HKU-COMP3358-JPoker24 Report

Document Directory

1. Environment Set Up

This section provides a guidence on how to set up the environment to run the jar.

1.1 Overview

System

- Linux Ubuntu 22.04

Dependencies

- openjdk version "11.0.22" 2024-01-16
- mysql Ver 8.0.36-0ubuntu0.22.04.1 for Linux on x86_64 ((Ubuntu))
- mysql-connector-j_8.4.0-1ubuntu22.04_all
- glassfish-6.1.0

Assumption

- RMI, JMS use localhost.

1.2 Set Up MySQL

1.2.1 Install MySQL

Install MySQL server in Linux terminal.

```
sudo apt install mysql-server
sudo service mysql status
sudo apt install mysql-client
```

1.2.2 Set Up Database & Tables

Open MySQL Console.

```
sudo mysql -u root -p
```

Set Up Database and Database User.

```
CREATE DATABASE GameDB;
CREATE USER 'gameUser'@'localhost' IDENTIFIED BY 'gamePassword';
GRANT ALL PRIVILEGES ON GameDB.* TO 'gameUser'@'localhost';
FLUSH PRIVILEGES;
```

Switch to the Game Database.

```
USE GameDB;
```

Set Up Tables.

```
CREATE TABLE Users (
    name VARCHAR(32) NOT NULL,
    password VARCHAR(32) NOT NULL,
    is_online BOOLEAN NOT NULL DEFAULT FALSE,
    PRIMARY KEY (name)
);

CREATE TABLE Games (
    id INT NOT NULL AUTO_INCREMENT,
    completion_time DECIMAL(10, 3),
    PRIMARY KEY (id)
);

CREATE TABLE Participations (
    game_id INT NOT NULL,
    user_name VARCHAR(32) NOT NULL,
    is_winner BOOLEAN NOT NULL DEFAULT FALSE,
    PRIMARY KEY (user_name, game_id),
    FOREIGN KEY (user_name) REFERENCES Users(name),
    FOREIGN KEY (game_id) REFERENCES Games(id)
);
```

Quit MySQL Console.

```
\q
```

1.2.3 Prepare MySQL JDBC Driver

- Download MySQL JDBC driver `mysql-connector-j_8.4.0-1ubuntu22.04_all` at http://dev.mysql.com/downloads/connector/j/
- Find the **`mysql-connector-j-8.4.0.jar`** at `.../mysql-connector-j_8.4.0-1ubuntu22.04_all/usr/share/java/mysql-connector-j-8.4.0.jar`, and remember the path to it as **`$mysql_connector_path`**.

1.3 Set Up Glassfish 6.1.0 (JMS Service)

- **Important**: Glassfish 6.1.0 is very different from Glassfish 5, since it migrate the `jms` package from `javax.jms` to `jakarta.jms`. Please **DO NOT** run this application under Glassfish 5.

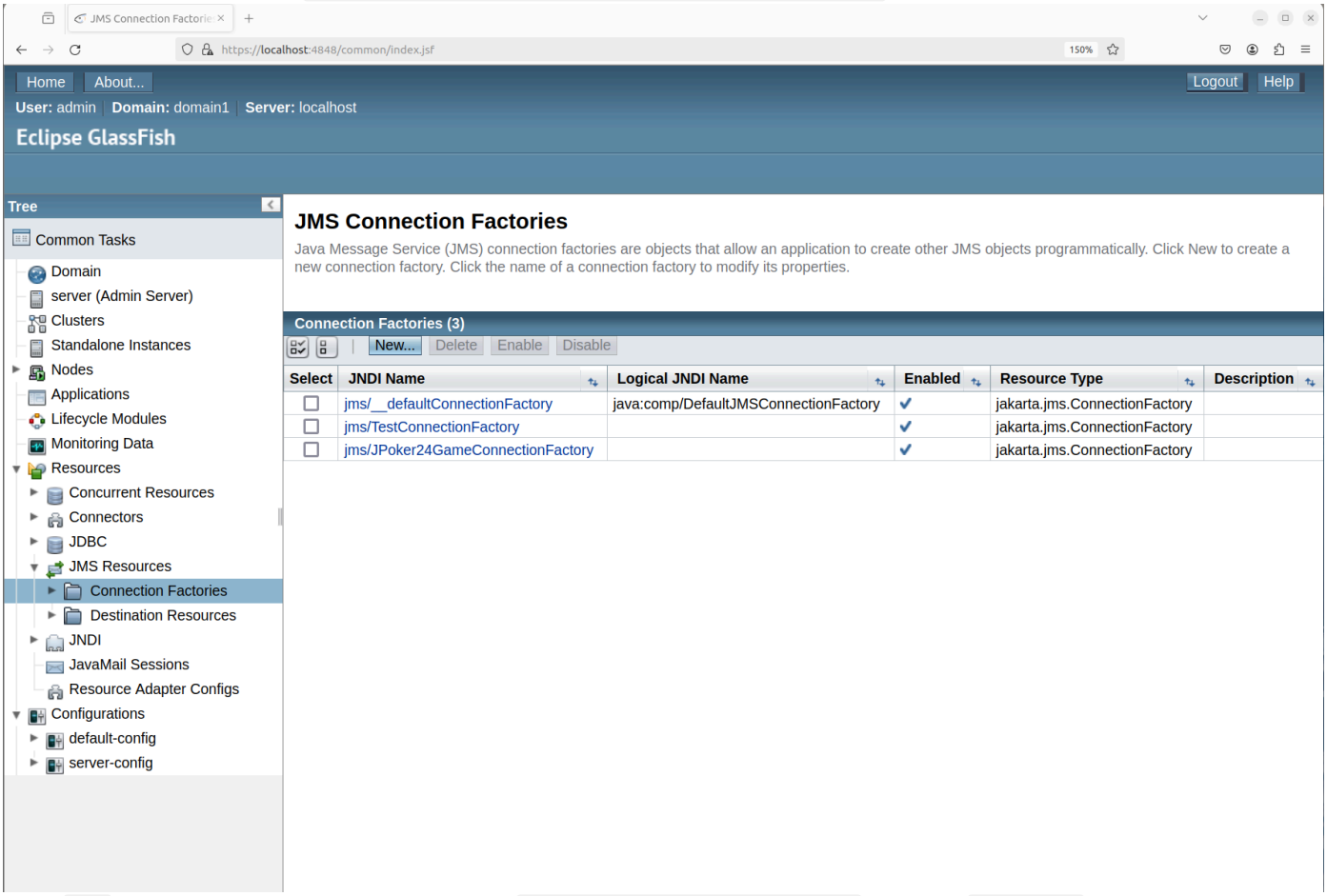
1.3.1 Install Glassfish 6.1.0 on Linux Ubuntu

- Follow the tutorial at https://www.howtoforge.com/how-to-install-glassfish-on-ubuntu-22-04/ to download and set up glassfish 6.1.0.

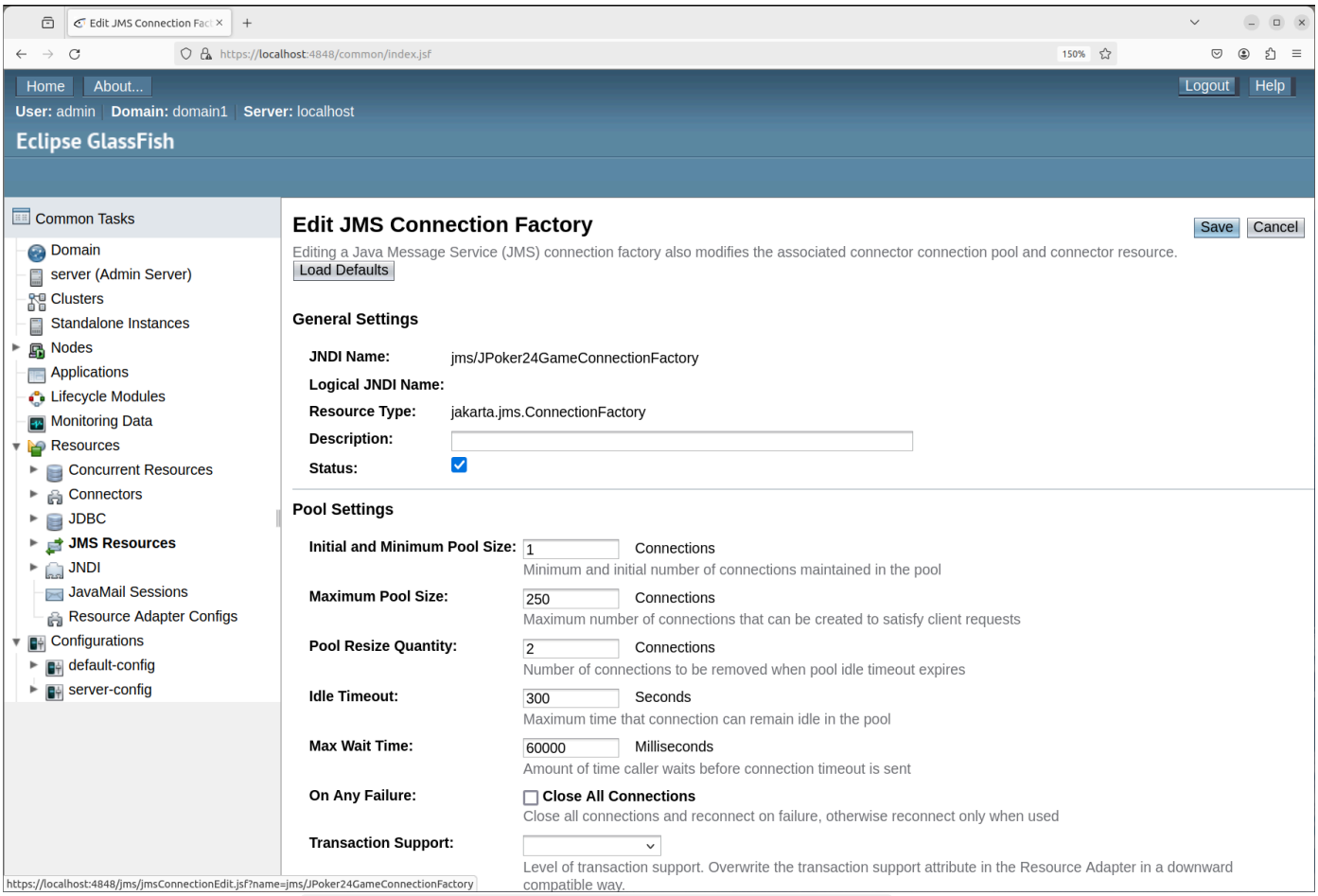
- Suppose you follow the guideline and download the `glassfish-6.1.0`.
- Find the **`gf-client.jar`** at `.../glassfish-6.1.0/glassfish6/glassfish/lib/gf-client.jar`, and remember the path to it as **`$gf_client_path`**.

1.3.2 Set Up Glassfish JMS Service

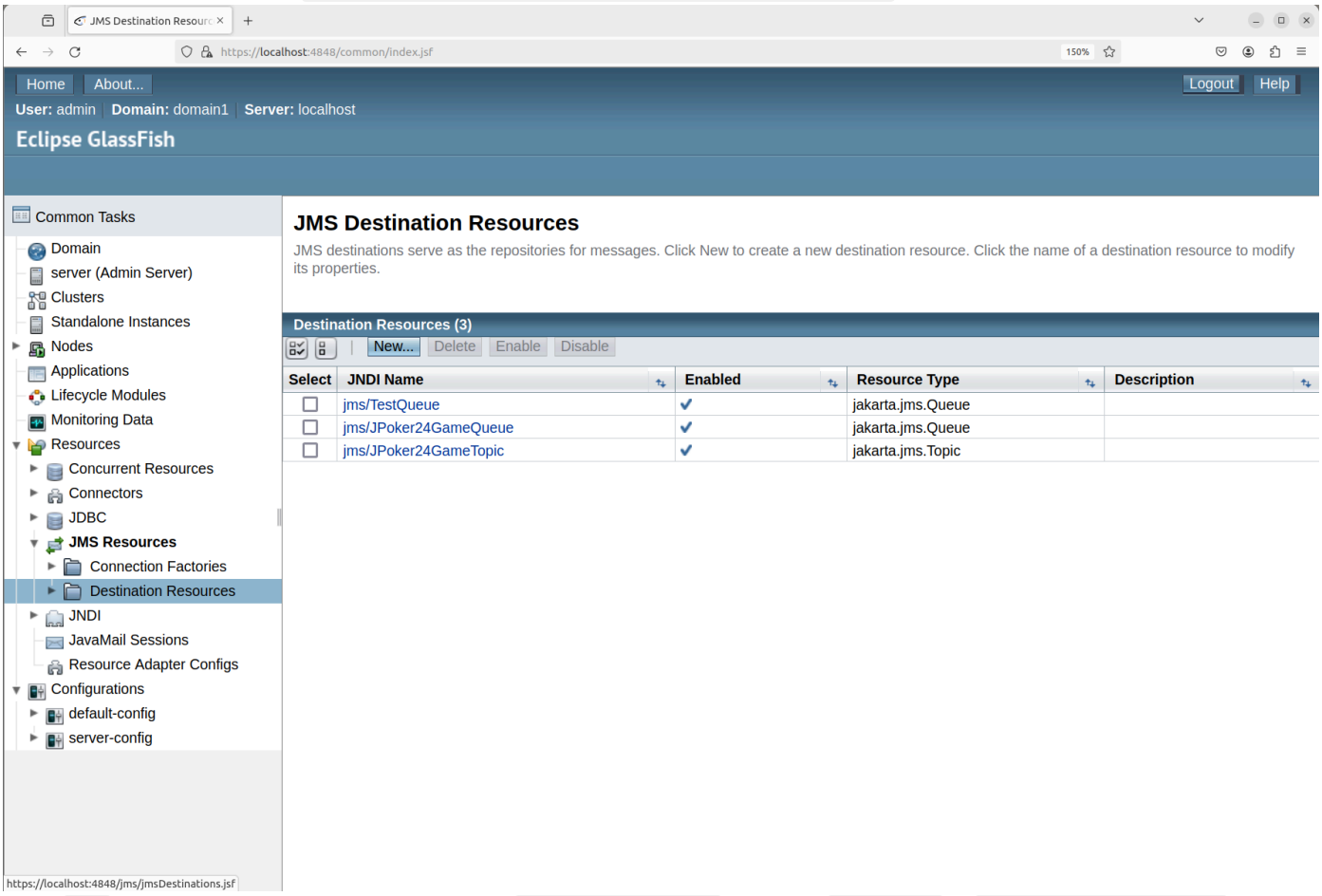
- Enter you glassfish admin console at http://localhost:4848, and login to it.
- Under side bar, navigate to `Resources -> JMS Resources -> Connection Factories`.



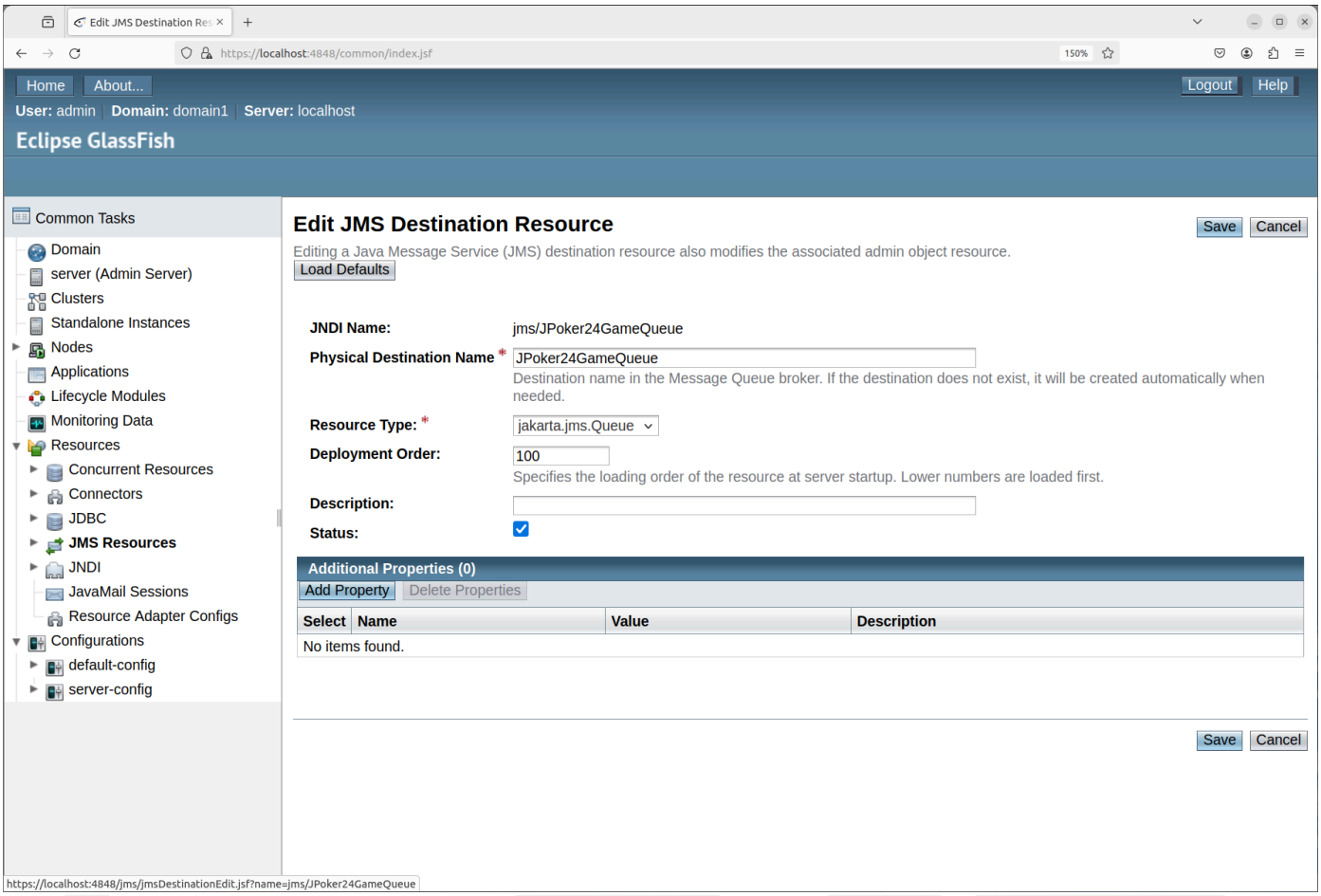
- Click `New` Button on the right Panel to create a `JPoker24GameConnectionFactory`, the field `JNDI Name` is `jms/JPoker24GameConnectionFactory` and the `Resource Type` is `jakarta.jms.ConnectionFactory`.



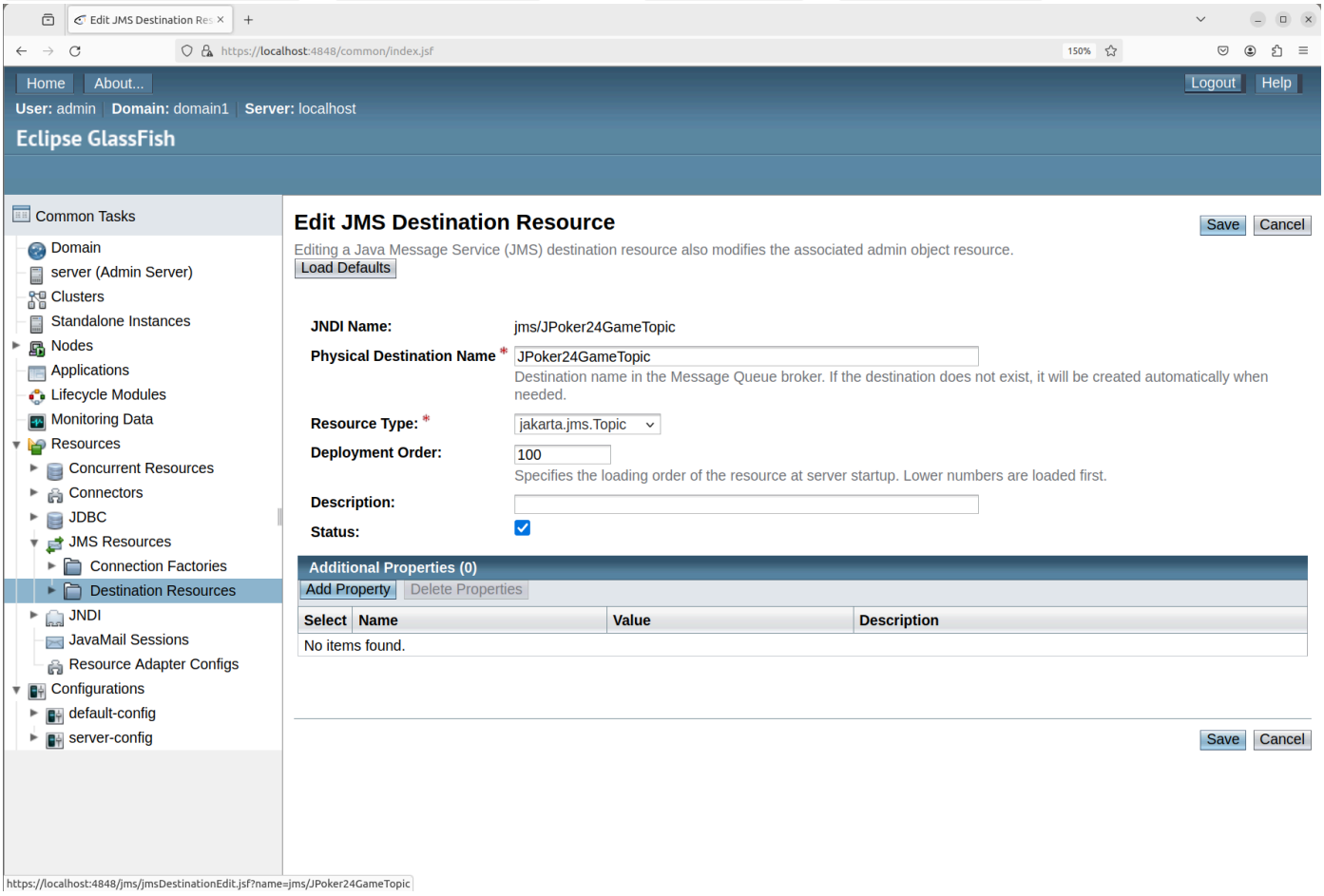
- Under side bar, navigate to `Resources -> JMS Resources -> Destination Resources`.



- Click `New` Button on the right Panel to create a `JPoker24GameQueue`, the field `JNDI Name` is `jms/JPoker24GameQueue`, the `Physical Destination Name` is `JPoker24GameQueue`, and the `Resource Type` is `jakarta.jms.Queue`.



- Click `New` Button on the right Panel to create a `JPoker24GameTopic`, the field `JNDI Name` is `jms/JPoker24GameTopic`, the `Physical Destination Name` is `JPoker24GameTopic`, and the `Resource Type` is `jakarta.jms.Topic`.



2 How to Run the Program

2.1 Run Server & Client

1. Open the terminal under `JPoker24Game` directory. Copy `glassfish-6.1.0` and `mysql-connector-j_8.4.0-1ubuntu22.04_all`, which you download in **section 1.2.3** and **1.3.1** respectively, under `lib` if you want to directly copy and paste the command to run `.jar` file.

   File Structure of Submitted File

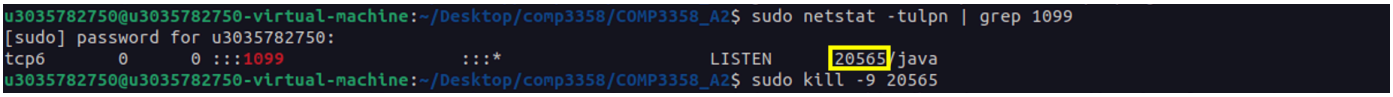
   ```
   JPoker24Game                (Open Linux Terminal Here)
   ├── lib
   │   ├── glassfish-6.1.0
   │   └── mysql-connector-j_8.4.0-1ubuntu22.04_all
   ├── JPoker24Game.jar
   ├── JPoker24GameServer.jar
   └── security.policy
   ```

2. Enter command below to check the **availability of port 1099**.

   ```
   sudo netstat -tulpn | grep 1099
   ```

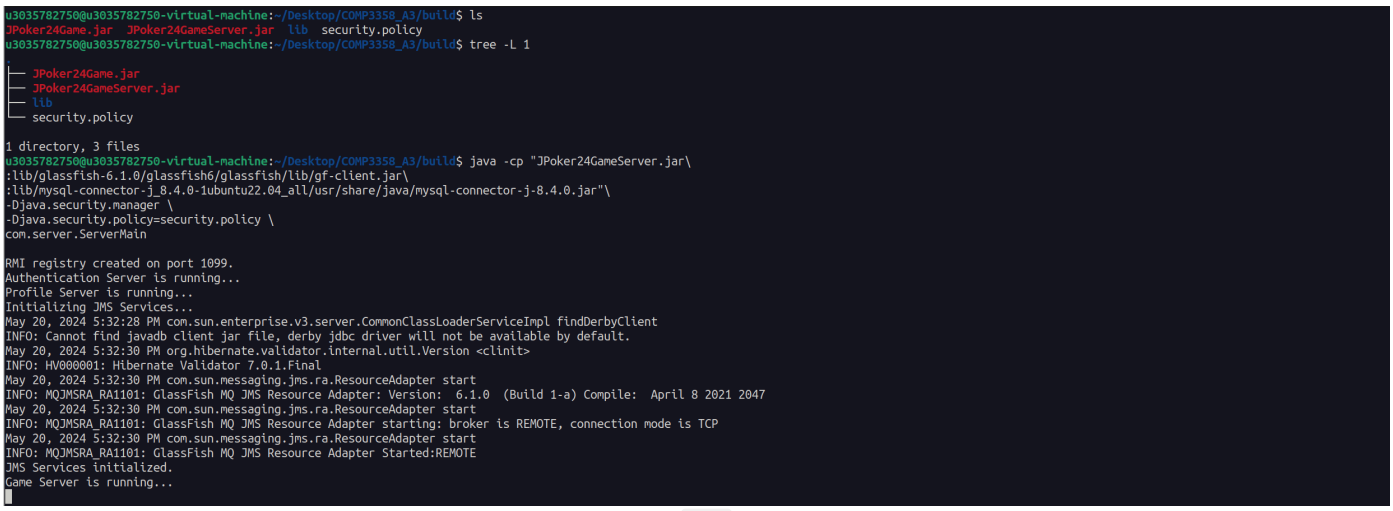
3. If Occupied, enter command below to kill the thread. Replace **$PID** with the PID shown output of the command above. You must ensure port 1099 is available. A demo can found in image.

   ```
   sudo kill -9 $PID
   ```



4. To start the server, use command below if you follow the directory structure in 1.

   ```
   java -cp "JPoker24GameServer.jar\
   :lib/glassfish-6.1.0/glassfish6/glassfish/lib/gf-client.jar\
   :lib/mysql-connector-j_8.4.0-1ubuntu22.04_all/usr/share/java/mysql-connector-j-8.4.0.jar"\
   -Djava.security.manager \
   -Djava.security.policy=security.policy \
   com.server.ServerMain
   ```



   If you are run at other place, or did not proper configure the `lib` directory, please use the command template below to execute the jar file.

   - Replace **$server_jar_path** with path to **JPoker24GameServer.jar**.
   - Replace **$mysql_connector_path** with the path to **mysql-connector-j-8.4.0.jar**.
   - Replace **$gf_client_path** with path to **gf-client.jar** of glassfish 6.1.0.

- Replace **$security_policy_path** with path to **security.policy**.

```
java -cp "$server_jar_path\
:$mysql_connector_path\
:$gf_client_path" \
-Djava.security.manager -Djava.security.policy=$security_policy_path \
com.server.ServerMain
```

5. To start the server, use command below if you follow the directory structure in 1.

```
java -cp "JPoker24Game.jar\
:lib/glassfish-6.1.0/glassfish6/glassfish/lib/gf-client.jar" \
-Djava.security.manager \
-Djava.security.policy=security.policy \
com.client.ClientMain localhost
```

If you are run at other place, or did not proper configure the `lib` directory, please use the command template below to execute the jar file.

- Replace **$client_jar_path** with path to **JPoker24Game.jar**.
- Replace **$gf_client_path** with path to **gf-client.jar** of glassfish 6.1.0.
- Replace **$security_policy_path** with path to **security.policy**.

```
java -cp "$client_jar_path\
:$gf_client_path" \
-Djava.security.manager \
-Djava.security.policy=$security_policy_path \
com.client.ClientMain localhost
```

6. Ensure you provide sufficient permission in security policy. Below are a safe option.

```
grant {
    permission java.security.AllPermission;
};
```

2.2 Inspect the MySQL Database

1. Open MySQL console in linux terminal.

```
sudo mysql -u root -p
```

2. Switch to the database we use.

```
USE GameDB;
```

3. Repeatly enter commands below to inspect the three tables we created.

```
SELECT * FROM Users;
SELECT * FROM Games;
SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
```

2.3 View Source Code

Following the assignment instruction, the source code has been packed within the `.jar` file. To view the source code, please decompress the `.jar` file by command below.

```
jar xf filename.jar
```

Regarding the strucuture of `.jar` file, all the source code are under `com` directory. The `jms`, `common`, `enum`, `utils` package are shared by both server and client, so view them once is enough.

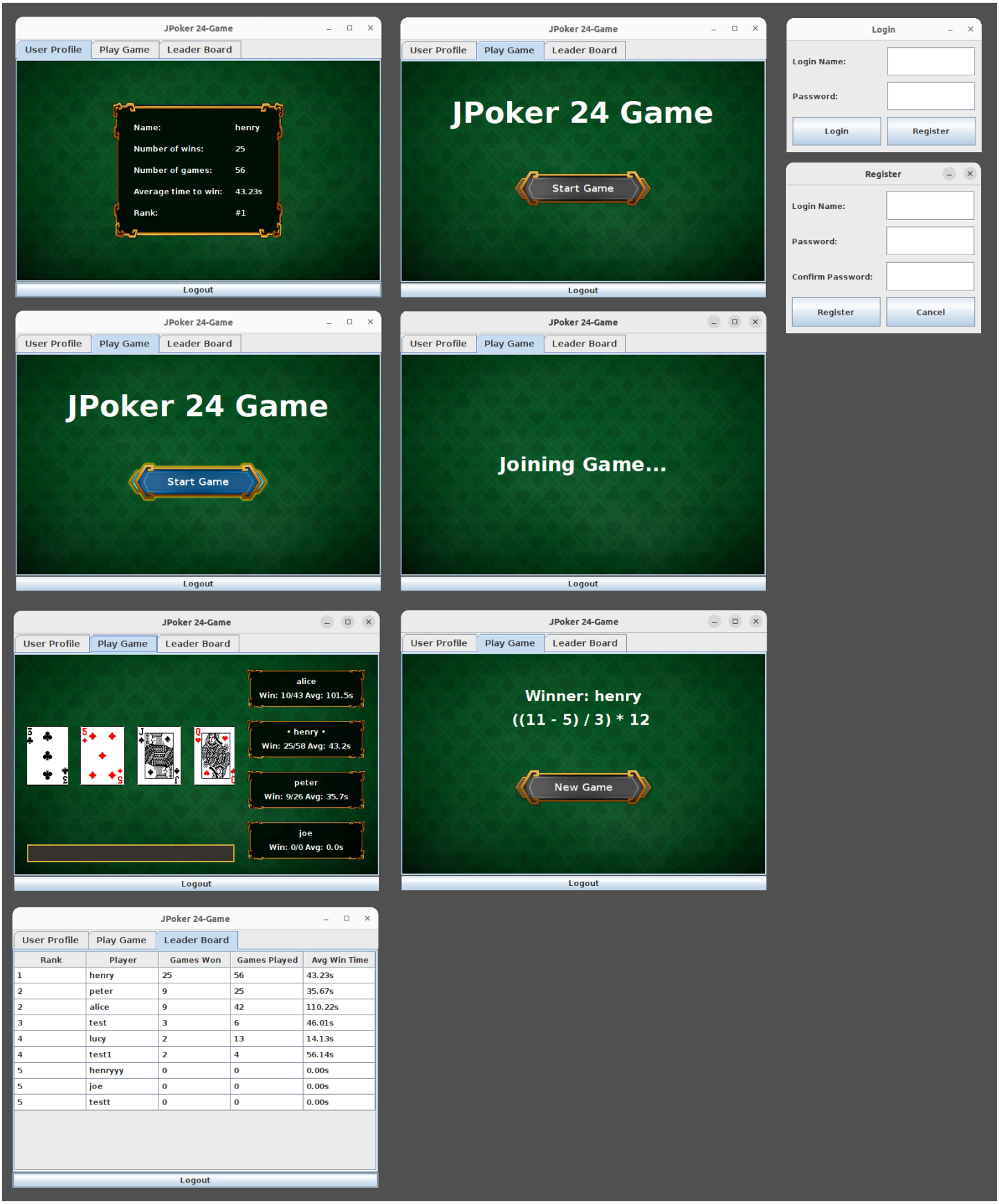
```
JPoker24Game.jar
├── assets
│   └── images
├── com
│   ├── client
│   ├── ui
│   ├── jms
│   ├── common
│   ├── enums
│   └── utils
└── META-INF
    └── MANIFEST.MF
```

```
JPoker24GameServer.jar
├── com
│   ├── server
│   ├── handler
│   ├── jms
│   ├── common
│   ├── enums
│   └── utils
└── META-INF
    └── MANIFEST.MF
```

3. Game Demo

2.1 GUI Design

Diagram below shows the overview of client GUI. The left side shows different panels in main frame, including user profile panel, game panels in diffrent stage, and leaderborad panel. The rgiht side shows the login and sign up window. Notice that hover effect has implemented on the button. Warning pop up will not be shown here as it has been included in previous report.



2.2 Basic Game Play Mechanism

2.2.1 Basic Game Flow (Game Stages & Database Handling)

1. **Client Initialization**: The user initiates gameplay by clicking the "Start Game" button on the client interface. This action sends a join request to the server via a JMS queue. The client then displays a waiting panel while it awaits server response.

Initial Client State (2 Players & 1 Outsider)

One Player Click on Start Game

```
Game Manager is running...

> User Information:
- Username:            Alex
- Password:            1234
- Is Online:           true
- Num of games won:    0
- Num of games played: 0
- Avg win time:        0.0
- Rank:                1

> Message sent to server
- Requesting game session
```

Client Side Log for Alex Sending Joining Request

```
mysql> SELECT * FROM Games;
Empty set (0.00 sec)

mysql> SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
Empty set (0.00 sec)
```

Database Log at Initial State (Empty)

2. **Server Session Handling**: Upon receiving the join request, the server either assigns the user to an existing game session or creates a new one if none are available. Each game session functions as a separate "game room," allowing for the isolation of different groups of players. Following the assignment, the session triggers a start timer which we will discuss later, creates a database record for the session, and transmits the session ID back to the client through the JMS queue.

```
Game Server is running...

> Message received from Alex
- Player Alex request to join the game
- Adding player Alex to an available session
- No available session found, creating a new session
- New session created: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Session initiate with status: WAITING_FOR_PLAYERS_TO_JOIN
- Number of existing sessions: 1
- Existing sessions: 794e
- Game session assigned to player Alex: 0310f458-e58a-4b14-aa7d-4ad02008794e
```

Server Side Log for Session Creation and Assignment

```
mysql> SELECT * FROM Games;
Empty set (0.00 sec)

mysql> SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
Empty set (0.00 sec)

mysql> SELECT * FROM Games;
+----+-----------------+
| id | completion_time |
+----+-----------------+
|  1 |            NULL |
+----+-----------------+
1 row in set (0.00 sec)

mysql> SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
Empty set (0.00 sec)
```

Game Session Session Record Creation in Databse

3. **Client Session Subscription**: After receiving the session ID, the client subscribes to a session-specific JMS topic. This is achieved by setting a selector with the session ID, which ensures that the client only receives messages pertinent to its game room. Subsequently, the client sends a readiness message to the server via the JMS queue, indicating its preparedness to engage in the game.

```
> User Information:
- Username:            Alex
- Password:            1234
- Is Online:           true
- Num of games won:    0
- Num of games played: 0
- Avg win time:        0.0
- Rank:                1

> Message sent to server
- Requesting game session

> Message received from server
- The server accepted the game join request
- Game session id obtained: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Topic message receiver initialized for session: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message sent to server
- Ready for game
```

Client Side Log for Session Subscription of Alex

4. **Server Game Initialization**: When all required players in a session are ready, the server finalizes the game setup by distributing necessary game elements such as cards and participant details. A game start message is then disseminated to the session's JMS topic, which has a string property of `SesseionID = '$sessionId'`. Concurrently, the server updates the game session's database record with participant details.

```
- Game session assigned to player Alex: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message received from Alex
- Player Alex is ready for the game

> Message received from Bella
- Player Bella request to join the game
- Adding player Bella to an available session
- Found an available session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- 10 seconds elapsed for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Minimum number of players reached for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Session moved to the next stage: WAITING_FOR_PLAYERS_TO_READY
- Game session assigned to player Bella: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message received from Bella
- Player Bella is ready for the game
- All players are ready for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Initiating game start for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Move to the next stage: GAME_STARTED
- Broadcasted game start message to players for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
```

Server Side Log for Initialization of Game

```
mysql> SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
Empty set (0.00 sec)

mysql> SELECT * FROM Games;
+----+-----------------+
| id | completion_time |
+----+-----------------+
|  1 |            NULL |
+----+-----------------+
1 row in set (0.00 sec)

mysql> SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
+---------+-----------+-----------+
| game_id | user_name | is_winner |
+---------+-----------+-----------+
|       1 | Alex      |         0 |
|       1 | Bella     |         0 |
+---------+-----------+-----------+
2 rows in set (0.00 sec)
```

Database Log for Participation Record

5. **Client Game Start**: Upon reception of the game start message, client in the session update their GUI to display the cards and participant information provided. Players write expressions using the value of four cards to achieve the target number 24 and submit their answers via the JMS queue to the server. The submission of answer is done by entering expression in input field and press `ENTER`.

```
- Num of games won:    0
- Num of games played: 0
- Avg win time:        0.0
- Rank:                1

> Message sent to server
- Requesting game session

> Message received from server
- The server accepted the game join request
- Game session id obtained: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Topic message receiver initialized for session: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message sent to server
- Ready for game

> Message received from server
- The server started the game since all players ready
- Game UI updated
```

Client Log for Receiving Game Start Message

Game Started and One User Entering Correct Answer

```
- Rank:                1

> Message sent to server
- Requesting game session

> Message received from server
- The server accepted the game join request
- Game session id obtained: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Topic message receiver initialized for session: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message sent to server
- Ready for game

> Message received from server
- The server started the game since all players ready
- Game UI updated

> Message sent to server
- Submitting answer: 4 * ((8 + 11) - 13)
```

Client Log for Answer Submission

6. **Server Expression Validation**: The server validates any received expressions. If an expression correctly forms the number 24, the server updates the database with the winner's details and broadcasts the winning announcement to all players in the game room via the JMS topic. It also sends updated leaderboard information to all players.

```
- 10 seconds elapsed for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Minimum number of players reached for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Session moved to the next stage: WAITING_FOR_PLAYERS_TO_READY
- Game session assigned to player Bella: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message received from Bella
- Player Bella is ready for the game
- All players are ready for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Initiating game start for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Move to the next stage: GAME_STARTED
- Broadcasted game start message to players for session: 0310f458-e58a-4b14-aa7d-4ad02008794e

> Message received from Alex
- Player Alex submitted an answer
- Player Alex submitted the correct answer: 4 * ((8 + 11) - 13)
- Winner is Alex with expression 4 * ((8 + 11) - 13)
- Broadcasted game end message to players for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Broadcasted update leaderboard message to all online players
- Move to the next stage: GAME_ENDED
- Existing session removed: 0310f458-e58a-4b14-aa7d-4ad02008794e
```

Server Side Log for Answer Processing, Winner Broadcast to sesion players & Leaderboard Broadcast to all users

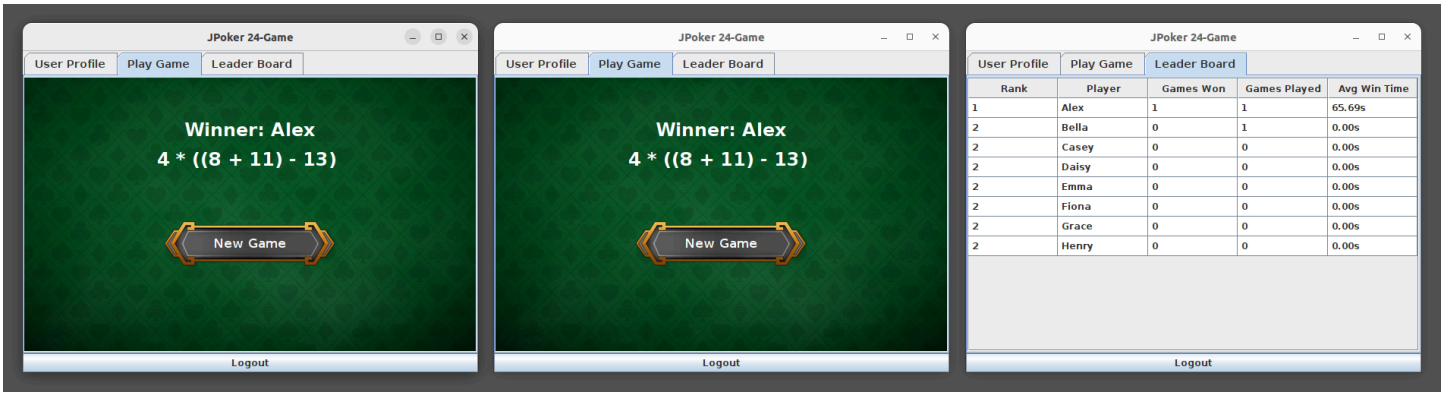
```
+---------+-----------+-----------+
2 rows in set (0.00 sec)

mysql> SELECT * FROM Games;
+----+-----------------+
| id | completion_time |
+----+-----------------+
|  1 |          65.693 |
+----+-----------------+
1 row in set (0.00 sec)

mysql> SELECT * FROM Participations ORDER BY game_id ASC, is_winner DESC, user_name ASC;
+---------+-----------+-----------+
| game_id | user_name | is_winner |
+---------+-----------+-----------+
|       1 | Alex      |         1 |
|       1 | Bella     |         0 |
+---------+-----------+-----------+
2 rows in set (0.00 sec)
```

Database Log on Updating Game Completion Time and Winner

7. **Client Winner Display**: The client receives and displays the winner's details and their successful expression on the GUI, offering congratulations. Also, this triggers players of the session to update their personal profile and corresponding panel, as it changes.
8. **Client Leaderboard Update**: The client receives updated leaderboard information and refreshes the GUI, to reflect the new standings.

```
> Message sent to server
- Ready for game

> Message received from server
- The server started the game since all players ready
- Game UI updated

> Message sent to server
- Submitting answer: 4 * ((8 + 11) - 13)

> Message received from server
- The server ended the game since a player won

> Message received from server
- The server sent the latest leaderboard
- Topic message receiver dropped for session: 0310f458-e58a-4b14-aa7d-4ad02008794e
- Game UI updated
- User profile updated
- Leaderboard updated
```

Game Session End Message & LeaderBoard Update Message Received



Display of Game Winner for Session Players (left) & Global Leaderboard Update (right)

Personal Profile Update for Session Player

9. The communication design utilizes JMS queues with selectors on unique Receiver IDs for secure P2P communication between the client and server, ensuring that messages are delivered to and received from the correct parties, thereby enhancing the reliability and privacy of interactions. Meanwhile, the use of JMS topics with session ID selectors allows for efficient, targeted broadcasting to all players within a specific game room, or all online players.

2.2.2 Game Join Handling (Case Handling)

In the game, various mechanisms have been developed to manage how players can join a game. Initially, the game room status is set to `WAITING_FOR_PLAYERS_TO_JOIN`.

The game room requires a minimum of 2 players and can accommodate a maximum of 4 players.

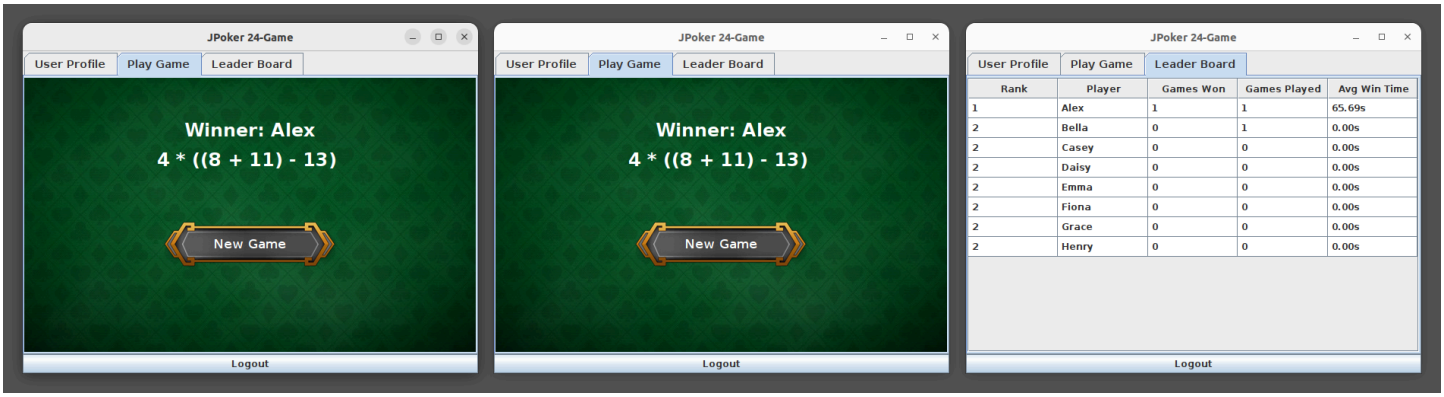
Players have a 10-second window to join the game room, provided the maximum capacity has not been reached. If the maximum capacity is reached within this time, the game room status changes to `WAITING_FOR_PLAYERS_TO_READY`.

If the minimum capacity is met 10 seconds after the game room creation, or upon subsequent player joins, the status also transitions to `WAITING_FOR_PLAYERS_TO_READY`.

Upon the current status is `WAITING_FOR_PLAYERS_TO_READY` and receiving a readiness confirmation from each player, the game checks if all players are ready (Note: At t=10s, a check will also be triggered if minimum requirement is reached). If so, the game immediately proceeds to prepare the necessary game materials and broadcasts them to the players in the session.

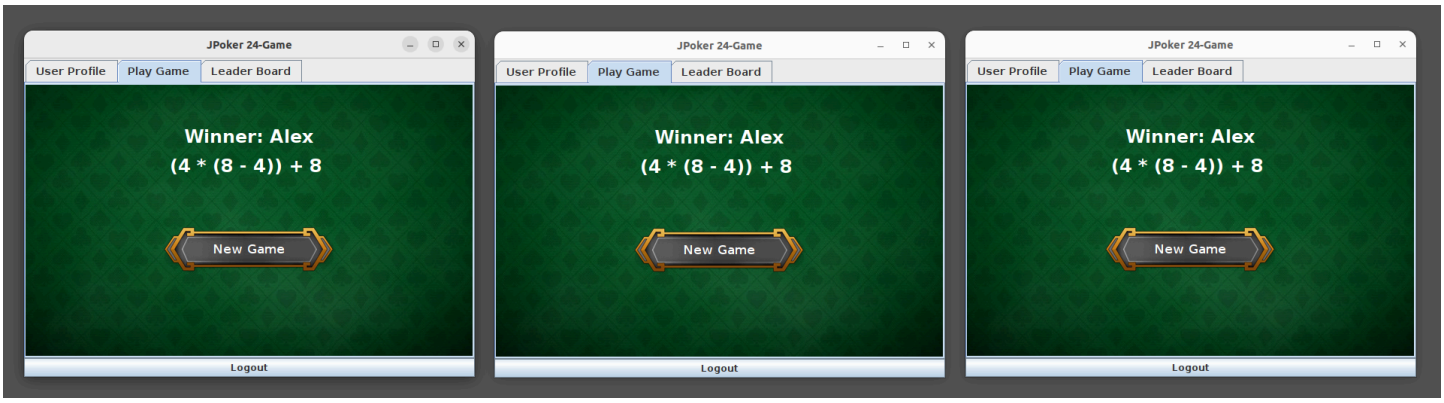
These settings ensure that the game session can allow fill up if all players join within the initial 10-second window, and can start quickly after this window if the minimum player requirement is met.

Game with 2 Players



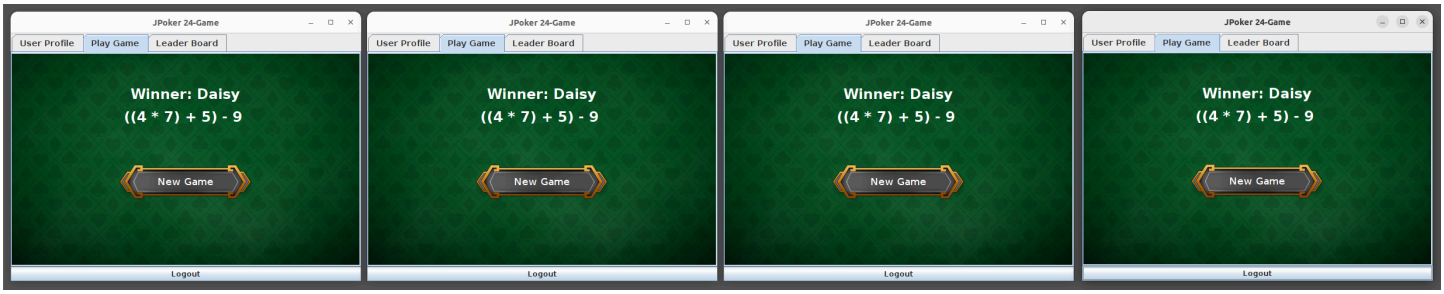
Game with 2 Players (Win)

Game with 3 Players



Game with 3 Players(Win)

Game with 4 Players

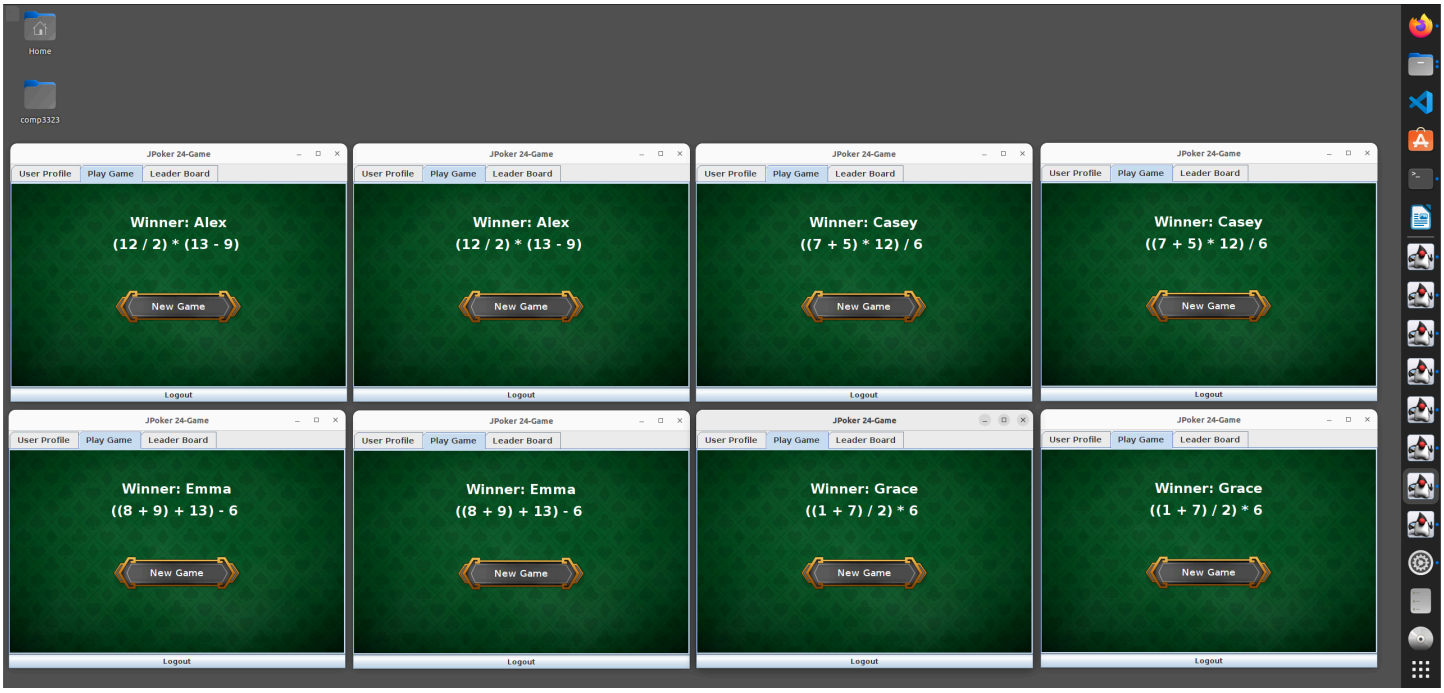


Game with 4 Players (Win)

2.2.3 Multi-Session Support (Session Management)

The game suppor multiple session (game room). Image below shows the 4 game session playing at the same time, each group have 2 users. The sessions are `TOP LEFT`, `TOP RIGHT`, `BOTTOM LEFT`, `BOTTOM RIGHT`.

Game with 4 Room



Game with 4 Room (4 Separate Win)

2.3 Answer Evaluation and Validation

The section above already shows the ability of app handling a string expression, especially calculating whether the result equals to 24. This section will majorly show the case including:

- validation: missing number
- validation: excess number
- validation: use of invalid operators
- evaluation: incorrect result of valid expression (not equal to 24)

Please view these cases from left to right in the image below:

Game with 4 Room

Note: for the all these cases, the game will allow player to have more trial by click the `OK` button.