

Introduction to Next-Generation Wireless Network - HW3

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專案概述

- 以Python編寫server.py和client.py，透過TCP socket和threading的機制在本地端建立多人聊天室，提供最高5位用戶同時聊天。

測試報告

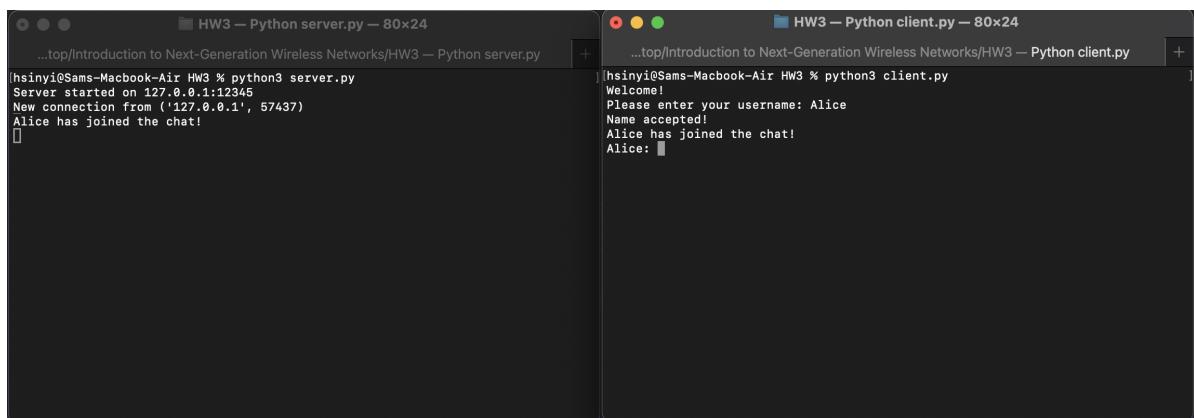
步驟 1：啟動伺服器和客戶端，測試用戶名註冊與連線狀態

1. 啟動server，顯示IP和Port。



```
[hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
```

2. 啟動 Alice 客戶端，輸入用戶名 Alice



```
[hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
```

```
[hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Alice:
```

3. 啟動 Bob 和 Charlie 客戶端，分別輸入用戶名

- 其他用戶端皆收到新用戶加入通知
- Server顯示新連線資訊

```

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python server.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
New connection from ('127.0.0.1', 57460)
Bob has joined the chat!
New connection from ('127.0.0.1', 57462)
Charlie has joined the chat!
Alice: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Bob
Name accepted!
Bob has joined the chat!
Charlie has joined the chat!
Bob: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Charlie
Name accepted!
Charlie has joined the chat!
Charlie: []

```

步驟 2：測試訊息傳遞與廣播格式

- 在 Alice 客戶端輸入訊息 Hi everyone!

```

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python server.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
New connection from ('127.0.0.1', 57460)
Bob has joined the chat!
New connection from ('127.0.0.1', 57462)
Charlie has joined the chat!
Alice sent: Hi everyone!
Alice: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Alice: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Bob
Name accepted!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py - 80x24
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Charlie
Name accepted!
Charlie has joined the chat!
Alice: Hi everyone!
Charlie: []

```

2. 在 Bob 客戶端輸入訊息 Hello Alice!

The image shows four terminal windows side-by-side. The top-left window (server) shows the server starting and accepting connections from Alice, Bob, and Charlie. The top-right window (client for Alice) shows Alice joining the chat and sending 'Hello Alice!'. The bottom-left window (client for Bob) shows Bob joining and sending 'Hello Alice!'. The bottom-right window (client for Charlie) shows Charlie joining and sending 'Hello Alice!'. All clients respond with 'Alice: []' at the end.

```
...top/Introduction to Next-Generation Wireless Networks/HW3 - Python server.py
hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
New connection from ('127.0.0.1', 57460)
Bob has joined the chat!
New connection from ('127.0.0.1', 57462)
Charlie has joined the chat!
Alice sent: Hi everyone!
Bob sent: Hello Alice!
Charlie sent: Hello Alice!
Alice: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
Charlie: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Bob
Name accepted!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
Charlie: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Charlie
Name accepted!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
Charlie: []
```

步驟 3：測試最大連線數限制、名稱不可重複

1. David 客戶端嘗試輸入用戶名 Alice（已被使用）

- 嘗試以Alice為用戶名加入

The image shows three terminal windows. The left window (server) shows a new connection from Alice. The middle window (client for Alice) fails to register because the name 'Alice' is already in use, displaying an error message. The right window (client for Bob) successfully registers and sends 'Hello Alice!'.

```
...top/Introduction to Next-Generation Wireless Networks/HW3 - Python server.py
hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Charlie has joined the chat!
[Restored Dec 13, 2024 at 8:37:46 PM]
Last login: Fri Dec 13 13:36:21 on ttys009
/Users/hsinyi/zprofile:6: command not found: `eval
/Users/hsinyi/zprofile:7: command not found: `eval
/Users/hsinyi/zprofile:7: command not found: `eval
/Users/hsinyi/zprofile:7: command not found: `eval
/Users/hsinyi/zprofile:export:13: not valid in this context: /opt/wabt
Restored session: Fri Dec 13 13:36:51 CST 2024
hsinyi@Sams-Macbook-Air HW3 % clear

hsinyi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
New connection from ('127.0.0.1', 57460)
Bob has joined the chat!
New connection from ('127.0.0.1', 57462)
Charlie has joined the chat!
Alice sent: Hi everyone!
Bob sent: Hello Alice!
Charlie sent: Hello Alice!
Alice: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
Charlie: []

...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py
hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name already in use. Please enter a different name.
Please enter your username: []
```

- 以David為用戶名加入

```

[...]
Last login: Fri Dec 13 13:36:21 on ttys009
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 server.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
Charlie: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Alice
Name already in use. Please enter a different name.
Please enter your username: David
Name accepted!
David has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 - zsh - 80x24
[...]
bind not found: '
and not found: 'eval
and not found: '
and not found: '
and not found: '
l3: not valid in this context: /opt/wabt
silent.py
:|
or a different name.
id
[...]
[...]

```

2. Eve 客戶端輸入用戶名 Eve

```

[...]
Last login: Fri Dec 13 13:36:21 on ttys009
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 server.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
Charlie: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Bob has joined the chat!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: has joined the chat!
Alice: [...]
[...]
hshinyi@Sams-Macbook-Air HW3 % python3 client.py
[...]
Welcome!
Please enter your username: Eve
Name accepted!
Eve has joined the chat!
Bob: [...]
[...]

```

3. 啟動第 6 個客戶端，輸入用戶名

```
[...top/Introduction to Next-Generation Wireless Networks/HW3 - Python server.py]
[...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py]
[...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py]

[User@hainy1:~/zsh-profile]$ command not found: 'eval'
[User@hainy1:~/zsh-profile]$ command not found: '
[User@hainy1:~/zsh-profile$ export13: not valid in this context: /opt/wabt
Restored session: Fri Dec 13 13:36:51 CST 2024
[hainy@Sams-Macbook-Air HW3 % clear

[hainy@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:12345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
Bob has joined the chat!
Bob has joined the chat!
New connection from ('127.0.0.1', 57440)
Charlie has joined the chat!
Alice sent: Hi everyone!
Alice sent: Hello Alice!
New connection from ('127.0.0.1', 57428)
David has joined the chat!
New connection from ('127.0.0.1', 57567)
Eve has joined the chat!
Connection attempt from ('127.0.0.1', 57609) rejected: Maximum connections reached.
[]

[...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py]
[...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py]
[...top/Introduction to Next-Generation Wireless Networks/HW3 - Python client.py]

[hainy@Sams-Macbook-Air HW3 - zsh - 80x24
[...top/Introduction to Next-Generation Wireless Networks/HW3 - zsh
[hainy@Sams-Macbook-Air HW3 % python3 client.py
client.py
different name.

[hainy@Sams-Macbook-Air HW3 % ]'

[hainy@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Bob
Name accepted!
Bob has joined the chat!
Alice has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David has joined the chat!
Eve has joined the chat!
Bob: []

[hainy@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Charlie
Name accepted!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David has joined the chat!
Eve has joined the chat!
Charlie: []

[hainy@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Eve
Name accepted!
Eve has joined the chat!
Eve: []
```

步驟 4：測試退出指令與狀態更新、測試歷史訊息不可見性

1. 在 Charlie 客戶端輸入 exit

```
...top/Introduction to Next-Generation Wireless Networks/HW3 -- Python server.py + HW3 -- Python server.py - 80x24
...top/Introduction to Next-Generation Wireless Networks/HW3 -- Python server.py + HW3 -- Python client.py - 80x24
...top/Introduction to Next-Generation Wireless Networks/HW3 -- Python client.py + HW3 -- Python client.py - 80x24
...top/Introduction to Next-Generation Wireless Networks/HW3 -- Python client.py + HW3 -- zsh - 80x24
...top/Introduction to Next-Generation Wireless Networks/HW3 -- zsh + Python client.py - 80x24
...top/Introduction to Next-Generation Wireless Networks/HW3 -- Python client.py + Python client.py - 80x24

hsinyi@Sams-Macbook-Air:~/Desktop$ python3 server.py
[...]
hsinyi@Sams-Macbook-Air:~/Desktop$ python3 client.py
[...]
hsinyi@Sams-Macbook-Air:~/Desktop$ python3 client.py
[...]
```

2. 啟動新客戶端，輸入用戶名 Charlie，確認伺服器允許重新註冊。

```

...top/Introduction to Next-Generation Wireless Networks/HW3 — Python server.py
/hsinvi@Sams-Macbook-Air:~/Desktop$ python3 server.py
Restored session: Fri Dec 13 13:36:51 CST 2024
[hsinyi@Sams-Macbook-Air HW3 % clear

(hsinvi@Sams-Macbook-Air HW3 % python3 server.py
Server started on 127.0.0.1:2345
New connection from ('127.0.0.1', 57437)
Alice has joined the chat!
New connection from ('127.0.0.1', 57462)
Bob has joined the chat!
Charlie has joined the chat!
Charlie has joined the chat!
Alice says: Hi everyone!
Bob says: Hello Alice!
New connection from ('127.0.0.1', 57528)
David has joined the chat!
New connection from ('127.0.0.1', 57867)
Eve has joined the chat!
Connection attempt from ('127.0.0.1', 57609) rejected: Maximum connections reached.
Charlie has left the chat.
New connection from ('127.0.0.1', 57637)
Charlie has joined the chat!
[hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Alice
Name accepted!
Alice has joined the chat!
Charlie has joined the chat!
David has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: Hello Alice!
Eve: Hello Alice!
Charlie: Hello Alice!
Alice: Eve, can you help me?
Bob: Sure, what's the problem?
Charlie: I'm having trouble connecting to the server.
David: No problem, let me check.
Eve: I think it might be a connection issue.
Alice: Thank you all for your help!
Bob: You're welcome!
Charlie: I appreciate it!
David: Glad to help!
Eve: Let's keep in touch!
Alice: See you later!
Bob: Bye!
Charlie: Bye!
David: Bye!
Eve: Bye!
Alice: 
[hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: David
Name already in use. Please enter a different name.
Please enter your username: David
Name accepted!
David has joined the chat!
Eve has joined the chat!
Charlie: Hello Alice!
Alice: Hi everyone!
Bob: Hello Alice!
David: Hello Alice!
Eve: Hello Alice!
Charlie: Hello Alice!
Alice: Eve, can you help me?
Bob: Sure, what's the problem?
Charlie: I'm having trouble connecting to the server.
David: No problem, let me check.
Eve: I think it might be a connection issue.
Alice: Thank you all for your help!
Bob: You're welcome!
Charlie: I appreciate it!
David: Glad to help!
Eve: Let's keep in touch!
Alice: See you later!
Bob: Bye!
Charlie: Bye!
David: Bye!
Eve: Bye!
Alice: 
[hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Eve
Name accepted!
Eve has joined the chat!
Charlie has left the chat!
Charlie has joined the chat!
David: 
[hsinyi@Sams-Macbook-Air HW3 % python3 client.py
Welcome!
Please enter your username: Charlie
Name accepted!
Charlie has joined the chat!
Alice: Hi everyone!
Bob: Hello Alice!
David: Hello Alice!
Eve: Hello Alice!
Charlie: Hello Alice!
Alice: Eve, can you help me?
Bob: Sure, what's the problem?
Charlie: I'm having trouble connecting to the server.
David: No problem, let me check.
Eve: I think it might be a connection issue.
Alice: Thank you all for your help!
Bob: You're welcome!
Charlie: I appreciate it!
David: Glad to help!
Eve: Let's keep in touch!
Alice: See you later!
Bob: Bye!
Charlie: Bye!
David: Bye!
Eve: Bye!
Alice: 

```

程式碼解釋 - server.py

1. Import



2. 類別與全域變數

- Clients**：用於儲存所有已連接用戶資訊。
- MAX_CLIENTS**：限制伺服器同時連接的用戶數量上限為 5。

```
1 class Server:  
2     Clients = []  
3     MAX_CLIENTS = 5
```

3. 初始化server

- `socket.AF_INET` : IPv4 協議。
- 允許port重複使用，避免程式結束後，port被占用無法重新啟動server。
- 綁定IP和PORT，如127.0.0.1:12345。
- 設定最大連接數為5。
- 註冊關機信號：當接收到 `SIGINT` 信號（如按下 `Ctrl+C`），會執行 `shutdown` 方法。

```
1 def __init__(self, HOST, PORT):  
2     self.socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)  
3     self.socket.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)  
4     self.socket.bind((HOST, PORT))  
5     self.socket.listen(self.MAX_CLIENTS)  
6     print(f"Server started on {HOST}:{PORT}")  
7     signal.signal(signal.SIGINT, self.shutdown)
```

4. 關機處理 (`shutdown`)

- 廣播server關閉訊息，關閉所有的用戶連線。

```
● ● ●  
1 def shutdown(self, signum, frame):  
2     print("\nShutting down the server...")  
3     for client in Server.Clients:  
4         client["client_socket"].close()  
5     self.socket.close()  
6     sys.exit(0)
```

5. 用戶名稱檢查 (`is_name_unique`)

- 如果名稱已存在於 `clients` 中，返回 `False`；否則返回 `True`。

```
● ● ●  
1 def is_name_unique(self, name):  
2     return all(client["client_name"] != name for client in self.Clients)
```

6. 飼服器主迴圈 (`listen`)

- 如果當前連線數量已達上限，拒絕新連線並發送提示訊息。
- 接收用戶端傳來的名稱，若名稱唯一則允許連線，否則要求重新輸入。
- 若成功加入則在server顯示用戶名和成功加入資訊，並廣播給當前聊天室中用戶。

- 為每位連接用戶啟動新的thread處理訊息。



```

1  def listen(self):
2      while True:
3          client_socket, client_address = self.socket.accept()
4
5          if len(self.Clients) >= self.MAX_CLIENTS:
6              print(f"Connection attempt from {client_address} rejected: Maximum connections reached.")
7              client_socket.send("Unable to connect: Maximum connections reached.".encode())
8              client_socket.close()
9              continue # Keep listening for other connections
10
11         print(f"New connection from {client_address}")
12         client_socket.send("Welcome!".encode())
13
14     # Validate username
15     while True:
16         try:
17             client_name = client_socket.recv(1024).decode()
18             if self.is_name_unique(client_name):
19                 client_socket.send("Name accepted!".encode())
20                 break
21             else:
22                 client_socket.send("Name already in use. Please enter a different name.".encode())
23         except socket.error:
24             print(f"Error receiving username from {client_address}.")
25             client_socket.close()
26             return
27
28     client = {"client_name": client_name, "client_socket": client_socket}
29     print(f"{client_name} has joined the chat!")
30     self.broadcast_message(client_name, f"{client_name} has joined the chat!")
31     self.Clients.append(client)
32     Thread(target=self.handle_client, args=(client,)).start()

```

7. 用戶訊息處理 (`handle_client`)

- 從用戶端接收訊息並進行處理。
- 如果用戶傳送訊息 `exit`，廣播離開訊息並移除用戶。
- 如果用戶傳送非 `exit` 訊息，則將訊息加上發送訊息用戶名稱，廣播給所有用戶。

```
1 def handle_client(self, client):
2     client_name = client["client_name"]
3     client_socket = client["client_socket"]
4
5     while True:
6         try:
7             message = client_socket.recv(1024).decode()
8             if not message: # Handle case where the client disconnects without sending 'exit'
9                 raise ConnectionResetError
10
11            if message.strip().lower() == "exit":
12                self.broadcast_message(client_name, f"{client_name} has left the chat!")
13                print(f"{client_name} has left the chat.")
14                self.Clients.remove(client)
15                client_socket.close()
16                break # Exit the loop and stop handling this client
17            else:
18                # Prepend the username to the message
19                formatted_message = f"{client_name}: {message}"
20                # Alice sent: Hi everyone!
21                print(f"{client_name} sent: {message}")
22                self.broadcast_message(client_name, formatted_message)
23        except (ConnectionResetError, BrokenPipeError, OSError):
24            # Handle cases where the connection is forcibly closed
25            print(f"{client_name} has disconnected unexpectedly.")
26            self.Clients.remove(client)
27            client_socket.close()
28            break # Exit the loop and stop handling this client
```

8. 廣播訊息 (`broadcast_message`)

- 將訊息發送給所有連線用戶，包含訊息的發送者。

```
1 def broadcast_message(self, sender_name, message):
2     for client in self.Clients:
3         # if client["client_name"] != sender_name:
4             client["client_socket"].send(message.encode())
```

9. 啟動Server

- 設定server IP與port。
- 進入主迴圈，等待用戶端連線。



```
1 if __name__ == "__main__":
2     server = Server("127.0.0.1", 12345)
3     server.listen()
```

程式碼解釋 - client.py

1. Import

```
1 import socket  
2 from threading import Thread  
3 import os  
4 import sys
```

2. client初始化 (`__init__`)

- 初始化用戶端的 TCP 連線。
- 嘗試連線至server (HOST, PORT)
 - 若伺服器回應"Unable to connect"，用戶端會關閉socket並結束，否則顯示訊息並繼續。

```
1 class Client:
2     def __init__(self, HOST, PORT):
3         self.socket = socket.socket()
4     try:
5         self.socket.connect((HOST, PORT))
6         server_response = self.socket.recv(1024).decode()
7         if "Unable to connect" in server_response:
8             print(server_response)
9             self.socket.close()
10            os._exit(0)
11        print(server_response) # Server's welcome message
12    except ConnectionRefusedError:
13        print("Unable to connect to the server.")
14        sys.exit(0)
```

3. 驗證用戶名稱

- 用戶輸入名稱發送給server
- 若名稱唯一，伺服器回應“Name accepted”，進入聊天室。
 - server顯示使用者已加入聊天室
 - 開設新的thread用於接收訊息
 - 主thread用於發送訊息
- 若名稱已被使用，伺服器回應錯誤訊息，用戶需重新輸入。

```
1 # Send and validate username
2 while True:
3     self.name = input("Please enter your username: ")
4     self.socket.send(self.name.encode())
5     response = self.socket.recv(1024).decode()
6     if "Name accepted!" in response:
7         print(response)
8         break
9     print(response)
10
11 print(f"{self.name} has joined the chat!")
12 Thread(target=self.receive_message).start()
13 self.send_message()
```

4. 傳送訊息 (`send_message`)

- 用戶輸入訊息後，訊息會即時發送至server。
- 若用戶輸入 `exit`，發送退出指令給server，並結束程式。
- 每次發送訊息後清除上一行輸入內容，避免回顯。

```
1 def send_message(self):
2     while True:
3         # Display the prompt dynamically
4         sys.stdout.write(f"{self.name}: ")
5         sys.stdout.flush()
6         message = input()
7
8         if message.strip().lower() == "exit":
9             self.socket.send("exit".encode())
10            print("You left the chat.\nDisconnected from server.")
11            os._exit(0)
12
13         # Send the plain message to the server
14         self.socket.send(message.encode())
15
16         # Clear the input line after sending the message
17         sys.stdout.write("\033[F\033[K") # Move up and clear line
18         sys.stdout.flush()
```

5. 接收訊息 (`receive_message`)

- 持續接收伺服器傳來的訊息並即時顯示。
- 清除並重新顯示提示，當接收到訊息時，清除當前輸入行並顯示server訊息。
- 隨後重新顯示用戶的提示行 (`<用户名>:`) 。

```
● ● ●  
1 def receive_message(self):  
2     while True:  
3         try:  
4             server_message = self.socket.recv(1024).decode()  
5             if not server_message:  
6                 raise ConnectionResetError  
7             # Clear the current input line, display server message, and re-prompt  
8             sys.stdout.write("\r\033[K") # Clear the current line  
9             sys.stdout.write(f"{server_message}\n") # Print server message  
10            sys.stdout.write(f"{self.name}: ") # Re-display prompt  
11            sys.stdout.flush()  
12        except (ConnectionResetError, OSError):  
13            print("Disconnected from server.")  
14            os._exit(0)
```

6. 啟動client

- 透過server IP與Port建立連線。

```
● ● ●  
1 if __name__ == "__main__":  
2     Client("127.0.0.1", 12345)  
3
```