

Introduction to Software Engineering

Data Design



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1.1 Data Diagram

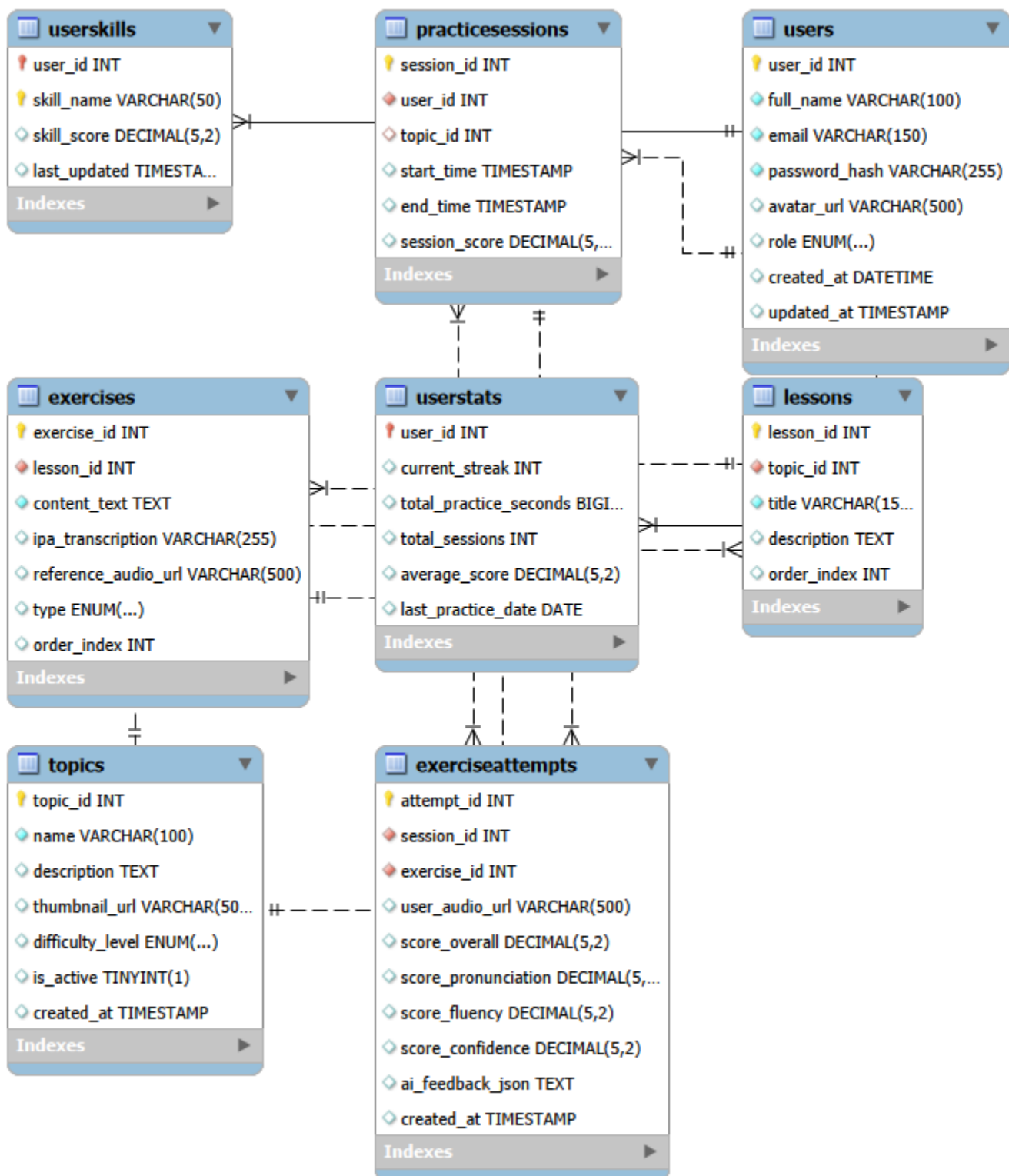


Diagram Description:

The data system is designed following the Relational Database model, focusing on managing users, the learning curriculum (Topics/Lessons/Exercises), and practice results.

- **Core:** The `users` table manages user identity and authentication.
- **Learning Content:** Organized hierarchically: `topics` contain multiple `lessons`, and `lessons` contain multiple `exercises`.
- **Practice Activity:** When users practice, high-level data is recorded in `practicesessions`, while specific details for each attempt are stored in `exerciseattempts`.
- **Statistics:** The `userstats` and `userskills` tables aggregate performance data to generate reports and track user progress

1.2 Data Specification

1. Table `users`

Stores user account information and personal profiles.

| Attribute Name | Data Type | Constraints | Key Type | Description |
|------------------------|--------------|--------------------------|----------|---------------------------------|
| <code>user_id</code> | INT | Auto Increment, Not Null | PK | Unique identifier for the user. |
| <code>full_name</code> | VARCHAR(100) | Not Null | | User's full display name. |

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|---------------|--------------|-----------------------------|--|---------------------------------|
| email | VARCHAR(150) | Unique, Not Null | | User's login email address. |
| password_hash | VARCHAR(255) | Not Null | | Encrypted (hashed) password. |
| avatar_url | VARCHAR(500) | Nullable | | URL to the user's avatar image. |
| role | ENUM(...) | Values: 'USER', 'ADMIN' | | User role within the system. |
| created_at | DATETIME | Default NOW() | | Account creation timestamp |
| updated_at | TIMESTAMP | On Update CURRENT_TIMESTAMP | | Last profile update timestamp |

2. Table topics

Stores broad categories or themes in the curriculum.

| Attribute Name | Data Type | Constraints | Key Type | Description |
|------------------|--------------|----------------------------------|----------|---|
| topic_id | INT | Auto Increment, Not Null | PK | Unique identifier for the topic. |
| name | VARCHAR(100) | Not Null | | Name of the topic (e.g., Travel, Business). |
| description | TEXT | Nullable | | Detailed description of the topic. |
| thumbnail_url | VARCHAR(500) | Nullable | | URL for the topic's cover image. |
| difficulty_level | ENUM(...) | Values: 'Easy', 'Medium', 'Hard' | | Difficulty level of the topic. |
| is_active | TINYINT(1) | Default 1 (True) | | Topic activation status. |
| created_at | TIMESTAMP | Default NOW() | | Record creation timestamp. |

3. Table lessons

Stores individual lessons belonging to a specific topic.

| Attribute Name | Data Type | Constraints | Key Type | Description |
|----------------|--------------|--------------------------|----------|---|
| lesson_id | INT | Auto Increment, Not Null | PK | Unique identifier for the lesson. |
| topic_id | INT | Not Null | FK | Foreign key linking to the topics table. |
| title | VARCHAR(150) | Not Null | | Title of the lesson. |
| description | TEXT | Nullable | | Introduction or summary of the lesson. |
| order_index | INT | Not Null | | Display order of the lesson within the topic. |

4. Table exercises

Stores specific exercises within a lesson.

| Attribute Name | Data Type | Constraints | Key Type | Description |
|----------------|-----------|--------------------------|----------|-------------------------------------|
| exercise_id | INT | Auto Increment, Not Null | PK | Unique identifier for the exercise. |

| | | | | |
|---------------------|--------------|---------------------------------|----|---|
| lesson_id | INT | Not Null | FK | Foreign key linking to the lessons table. |
| content_text | TEXT | Not Null | | The text content for reading/practice. |
| ipa_transcription | VARCHAR(255) | Nullable | | Standard IPA transcription of the text. |
| reference_audio_url | VARCHAR(500) | Nullable | | URL for native speaker reference audio. |
| type | ENUM(...) | Values: 'Speaking', 'Listening' | | Type of exercise. |
| order_index | INT | Not Null | | Order of the exercise within the lesson. |

5. Table practicesessions

Stores high-level data about a user's practice session.

| Attribute Name | Data Type | Constraints | Key Type | Description |
|----------------|-----------|-------------|----------|-------------|
|----------------|-----------|-------------|----------|-------------|

| | | | | |
|---------------|---------------|-----------------------------|----|---|
| session_id | INT | Auto Increment, Not Null | PK | Unique identifier for the session. |
| user_id | INT | Not Null | FK | The user who performed the session. |
| topic_id | INT | Not Null | FK | The topic practiced during the session. |
| start_time | TIMESTAMP | Not Null | | Session start time. |
| end_time | TIMESTAMP | Nullable | | Session end time. |
| session_score | DECIMAL(5, 2) | Min 0, Max 100 | | Aggregate score for the entire session. |

6. Table `exerciseattempts`

Stores detailed results of every attempt (recording/answer) for an exercise.

| Attribute Name | Data Type | Constraints | Key Type | Description |
|----------------|-----------|-----------------------------|----------|------------------------------------|
| attempt_id | INT | Auto Increment, Not Null | PK | Unique identifier for the attempt. |

| | | | | |
|---------------------|--------------|----------------|----|--|
| session_id | INT | Not Null | FK | Links to the practicesessions table. |
| exercise_id | INT | Not Null | FK | Links to the exercises table. |
| user_audio_url | VARCHAR(500) | Nullable | | URL to the user's recorded audio file. |
| score_overall | DECIMAL(5,2) | Min 0, Max 100 | | Overall score generated by AI. |
| score_pronunciation | DECIMAL(5,2) | Min 0, Max 100 | | Component score for pronunciation. |
| score_fluency | DECIMAL(5,2) | Min 0, Max 100 | | Component score for fluency. |
| score_confidence | DECIMAL(5,2) | Min 0, Max 100 | | Component score for confidence. |
| ai_feedback_json | TEXT | JSON format | | Detailed AI feedback (phoneme errors, etc.). |
| created_at | TIMESTAMP | Default NOW() | | Timestamp when the attempt was submitted. |

7. Table `userstats`

Stores aggregated statistics for a user (1-to-1 relationship with `users`).

| Attribute Name | Data Type | Constraints | Key Type | Description |
|------------------------|---------------|----------------|----------|---|
| user_id | INT | Not Null | PK, FK | Links 1-to-1 with the users table. |
| current_streak | INT | Default 0 | | Current count of consecutive practice days. |
| total_practice_seconds | BIGINT | Default 0 | | Total time spent practicing (in seconds). |
| total_sessions | INT | Default 0 | | Total number of completed sessions. |
| average_score | DECIMAL(5, 2) | Min 0, Max 100 | | Average score across all exercises. |
| last_practice_date | DATE | Nullable | | The date of the most recent practice. |

8. Table userskills

Stores specific skill ratings for a user (e.g., Intonation, Pronunciation).

| Attribute Name | Data Type | Constraints | Key Type | Description |
|----------------|---------------|----------------|----------|---|
| user_id | INT | Not Null | PK, FK | Links to the users table. |
| skill_name | VARCHAR(50) | Not Null | PK | Name of the skill (Part of Composite PK). |
| skill_score | DECIMAL(5, 2) | Min 0, Max 100 | | Current score/rating for this skill. |
| last_updated | TIMESTAMP | Default NOW() | | Timestamp of the last score update. |