

LAPORAN PRAKTIKUM PEMROGRAMAN JARINGAN



Disusun oleh:

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MATA KULIAH : PEMROGRAMAN JARINGAN

**FAKULTAS ILMU KOMPUTER
PROGRAM STUDI TEKNIK INFORMATIKA
UNIVERSITAS INDONESIA TIMUR
MAKASSAR
2026**

BAB I

KONSEP DASAR PEMOGRAMAN JARINGAN

Pemograman jaringan adalah proses pembuatan aplikasi yang memungkinkan komputer atau perangkat lain saling berkomunikasi melalui jaringan.

HASIL:

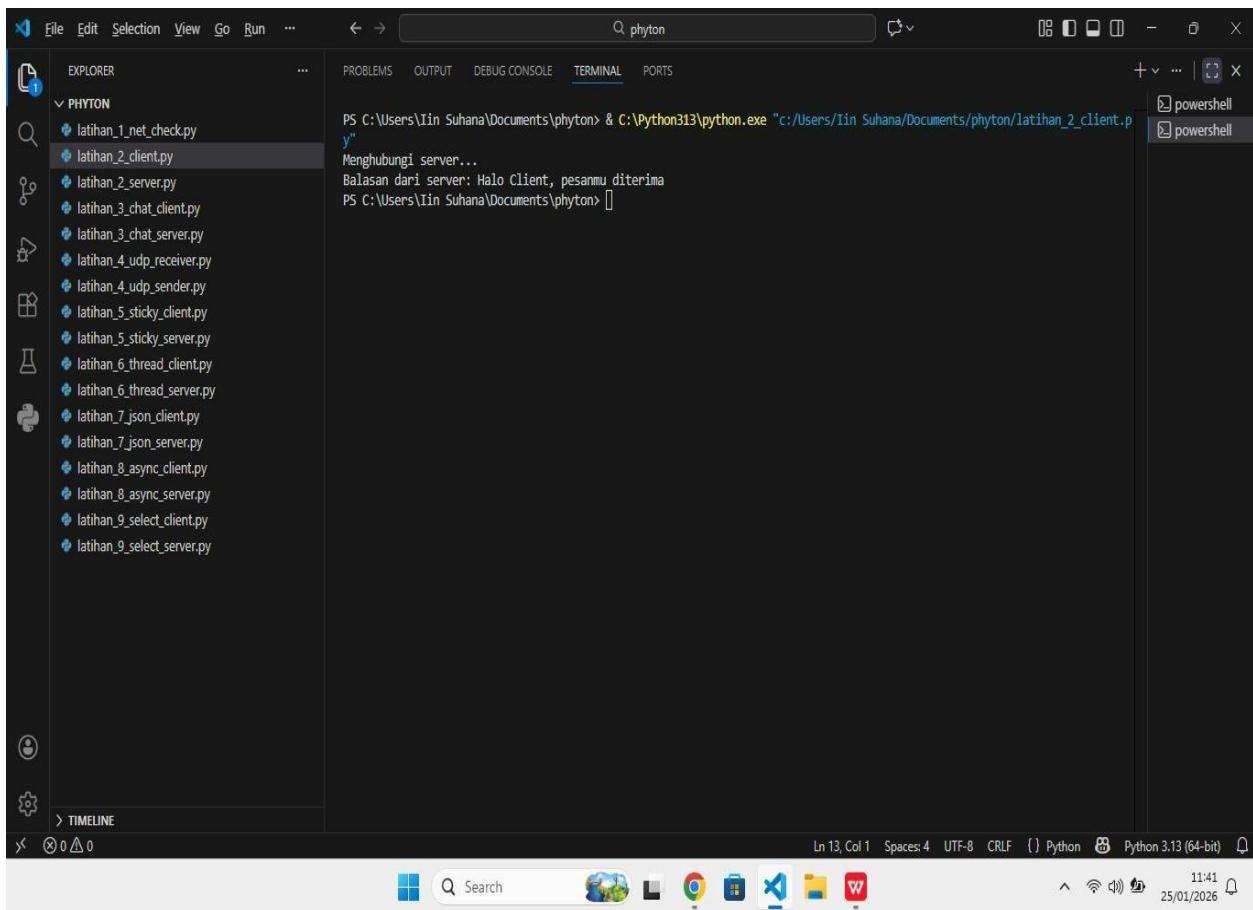
```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_1_net_check.py"
*** Network Information Tool ***
Hostname : DESKTOP-HHJA5SU
IP Address: 192.168.56.1
PS C:\Users\Iin Suhana\Documents\phyton>
```

BAB II

SOCKET API DASAR

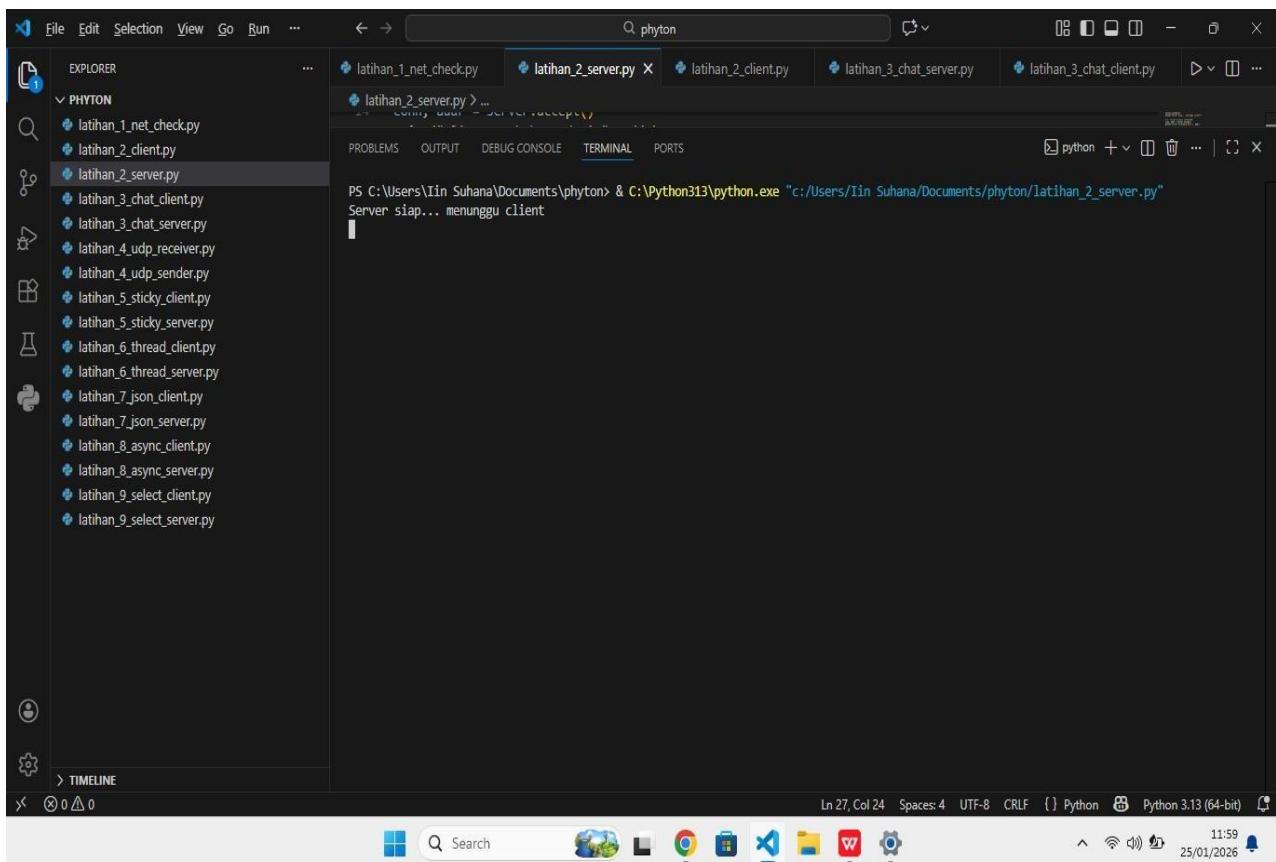
Socket adalah titik akhir komunikasi yang digunakan oleh aplikasi untuk mengirim dan menerima data melalui jaringan. Socket menjadi penghubung antara aplikasi dan protokol jaringan.

Hasil:



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows a folder named "PHYTON" containing several Python files: latihan_1_net_check.py, latihan_2_client.py, latihan_2_server.py, latihan_3_chat_client.py, latihan_3_chat_server.py, latihan_4_udp_receiver.py, latihan_4_udp_sender.py, latihan_5_sticky_client.py, latihan_5_sticky_server.py, latihan_6_thread_client.py, latihan_6_thread_server.py, latihan_7_json_client.py, latihan_7_json_server.py, latihan_8_async_client.py, latihan_8_async_server.py, latihan_9_select_client.py, and latihan_9_select_server.py.
- Terminal:** Displays the command PS C:\Users\Iin Suhana\Documents\phyton & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_2_client.py". The output shows the client connecting to the server and receiving the message "Balasan dari server: Halo Client, pesanmu diterima".
- Status Bar:** Shows the current file path as C:\Users\Iin Suhana\Documents\phyton\latihan_2_client.py, line 13, column 1, and other settings like spaces: 4, UTF-8, CRLF, Python 3.13 (64-bit).
- Taskbar:** Shows icons for various applications including File Explorer, Task View, Google Chrome, Microsoft Edge, and VS Code.

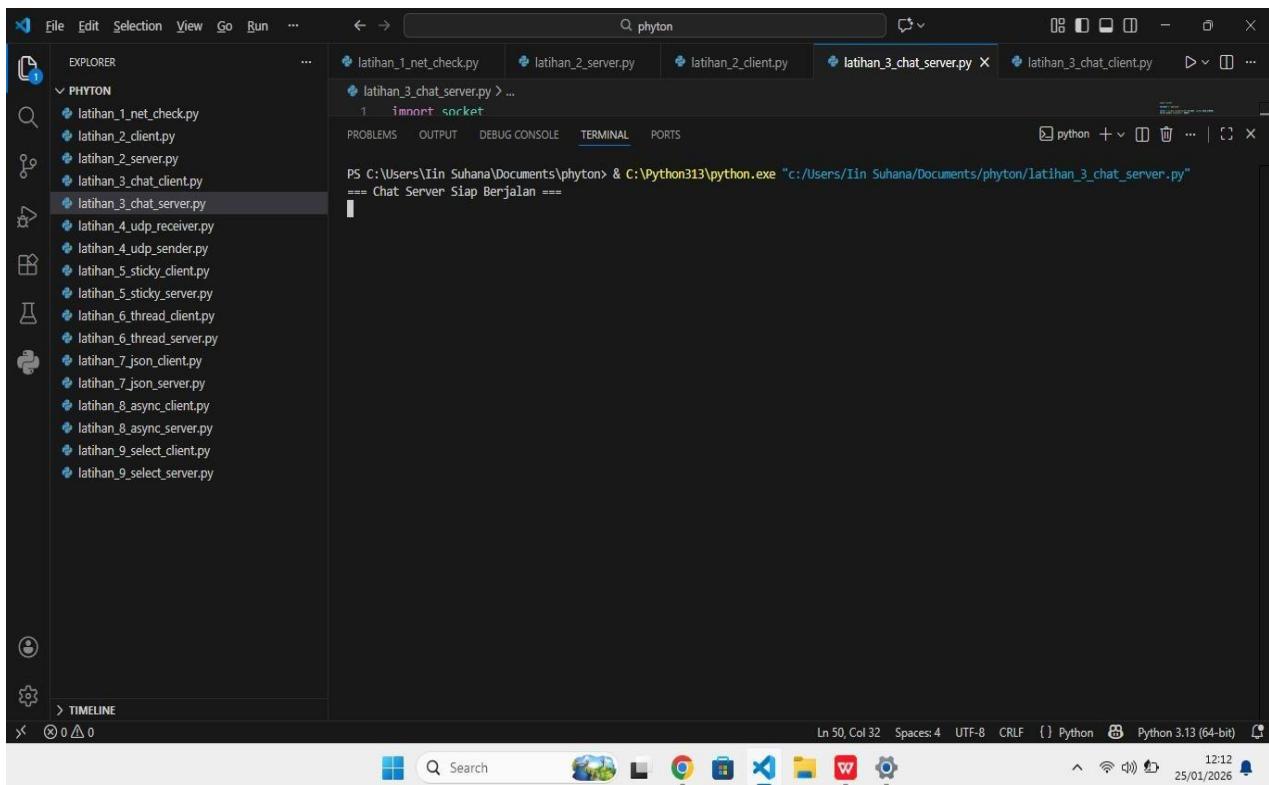


BAB IV

PROTOKOL TCP (APLIKASI CHAT)

TCP (Transmission Control Protocol) adalah protokol komunikasi yang bersifat andal dan berorientasi koneksi. TCP memastikan data sampai ke tujuan tanpa kehilangan dan dalam urutan yang benar.

HASIL:



The screenshot shows the Visual Studio Code (VS Code) interface. The left sidebar (EXPLORER) lists several Python files under the 'PHYTON' folder, including 'latihan_1_net_check.py', 'latihan_2_server.py', 'latihan_2_client.py', 'latihan_3_chat_server.py', 'latihan_3_chat_client.py', 'latihan_4_udp_receiver.py', 'latihan_4_udp_sender.py', 'latihan_5_sticky_client.py', 'latihan_5_sticky_server.py', 'latihan_6_thread_client.py', 'latihan_6_thread_server.py', 'latihan_7_json_client.py', 'latihan_7_json_server.py', 'latihan_8_async_client.py', 'latihan_8_async_server.py', 'latihan_9_select_client.py', and 'latihan_9_select_server.py'. The 'latihan_3_chat_server.py' file is currently selected. The right side of the screen shows the terminal window with the following output:

```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_3_chat_server.py"
== Chat Server Siap Berjalan ==
```

The terminal also shows the current working directory as 'C:\Users\Iin Suhana\Documents\phyton' and the command used to run the script. The status bar at the bottom indicates the file has 50 lines, 32 columns, and 4 spaces, and is using UTF-8 encoding. It also shows the Python version as 3.13 (64-bit).

The screenshot shows a Microsoft Visual Studio Code (VS Code) interface. The left sidebar displays a file tree under the 'EXPLORER' tab, with a section for 'PHYTON' containing files like 'latihan_1_net_check.py', 'latihan_2_client.py', 'latihan_2_server.py', 'latihan_3_chat_client.py' (which is selected), 'latihan_3_chat_server.py', 'latihan_4_udp_receiver.py', 'latihan_4_udp_sender.py', 'latihan_5_sticky_client.py', 'latihan_5_sticky_server.py', 'latihan_6_thread_client.py', 'latihan_6_thread_server.py', 'latihan_7_json_client.py', 'latihan_7_json_server.py', 'latihan_8_async_client.py', 'latihan_8_async_server.py', 'latihan_9_select_client.py', and 'latihan_9_select_server.py'. The main workspace is a terminal window titled 'python' with the following content:

```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_3_chat_client.py"
Masukkan password:
Password > admin123
Password benar. Selamat datang di chat!

Client > hai
Server > C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_3_chat_client.py"
Client > bye
*** Client Ditutup ***
PS C:\Users\Iin Suhana\Documents\phyton>
```

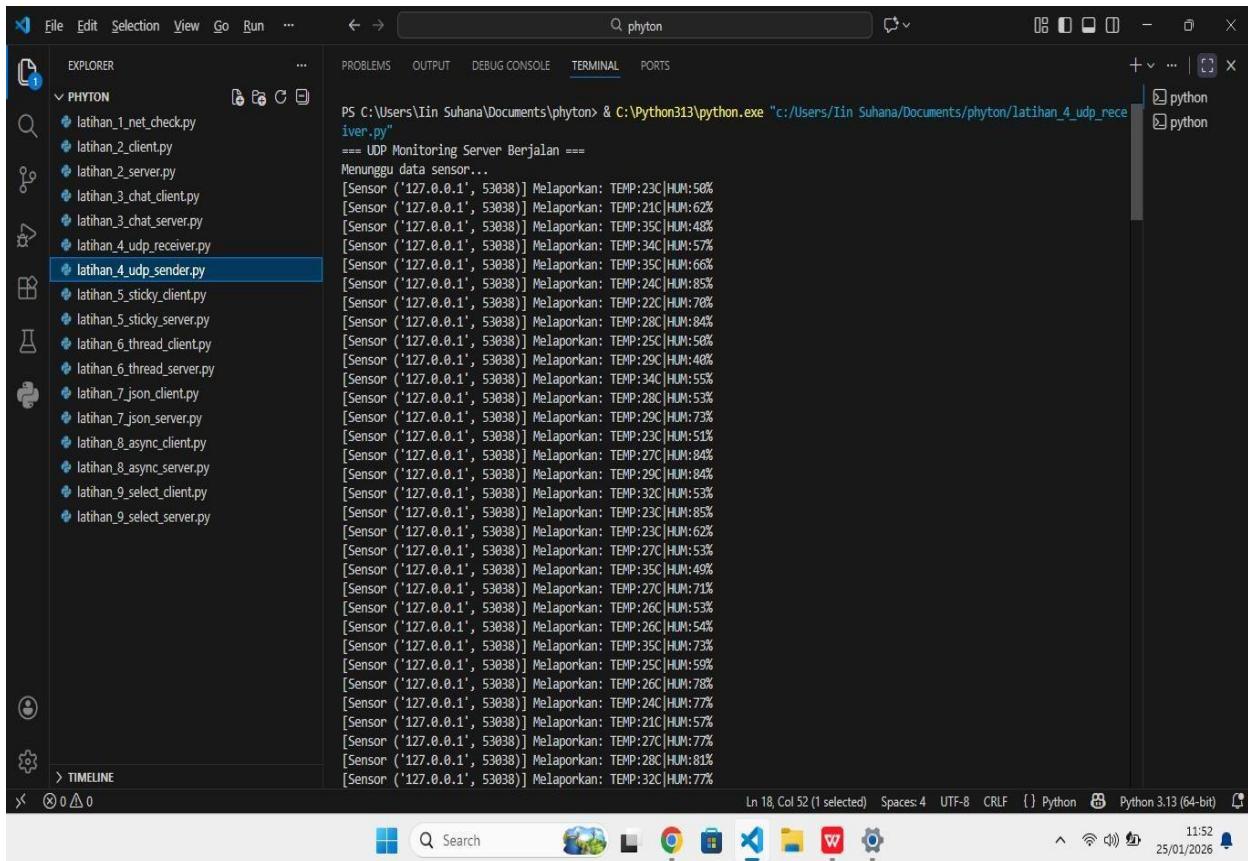
The status bar at the bottom indicates the terminal has 17 lines, 24 columns, 4 spaces, and is using UTF-8 encoding. It also shows 'Python 3.13 (64-bit)' and the date '25/01/2026'.

BAB IV

PROTOKOL UDP (STREAMING & BROADCASTING)

UDP (User Datagram Protocol) adalah protokol komunikasi jaringan yang tidak berorientasi koneksi. Artinya, UDP tidak membangun koneksi terlebih dahulu sebelum mengirim data. Data dikirim dalam bentuk paket tanpa jaminan apakah paket tersebut sampai ke tujuan atau tidak

HASIL:



The screenshot shows a Windows desktop environment with a Visual Studio Code (VS Code) window open. The terminal tab is active, showing the output of a Python script named 'latihan_4_udp_reciever.py'. The script is monitoring UDP traffic on port 53038 and printing sensor data to the console. The output is as follows:

```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_4_udp_reciever.py"
*** UDP Monitoring Server Berjalan ***
Menunggu data sensor...
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:23|HUM:50%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:21|HUM:62%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:35|HUM:48%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:34|HUM:57%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:35|HUM:66%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:24|HUM:85%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:22|HUM:70%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:28|HUM:84%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:25|HUM:50%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:29|HUM:40%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:34|HUM:55%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:28|HUM:53%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:29|HUM:73%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:23|HUM:51%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:27|HUM:84%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:29|HUM:84%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:32|HUM:53%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:23|HUM:85%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:23|HUM:62%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:27|HUM:53%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:35|HUM:49%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:27|HUM:71%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:26|HUM:53%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:26|HUM:54%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:35|HUM:73%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:25|HUM:59%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:26|HUM:78%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:24|HUM:77%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:21|HUM:57%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:27|HUM:77%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:28|HUM:81%
[Sensor ('127.0.0.1', 53038)] Melaporkan: TEMP:32|HUM:77%
```

The screenshot shows a terminal window with the following text:

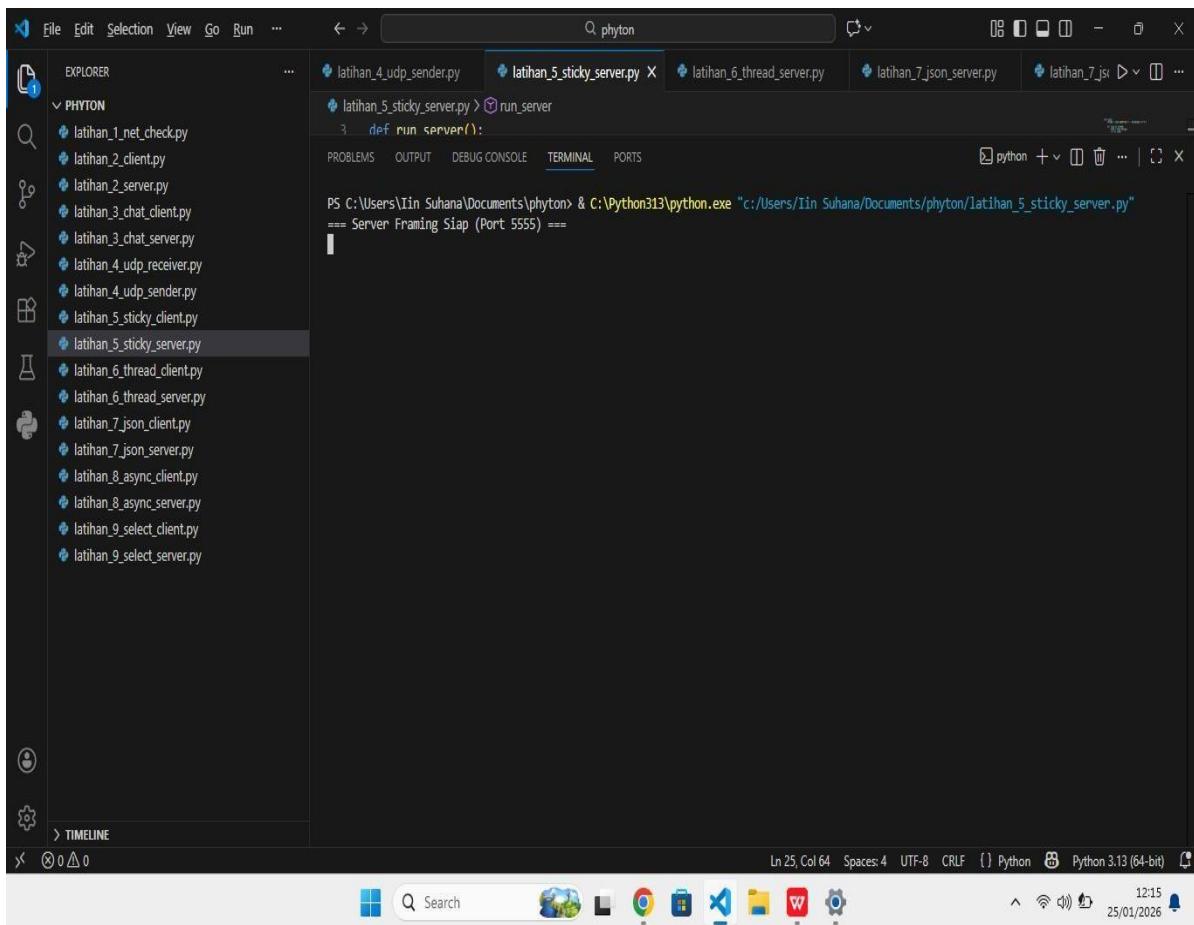
```
PS C:\Users\Iin Suhana\Documents\python> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/python/latihan_4_udp_sender.py"
TARGET IP = 'localhost' # Ganti IP ini jika server ada di komputer lain
==> Sensor Aktif. Mengirim data ke ('localhost', 9999)
Mengirim -> TEMP:31C|HUM:46%
Mengirim -> TEMP:24C|HUM:67%
Mengirim -> TEMP:29C|HUM:44%
Mengirim -> TEMP:31C|HUM:88%
Mengirim -> TEMP:35C|HUM:77%
Mengirim -> TEMP:31C|HUM:84%
Mengirim -> TEMP:33C|HUM:51%
Mengirim -> TEMP:27C|HUM:78%
Mengirim -> TEMP:35C|HUM:83%
Mengirim -> TEMP:32C|HUM:70%
Mengirim -> TEMP:23C|HUM:50%
Mengirim -> TEMP:34C|HUM:73%
Mengirim -> TEMP:22C|HUM:77%
```

BAB V

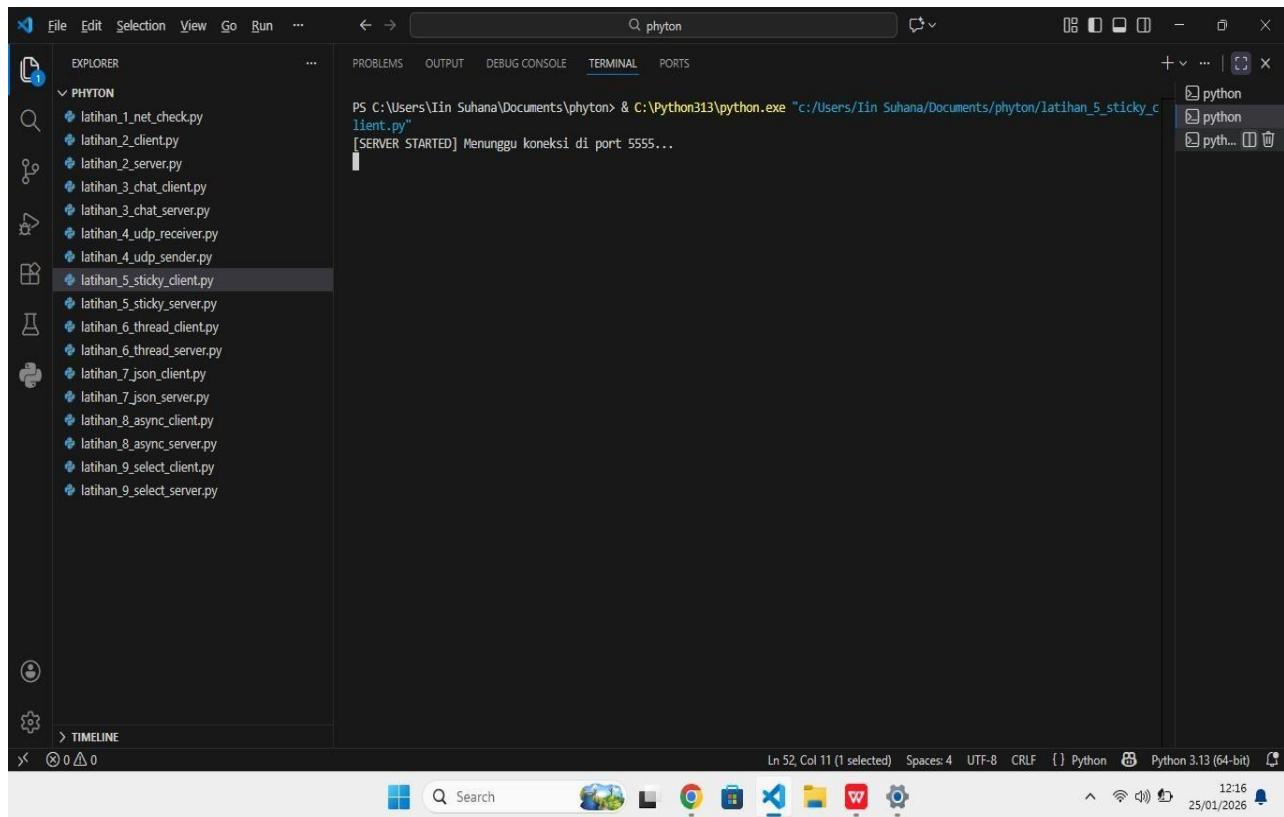
ERROR HANDLING & FRAMING DATA

Error handling adalah proses penanganan kesalahan yang terjadi selama komunikasi jaringan. Kesalahan dapat terjadi karena gangguan jaringan, koneksi terputus, atau data yang tidak sesuai format.

HASIL:



```
File Edit Selection View Go Run ... ⏪ ⏩ python
EXPLORER latihan_4_udp_sender.py latihan_5_sticky_server.py X latihan_6_thread_server.py latihan_7_json_server.py latihan_7_jsi D ...
PHYTON latihan_1_net_check.py
latihan_2_client.py
latihan_2_server.py
latihan_3_chat_client.py
latihan_3_chat_server.py
latihan_4_udp_receiver.py
latihan_4_udp_sender.py
latihan_5_sticky_client.py
latihan_5_sticky_server.py
latihan_6_thread_client.py
latihan_6_thread_server.py
latihan_7_json_client.py
latihan_7_json_server.py
latihan_8_async_client.py
latihan_8_async_server.py
latihan_9_select_client.py
latihan_9_select_server.py
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
PS C:\Users\Iin Suhana\Documents\python> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/python/latihan_5_sticky_server.py"
*** Server Framing Siap (Port 5555) ===
```



BAB VI

CONCURRENCY PART I (THREADING)

Concurrency adalah kemampuan suatu sistem untuk menangani beberapa proses atau koneksi secara bersamaan. Dalam pemrograman jaringan, concurrency sangat penting agar server dapat melayani banyak client.

HASIL:

The screenshot shows a Windows desktop environment with a Python code editor window open. The window title is "python". The left sidebar shows a file tree under "EXPLORER" with various Python files listed. The main area shows a terminal window with the following text:

```
PS C:\Users\Iin Suhana\Documents\python> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/python/latihan_6_thread_server.py"
[SERVER STARTED] Menunggu koneksi di port 5555...
```

The terminal tab is selected at the bottom of the window. The status bar at the bottom right shows the date and time: "25/01/2026 13:49".

A screenshot of the Visual Studio Code (VS Code) interface. The left sidebar shows a file tree under the 'EXPLORER' tab, with a 'PHYTON' folder expanded. Inside 'PHYTON', several Python files are listed, including 'latihan_1_net_check.py', 'latihan_2_client.py', 'latihan_2_server.py', 'latihan_3_chat_client.py', 'latihan_3_chat_server.py', 'latihan_4_udp_receiver.py', 'latihan_4_udp_sender.py', 'latihan_5_sticky_client.py', 'latihan_5_sticky_server.py', 'latihan_6_thread_client.py' (which is selected), 'latihan_6_thread_server.py', 'latihan_7_json_client.py', 'latihan_7_json_server.py', 'latihan_8_async_client.py', 'latihan_8_async_server.py', 'latihan_9_select_client.py', and 'latihan_9_select_server.py'. The main workspace area contains a terminal window with the following text:

```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_6_thread_client.py"
Terhubung ke server. Ketik pesan, ketik 'bye' untuk keluar.
>> bye
Koneksi ditutup
PS C:\Users\Iin Suhana\Documents\phyton>
```

The status bar at the bottom indicates the terminal is at line 18, column 25, with 4 spaces, using UTF-8 encoding, and is connected to Python 3.13 (64-bit). The system tray shows the date and time as 25/01/2026 at 12:18.

BAB VII

SERIALISASI DATA (JSON & PICKLE)

Serialisasi data adalah proses mengubah data menjadi format tertentu agar dapat dikirim melalui jaringan atau disimpan.

HASIL:

The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Run, ...
- Search Bar:** Q python
- Explorer:** Shows a folder named "PHYTON" containing various Python files: latihan_1_net_check.py, latihan_2_client.py, latihan_2_server.py, latihan_3_chat_client.py, latihan_3_chat_server.py, latihan_4_udp_receiver.py, latihan_4_udp_sender.py, latihan_5_sticky_client.py, latihan_5_sticky_server.py, latihan_6_thread_client.py, latihan_6_thread_server.py, latihan_7_json_client.py, latihan_7_json_server.py (which is selected), latihan_8_async_client.py, latihan_8_async_server.py, latihan_9_select_client.py, and latihan_9_select_server.py.
- Terminal:** The terminal tab is active, showing the command PS C:\Users\Lin Suhana\Documents\python> & C:\Python313\python.exe "c:/Users/Lin Suhana/Documents/python/latihan_7_json_server.py" and the response === Database Server (JSON) Berjalan di Port 6000 ===.
- Status Bar:** Shows Ln 9, Col 2, Spaces: 4, UTF-8, CRLF, Python 3.13 (64-bit), and the date/time 25/01/2026 12:19.

The screenshot shows a Visual Studio Code (VS Code) interface with the following details:

- File Explorer:** On the left, it lists several Python files: latihan_1_net_check.py, latihan_2_client.py, latihan_2_server.py, latihan_3_chat_client.py, latihan_3_chat_server.py, latihan_4_udp_receiver.py, latihan_4_udp_sender.py, latihan_5_sticky_client.py, latihan_5_sticky_server.py, latihan_6_thread_client.py, latihan_6_thread_server.py, latihan_7_json_client.py, latihan_7_json_server.py, latihan_8_async_client.py, latihan_8_async_server.py, latihan_9_select_client.py, and latihan_9_select_server.py.
- Terminal:** The main area displays the output of a Python script. It shows two requests to a JSON server:
 - Mengirim request NIM: 101
 - Respon Server:

```
{ "status": "SUKSES", "data": { "nama": "iin suhana", "prodi": "Teknik Informatika", "ipk": 3.75 } }
```
 - Mengirim request NIM: 999
 - Respon Server:

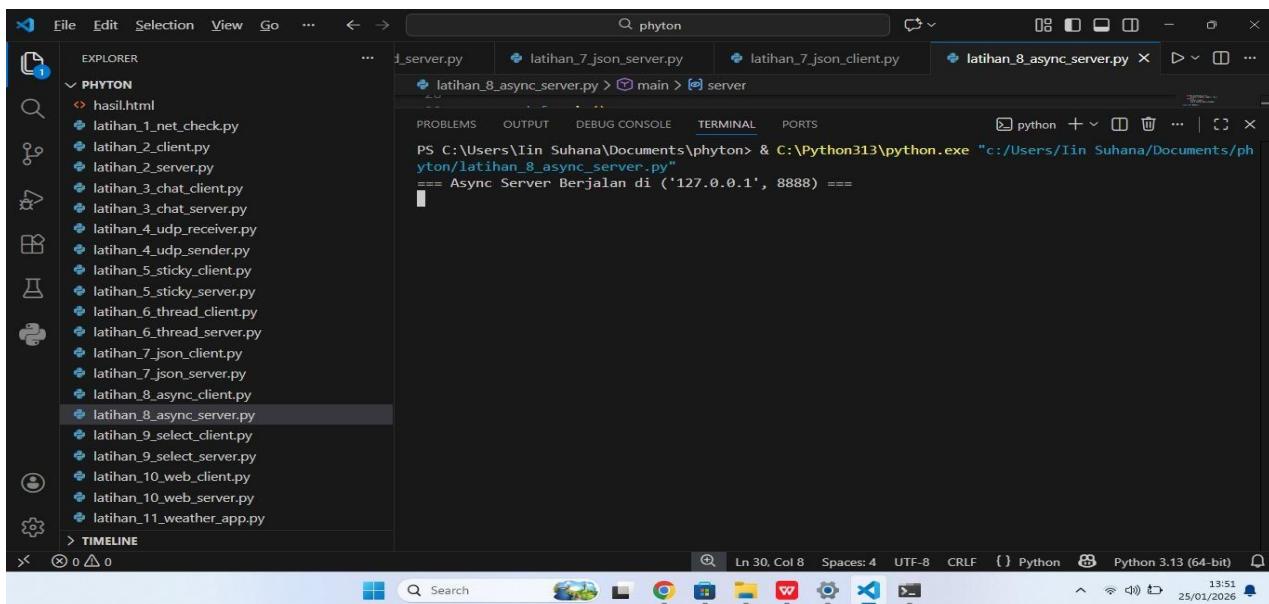
```
{ "status": "GAGAL", "pesan": "NIM tidak ditemukan" }
```
- Status Bar:** At the bottom, it shows the current file is "latihan_7_json_client.py", and the status bar indicates "Ln 12, Col 1" with "Spaces: 4", "UTF-8", "CRLF", and "Python 3.13 (64-bit)".
- Taskbar:** The taskbar at the bottom includes icons for Search, File Explorer, Terminal, and other common tools.

BAB VIII

ASYNCHRONOUS I/O (CONCURRENCY PART II)

Asynchronous I/O memungkinkan program melakukan proses input dan output tanpa harus menunggu proses lain selesai.

HASIL:



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows a folder named "PHYTON" containing various Python files such as "latihan_1_net_check.py", "latihan_2_client.py", "latihan_2_server.py", etc., up to "latihan_11_weather_app.py".
- Terminal:** Displays the command "PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_8_async_server.py"" followed by the output "==== Async Server Berjalan di ('127.0.0.1', 8888) ===".
- Status Bar:** Shows the current file is "latihan_8_async_server.py", the line number is 30, column 8, and the Python version is 3.13 (64-bit).

A screenshot of a Windows desktop environment. In the foreground, a Microsoft Visual Studio Code (VS Code) window is open. The terminal tab is active, showing the output of a Python script named `latihan_8_async_client.py`. The script connects to a server and prints a message before exiting. The file explorer sidebar shows a folder named `PHYTON` containing various Python files related to networking and JSON processing. The taskbar at the bottom displays several pinned icons, including File Explorer, Edge browser, Google Chrome, Task View, File History, and File Explorer again. The system tray shows the date as 25/01/2026 and the time as 12:21.

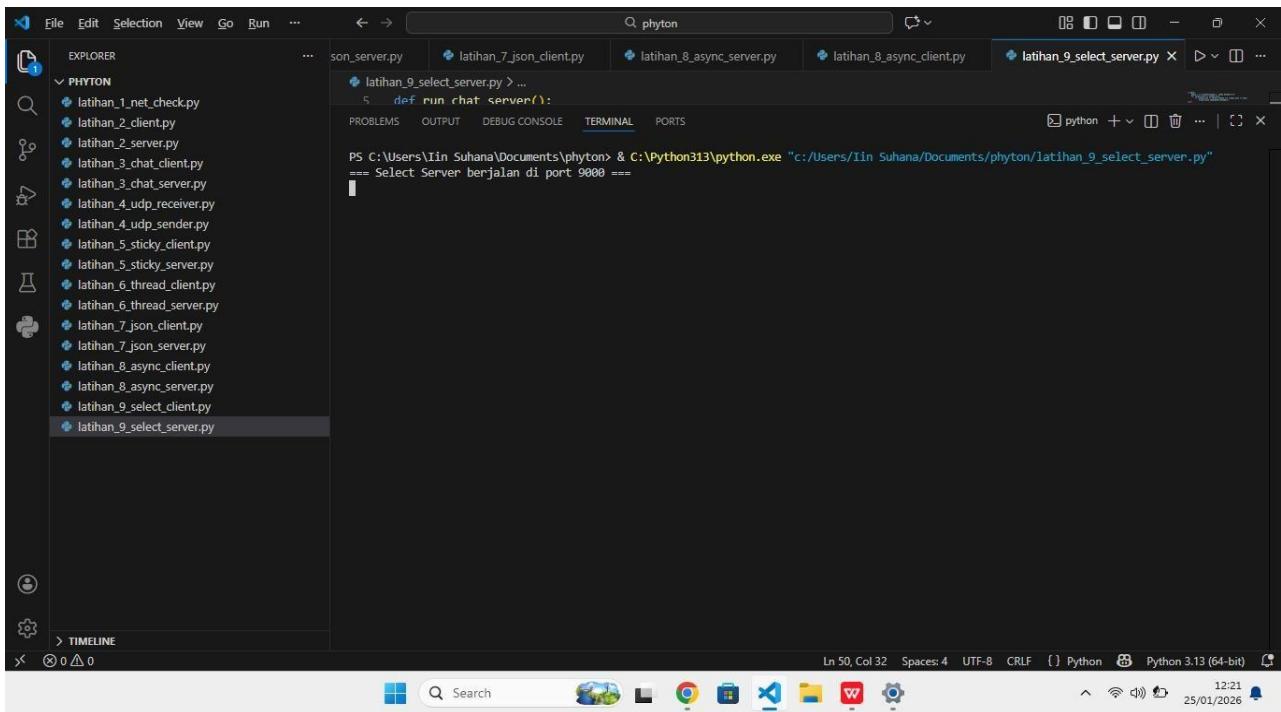
```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_8_async_client.py"
Terkoneksi ke server!
Ketik pesan (atau 'bye' untuk keluar): bye
Menutup koneksi...
PS C:\Users\Iin Suhana\Documents\phyton>
```

BAB IX

I/O MULTIPLEXING (SELECT & POLL)

Select digunakan untuk memantau banyak socket dalam satu waktu.

HASIL:



The screenshot shows a code editor interface with the following details:

- Explorer Sidebar:** Shows a tree view of Python files under the "PHYTON" category. The files listed are: latihan_1_net_check.py, latihan_2_client.py, latihan_2_server.py, latihan_3_chat_client.py, latihan_3_chat_server.py, latihan_4_udp_receiver.py, latihan_4_udp_sender.py, latihan_5_sticky_client.py, latihan_5_sticky_server.py, latihan_6_thread_client.py, latihan_6_thread_server.py, latihan_7_json_client.py, latihan_7_json_server.py, latihan_8_async_client.py, latihan_8_async_server.py, latihan_9_select_client.py, and latihan_9_select_server.py. The file "latihan_9_select_client.py" is currently selected.
- Main Editor Area:** Displays the content of the selected file, "latihan_9_select_client.py". The code includes a main function definition and a message indicating a connection to a server at 127.0.0.1:9000.
- Terminal:** Shows a command being run in the terminal window:

```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_9_select_client.py"
```

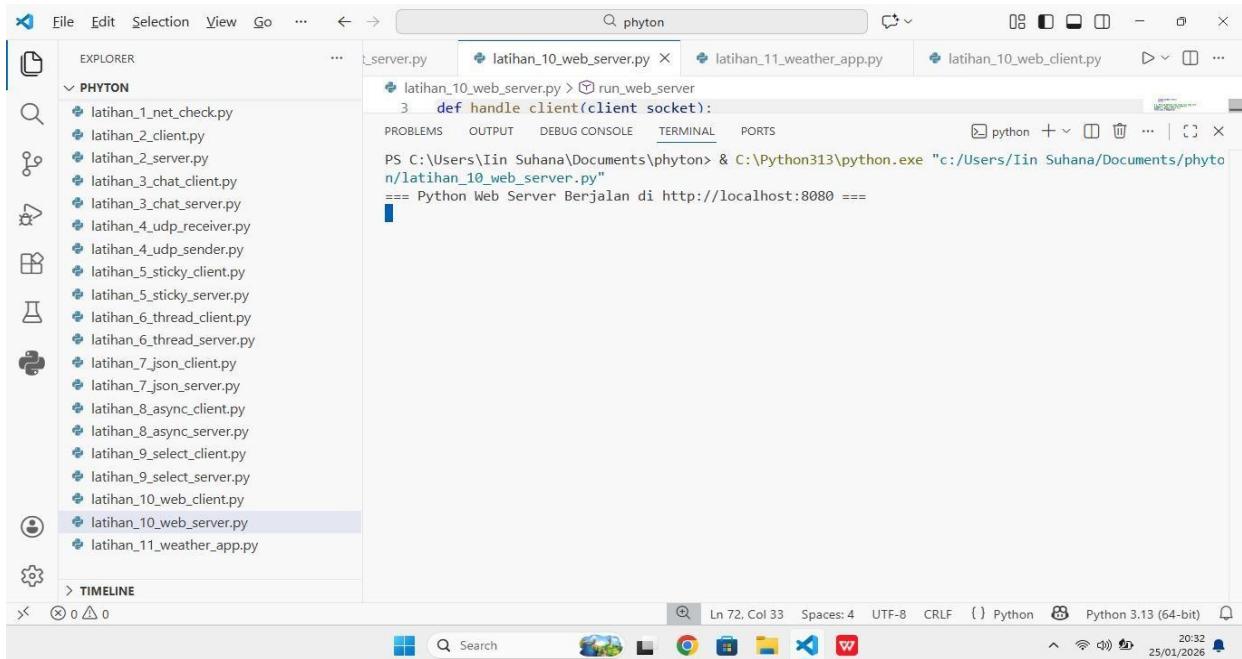
A message "Terkoneksi ke server 127.0.0.1:9000" is displayed below the command.
- Bottom Status Bar:** Provides information about the current file (ln 36, col 11), encoding (UTF-8), and Python version (Python 3.13 (64-bit)). It also shows the date and time (25/01/2026, 12:21).

BAB X

PROTOKOL HTTP & WEB SERVER

HTTP adalah protokol komunikasi yang digunakan pada web.

HASIL:



The screenshot shows a Python code editor interface. The left sidebar has a tree view under 'EXPLORER' labeled 'PHYTON' containing files like 'latihan_1_net_check.py', 'latihan_2_client.py', etc. The main area shows a code editor with the following content:

```
l_server.py  latihan_10_web_server.py  latihan_11_weather_app.py  latihan_10_web_client.py
latihan_10_web_server.py > run_web_server
3   def handle_client(client_socket):
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_10_web_server.py"
== Python Web Server Berjalan di http://localhost:8080 ==
```

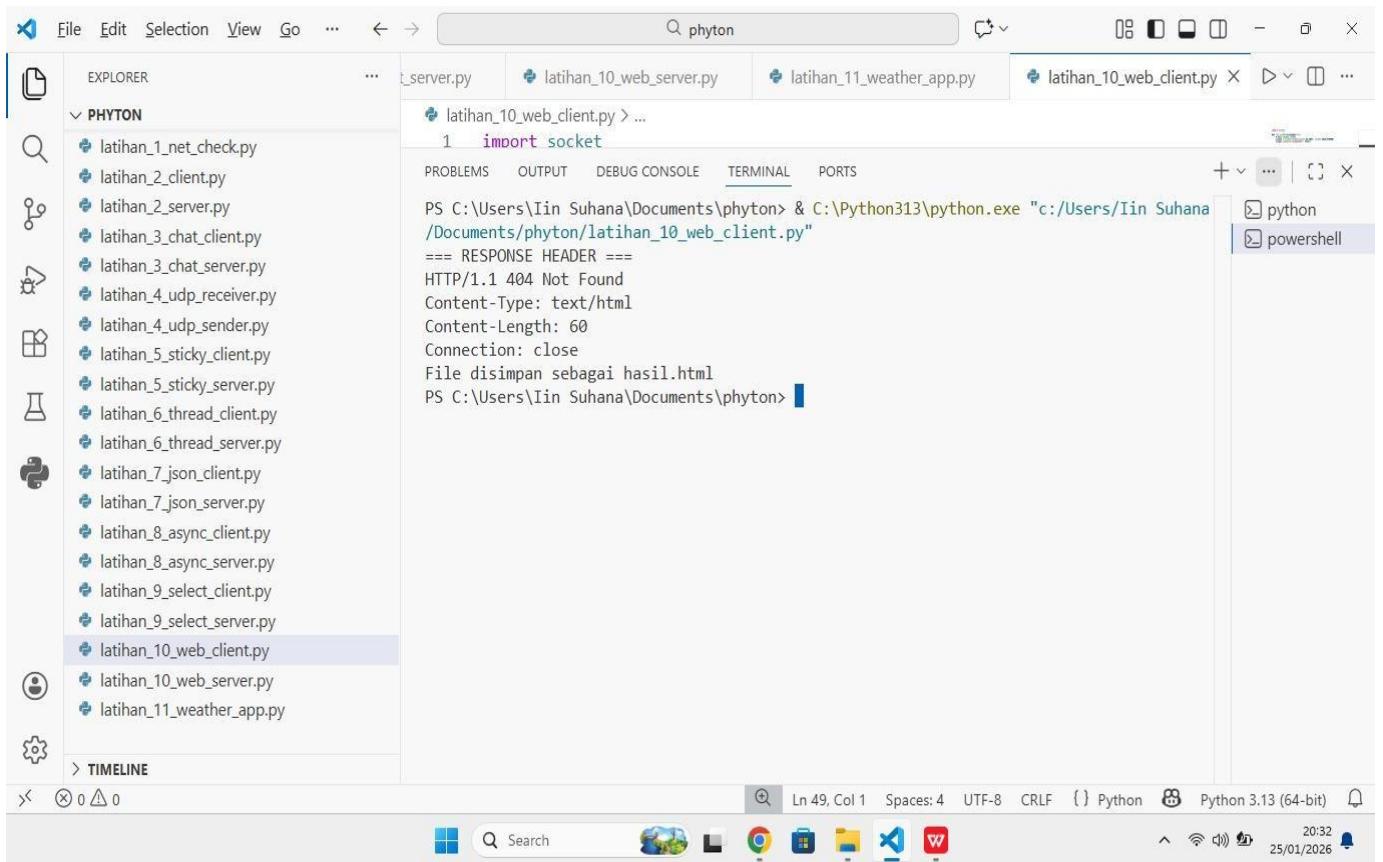
The terminal window shows the command being run and the resulting output: "Python Web Server Berjalan di http://localhost:8080 ==". The status bar at the bottom indicates the file is 'l_server.py', line 72, column 33, with 4 spaces, using UTF-8 encoding, and Python 3.13 (64-bit). The date and time shown are 25/01/2026 at 20:32.

BAB XI

REST API & WEB SERVICES

REST API adalah layanan web berbasis HTTP untuk pertukaran data.

HASIL:



The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows a folder named "EXPLORER" containing a "PHYTON" folder with files: latihan_1_net_check.py, latihan_2_client.py, latihan_2_server.py, latihan_3_chat_client.py, latihan_3_chat_server.py, latihan_4_udp_receiver.py, latihan_4_udp_sender.py, latihan_5_sticky_client.py, latihan_5_sticky_server.py, latihan_6_thread_client.py, latihan_6_thread_server.py, latihan_7_json_client.py, latihan_7_json_server.py, latihan_8_async_client.py, latihan_8_async_server.py, latihan_9_select_client.py, latihan_9_select_server.py, latihan_10_web_client.py (selected), latihan_10_web_server.py, and latihan_11_weather_app.py.
- Terminal:** Displays the command "python latihan_10_web_client.py" being run, followed by the response:

```
PS C:\Users\Iin Suhana\Documents\phyton> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/latihan_10_web_client.py"
HTTP/1.1 404 Not Found
Content-Type: text/html
Content-Length: 60
Connection: close
File disimpan sebagai hasil.html
PS C:\Users\Iin Suhana\Documents\phyton>
```
- Status Bar:** Shows the current file is "latihan_10_web_client.py", line 49, column 1, with 4 spaces, using UTF-8 encoding, and Python 3.13 (64-bit) as the language.
- System Tray:** Shows the date and time as 25/01/2026 at 20:32.

The screenshot shows a Python code editor interface with several tabs open. The tabs include: _client.py, latihan_9_select_server.py, latihan_10_web_server.py, latihan_11_weather_app.py, and latihan_11_weather_app.py (the active tab). The terminal window displays the output of running the script, which includes weather data for Manado and Makassar. The data for Manado is as follows:

```
--- Mengambil Data Cuaca untuk Manado ---
Suhu Saat Ini: 28.2°C
Kecepatan Angin: 3.0 km/h
Koordinat: 1.4748, 124.8421
```

The data for Makassar is as follows:

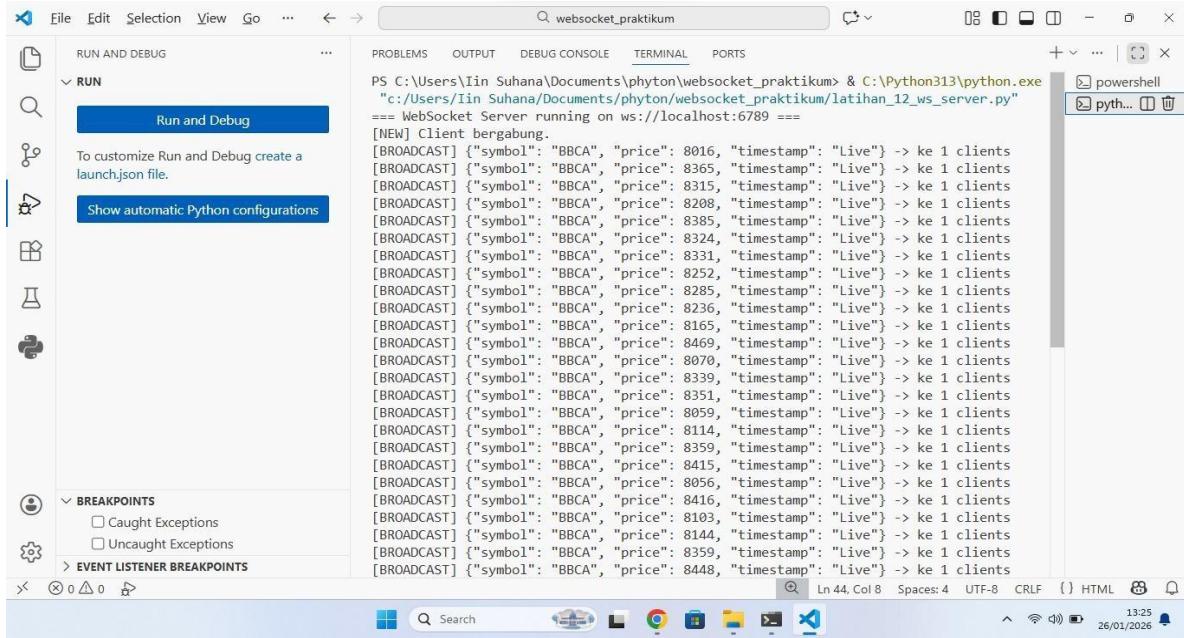
```
--- Mengambil Data Cuaca untuk Makassar ---
Suhu Saat Ini: 28.1°C
Kecepatan Angin: 8.9 km/h
Koordinat: -5.1477, 119.4327
```

BAB XII

REAL TIME COMMUNICATION (WEB SOCKET)

WebSocket memungkinkan komunikasi dua arah secara real-time.

HASIL:



The screenshot shows a terminal window titled "websocket_praktikum" running in a Python environment. The command run was "C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/python/websocket_praktikum/latihan_12_ws_server.py"" and the output indicates a WebSocket Server is running on ws://localhost:6789. The log shows multiple broadcast messages being sent to clients, each containing a symbol ("BBCA"), price (e.g., 8016, 8365, 8315, 8208, 8385, 8324, 8331, 8252, 8285, 8236, 8165, 8469, 8070, 8339, 8351, 8059, 8114, 8359, 8415, 8056, 8416, 8103, 8144, 8359, 8448), and a timestamp ("Live").

```
PS C:\Users\Iin Suhana\Documents\python\websocket_praktikum & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/python/websocket_praktikum/latihan_12_ws_server.py"
== WebSocket Server running on ws://localhost:6789 ==
[NEW] Client bergabung.
[BROADCAST] {"symbol": "BBCA", "price": 8016, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8365, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8315, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8208, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8385, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8324, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8331, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8252, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8285, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8236, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8165, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8469, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8070, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8339, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8351, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8059, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8114, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8359, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8415, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8056, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8416, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8103, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8144, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8359, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8448, "timestamp": "Live"} -> ke 1 clients
```



BAB XIII

KEAMANAN JARINGAN (NETWORK SECURITY)

Keamanan jaringan bertujuan melindungi data dan sistem.

HASIL:

The screenshot shows a terminal window titled "secure_chat" running in a code editor. The terminal output is as follows:

```
PS C:\Users\Iin Suhana\Documents\phyton\secure_chat> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/secure_chat/secure_client.py"
Menghubungkan ke Secure Server...
Terhubung dengan Cipher: ('TLS_AES_256_GCM_SHA384', 'TLSv1.3', 256)
Balasan Server: Pesan Anda aman bersama kami.
PS C:\Users\Iin Suhana\Documents\phyton\secure_chat>
```

The terminal interface includes standard Windows-style icons for file operations (New, Open, Save, etc.) and a status bar at the bottom showing the current directory, line number, column number, and encoding.

A screenshot of a Windows desktop environment. In the center is a terminal window from Visual Studio Code (VS Code) titled "secure_chat". The terminal shows the following command-line session:

```
c:\Users\Iin Suhana\Documents\python\secure_chat>generate_cert.py
c:\Users\Iin Suhana\Documents\python\secure_chat>generate_cert.py:32: DeprecationWarning: datetime.datetime.utcnow() is deprecated and scheduled for removal in a future version. Use timezone-aware objects to represent datetimes in UTC: datetime.datetime.now(datetime.UTC).
    datetime.datetime.utcnow()
c:\Users\Iin Suhana\Documents\python\secure_chat>generate_cert.py:34: DeprecationWarning: datetime.datetime.utcnow() is deprecated and scheduled for removal in a future version. Use timezone-aware objects to represent datetimes in UTC: datetime.datetime.now(datetime.UTC).
    datetime.datetime.utcnow() + datetime.timedelta(days=365)
Sertifikat berhasil dibuat: server_cert.pem & server_key.pem
PS C:\Users\Iin Suhana\Documents\python\secure_chat>
```

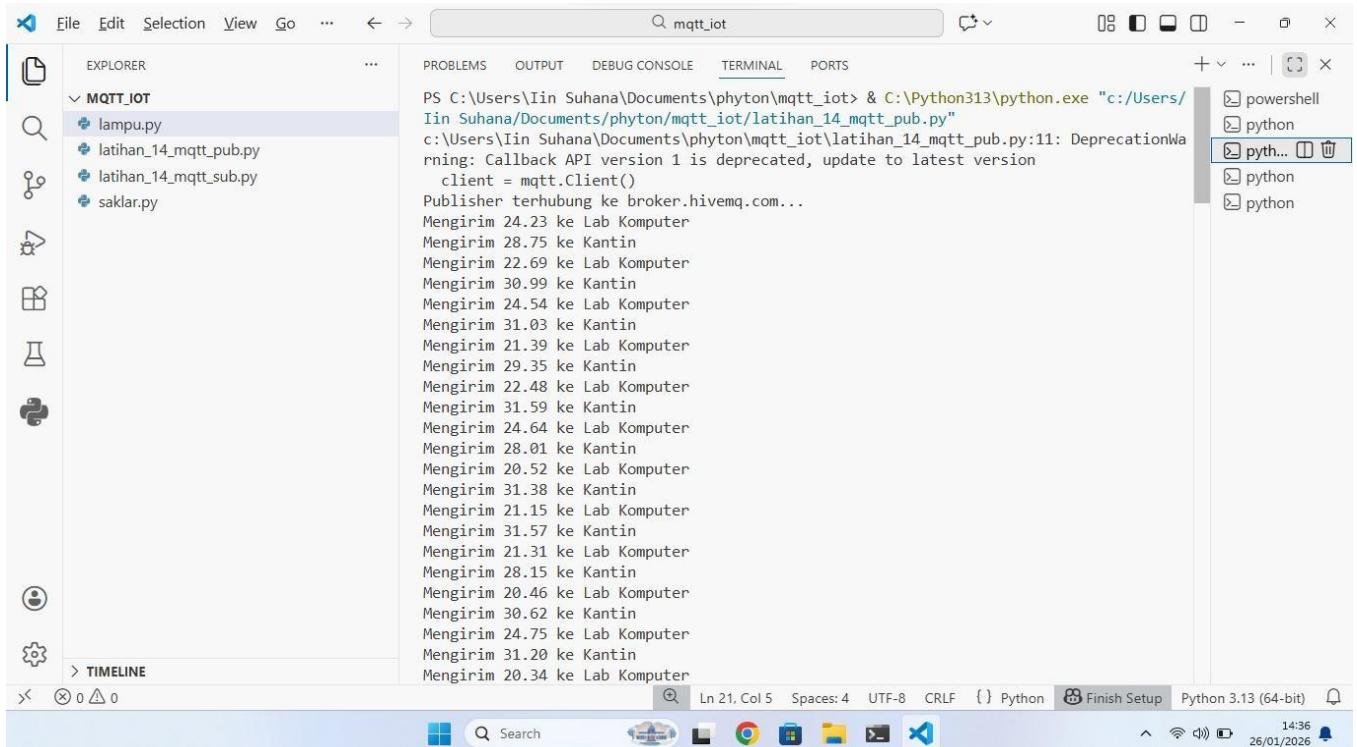
The VS Code interface includes a sidebar with icons for file operations like Open, Save, Find, and Settings. The status bar at the bottom shows the current file path as "C:\Users\Iin Suhana\Documents\python\secure_chat", line 5, column 28, and encoding as UTF-8. It also indicates the Python version as "Python 3.13 (64-bit)".

BAB XIV

ARSITEKTUR SISTEM TERDISTRIBUSI & IoT (MQTT)

Arsitektur sistem terdistribusi adalah desain sistem dimana komponen-komponen aplikasi berjalan pada beberapa komputer/node berbeda yang saling terhubung melalui jarigan dan bekerja seolah-olah satu sistem.

HASIL:



The screenshot shows a terminal window with the following output:

```
PS C:\Users\Iin Suhana\Documents\phyton\mqtt_iot> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/mqtt_iot/latihan_14_mqtt_pub.py"
c:/Users/Iin Suhana/Documents/phyton/mqtt_iot/latihan_14_mqtt_pub.py:11: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  client = mqtt.Client()
Publisher terhubung ke broker.hivemq.com...
Mengirim 24.23 ke Lab Komputer
Mengirim 28.75 ke Kantin
Mengirim 22.69 ke Lab Komputer
Mengirim 30.99 ke Kantin
Mengirim 24.54 ke Lab Komputer
Mengirim 31.03 ke Kantin
Mengirim 21.39 ke Lab Komputer
Mengirim 29.35 ke Kantin
Mengirim 22.48 ke Lab Komputer
Mengirim 31.59 ke Kantin
Mengirim 24.64 ke Lab Komputer
Mengirim 28.01 ke Kantin
Mengirim 20.52 ke Lab Komputer
Mengirim 31.38 ke Kantin
Mengirim 21.15 ke Lab Komputer
Mengirim 31.57 ke Kantin
Mengirim 21.31 ke Lab Komputer
Mengirim 28.15 ke Kantin
Mengirim 20.46 ke Lab Komputer
Mengirim 30.62 ke Kantin
Mengirim 24.75 ke Lab Komputer
Mengirim 31.20 ke Kantin
Mengirim 20.34 ke Lab Komputer
```

The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows a folder named "MQTT_IOT" containing files: lampu.py, latihan_14_mqtt_pub.py, latihan_14_mqtt_sub.py, and saklar.py.
- Terminal:** Displays the command PS C:\Users\Iin Suhana\Documents\phyton\mqtt_iot & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/mqtt_iot/latihan_14_mqtt_sub.py" followed by the Python script's output:

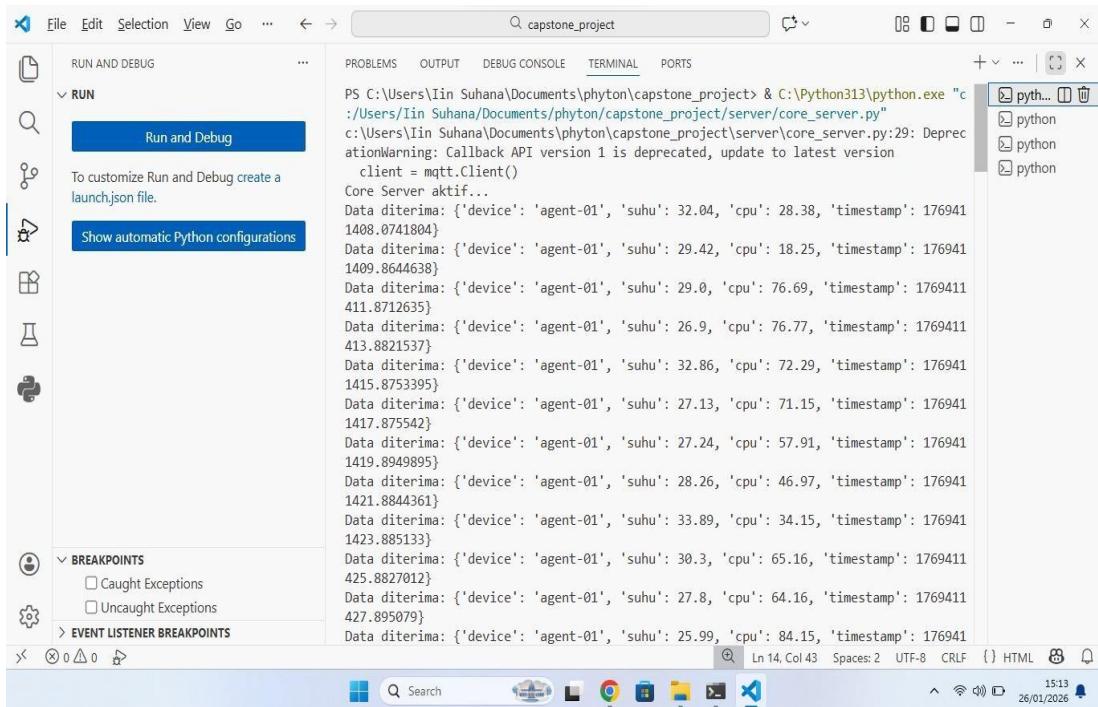
```
c:\Users\Iin Suhana\Documents\phyton\mqtt_iot\latihan_14_mqtt_sub.py:26: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
    client = mqtt.Client()
Menghubungkan ke broker.hivemq.com...
[SUKSES] Terhubung ke Broker!
Data Masuk dari [lab_komputer]: 24.23°C
Data Masuk dari [kantin]: 28.75°C
Data Masuk dari [lab_komputer]: 22.69°C
Data Masuk dari [kantin]: 30.99°C
Data Masuk dari [lab_komputer]: 24.54°C
Data Masuk dari [kantin]: 31.03°C
Data Masuk dari [lab_komputer]: 21.39°C
Data Masuk dari [kantin]: 29.35°C
Data Masuk dari [lab_komputer]: 22.48°C
Data Masuk dari [kantin]: 31.59°C
Data Masuk dari [lab_komputer]: 24.64°C
Data Masuk dari [kantin]: 28.01°C
Data Masuk dari [lab_komputer]: 20.52°C
Data Masuk dari [kantin]: 31.38°C
Data Masuk dari [lab_komputer]: 21.15°C
Data Masuk dari [kantin]: 31.57°C
Data Masuk dari [lab_komputer]: 21.31°C
Data Masuk dari [kantin]: 28.15°C
Data Masuk dari [lab_komputer]: 20.46°C
Data Masuk dari [kantin]: 30.62°C
Data Masuk dari [lab_komputer]: 24.75°C
Data Masuk dari [kantin]: 31.20°C
```
- Output:** Shows a sidebar with "powershell" and multiple "python" entries.
- Bottom Status Bar:** Includes icons for file operations, search, and terminal status (Ln 21. Col 5, Spaces: 4, UTF-8, CRLF).
- Bottom Icons:** Standard Windows taskbar icons for File Explorer, Task View, Start, and others.

BAB XV

PENUTUP & PROYEK AKHIR (Capstone Project)

Bab penutup merangkum seluruh materi pemrograman jaringan yang telah dipelajari dari bab awal hingga bab lanjutan. Seluruh konsep tersebut diintegrasikan dalam proyek akhir atau capstone project.

HASIL:



The screenshot shows the PyCharm IDE interface. The terminal window displays a series of JSON data messages received from an MQTT client. The data contains device information such as 'device': 'agent-01', 'suhu' (temperature), and 'cpu' usage over time. The log output is as follows:

```
PS C:\Users\Iin Suhana\Documents\python\capstone_project & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/python/capstone_project/server/core_server.py"
c:/Users/Iin Suhana/Documents/python/capstone_project/server/core_server.py:29: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  client = mqtt.Client()
Core Server aktif...
Data diterima: {'device': 'agent-01', 'suhu': 32.04, 'cpu': 28.38, 'timestamp': 1769411408.0741804}
Data diterima: {'device': 'agent-01', 'suhu': 29.42, 'cpu': 18.25, 'timestamp': 1769411409.8644638}
Data diterima: {'device': 'agent-01', 'suhu': 29.0, 'cpu': 76.69, 'timestamp': 1769411411.8712635}
Data diterima: {'device': 'agent-01', 'suhu': 26.9, 'cpu': 76.77, 'timestamp': 1769411413.8821537}
Data diterima: {'device': 'agent-01', 'suhu': 32.86, 'cpu': 72.29, 'timestamp': 1769411415.8753395}
Data diterima: {'device': 'agent-01', 'suhu': 27.13, 'cpu': 71.15, 'timestamp': 1769411417.875542}
Data diterima: {'device': 'agent-01', 'suhu': 27.24, 'cpu': 57.91, 'timestamp': 1769411419.8949895}
Data diterima: {'device': 'agent-01', 'suhu': 28.26, 'cpu': 46.97, 'timestamp': 1769411421.8844361}
Data diterima: {'device': 'agent-01', 'suhu': 33.89, 'cpu': 34.15, 'timestamp': 1769411423.885133}
Data diterima: {'device': 'agent-01', 'suhu': 30.3, 'cpu': 65.16, 'timestamp': 1769411425.8827012}
Data diterima: {'device': 'agent-01', 'suhu': 27.8, 'cpu': 64.16, 'timestamp': 1769411427.895079}
Data diterima: {'device': 'agent-01', 'suhu': 25.99, 'cpu': 84.15, 'timestamp': 1769411429.895133}
```

The screenshot shows the Visual Studio Code interface with the title bar "capstone_project". The left sidebar has "RUN AND DEBUG" selected, with "RUN" expanded, showing "Run and Debug" highlighted. The main area is a terminal window displaying the output of a Python script. The output shows:

```
PS C:\Users\Iin Suhana\Documents\phyton\capstone_project> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/capstone_project/server/api.py"
* Serving Flask app 'api'
* Debug mode: off
WARNING: This is a development server. Do not use it in a production deployment. Use a production WSGI server instead.
* Running on http://127.0.0.1:5000
Press CTRL+C to quit
127.0.0.1 - - [26/Jan/2026 15:10:22] "OPTIONS /login HTTP/1.1" 200 -
127.0.0.1 - - [26/Jan/2026 15:11:55] "OPTIONS /login HTTP/1.1" 200 -
```

The status bar at the bottom shows "Ln 14, Col 43" and "15:13 26/01/2026".

The screenshot shows the Visual Studio Code interface with the title bar "capstone_project". The left sidebar has "RUN AND DEBUG" selected, with "RUN" expanded, showing "Run and Debug" highlighted. The main area is a terminal window displaying the output of a Python script. The output shows:

```
PS C:\Users\Iin Suhana\Documents\phyton\capstone_project> & C:\Python313\python.exe "c:/Users/Iin Suhana/Documents/phyton/capstone_project/server/websocket_server.py"
WebSocket server aktif di port 8765
```

The status bar at the bottom shows "Ln 14, Col 43" and "15:13 26/01/2026".