This is a simplified backend implementation for the real-time quiz application.
The system is designed for demonstration purposes, with mocks for the external systems like the Flutter app and the database.
This backend incorporates the key feature of Quiz Participation.
Note: To simplify the demonstration, the database structure has been intentionally simplified as well.

Directory structure

backend/

```
│
├─── app/
│    ├─── main.py          # Entry point for the FastAPI server
│    ├─── database.py      # Database setup and queries
│    ├─── models.py        # Database schemas and models
│    ├─── quiz_logic.py    # Core logic for quiz
│    ├─── websocket.py     # WebSocket handlers
│
└─── requirements.txt      # Python dependencies
```

Preparation

Set up virtual environment

```
python -m venv venv
venv\Scripts\activate
pip install -r requirements.txt
```

Prepare the Database

Start PostgreSQL and create a new database for the project

```
CREATE DATABASE quiz_app;
```

Update the DATABASE_URL in the code to match PostgreSQL credentials

```
DATABASE_URL = "postgresql://<username>:<password>@<host>:<port>/quiz_app"
```

Example Table Creation

- quizzes Table

```
CREATE TABLE quizzes (
    quiz_id VARCHAR PRIMARY KEY,
    name VARCHAR NOT NULL,
```

```
    start_time TIMESTAMP NOT NULL,
    end_time TIMESTAMP NOT NULL,
    questions JSONB NOT NULL -- Store an array of question IDs
);
```

- users Table

```
CREATE TABLE users (
    id VARCHAR PRIMARY KEY,
    username VARCHAR(100) UNIQUE NOT NULL,
    password VARCHAR(100) NOT NULL
);
```

Insert sample data

- quizzes Table

```
INSERT INTO quizzes (quiz_id, name, start_time, end_time, questions)
VALUES
('voc202411290900', 'Vocabulary 0900', '2024-11-29 09:00:00', '2024-11-29
09:30:00', '["q1", "q2", "q3", "q4", "q5"]'),
('lis202411290900', 'Listening 0900', '2024-11-29 09:00:00', '2024-11-29
09:30:00', '["q6", "q7", "q8", "q9", "q10"]'),
('gra202411290900', 'Grammar 0900', '2024-11-29 09:00:00', '2024-11-29
09:30:00', '["q11", "q12", "q13", "q14", "q15"]'),
('all202411290900', 'All 0900', '2024-11-29 09:00:00', '2024-11-29
09:30:00', '["q16", "q17", "q18", "q19", "q20"]'),
('voc202411291200', 'Vocabulary 1200', '2024-11-29 12:00:00', '2024-11-29
12:30:00', '["q21", "q22", "q23", "q24", "q25"]'),
('lis202411291200', 'Listening 1200', '2024-11-29 12:00:00', '2024-11-29
12:30:00', '["q26", "q27", "q28", "q29", "q30"]'),
('gra202411291200', 'Grammar 1200', '2024-11-29 12:00:00', '2024-11-29
12:30:00', '["q31", "q1", "q2", "q3", "q4"]'),
('all202411291200', 'All 1200', '2024-11-29 12:00:00', '2024-11-29
12:30:00', '["q5", "q6", "q7", "q8", "q9"]'),
('voc202412011415', 'Vocabulary 1415', '2024-12-01 14:15:00', '2024-12-01
14:35:00', '["q1", "q2", "q3", "q4", "q5"]'),
('lis202412011415', 'Listening 1415', '2024-12-01 14:15:00', '2024-12-01
14:35:00', '["q16", "q17", "q18", "q19", "q20"]'),
('gra202412011415', 'Grammar 1415', '2024-12-01 14:15:00', '2024-12-01
14:35:00', '["q21", "q22", "q23", "q24", "q25"]');
```

- users Table

```
INSERT INTO users (id, username, password) VALUES
('1a2b3c', 'john_doe', 'password123'),
('4d5e6f', 'alice_smith', 'qwerty456'),
```

```
('7g8h9i', 'mike_jones', 'securePass78'),
('0j1k2l', 'sarah_lee', 'abcDEF123'),
('3m4n5o', 'david_brown', 'P@ssw0rd!'),
('6p7q8r', 'emma_wilson', 'sunshine321'),
('9s0t1u', 'noah_davis', 'hunter2good'),
('2v3w4x', 'lily_moore', 'blueSky!23'),
('5y6z7a', 'james_taylor', 'winterIsComing42'),
('8b9c0d', 'olivia_clark', 'ilovepizza88'),
('1e2f3g', 'samuel_johnson', 'b3tterSecure!');
```

Testing Real-Time Quiz Participation

Run the Backend

Start the FastAPI server using Uvicorn

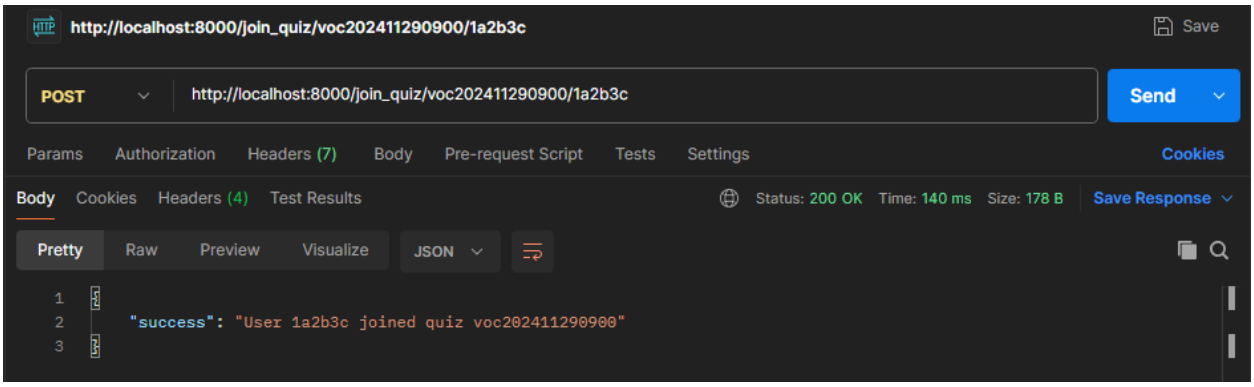
```
uvicorn app.main:app --reload
```

Join a Quiz via REST API

Use Postman to call

```
POST /join_quiz/{quiz_id}/{user_id}
```

Replace {quiz_id} and {user_id} with appropriate values. Example:

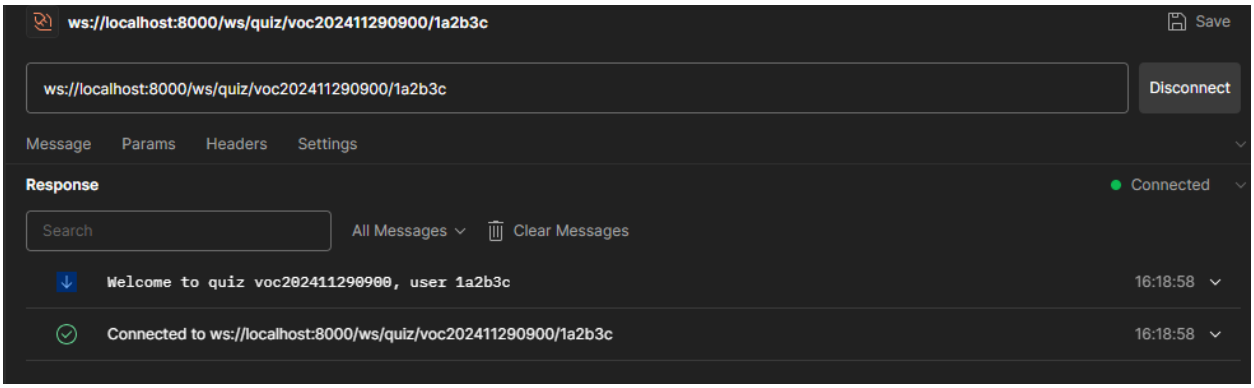


Real-Time Interaction via WebSocket

Connect to WebSocket using Postman

```
ws://localhost:8000/ws/quiz/{quiz_id}/{user_id}
```

Replace {quiz_id} and {user_id} with appropriate values. Example:


ws://localhost:8000/ws/quiz/voc202411290900/1a2b3c
Save
ws://localhost:8000/ws/quiz/voc202411290900/1a2b3c
Disconnect
Message
Params
Headers
Settings
Response
Connected
Search
All Messages
Clear Messages
Welcome to quiz voc202411290900, user 1a2b3c
16:18:58
Connected to ws://localhost:8000/ws/quiz/voc202411290900/1a2b3c
16:18:58