT DISTINCT artist_name
FROM music_catalog_staging;
```

You will get a **unique constraint violation** because `Billie Eilish`, `billie eilish`, and `BILLIE EILISH` are treated as three different artists. PostgreSQL is not vibes-based. It is very literal. The staging data must be cleaned first.

3.6 Knowledge Check 1

Why does inserting distinct artist names from the staging table into the artists table fail?

A) The artists table does not exist yet

B) The staging table has no primary key

C) Inconsistent casing creates false "distinct" values that violate the UNIQUE constraint

D) INSERT INTO ... SELECT is not valid SQL

3.7 Answer: Knowledge Check 1

C) Inconsistent casing creates false "distinct" values that violate the UNIQUE constraint

`'Billie Eilish'`, `'billie eilish'`, and `'BILLIE EILISH'` are three different strings to PostgreSQL. The UNIQUE constraint on `artist_name` catches the duplicates that would result from `initcap()` or other normalization later. We must clean first, then insert.

4 Phase 2: Interviewing the Dataset

4.1 Quick Inspection Checklist

We are interviewing the data. Think of it like a job interview, except the candidate showed up in pajamas and lied on the resume. Run each of these in Beekeeper. Write down what you find.

Duplicates by catalog_id:

```sql
SELECT catalog_id, count(*) AS cnt
FROM music_catalog_staging
GROUP BY catalog_id
HAVING count(*) > 1;
```

Content duplicates (different ID, same song):

```sql
SELECT artist_name, album_title, track_title, track_number,
       count(*) AS cnt
FROM music_catalog_staging
GROUP BY artist_name, album_title, track_title, track_number
HAVING count(*) > 1;
```

4.2 NULL Values

```sql
SELECT
    count(*) AS total_rows,
    count(*) - count(genre) AS missing_genre,
    count(*) - count(label) AS missing_label,
    count(*) - count(track_title) AS missing_track,
    count(*) - count(track_number) AS missing_track_num,
    count(*) - count(track_duration_sec) AS missing_duration
FROM music_catalog_staging;
```

Which artists have NULLs? Find out:

```sql
SELECT catalog_id, artist_name, album_title, genre, label,
       track_title
FROM music_catalog_staging
WHERE genre IS NULL
   OR label IS NULL
   OR track_title IS NULL;
```

4.3 Casing Chaos

```sql
SELECT DISTINCT artist_name
FROM music_catalog_staging
ORDER BY artist_name;
```

You should see entries like:

- `Billie Eilish` vs `billie eilish` vs `BILLIE EILISH`
- `The Weeknd` vs `the weeknd` vs `THE WEEKND`
- `sabrina carpenter` vs `Sabrina Carpenter`
- `chappell roan` vs `Chappell Roan`
- `sza` vs `SZA`

Same artist, different strings. The database sees them as completely different values. It has zero chill about this.

4.4 Typos and Bad Values

Check for misspellings:

```sql
SELECT DISTINCT artist_name
FROM music_catalog_staging
ORDER BY lower(artist_name);
```

Spot it? `Dua Lippa` – one too many p's.

Check for bad numeric values:

```sql
SELECT catalog_id, artist_name, album_title, release_year
FROM music_catalog_staging
WHERE release_year NOT BETWEEN 1900 AND 2100;
```

```sql
SELECT catalog_id, artist_name, album_title, duration_min
FROM music_catalog_staging
WHERE duration_min <= 0;
```

Lil Nas X released an album in 2210? Harry Styles has negative album duration? I want whatever time machine the data entry person was using.

4.5 Inconsistent Labels

```sql
SELECT label, count(*) AS cnt
FROM music_catalog_staging
WHERE label IS NOT NULL
GROUP BY label
ORDER BY label;
```

You will see variations like:

- `Geffen` vs `Geffen Records`
- `Columbia` vs `Columbia Records`
- `Island` vs `Island Records`
- `Interscope` vs `Interscope Records`
- `TDE` vs `Top Dawg Entertainment` vs `TDE/RCA`
- `XO` vs `Republic` vs `XO/Republic`
- `Warner` vs `Warner Records`

4.6 Data Quality Summary

Issue	Details
Exact duplicate (same catalog_id)	CAT-2001 appears twice
Content duplicate (different ID)	CAT-2099 duplicates CAT-2090
NULL genre	Doja Cat (1 row), Bad Bunny (2 rows)
NULL label	Bad Bunny (1 row)
NULL track info	Tyler the Creator (1 row)
Inconsistent artist casing	8+ artists affected
Artist typo	Dua Lippa
Inconsistent label names	6+ label variations
Inconsistent genre casing	pop vs Pop, r&b vs R&B, hip-hop vs Hip-Hop
Bad release year	2210 (should be 2021)
Negative duration	-41.8 (should be 41.8)

That is a lot of mess for 48 rows. Imagine a dataset with 6 million. This is why data people drink coffee. Time to fix it.

4.7 Your Turn: Document the Issues

Before we start cleaning, **add a comment block to your `cleanup.sql`** listing every issue you found. This is your cleaning plan.

```
-- ============================================================
-- DATA QUALITY ISSUES FOUND:
-- 1. Exact duplicate: CAT-2001
-- 2. Content duplicate: CAT-2099 = CAT-2090
-- 3. NULL genre: Doja Cat, Bad Bunny
-- ... (list them all)
-- ============================================================
```

5 Phase 3: Safety First

5.1 Back Up the Table

Before touching anything, make a copy. Add this to your `cleanup.sql`:

```sql
CREATE TABLE music_catalog_staging_backup AS
SELECT * FROM music_catalog_staging;
```

Verify:

```sql
SELECT
    (SELECT count(*) FROM music_catalog_staging) AS original,
    (SELECT count(*) FROM music_catalog_staging_backup) AS backup;
```

Both should show **48**. This is your safety net. The database equivalent of saving your game before the boss fight.

5.2 Column Copies: The Belt-and-Suspenders Approach

We will create "clean" copies of columns we plan to modify. This way, the original data stays intact while we work on the copies.

```sql
ALTER TABLE music_catalog_staging
    ADD COLUMN artist_name_clean varchar(200);

UPDATE music_catalog_staging
SET artist_name_clean = artist_name;
```

Add this to your `cleanup.sql`. We will do the same for genre and label shortly.

5.3 Knowledge Check 2

You want to fix typos in artist_name. Which approach is safest?

A) UPDATE artist_name directly, then hope you got it right

B) Create a backup table, add a clean column, fix the clean column, verify, then replace

C) DELETE all the bad rows and re-insert them

D) DROP the table and start over

5.4 Answer: Knowledge Check 2

B) Create a backup table, add a clean column, fix the clean column, verify, then replace

This is the professional pattern: backup, copy, modify copy, verify, replace. You always have a way back. Option A is living dangerously. Option C is arson. Option D is witness protection.

6 Phase 4: Cleaning with UPDATE

6.1 The UPDATE Statement

Quick syntax review from Chapter 10:

```sql
-- Update all rows
UPDATE table_name
SET column = value;

-- Update specific rows
UPDATE table_name
SET column = value
WHERE condition;

-- Update multiple columns
UPDATE table_name
SET column_a = value_a,
    column_b = value_b
WHERE condition;
```

The **WHERE clause is critical**. Without it, every row gets updated. This is the SQL equivalent of replying-all to the entire company. Do not do it.

6.2 The RETURNING Clause

PostgreSQL lets you see what changed without running a separate SELECT:

```sql
UPDATE music_catalog_staging
SET artist_name_clean = 'Billie Eilish'
WHERE lower(artist_name) = 'billie eilish'
RETURNING catalog_id, artist_name, artist_name_clean;
```

This shows you the before (artist_name) and after (artist_name_clean) for every row that was modified. Use it to verify your changes inline.

6.3 Fixing Artist Name Casing

Add each of these to your `cleanup.sql`. Run them one at a time and verify with RETURNING:

```sql
UPDATE music_catalog_staging
SET artist_name_clean = 'Olivia Rodrigo'
WHERE lower(artist_name) = 'olivia rodrigo';

UPDATE music_catalog_staging
SET artist_name_clean = 'Billie Eilish'
WHERE lower(artist_name) = 'billie eilish';

UPDATE music_catalog_staging
SET artist_name_clean = 'The Weeknd'
WHERE lower(artist_name) = 'the weeknd';

UPDATE music_catalog_staging
SET artist_name_clean = 'Dua Lipa'
WHERE lower(artist_name) IN ('dua lipa', 'dua lippa');

UPDATE music_catalog_staging
SET artist_name_clean = 'SZA'
WHERE lower(artist_name) = 'sza';

UPDATE music_catalog_staging
SET artist_name_clean = 'Lil Nas X'
WHERE lower(artist_name) = 'lil nas x';

UPDATE music_catalog_staging
SET artist_name_clean = 'Doja Cat'
```

```sql
WHERE lower(artist_name) = 'doja cat';

UPDATE music_catalog_staging
SET artist_name_clean = 'Harry Styles'
WHERE lower(artist_name) = 'harry styles';

UPDATE music_catalog_staging
SET artist_name_clean = 'Chappell Roan'
WHERE lower(artist_name) = 'chappell roan';

UPDATE music_catalog_staging
SET artist_name_clean = 'Sabrina Carpenter'
WHERE lower(artist_name) = 'sabrina carpenter';

UPDATE music_catalog_staging
SET artist_name_clean = 'Bad Bunny'
WHERE lower(artist_name) = 'bad bunny';

UPDATE music_catalog_staging
SET artist_name_clean = 'Tyler the Creator'
WHERE lower(artist_name) = 'tyler the creator';
```

Notice the Dua Lipa UPDATE catches both the casing issue AND the typo (`dua lippa`) in one statement by using `IN`. Two birds, one WHERE clause. Efficient. Unlike this dataset.

6.4 Verify Artist Cleanup

```sql
SELECT DISTINCT artist_name, artist_name_clean
FROM music_catalog_staging
ORDER BY artist_name_clean;
```

Every artist should now have exactly one clean name. If you see any leftover inconsistencies, add another UPDATE.

6.5 Your Turn: Fix the Genres

Create and populate a genre_clean column, then standardize the genres.

```sql
ALTER TABLE music_catalog_staging
    ADD COLUMN genre_clean varchar(50);

UPDATE music_catalog_staging
```

```sql
SET genre_clean = initcap(genre)
WHERE genre IS NOT NULL;
```

Check the result:

```sql
SELECT DISTINCT genre, genre_clean
FROM music_catalog_staging
ORDER BY genre_clean;
```

There is a problem. What is `initcap()` doing to `R&B` and `Hip-Hop`? Trust but verify. Always verify.

6.6 The initcap() Gotcha

`initcap('r&b')` returns `R&B` (correct, because `&` is a word boundary).

`initcap('hip-hop')` returns `Hip-Hop` (correct, `-` is a word boundary).

But verify this actually worked for your data. If any edge cases remain, fix them manually:

```sql
UPDATE music_catalog_staging
SET genre_clean = 'R&B'
WHERE lower(genre) = 'r&b';

UPDATE music_catalog_staging
SET genre_clean = 'Hip-Hop'
WHERE lower(genre) = 'hip-hop';
```

6.7 Knowledge Check 3

What does `initcap('hip-hop')` return in PostgreSQL?

A) `HIP-HOP`

B) `Hip-hop`

C) `Hip-Hop`

D) `hip-hop`

6.8 Answer: Knowledge Check 3

C) `Hip-Hop`

PostgreSQL's `initcap()` treats hyphens as word boundaries and capitalizes the first letter of each "word." So `hip` becomes `Hip` and `hop` becomes `Hop`. This works in our favor here, but be careful with strings like `mcdonald` where `initcap()` gives `Mcdonald` instead of `McDonald`.

6.9 Your Turn: Fix the Labels

Create a label_clean column, then standardize label names. The goal is one canonical name per label.

```sql
ALTER TABLE music_catalog_staging
    ADD COLUMN label_clean varchar(100);

UPDATE music_catalog_staging
SET label_clean = label;
```

Now standardize. Here are some to get you started – add these to your `cleanup.sql`:

```sql
UPDATE music_catalog_staging
SET label_clean = 'Geffen Records'
WHERE label_clean LIKE 'Geffen%';

UPDATE music_catalog_staging
SET label_clean = 'Interscope Records'
WHERE label_clean LIKE 'Interscope%';

UPDATE music_catalog_staging
SET label_clean = 'Columbia Records'
WHERE label_clean LIKE 'Columbia%';

UPDATE music_catalog_staging
SET label_clean = 'Island Records'
WHERE label_clean LIKE 'Island%';

UPDATE music_catalog_staging
SET label_clean = 'Warner Records'
WHERE label_clean LIKE 'Warner%';

UPDATE music_catalog_staging
SET label_clean = 'Top Dawg Entertainment'
```

```sql
WHERE label_clean IN ('TDE', 'Top Dawg Entertainment', 'TDE/RCA');

UPDATE music_catalog_staging
SET label_clean = 'XO/Republic'
WHERE label_clean IN ('XO', 'Republic', 'XO/Republic');

UPDATE music_catalog_staging
SET label_clean = 'Kemosabe Records'
WHERE label_clean LIKE 'Kemosabe%';

UPDATE music_catalog_staging
SET label_clean = 'Rimas Entertainment'
WHERE label_clean LIKE 'Rimas%';
```

6.10 Verify Label Cleanup

```sql
SELECT DISTINCT label, label_clean
FROM music_catalog_staging
WHERE label IS NOT NULL
ORDER BY label_clean;
```

Each original label variation should map to exactly one canonical name.

6.11 Fixing Bad Numeric Values

Lil Nas X's release year 2210 should be 2021:

```sql
UPDATE music_catalog_staging
SET release_year = 2021
WHERE catalog_id = 'CAT-2050'
RETURNING catalog_id, artist_name_clean, release_year;
```

Harry Styles' negative duration:

```sql
UPDATE music_catalog_staging
SET duration_min = 41.8
WHERE catalog_id = 'CAT-2070'
RETURNING catalog_id, artist_name_clean, duration_min;
```

Always use the most specific WHERE clause possible. Targeting by catalog_id hits exactly one row.

6.12 Filling NULL Values

We know these facts from research:

- Doja Cat's "Woman" is Pop
- Bad Bunny's genre is Reggaeton
- Bad Bunny's label is Rimas Entertainment

```sql
UPDATE music_catalog_staging
SET genre_clean = 'Pop'
WHERE artist_name_clean = 'Doja Cat'
  AND genre_clean IS NULL;

UPDATE music_catalog_staging
SET genre_clean = 'Reggaeton'
WHERE artist_name_clean = 'Bad Bunny'
  AND genre_clean IS NULL;

UPDATE music_catalog_staging
SET label_clean = 'Rimas Entertainment'
WHERE artist_name_clean = 'Bad Bunny'
  AND label_clean IS NULL;
```

6.13 Knowledge Check 4

You accidentally run `UPDATE music_catalog_staging SET genre_clean = 'Pop';` without a WHERE clause. What happens?

A) Only rows where genre_clean is NULL get updated

B) Only Pop rows get updated

C) Every single row in the table gets genre_clean set to 'Pop'

D) PostgreSQL asks you to confirm first

6.14 Answer: Knowledge Check 4

C) Every single row in the table gets genre_clean set to 'Pop'

No WHERE clause means ALL rows. PostgreSQL does not ask "are you sure?" It just does it. Immediately. With enthusiasm. This is why we made a backup and why we use transactions (coming up next). If this happens to you, restore from the backup column: `UPDATE music_catalog_staging SET genre_clean = genre;`

7 Phase 5: Removing Bad Rows

7.1 DELETE FROM

```sql
-- Delete specific rows
DELETE FROM table_name
WHERE condition;

-- Delete ALL rows (the nuclear option)
DELETE FROM table_name;
```

Like UPDATE, the WHERE clause is your friend. Without it, you lose everything. DELETE without WHERE is the database equivalent of moving out and taking the furniture, the walls, and the foundation.

7.2 Removing the Exact Duplicate

CAT-2001 appears twice. Remove one copy using PostgreSQL's `ctid`:

```sql
DELETE FROM music_catalog_staging
WHERE ctid NOT IN (
    SELECT min(ctid)
    FROM music_catalog_staging
    GROUP BY catalog_id, artist_name, album_title, track_title,
             track_number
);
```

This keeps the first physical copy of each row and removes subsequent duplicates. `ctid` is PostgreSQL's internal row address. Think of it as the row's home address – even identical twins live at different addresses.

7.3 Removing the Content Duplicate

CAT-2099 is a copy of Sabrina Carpenter's "Espresso" with a different catalog_id:

```sql
DELETE FROM music_catalog_staging
WHERE catalog_id = 'CAT-2099';
```

7.4 Removing the Incomplete Row

Tyler the Creator's row has NULL track info. We need track data for our normalized tables:

```sql
DELETE FROM music_catalog_staging
WHERE track_title IS NULL;
```

7.5 Verify Row Count

```sql
SELECT count(*) FROM music_catalog_staging;
```

Started with 48. Removed: 1 exact duplicate + 1 content duplicate + 1 NULL track = **45 rows remaining**. If you got a different number, something has gone sideways. Do not proceed. Do not pass GO. Do not collect $200.

7.6 Knowledge Check 5

What is the difference between `DELETE FROM table_name;` and `DROP TABLE table_name;`?

A) They do the same thing

B) DELETE removes all rows but keeps the table structure; DROP removes the table entirely

C) DROP removes all rows but keeps the table structure; DELETE removes the table entirely

D) DELETE is faster than DROP on large tables

7.7 Answer: Knowledge Check 5

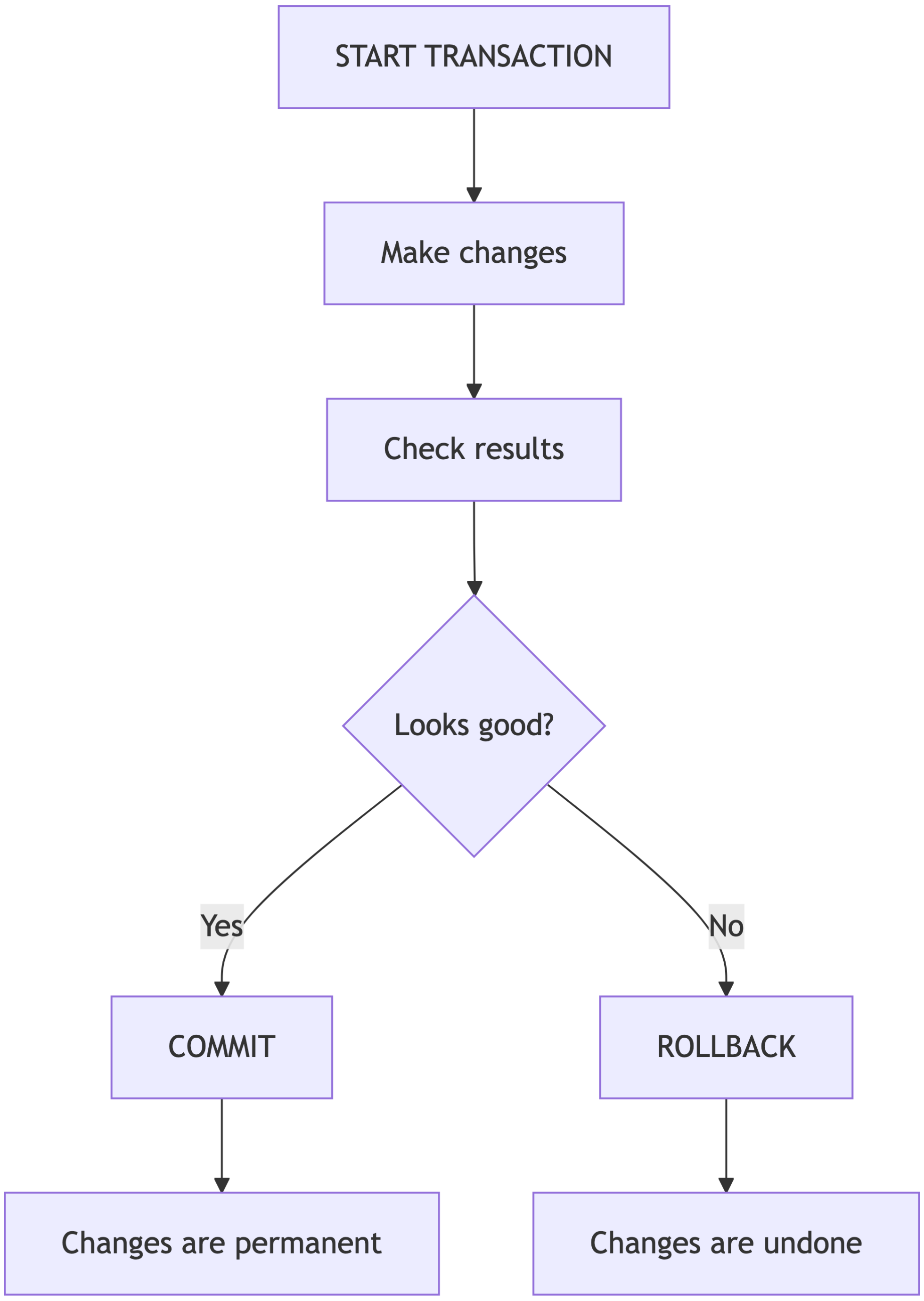
B) DELETE removes all rows but keeps the table structure; DROP removes the table entirely

After DELETE, the table exists but is empty. You can INSERT new data immediately. After DROP, the table is gone. Its columns, constraints, indexes, everything. Gone. Reduced to atoms. One empties the filing cabinet. The other throws the filing cabinet into the sun.

8 Phase 6: Transactions

8.1 Why Transactions

Every UPDATE and DELETE we have run so far was **permanent** the moment we hit Enter. No confirmation dialog. No "are you sure?" No safety net. Just pure, unfiltered commitment. Transactions let us preview changes and undo them if needed. They are the "try before you buy" of SQL.


START TRANSACTION
Make changes
Check results
Looks good?
Yes
No
COMMIT
ROLLBACK
Changes are permanent
Changes are undone

8.2 Transaction Demo: The Intentional Mistake

Let us try an UPDATE inside a transaction and intentionally mess it up:

```sql
START TRANSACTION;

UPDATE music_catalog_staging
SET artist_name_clean = 'Billlie Eilish'  -- oops, triple L
WHERE artist_name_clean = 'Billie Eilish';

-- Check what we did
SELECT DISTINCT artist_name_clean
FROM music_catalog_staging
ORDER BY artist_name_clean;

-- That is wrong. Undo everything.
ROLLBACK;
```

After ROLLBACK, the data is exactly as it was before START TRANSACTION.

8.3 Transaction Demo: The Correct Fix

```sql
START TRANSACTION;

UPDATE music_catalog_staging
SET artist_name_clean = 'Billie Eilish'
WHERE lower(artist_name) = 'billie eilish';

-- Verify
SELECT DISTINCT artist_name_clean
FROM music_catalog_staging
WHERE lower(artist_name) = 'billie eilish';

-- Looks correct. Lock it in.
COMMIT;
```

After COMMIT, the changes are permanent.

8.4 When to Use Transactions

Use a Transaction	Skip it
Bulk UPDATEs on many rows	SELECT queries (read-only)
Any DELETE operation	When you have a backup and are confident
Multi-step changes that must all succeed	Adding columns (ALTER TABLE)
When you are not sure about your WHERE clause	Single-row changes with RETURNING

Pro tip: if you are asking "should I use a transaction?" the answer is yes. Much like "should I save my document?" the answer is always yes.

8.5 Your Turn: Transaction Practice

Try this in Beekeeper:

```sql
START TRANSACTION;

DELETE FROM music_catalog_staging
WHERE genre_clean = 'Pop';

-- How many rows are left?
SELECT count(*) FROM music_catalog_staging;

-- That deleted way too much! Undo.
ROLLBACK;

-- Verify everything is back
SELECT count(*) FROM music_catalog_staging;
```

You should see the count drop dramatically after DELETE, then return to 45 after ROLLBACK.

8.6 Knowledge Check 6

You started a transaction and ran an UPDATE that changed 500 rows incorrectly. What undoes the damage?

A) `UNDO;`

B) `CTRL+Z;`

C) `ROLLBACK;`

D) `REVERT;`

8.7 Answer: Knowledge Check 6

C) `ROLLBACK;`

ROLLBACK reverses all changes since START TRANSACTION. There is no UNDO or CTRL+Z in SQL. CTRL+Z works in your text editor, not on your database. I have seen grown adults try CTRL+Z on a production database. It did not end well. For anyone.

9 Phase 7: Column Cleanup and Migration

9.1 Swapping Clean Columns In

Now that our clean columns are verified, replace the originals:

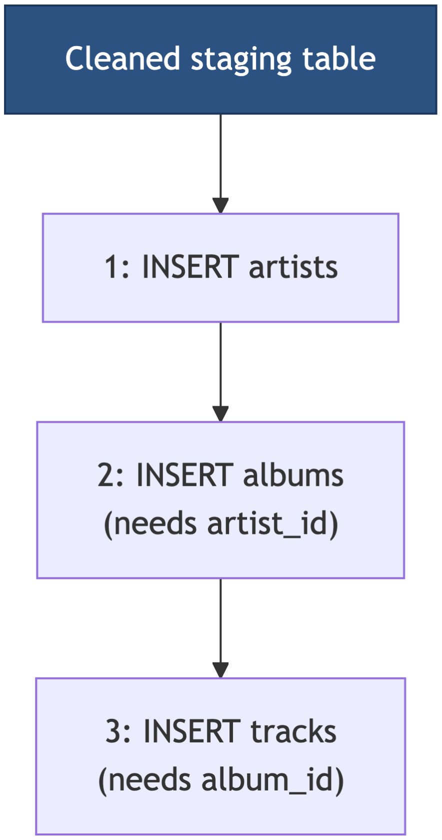
```sql
-- Drop the original messy columns
ALTER TABLE music_catalog_staging DROP COLUMN artist_name;
ALTER TABLE music_catalog_staging DROP COLUMN genre;
ALTER TABLE music_catalog_staging DROP COLUMN label;

-- Rename clean columns
ALTER TABLE music_catalog_staging
    RENAME COLUMN artist_name_clean TO artist_name;
ALTER TABLE music_catalog_staging
    RENAME COLUMN genre_clean TO genre;
ALTER TABLE music_catalog_staging
    RENAME COLUMN label_clean TO label;
```

Verify the result:

```sql
SELECT DISTINCT artist_name, genre, label
FROM music_catalog_staging
ORDER BY artist_name;
```

Clean, consistent, ready to migrate. Our data finally looks like it was entered by someone who cares.

9.2 The Migration Plan


Cleaned staging table
1: INSERT artists
2: INSERT albums (needs artist_id)
3: INSERT tracks (needs album_id)

Order matters. Parents before children. Always. We must insert artists first (no dependencies), then albums (needs artist_id), then tracks (needs album_id). Foreign keys enforce this order. Try to skip ahead and PostgreSQL will politely but firmly ruin your afternoon.

9.3 Step 1: Migrate Artists

```sql
INSERT INTO artists (artist_name)
SELECT DISTINCT artist_name
FROM music_catalog_staging
ORDER BY artist_name;
```

Verify:

```sql
SELECT * FROM artists ORDER BY artist_id;
```

You should see one row per unique artist, each with a generated `artist_id`.

9.4 Step 2: Migrate Albums

Albums need an `artist_id` from the artists table. We join the staging table with artists to get it:

```sql
INSERT INTO albums (album_title, release_year, genre, label,
                    duration_min, artist_id)
SELECT DISTINCT
    s.album_title,
    s.release_year,
    s.genre,
    s.label,
    s.duration_min,
    a.artist_id
FROM music_catalog_staging s
JOIN artists a ON s.artist_name = a.artist_name;
```

Wait – this will error if the staging table has inconsistent album-level data (different genre or label for the same album). Let us check:

```sql
SELECT album_title, artist_name,
       count(DISTINCT genre) AS genre_count,
       count(DISTINCT label) AS label_count
FROM music_catalog_staging
GROUP BY album_title, artist_name
HAVING count(DISTINCT genre) > 1
    OR count(DISTINCT label) > 1;
```

If any rows appear, fix those inconsistencies before migrating.

9.5 Handling Album-Level Inconsistencies

If the query above shows albums with multiple genres or labels, pick the correct value and update:

```sql
-- Example: if After Hours has both 'R&B' and another genre
UPDATE music_catalog_staging
SET genre = 'R&B'
WHERE album_title = 'After Hours';

-- Example: standardize label for an album
UPDATE music_catalog_staging
SET label = 'XO/Republic'
WHERE album_title = 'After Hours';
```

Now retry the album migration INSERT.

9.6 Step 3: Migrate Tracks

Tracks need an `album_id`. We join through both staging, artists, and albums:

```sql
INSERT INTO tracks (track_title, track_number, duration_sec, album_id)
SELECT
    s.track_title,
    s.track_number,
    s.track_duration_sec,
    al.album_id
FROM music_catalog_staging s
JOIN artists a ON s.artist_name = a.artist_name
JOIN albums al ON s.album_title = al.album_title
               AND a.artist_id = al.artist_id;
```

9.7 Verify the Migration

```sql
-- Count check
SELECT 'artists' AS tbl, count(*) AS rows FROM artists
UNION ALL
SELECT 'albums', count(*) FROM albums
UNION ALL
SELECT 'tracks', count(*) FROM tracks;
```

```sql
-- Spot check: show all tracks with their album and artist
SELECT a.artist_name, al.album_title, al.release_year,
       t.track_number, t.track_title, t.duration_sec
FROM tracks t
JOIN albums al ON t.album_id = al.album_id
JOIN artists a ON al.artist_id = a.artist_id
ORDER BY a.artist_name, al.album_title, t.track_number;
```

If this looks right, congratulations. You have successfully cleaned and migrated dirty data into a normalized schema. This is genuinely 80% of what data professionals do for a living. The other 20% is explaining to stakeholders why the data was dirty in the first place.

9.8 Knowledge Check 7

Why must we insert into the artists table BEFORE the albums table?

A) Alphabetical order is required

B) Artists has a UNIQUE constraint

C) Albums has a foreign key referencing artists, so the artist must exist first

D) PostgreSQL requires tables to be populated in creation order

9.9 Answer: Knowledge Check 7

C) Albums has a foreign key referencing artists, so the artist must exist first

Foreign keys enforce referential integrity. You cannot insert an album with `artist_id = 5` if no artist with `artist_id = 5` exists yet. It is like trying to RSVP to a party that does not exist. The dependency chain is: artists, then albums, then tracks. Always.

9.10 Updating Across Tables

Chapter 10 also introduces updating one table using values from another. The ANSI SQL way uses a subquery:

```sql
UPDATE table_a
SET column = (SELECT column
              FROM table_b
              WHERE table_a.key = table_b.key)
WHERE EXISTS (SELECT 1
              FROM table_b
              WHERE table_a.key = table_b.key);
```

PostgreSQL also supports a simpler FROM-based syntax:

```sql
UPDATE table_a
SET column = table_b.column
FROM table_b
WHERE table_a.key = table_b.key;
```

This is useful when you need to update data in one table based on corrected values in another.

9.11 The Table Swap Trick

For large tables, adding and populating columns inflates table size because PostgreSQL keeps old row versions. A more efficient approach from Chapter 10:

```sql
-- Create improved copy with extra column
CREATE TABLE music_catalog_staging_v2 AS
SELECT *,
       now()::date AS cleaned_date
FROM music_catalog_staging;

-- Swap using renames
ALTER TABLE music_catalog_staging
    RENAME TO music_catalog_staging_old;
ALTER TABLE music_catalog_staging_v2
    RENAME TO music_catalog_staging;
ALTER TABLE music_catalog_staging_old
    RENAME TO music_catalog_staging_backup;
```

This avoids row inflation on large datasets. For our 45-row table it does not matter, but on millions of rows it is the difference between “that was fast” and “I am going to get lunch while this runs.”

10 Final Cleanup

10.1 Drop the Backup (When You Are Done)

Only after you have verified your normalized tables are correct. Not before. Not “I think it looks fine.” Verified. With queries. With your eyes. With conviction.

```sql
DROP TABLE IF EXISTS music_catalog_staging_backup;
DROP TABLE IF EXISTS music_catalog_staging;
```

10.2 Knowledge Check 8 (Open Answer)

You receive a 50,000-row CSV of customer orders. Some orders have misspelled product names, NULL shipping addresses, duplicate order IDs, and prices stored as negative numbers. Describe the **first six steps** you would take before loading this data into production tables.

Take 2 minutes. Write it down. Compare with a neighbor.

10.3 Sample Answer: Knowledge Check 8

1. Import into a **staging table** with no constraints
2. **Count rows** to verify the full file loaded
3. **Check for duplicates** using GROUP BY + HAVING on order IDs and on content columns
4. **Check for NULLs** in required fields (shipping address, product name)
5. **Create a backup** of the staging table
6. **Fix issues** using UPDATE with clean columns, DELETE for true duplicates, and transactions for safety

Then: verify, migrate to normalized tables, verify again. In that order. Always. I cannot stress this enough. I will haunt your databases if you skip verification.

10.4 Deliverable Checklist

Before you submit your `cleanup.sql`, make sure it contains:

- ☐ Comment header with your name and date
- ☐ Data quality issues documented as comments
- ☐ CREATE TABLE ... AS SELECT backup statement
- ☐ ALTER TABLE ADD COLUMN for clean columns
- ☐ UPDATE statements fixing artist names, genres, labels
- ☐ UPDATE statements fixing bad numeric values
- ☐ UPDATE statements filling NULL values
- ☐ DELETE statements removing duplicates and incomplete rows
- ☐ ALTER TABLE DROP/RENAME for column swap
- ☐ INSERT INTO ... SELECT for artists, albums, tracks
- ☐ Verification queries

11 Summary

11.1 Key Commands Cheat Sheet

Modification:

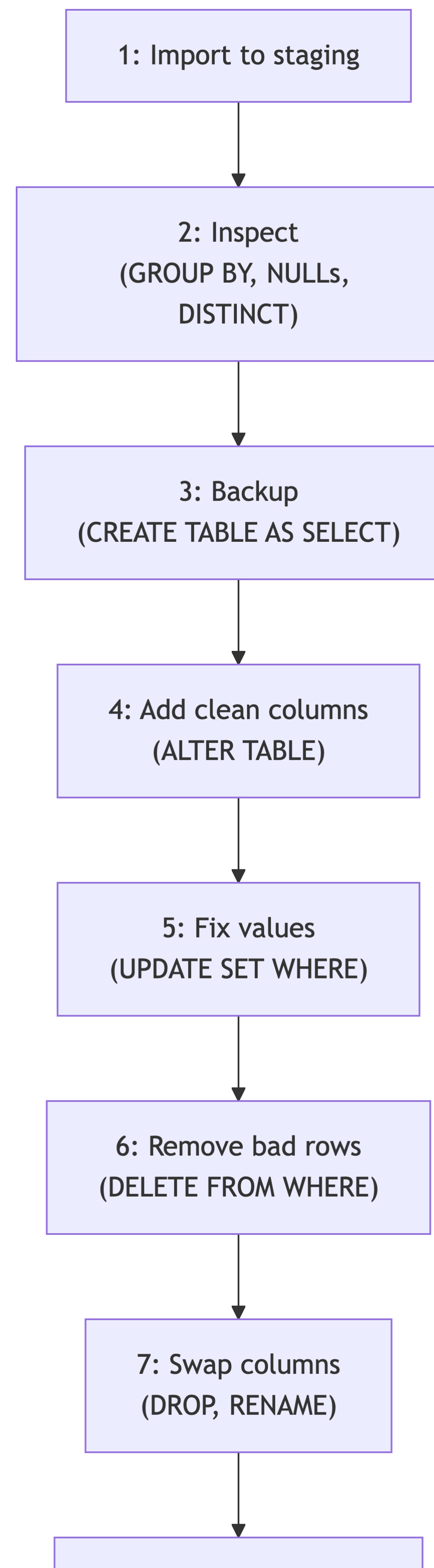
Task	SQL
Update data	`UPDATE SET WHERE`
Update + verify	`UPDATE ... RETURNING`
Add column	`ALTER TABLE ADD COLUMN`
Drop column	`ALTER TABLE DROP COLUMN`

Task	SQL
Rename column	`ALTER TABLE RENAME COLUMN`
Delete rows	`DELETE FROM WHERE`
Drop table	`DROP TABLE`

Safety and Migration:

Task	SQL
Backup table	`CREATE TABLE ... AS SELECT`
Begin transaction	`START TRANSACTION`
Save changes	`COMMIT`
Undo changes	`ROLLBACK`
Migrate data	`INSERT INTO ... SELECT`
Cross-table update	`UPDATE ... FROM`
Title case	`initcap()`
Concatenate	`||`

11.2 The Data Cleaning Pipeline


1: Import to staging
2: Inspect (GROUP BY, NULLs, DISTINCT)
3: Backup (CREATE TABLE AS SELECT)
4: Add clean columns (ALTER TABLE)
5: Fix values (UPDATE SET WHERE)
6: Remove bad rows (DELETE FROM WHERE)
7: Swap columns (DROP, RENAME)

12 What Is Next

12.1 Coming Up

Now that we can clean and migrate data, next we explore:

- Aggregate functions and grouping for analysis
- Statistical queries on our cleaned music database
- Window functions for rankings and running totals

Your cleaned, normalized music database will be the foundation for those analyses. Look at you, growing up. I am genuinely proud.

13 References

13.1 Sources

1. DeBarros, A. (2022). *Practical SQL: A Beginner's Guide to Storytelling with Data* (2nd ed.). No Starch Press. Chapter 10: Inspecting and Modifying Data.
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