

Test Report

Note on Report Formatting

In the following test report, color distinctions are used for messages in the terminal output:

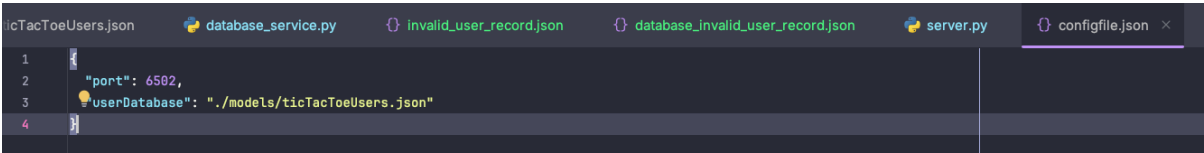
- **Green Text:** Messages sent by either the server or the client.
- **White Text:** Standard output (stdout/stderr) from the client or server.

Test Cases

1. Test Configuration File

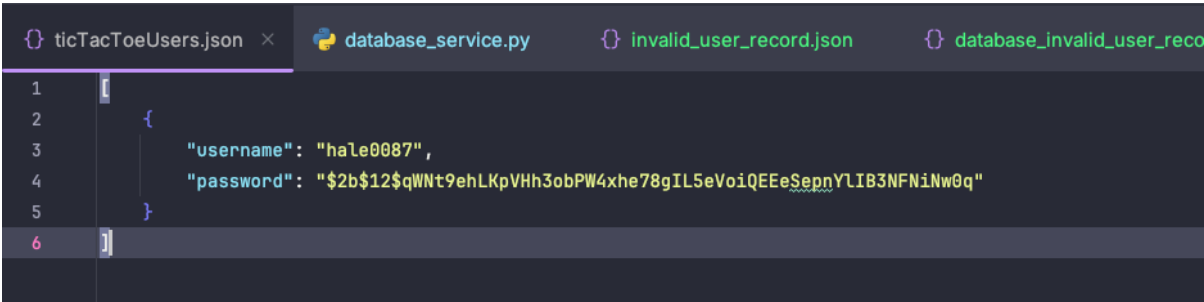
- **Valid Configuration:** The configuration and user database files are correctly formatted.

- This image shows the config file in a valid format:



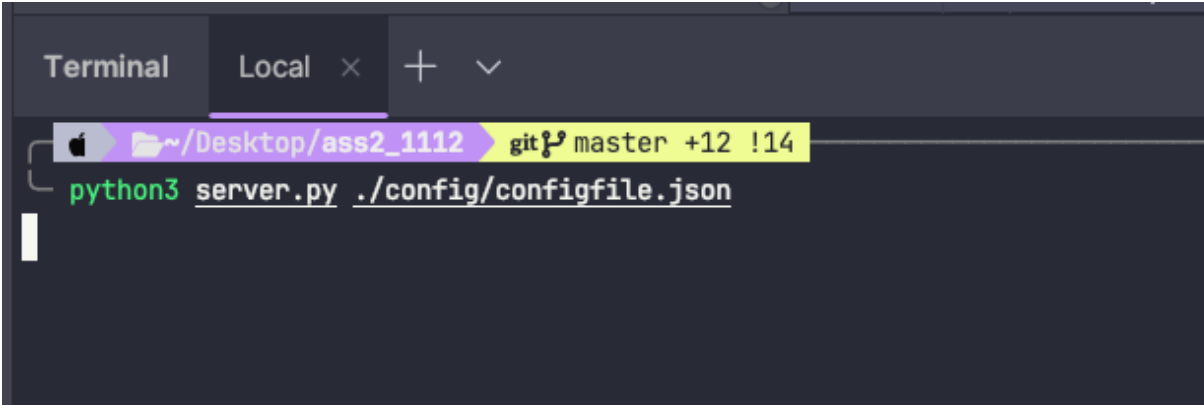
```
1 {
2   "port": 6502,
3   "userDatabase": "./models/ticTacToeUsers.json"
4 }
```

- This image shows the database in a valid format:



```
1 [
2   {
3     "username": "ha1e0087",
4     "password": "$2b$12$qWnt9ehLKpVHh3obPW4xhe78gILSeVoiQEEeSepnYLIB3NFNiNw0q"
5   }
6 ]
```

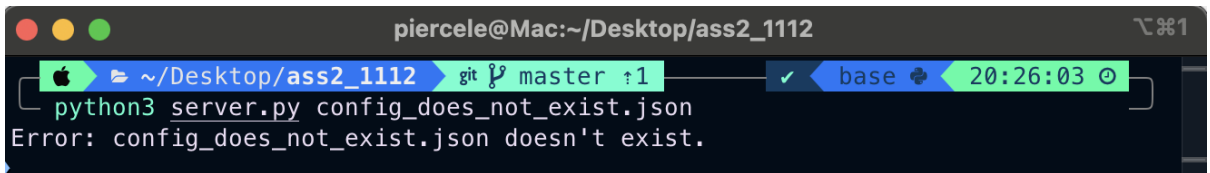
- This shows the successful execution without errors:



```
Terminal Local x + v
~/Desktop/ass2_1112 git master +12 !14
python3 server.py ./config/configfile.json
```

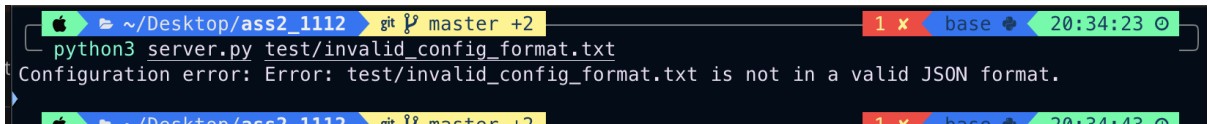
- **Server Configuration Cases:**

- **Case 1:** The path to the server configuration file does not exist, raising an error as expected.



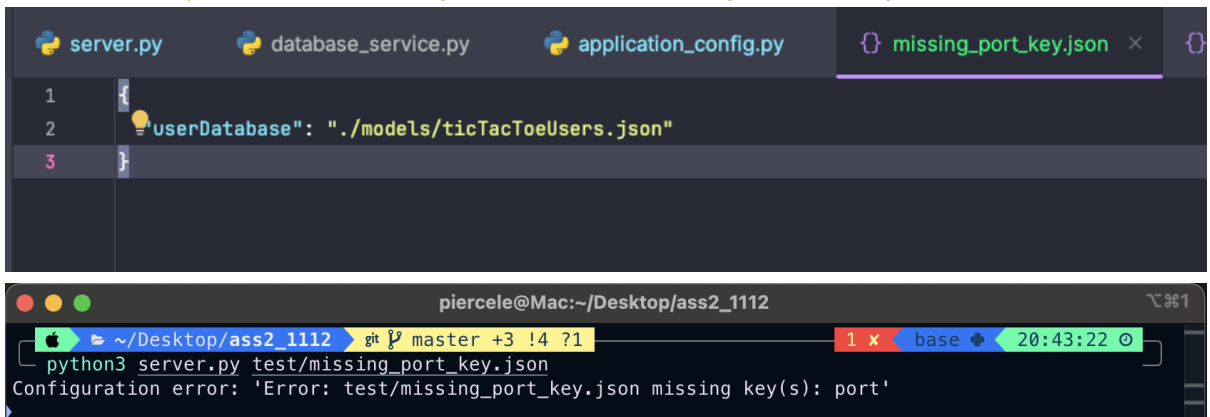
A terminal window titled 'piercele@Mac:~/Desktop/ass2_1112' showing a git status bar at 'master +1' and a timer at '20:26:03'. The command 'python3 server.py config_does_not_exist.json' is entered, resulting in the error: 'Error: config_does_not_exist.json doesn't exist.'

- **Case 2:** The server config file is not in valid JSON format, causing an error.



A terminal window titled 'piercele@Mac:~/Desktop/ass2_1112' showing a git status bar at 'master +2' and a timer at '20:34:23'. The command 'python3 server.py test/invalid_config_format.txt' is entered, resulting in the error: 'Configuration error: Error: test/invalid_config_format.txt is not in a valid JSON format.'

- **Case 3:** The "port" key is missing from the server config file, causing an error.

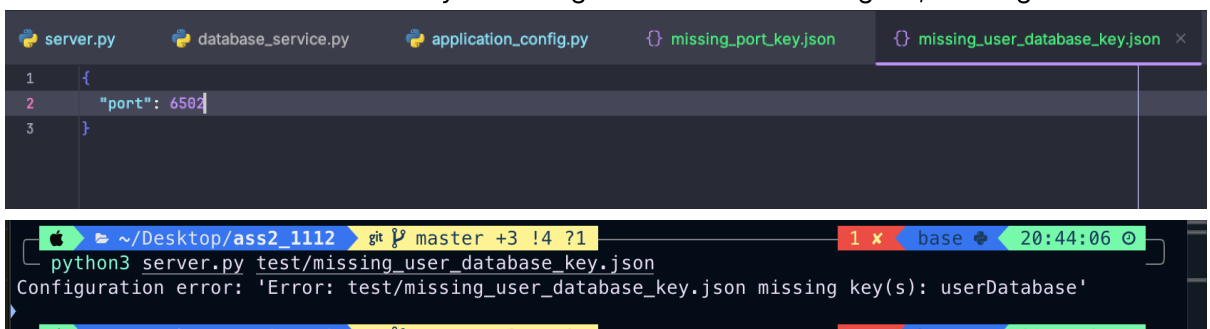


The code editor shows 'missing_port_key.json' with the following content:

```
1 {  
2   "userDatabase": "./models/ticTacToeUsers.json"  
3 }
```

The terminal window titled 'piercele@Mac:~/Desktop/ass2_1112' shows a git status bar at 'master +3 !4 ?1' and a timer at '20:43:22'. The command 'python3 server.py test/missing_port_key.json' is entered, resulting in the error: 'Configuration error: 'Error: test/missing_port_key.json missing key(s): port''

- **Case 4:** The "userDatabase" key is missing from the server config file, causing an error.

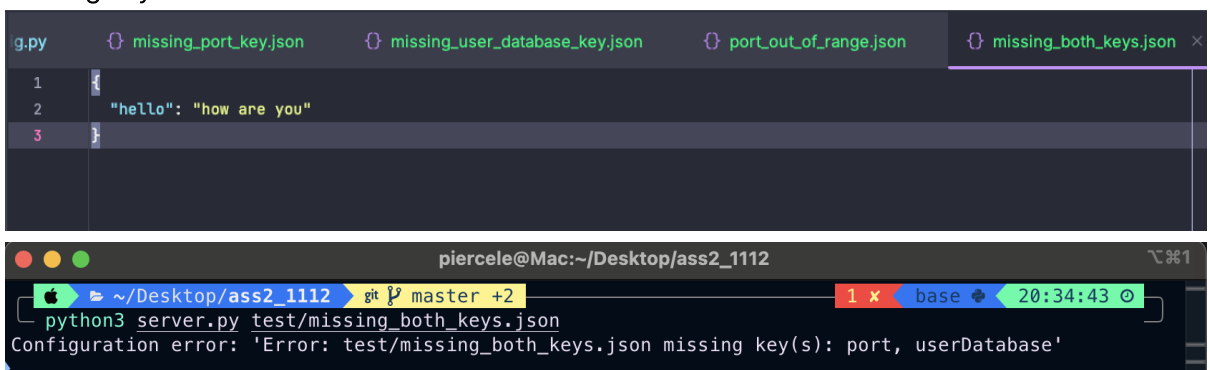


The code editor shows 'missing_user_database_key.json' with the following content:

```
1 {  
2   "port": 6502  
3 }
```

The terminal window titled 'piercele@Mac:~/Desktop/ass2_1112' shows a git status bar at 'master +3 !4 ?1' and a timer at '20:44:06'. The command 'python3 server.py test/missing_user_database_key.json' is entered, resulting in the error: 'Configuration error: 'Error: test/missing_user_database_key.json missing key(s): userDatabase''

- **Case 5:** Both "port" and "userDatabase" keys are missing, resulting in errors for both missing keys.



The code editor shows 'missing_both_keys.json' with the following content:

```
1 {  
2   "hello": "how are you"  
3 }
```

The terminal window titled 'piercele@Mac:~/Desktop/ass2_1112' shows a git status bar at 'master +2' and a timer at '20:34:43'. The command 'python3 server.py test/missing_both_keys.json' is entered, resulting in the error: 'Configuration error: 'Error: test/missing_both_keys.json missing key(s): port, userDatabase''

- **Case 6:** Unknown keys are present in the config file, which are ignored, allowing the program to run without errors.

- **Case 7:** An incorrect number of arguments are passed to the server, raising an error.

- **Case 8:** The port number is out of range, raising an error.

The screenshot shows two files open in VS Code. The active file, `application_config.py`, contains the following JSON configuration:

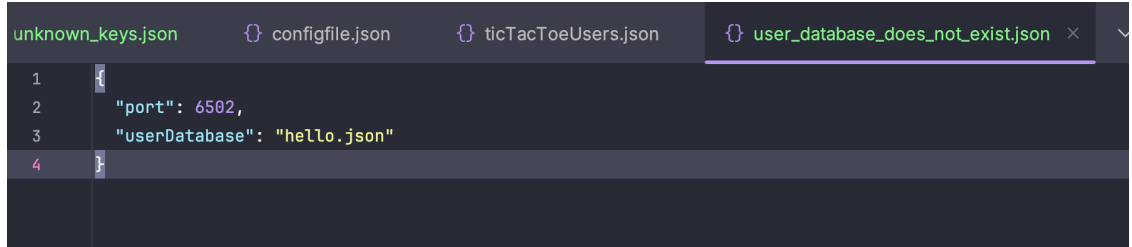
```
{  
  "port": 65020000000000000000000000000000,  
  "userDatabase": "./models/ticTacToeUsers.json"  
}
```

The second file, `port_out_of_range.json`, is currently empty.

- **User Database Cases:**

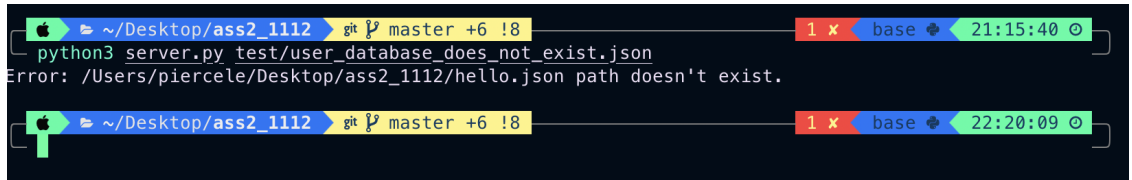
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- Configuration file points to a non-existent userDatabase path **"hello.json"**.



```
unknown_keys.json  configfile.json  ticTacToeUsers.json  user_database_does_not_exist.json x
1  {
2    "port": 6502,
3    "userDatabase": "hello.json"
4  }
```

- Client stdout shows an error for path **"/User/piercele/Desktop/ass2_1112/hello.json"**.

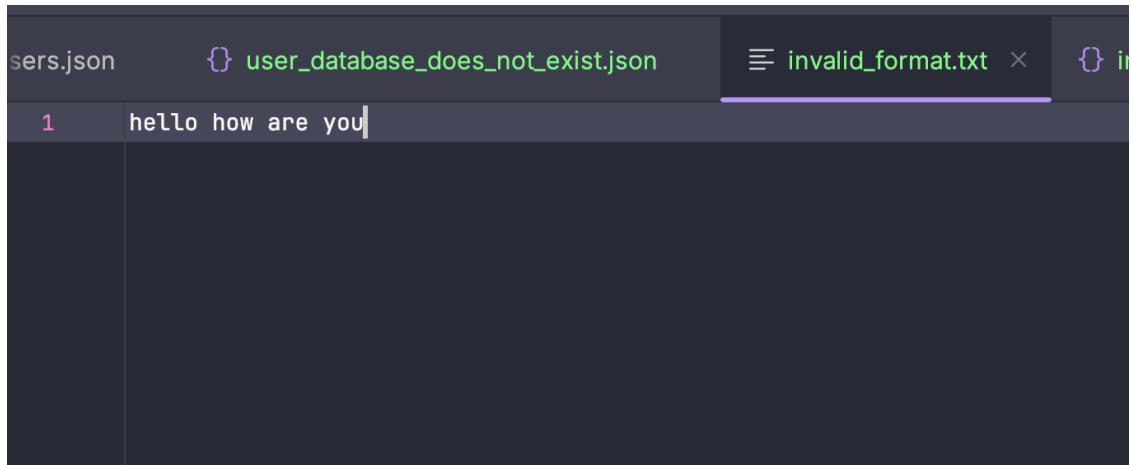


```
~/Desktop/ass2_1112 git master +6 !8 1 x base 21:15:40
python3 server.py test/user_database_does_not_exist.json
Error: /Users/piercele/Desktop/ass2_1112/hello.json path doesn't exist.

~/Desktop/ass2_1112 git master +6 !8 1 x base 22:20:09
```

- **Case 2:** User database is not in valid JSON format.

- **"invalid_format"** is a text file, which raises an error.



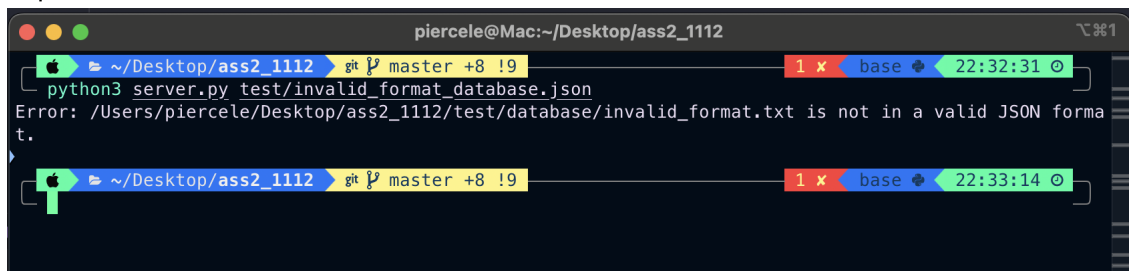
```
users.json  user_database_does_not_exist.json  invalid_format.txt x
1  hello how are you
```

- Configuration file correctly points to an invalid database path.



```
1  {
2    "port": 6502,
3    "userDatabase": "test/database/invalid_format.txt"
4  }
```

- Expected error result.



```
piercele@Mac:~/Desktop/ass2_1112
~/Desktop/ass2_1112 git master +8 !9 1 x base 22:32:31
python3 server.py test/invalid_format_database.json
Error: /Users/piercele/Desktop/ass2_1112/test/database/invalid_format.txt is not in a valid JSON format.

~/Desktop/ass2_1112 git master +8 !9 1 x base 22:33:14
```

- **Case 3:** User database is not a JSON array.

- "not_json_array.json" is not a JSON array format.

```

1 {
2   "hi": "hello"
3 }
4

```

- Configuration file points to a correctly formatted userDatabase path but with a non-array file.

```

1 {
2   "port": 6502,
3   "userDatabase": "test/database/not_json_array.json"
4 }

```

- Expected error result.

```

~/Desktop/ass2_1112 master +10 !12 base 22:37:18
python3 server.py test/user_database_not_json_array.json
Error: /Users/piercele/Desktop/ass2_1112/test/database/not_json_array.json is not a JSON array.
~/Desktop/ass2_1112 master +10 !12 base 22:37:40

```

○ Case 4: User record format is invalid.

- Database contains invalid keys like `firstName` and `lastName`.

```

1 [
2   {
3     "firstName": "Pierce",
4     "lastName": "Le",
5     "username": "hale0087",
6     "password": "$2b$12$qWnt9ehLKpVHh3obPW4xhe78gIL5eVoiQEEeSepnYLIB3NfNiNw0q"
7   }
8 ]

```

```

1 {
2   "port": 6502,
3   "userDatabase": "test/database/invalid_user_record.json"
4 }

```

- Expected error result.

```

~/Desktop/ass2_1112 master +12 !14 base 22:47:41
python3 server.py test/database_invalid_user_record.json
Error: /Users/piercele/Desktop/ass2_1112/test/database/invalid_user_record.json contains invalid user record
~/Desktop/ass2_1112 master +12 !14 base 22:47:44

```

3. Client Launching

- **Case 1:** An incorrect number of arguments passed to the client program.

```

piercele@Mac:~/Desktop/ass2_1112
~/Desktop/ass2_1112 git P master +12 !14
python3 client.py
Error: Expecting 2 arguments: <server address> <port>

~/Desktop/ass2_1112 git P master !1
python3 client.py hello world hehehehe
Error: Expecting 2 arguments: <server address> <port>

```

- **Case 2:** Client cannot connect to server at specified address and port. This includes invalid formats for port and host. The last case in the image fails due to the server not running.

```

piercele@Mac:~/Desktop/ass2_1112
~/De/ass2_1112 git P master !1
python3 client.py localhost 6500
Error: cannot connect to server at localhost and 6500.

~/Desktop/ass2_1112 git P master !1
python3 client.py 127.0.0.1 6500
Error: cannot connect to server at 127.0.0.1 and 6500.

~/Desktop/ass2_1112 git P master !1
python3 client.py hello hi
Error: cannot connect to server at hello and hi

~/Desktop/ass2_1112 git P master !1
python3 client.py 127.0.0.1 6502
Error: cannot connect to server at 127.0.0.1 and 6502.

~/Desktop/ass2_1112 git P master !1

```

- **Case 3:** Successfully connected to server.

```

56 def process_disconnect(self, conn): 2 usages PierceLe
python3 server.py ./config/configfile.json

76
77 def main(config_file): 1 usage PierceLe
78     try:

```

```

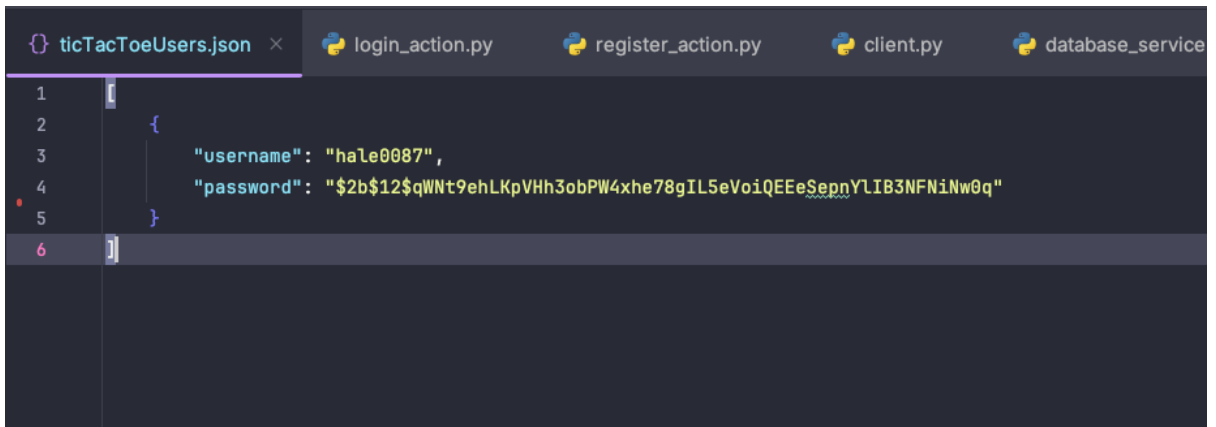
python3 client.py 127.0.0.1 6502

```

4. Register Testing

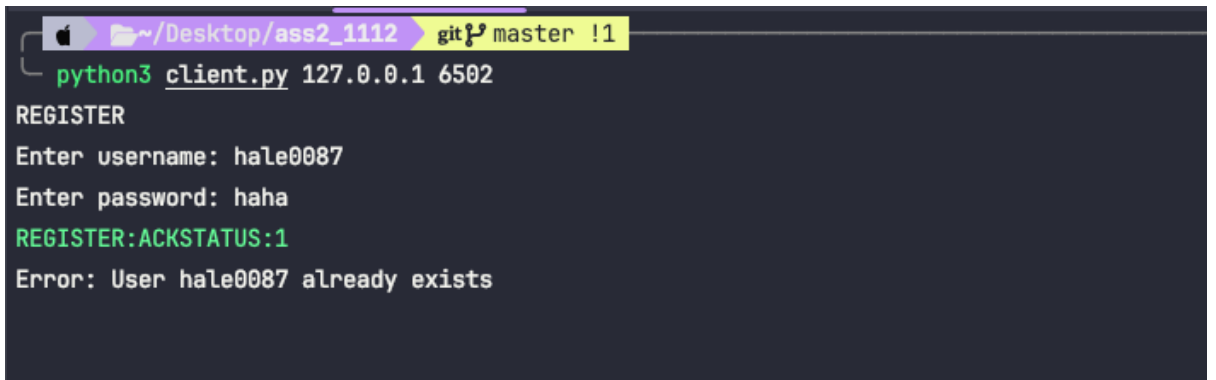
- **Case 1:** Username already exists in the user database.

- Database state before running the command:



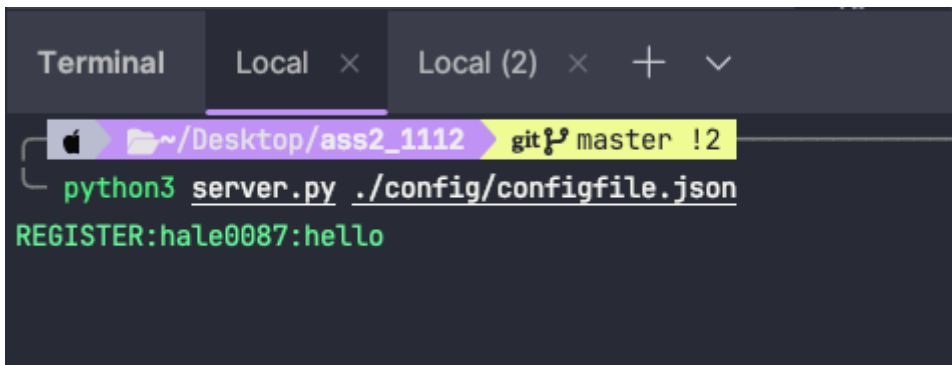
```
ticTacToeUsers.json x login_action.py register_action.py client.py database_service
1 [
2   {
3     "username": "hale0087",
4     "password": "$2b$12$qWnt9ehLKpVHh3obPW4xhe78gIL5eVoiQEEeSepnYLIB3NFnINw0q"
5   }
6 ]
```

- Client stdout shows server responding with status 1 for duplicate username hale0087.



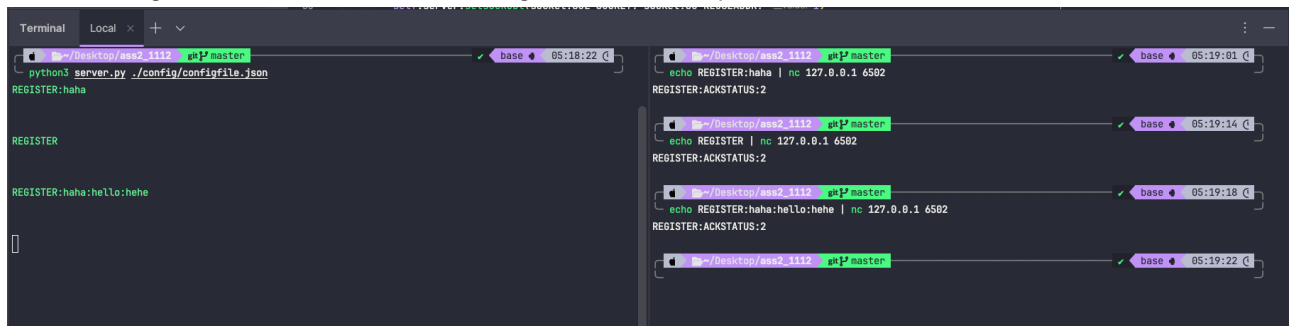
```
~/Desktop/ass2_1112 git master !1
python3 client.py 127.0.0.1 6502
REGISTER
Enter username: hale0087
Enter password: haha
REGISTER:ACKSTATUS:1
Error: User hale0087 already exists
```

- Server stdout confirmation:



```
Terminal Local x Local (2) x + v
~/Desktop/ass2_1112 git master !2
python3 server.py ./config/configfile.json
REGISTER:hale0087:hello
```

- Case 2:** Register with invalid format using nc. Server responds with status 2.



```
Terminal Local x + v
~/Desktop/ass2_1112 git master base 05:18:22
python3 server.py ./config/configfile.json
REGISTER:haha
REGISTER
REGISTER:haha:hello:hehe

~/Desktop/ass2_1112 git master base 05:19:01
echo REGISTER:haha | nc 127.0.0.1 6502
REGISTER:ACKSTATUS:2

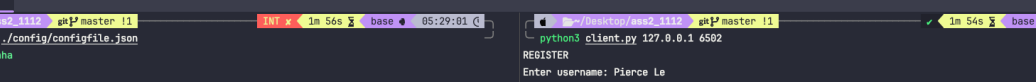
~/Desktop/ass2_1112 git master base 05:19:14
echo REGISTER | nc 127.0.0.1 6502
REGISTER:ACKSTATUS:2

~/Desktop/ass2_1112 git master base 05:19:18
echo REGISTER:haha:hello:hehe | nc 127.0.0.1 6502
REGISTER:ACKSTATUS:2

~/Desktop/ass2_1112 git master base 05:19:22
```

- The image shows two terminal windows side-by-side. The left window is titled 'Terminal' and shows a command prompt with the path 'C:\Users\master\anaconda3\python3'. The command 'python3 server.py ./config/configfile.json' has been executed. The right window is titled 'Local' and shows a command prompt with the path 'C:\Users\master\anaconda3\python3'. The command 'python3 client.py 127.0.0.1 6502' has been executed. The client output shows 'REGISTER' being sent, followed by 'Enter username: hahahahahahahahahahaha', and then an error message: 'Error: username Length limitation is 20 characters'. The prompt 'Enter username:' is shown again.

- [illegible]

- 
- The screenshot displays two terminal windows side-by-side, illustrating the registration process. The left window shows the execution of the server.py script, which outputs the message 'REGISTER:Pierce Le:haha'. The right window shows the execution of the client.py script, which outputs the message 'Successfully created user account Pierce Le'.
- ```
Terminal Local x + -
```
- ```
python3 server.py ./config/configfile.json
REGISTER:Pierce Le:haha
```
- ```
python3 client.py 127.0.0.1 6502
REGISTER
Enter username: Pierce Le
Enter password: haha
REGISTER:ACKSTATUS:0
Successfully created user account Pierce Le
```

- ```

1  [
2      {
3          "username": "haLe0087",
4          "password": "$2b$12$qWNt9ehLKpVHh3obPW4xhe78gIL5eVoiQEeSepnYLIB3NFNiNw0q"
5      },
6      {
7          "username": "Pierce Le",
8          "password": "$2b$12$r0EAo8IShkCI2LoLI3qWwu1jqsTuThkWLz8g/X6kLB3vCgd0yX8RK"
9      }
10 ]

```


- [illegible]

- **Database before test:**

```

1  {
2      {
3          "username": "hale0087",
4          "password": "$2b$12$qWnt9ehLKpVHh3obPW4xhe78gIL5eVoiQEe$sepnYLIB3NFNiNw0q"
5      },
6      {
7          "username": "Pierce Le",
8          "password": "$2b$12$r0EAo8IShkCI2LoLI3qWwu1jqsTuThkWLz8g/X6kLB3vCgd0yX8RK"
9      },
10     {
11         "username": "hehe",
12         "password": "$2b$12$.uX9z1ZCLKywhJ7DEhMpGug8/mxeobU0vRA1xs.J0A3QC.M/6vqA6"
13     }
14 }

```

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- **Case 1:** Login successful; server sends status 0.

```

python3 server.py ./config/configfile.json
LOGIN:haLe0087:hello

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: haLe0087
Enter password: hello
LOGIN:ACKSTATUS:0
Welcome haLe0087

```

- **Case 2:** Username not found; server sends status 1.

```

python3 server.py ./config/configfile.json
LOGIN:hoho:hehe

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: hoho
Enter password: hehe
LOGIN:ACKSTATUS:1
Error: User hoho not found

```

- **Case 3:** Incorrect password; server sends status 2.

```

python3 server.py ./config/configfile.json
LOGIN:haLe0087:hehu

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: haLe0087
Enter password: hehu
LOGIN:ACKSTATUS:2
Error: Wrong password for user haLe0087

```

- **Case 4:** Login message format is invalid. Tested with nc, server responds with status 3.

```

python3 server.py ./config/configfile.json
LOGIN:haLe0087
LOGIN
LOGIN:haha:haha:haha

echo LOGIN:haLe0087 | nc 127.0.0.1 6502
LOGIN:ACKSTATUS:3

echo LOGIN | nc 127.0.0.1 6502
LOGIN:ACKSTATUS:3

echo LOGIN:haha:haha:haha | nc 127.0.0.1 6502
LOGIN:ACKSTATUS:3

```

- **Case 5:** Account is already logged in from another client.

The screenshot shows two terminal windows. The left window, titled 'Terminal' with tabs 'Local' and '+', shows a server running 'python3 server.py ./config/configfile.json'. It receives two 'LOGIN:haLe0087:hello' messages. The right window, titled 'python3 client.py 127.0.0.1 6502', shows a client logging in with 'haLe0087' and 'hello'. The server responds with 'LOGIN:ACKSTATUS:4' and 'Error: The account has been logged in by another user'.

- **Case 6:** Login from a new connection while account is active on another. Log out from first connection, then successfully log in from new one.

The screenshot shows two terminal windows. The left window shows the server receiving three 'LOGIN:haLe0087:hello' messages. The first two result in 'LOGIN:ACKSTATUS:4' and an error. The third results in 'LOGIN:ACKSTATUS:0' and 'Welcome haLe0087'. The right window shows the client logging in with 'haLe0087' and 'hello'. The server responds with 'LOGIN:ACKSTATUS:4' and an error. The client then logs out with 'quit' and logs back in with 'haLe0087' and 'hello'. The server responds with 'LOGIN:ACKSTATUS:0' and 'Welcome haLe0087'.

6. Create Room Testing

- **Create Room Cases:**
 - **Case 1:** Room name contains invalid characters.

The screenshot shows two terminal windows. The left window shows the server receiving 'LOGIN:haLe0087:hello' and 'CREATE:hahahahahahahahahahahahahahaha'. The right window shows the client logging in with 'haLe0087' and 'hello'. The server responds with 'LOGIN:ACKSTATUS:0' and 'Welcome haLe0087'. The client then creates a room with 'CREATE:hahahahahahahahahahahahahahaha'. The server responds with 'CREATE:ACKSTATUS:1' and 'Error: Room hahahahahahahahahahahahahahaha is invalid'.

- **Case 2:** Room name already exists.

The screenshot shows two terminal windows. The left window shows the server receiving 'CREATE:hahahahahahahahahahahahahahaha', 'CREATE:dog', 'LOGIN:Pierce Le:haha', and 'CREATE:dog'. The right window shows the client logging in with 'haLe0087' and 'hello'. The server responds with 'LOGIN:ACKSTATUS:0' and 'Welcome haLe0087'. The client then creates a room with 'CREATE:hahahahahahahahahahahahahahaha'. The server responds with 'CREATE:ACKSTATUS:1' and 'Error: Room hahahahahahahahahahahahahahaha is invalid'. The client then creates a room with 'CREATE:dog'. The server responds with 'CREATE:ACKSTATUS:0' and 'Successfully created room dog. Waiting for other players to join'.

- **Case 3:** Room created successfully; server prompts client to wait for another user.

The screenshot shows two terminal windows. The left window shows the server receiving 'LOGIN:haLe0087:hello' and 'CREATE:hahahahahahahahahahahahahahaha'. The right window shows the client logging in with 'haLe0087' and 'hello'. The server responds with 'LOGIN:ACKSTATUS:0' and 'Welcome haLe0087'. The client then creates a room with 'CREATE:hahahahahahahahahahahahahahaha'. The server responds with 'CREATE:ACKSTATUS:1' and 'Error: Room hahahahahahahahahahahahahahaha is invalid'. The client then creates a room with 'CREATE:dog'. The server responds with 'CREATE:ACKSTATUS:0' and 'Successfully created room dog. Waiting for other players to join'.

- **Case 4:** Attempt to create room before authentication, prompting **BADAUTH** from server.

```

Terminal Local x + v
~/Desktop/ass2_1112 git master !4
python3 server.py ./config/configfile.json
CREATE:dog

~/Desktop/ass2_1112 git master !4
python3 client.py 127.0.0.1 6502
CREATE
Enter the room name you want to create: dog
BADAUTH

```

- **Case 5:** Room creation with invalid format, tested with **nc**. Logged in, then tested multiple invalid formats; server responds with status **4** for each.

```

~/Desktop/ass2_1112 git master
nc 127.0.0.1 6502
LOGIN:bin:bin
LOGIN:ACKSTATUS:0
CREATE
CREATE:ACKSTATUS:4
CREATE:haha:hoho
CREATE:ACKSTATUS:4
CREATE:hehe:h1h1:haha
CREATE:ACKSTATUS:4

```

7. Room List Testing

- **Room List Cases:**

- **Case 1:** Invalid format. Client attempts to view list with unspecified mode (should be PLAYER or VIEWER only).

```

Terminal Local x + v
~/Desktop/ass2_1112 git master !4
python3 server.py ./config/configfile.json
LOGIN:hale0087:hello
ROOMLIST:I dont know

~/Desktop/ass2_1112 git master !4
python3 client.py 127.0.0.1 6502
LOGIN
Enter username: hale0087
Enter password: hello
LOGIN:ACKSTATUS:0
Welcome hale0087
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) I dont know
ROOMLIST:ACKSTATUS:1
Error: Please input a valid mode.

```

- **Case 2:** Request room list before authentication, receiving **BADAUTH** from server.

```

Terminal Local x + v
~/Desktop/ass2_1112 git master !4
python3 server.py ./config/configfile.json
ROOMLIST:PLAYER

~/Desktop/ass2_1112 git master !4
python3 client.py 127.0.0.1 6502
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) PLAYER
BADAUTH

```

- **Case 3:** Room list viewed successfully.

```

Terminal Local x + v
~/Desktop/ass2_1112 git master !4
LOGIN:Pierce Le:haha
ROOMLIST:PLAYER
["Sydney"]
ROOMLIST:VIEWER
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) PLAYER
ROOMLIST:ACKSTATUS:0:Sydney
Room available to join as PLAYER are:
Sydney

~/Desktop/ass2_1112 git master !4
LOGIN:ACKSTATUS:0
Welcome hale0087
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) I dont know
ROOMLIST:ACKSTATUS:1
Error: Please input a valid mode.
Create
Enter the room name you want to create: Sydney
CREATE:ACKSTATUS:0
Successfully created room Sydney. Waiting for other players to join.

```

```

Terminal Local x + v
LOGIN:Pierce Le:haha
ROOMLIST:PLAYER
['Sydney']
ROOMLIST:VIEWER
[]
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) VIEWER
ROOMLIST:ACKSTATUS:0:Sydney
Room available to join as VIEWER are:
Sydney

LOGIN:ACKSTATUS:0
Welcome hale0087
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) I dont know
ROOMLIST:ACKSTATUS:1
Error: Please input a valid mode.
Create
Enter the room name you want to create: Sydney
CREATE:ACKSTATUS:0
Successfully created room Sydney. Waiting for other players to join.

```

- **Case 4:** Room list sorted alphabetically.

```

Terminal Local x + v
CREATE:Vietnam
ROOMLIST:PLAYER
['Sydney', 'Vietnam']
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) PLAYER
ROOMLIST:ACKSTATUS:0:Sydney,Vietnam
Room available to join as PLAYER are:
Sydney
Vietnam

Create
Enter the room name you want to create: Sydney
CREATE:ACKSTATUS:0
Successfully created room Sydney. Waiting for other players to join.
CREATE
Enter the room name you want to create: Vietnam
CREATE:ACKSTATUS:0
Successfully created room Vietnam. Waiting for other players to join.

```

- **Case 5:** Room is full, so can only join as VIEWER. Setup with players to make room full.

```

ROOMLIST:PLAYER
['SOFT2412']
LOGIN:hehe:hehe
ROOMLIST:PLAYER
['SOFT2412']
JOIN:SOFT2412:PLAYER
ROOMLIST:PLAYER
[]
ROOMLIST:VIEWER
[]

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: Pierce Le
Enter password: haha
LOGIN:ACKSTATUS:0
Welcome Pierce Le
ROOMLIST
Do you want to have a room list as a player or viewer? (PLAYER/VIEWER) PLAYER
ROOMLIST:ACKSTATUS:0:SOFT2412
Room available to join as PLAYER are:
SOFT2412
JOIN
Please enter the room name you want to join: SOFT2412
Please enter the mode you want to join: PLAYER
JOIN:ACKSTATUS:0
Successfully joined room SOFT2412 as a PLAYER
BEGIN:hale0087:Pierce Le
Match between hale0087 and Pierce Le will commence, it is currently hale0087's turn.

Enter username: hale0087
Enter password: hello
LOGIN:ACKSTATUS:0
Welcome hale0087
CREATE
Enter the room name you want to create: SOFT2412
CREATE:ACKSTATUS:0
Successfully created room SOFT2412. Waiting for other players to join.
BEGIN:hale0087:Pierce Le
Match between hale0087 and Pierce Le will commence, it is currently hale0087's turn.

```

- **Case 6:** Room list request in invalid format using `nc`. Logged in, then tested multiple invalid formats; server responds with status `1` for each.

```

nc 127.0.0.1 6502
LOGIN:hale0087:hello
LOGIN:ACKSTATUS:0
ROOMLIST
ROOMLIST:ACKSTATUS:1
ROOMLIST:haha
ROOMLIST:ACKSTATUS:1
ROOMLIST:haha:hehe:hoho
ROOMLIST:ACKSTATUS:1

```

8. Join Testing (continued)

- **Join Room Cases:**

- **Case 4:** Attempt to join a non-existent room.

```
JOIN
Please enter the room name you want to join: hello
Please enter the mode you want to join: PLAYER
JOIN:ACKSTATUS:1
Error: No room named hello
JOIN
Please enter the room name you want to join: hello
Please enter the mode you want to join: VIEWER
JOIN:ACKSTATUS:1
Error: No room named hello
```

- **Case 5:** Attempt to join before authentication, receiving **BDAUTH** from the server.

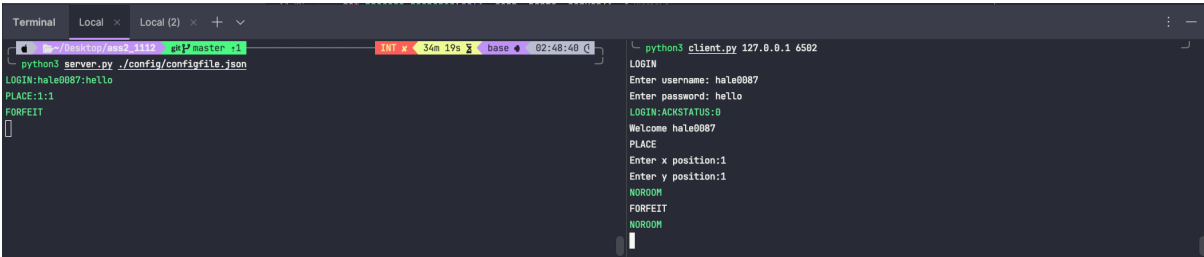
The screenshot shows two terminal windows. The left window is the server, running 'python3 server.py ./config/configfile.json'. It receives a 'JOIN:INF0112:PLAYER' message. The right window is the client, running 'python3 client.py 127.0.0.1 6502'. It prompts for a room name and mode, then receives a 'BDAUTH' message from the server.

- **Case 6:** Join room request in an invalid format. Tested using **nc**, with multiple invalid formats after logging in; server responds with status **1** for each.

The screenshot shows a netcat client session titled 'nc 127.0.0.1 6502'. The user is connected to a server at 127.0.0.1:6502. The session shows a successful login ('LOGIN:hale0087:hello', 'LOGIN:ACKSTATUS:0') followed by several invalid join requests. Each request is followed by a status '1' from the server, indicating an error. The requests are: 'JOIN', 'JOIN:ACKSTATUS:3', 'JOIN:haha', 'JOIN:ACKSTATUS:3', 'JOIN:haha:hehe:hoho', and 'JOIN:ACKSTATUS:3'.

9. Noroom Testing

- This test verifies that the client receives a **NOROOM** message if they attempt any room-related action without being in a room.

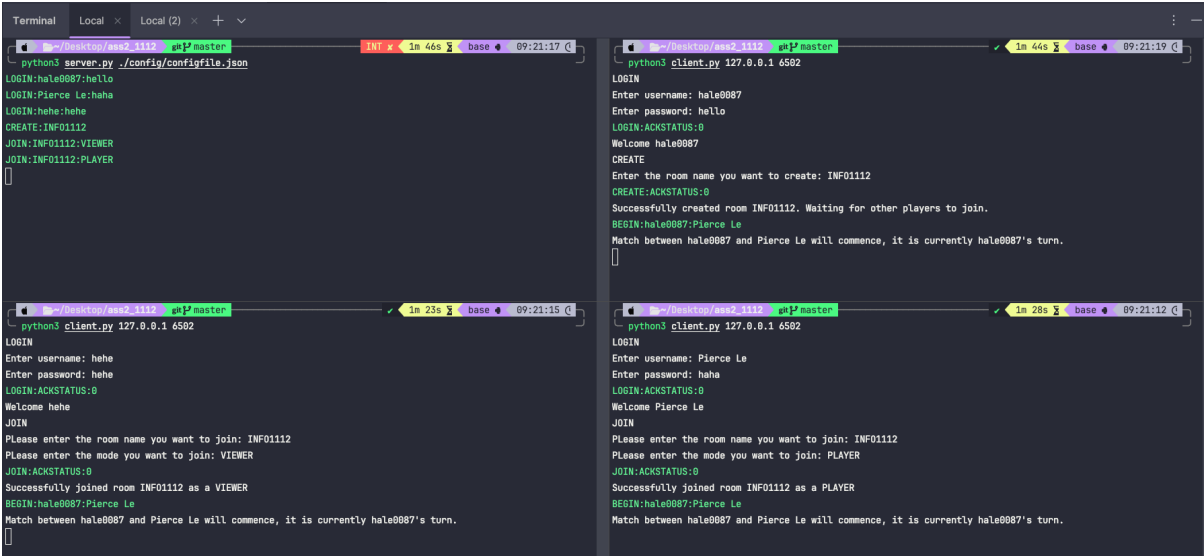


```
Terminal Local Local (2) +
python3 server.py ./config/configfile.json
LOGIN:haLe0087:hello
PLACE:1:1
FORFEIT

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: haLe0087
Enter password: hello
LOGIN:ACKSTATUS:0
Welcome haLe0087
PLACE
Enter x position:1
Enter y position:1
NOROOM
FORFEIT
NOROOM
```

10. Test BEGIN Message Delivery

- This test ensures that every client in a room (both viewers and players) receives the BEGIN message once the room has the required players and the game starts.



```
Terminal Local Local (2) +
python3 server.py ./config/configfile.json
LOGIN:haLe0087:hello
LOGIN:Pierce Le:haha
LOGIN:hehe:hehe
CREATE:INF0112
JOIN:INF0112:VIEWER
JOIN:INF0112:PLAYER

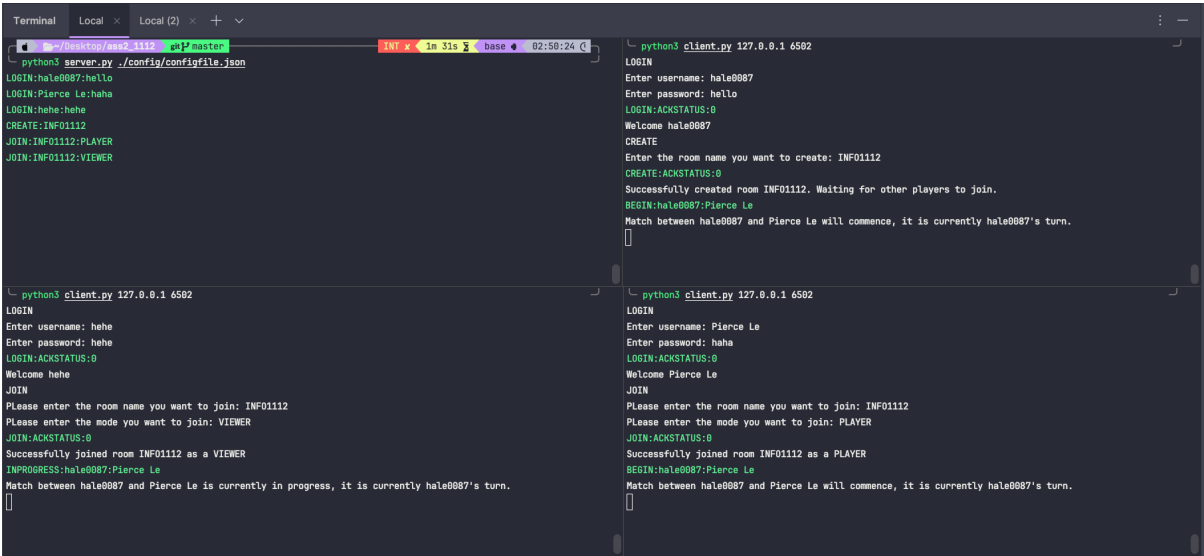
python3 client.py 127.0.0.1 6502
LOGIN
Enter username: haLe0087
Enter password: hello
LOGIN:ACKSTATUS:0
Welcome haLe0087
CREATE
Enter the room name you want to create: INF0112
CREATE:ACKSTATUS:0
Successfully created room INF0112. Waiting for other players to join.
BEGIN:haLe0087:Pierce Le
Match between haLe0087 and Pierce Le will commence, it is currently haLe0087's turn.

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: hehe
Enter password: hehe
LOGIN:ACKSTATUS:0
Welcome hehe
JOIN
Please enter the room name you want to join: INF0112
Please enter the mode you want to join: VIEWER
JOIN:ACKSTATUS:0
Successfully joined room INF0112 as a VIEWER
BEGIN:haLe0087:Pierce Le
Match between haLe0087 and Pierce Le will commence, it is currently haLe0087's turn.

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: Pierce Le
Enter password: haha
LOGIN:ACKSTATUS:0
Welcome Pierce Le
JOIN
Please enter the room name you want to join: INF0112
Please enter the mode you want to join: PLAYER
JOIN:ACKSTATUS:0
Successfully joined room INF0112 as a PLAYER
BEGIN:haLe0087:Pierce Le
Match between haLe0087 and Pierce Le will commence, it is currently haLe0087's turn.
```

11. INPROGRESS Message Test

- This test verifies that clients who join a room already in progress receive the INPROGRESS message. Specifically tested by joining as a VIEWER after the game has started.



```
Terminal Local Local (2) +
python3 server.py ./config/configfile.json
LOGIN:haLe0087:hello
LOGIN:Pierce Le:haha
LOGIN:hehe:hehe
CREATE:INF0112
JOIN:INF0112:PLAYER
JOIN:INF0112:VIEWER

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: haLe0087
Enter password: hello
LOGIN:ACKSTATUS:0
Welcome haLe0087
CREATE
Enter the room name you want to create: INF0112
CREATE:ACKSTATUS:0
Successfully created room INF0112. Waiting for other players to join.
BEGIN:haLe0087:Pierce Le
Match between haLe0087 and Pierce Le will commence, it is currently haLe0087's turn.

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: hehe
Enter password: hehe
LOGIN:ACKSTATUS:0
Welcome hehe
JOIN
Please enter the room name you want to join: INF0112
Please enter the mode you want to join: VIEWER
JOIN:ACKSTATUS:0
Successfully joined room INF0112 as a VIEWER
INPROGRESS:haLe0087:Pierce Le
Match between haLe0087 and Pierce Le is currently in progress, it is currently haLe0087's turn.

python3 client.py 127.0.0.1 6502
LOGIN
Enter username: Pierce Le
Enter password: haha
LOGIN:ACKSTATUS:0
Welcome Pierce Le
JOIN
Please enter the room name you want to join: INF0112
Please enter the mode you want to join: PLAYER
JOIN:ACKSTATUS:0
Successfully joined room INF0112 as a PLAYER
BEGIN:haLe0087:Pierce Le
Match between haLe0087 and Pierce Le will commence, it is currently haLe0087's turn.
```

12. In-Game Progress Testing

- In-Game Scenarios:

- **Case 1:** Player attempts to **PLACE** a coordinate outside the valid range **[0, 2]**. The program prompts the user until a valid coordinate is entered.

```

Terminal Local x Local (2) x + v
python3 server.py ./config/configfile.json
LOGIN:haLe0087:heLle
CREATE:INFO1112
LOGIN:hehe:hehe
JOIN:INFO1112:PLAYER

Enter the room name you want to create: INFO1112
CREATE:ACKSTATUS:0
Successfully created room INFO1112. Waiting for other players to join.
BEGIN:haLe0087:hehe
Match between haLe0087 and hehe will commence, it is currently haLe0087's turn.
PLACE
Enter x position:1
Error: Column values must be an integer between 0 and 2
Enter x position:1
Enter y position:1
Error: Row values must be an integer between 0 and 2
Enter y position:1
LOGIN
Enter username: hehe
Enter password: hehe
LOGIN:ACKSTATUS:0
Welcome hehe
JOIN
Please enter the room name you want to join: INFO1112
Please enter the mode you want to join: PLAYER
JOIN:ACKSTATUS:0
Successfully joined room INFO1112 as a PLAYER
BEGIN:haLe0087:hehe
Match between haLe0087 and hehe will commence, it is currently haLe0087's turn.

```

- **Case 2:** A player forfeits the game. All clients receive the correct **GAMEEND** message, with a message indicating that Pierce Le won due to opponent forfeiting.

```

Terminal Local x Local (2) x + v
python3 server.py ./config/configfile.json
LOGIN:haLe0087:hello
LOGIN:hehe:hehe
LOGIN:Pierce Le:hahe
CREATE:INFO1112
JOIN:INFO1112:PLAYER
JOIN:INFO1112:VIEWER
PLACE:1:1
FORFEIT

BEGIN:Pierce Le:haLe0087
Match between Pierce Le and haLe0087 will commence, it is currently Pierce Le's turn.
PLACE
Enter x position:1
Enter y position:1
BOARDSTATUS:000010000
| |
| |
| X |
| |
| |
Your opponent turn
GAMEEND:000010000:2:Pierce Le
Pierce Le won due to the opposing player forfeiting

BEGIN:Pierce Le:haLe0087
Match between Pierce Le and haLe0087 will commence, it is currently Pierce Le's turn.
BOARDSTATUS:000010000
| |
| |
| X |
| |
| |
Your turn now
FORFEIT
GAMEEND:000010000:2:Pierce Le
Pierce Le won due to the opposing player forfeiting
JOIN:ACKSTATUS:0
Successfully joined room INFO1112 as a VIEWER
INPROGRESS:Pierce Le:haLe0087
Match between Pierce Le and haLe0087 is currently in progress, it is currently Pierce Le's turn.
BOARDSTATUS:000010000
| |
| |
| X |
| |
| |
GAMEEND:000010000:2:Pierce Le
Pierce Le won due to the opposing player forfeiting

```

- **Case 3:** The game ends in a draw. The server sends **GAMEEND** to all clients in the room, with a message that the game ended in a draw.

Case 4: Normal game progression, followed by typical actions like **ROOMLIST** after the game ends. After **GAMEEND**, clients can proceed as usual, such as viewing the **ROOMLIST**, though it may be empty if no rooms are active.

Case 5: Players are allowed to make pre-moves. While Pierce Le waits for the opponent to **PLACE**, he is also able to prepare and submit his next **PLACE**.

TerminalLocalLocal (2) + -

python3 server.py ./config/configfile.json

LOGIN:Pierce Le:haha

CREATE:INFO1112

LOGIN:hehe:hehe

JOIN:VIEWER:d

JOIN:INFO1112:VIEWER

LOGIN:hale0087:hello

JOIN:INFO1112:PLAYER

PLACE:1:1

PLACE:0:0

PLACE:1:0

]

CREATE:ACKSTATUS:0

Successfully created room INFO1112. Waiting for other players to join.

BEGIN:Pierce Le:hale0087

Match between Pierce Le and hale0087 will commence, it is currently Pierce Le's turn.

PLACE

Enter x position:1

Enter y position:1

BOARDSTATUS:000010000

| |

| X |

| |

Your opponent turn

PLACE

Enter x position:0

Enter y position:0

BOARDSTATUS:020010000

| 0 |

| X |

| |

Your turn now

PLACE

Enter x position:1

Enter y position:0

BOARDSTATUS:020010000

| 0 |

| X |

| |

Enter password: hehe

LOGIN:ACKSTATUS:0

Welcome hehe

JOIN

Please enter the room name you want to join: VIEWER

Please enter the mode you want to join: d

JOIN:ACKSTATUS:3

Error: Invalid message format of JOIN

JOIN

Please enter the room name you want to join: INFO1112

Please enter the mode you want to join: VIEWER

JOIN:ACKSTATUS:0

Successfully joined room INFO1112 as a VIEWER

BEGIN:Pierce Le:hale0087

BEGIN:Pierce Le:hale0087

Match between Pierce Le and hale0087 will commence, it is currently Pierce Le's turn.

BOARDSTATUS:000010000

| |

| X |

| |

Your turn now

PLACE

Enter x position:1

Enter y position:0

BOARDSTATUS:020010000

| 0 |

| X |

| |

- **Case 6:** Normal game progression with one player winning. The correct output is displayed for both the winner, loser, and any viewers in the room.

TerminalLocalLocal (2) + -

LOGIN:Pierce Le:haha

CREATE:INFO1112

LOGIN:hehe:hehe

JOIN:VIEWER:d

JOIN:INFO1112:VIEWER

LOGIN:hale0087:hello

JOIN:INFO1112:PLAYER

PLACE:1:1

PLACE:0:0

PLACE:1:0

PLACE:1:2

PLACE:2:2

]

X | 0 |

| X |

| |

Your opponent turn

BOARDSTATUS:120010020

X | 0 |

| X |

| 0 |

Your turn now

PLACE

Enter x position:2

Enter y position:2

GAMEEND:120010021:0:Pierce Le

Congratulations, you won!

]

X | 0 |

| X |

| |

BOARDSTATUS:120010020

X | 0 |

| X |

| 0 |

GAMEEND:120010021:0:Pierce Le

Pierce Le has won this game

]

Your turn now

PLACE

Enter x position:1

Enter y position:2

BOARDSTATUS:120010020

X | 0 |

| X |

| 0 |

Your opponent turn

GAMEEND:120010021:0:Pierce Le

Sorry you lost. Good luck next time

]