

LAPORAN PRAKTIKUM PEMOGRAMAN JARINGAN



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Mata Kuliah : Bahasa Pemrograman Jaringan Komputer

PROGRAM STUDI TEKNIK INFORMATIKA

FAKULTAS ILMU KOMPUTER

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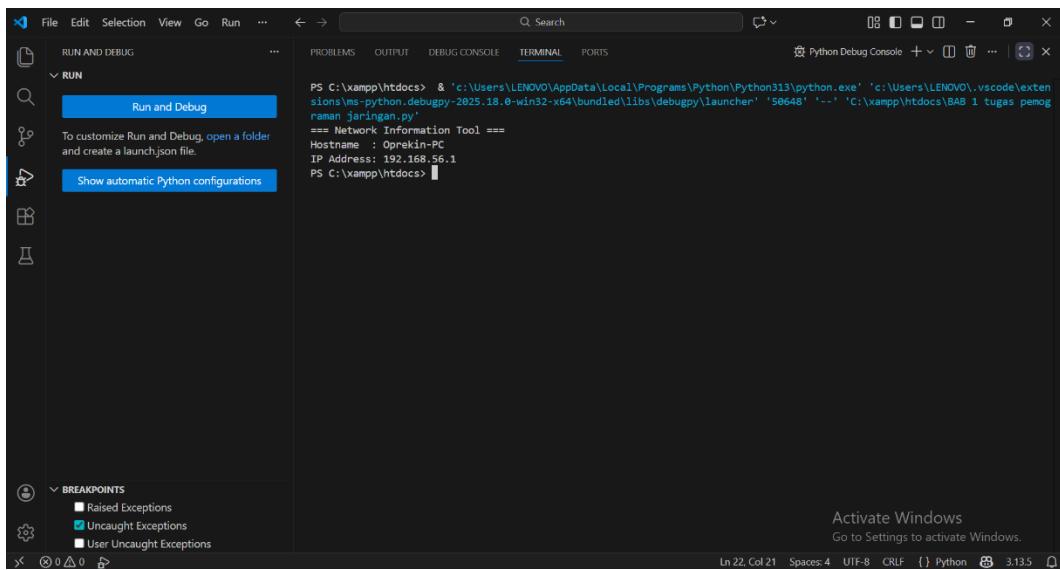
2026

BAB I

Konsep Dasar Pemrograman Jaringan

Praktikum Bab 1 Dimana script ini berguna saat mendeploy aplikasi ke Server Cloud untuk memastikan aplikasi berjalan di Hostname yang benar. konsep ini clint dan server saling terhubung melalui jaringan

Hasil :



The screenshot shows the Visual Studio Code interface with the terminal tab active. The terminal output is as follows:

```
PS C:\xampp\htdocs> & 'c:\Users\LENOVO\AppData\Local\Programs\Python\Python313\python.exe' 'c:\Users\LENOVO\.vscode\extensions\ms-python.python.debugpy-2025.18.0\win32-x64\bundled\libs\debugpy\launcher' '56648' --- 'C:\xampp\htdocs\BAB 1 tugas pemrograman jaringan.py'
==== Network Information Tool ====
Hostname : Oprekin-PC
IP Address: 192.168.56.1
PS C:\xampp\htdocs>
```

The left sidebar shows the 'RUN AND DEBUG' section with 'Run and Debug' highlighted. Below it, there's a note: 'To customize Run and Debug, open a folder and create a launch.json file.' At the bottom of the sidebar, there's a button labeled 'Show automatic Python configurations'.

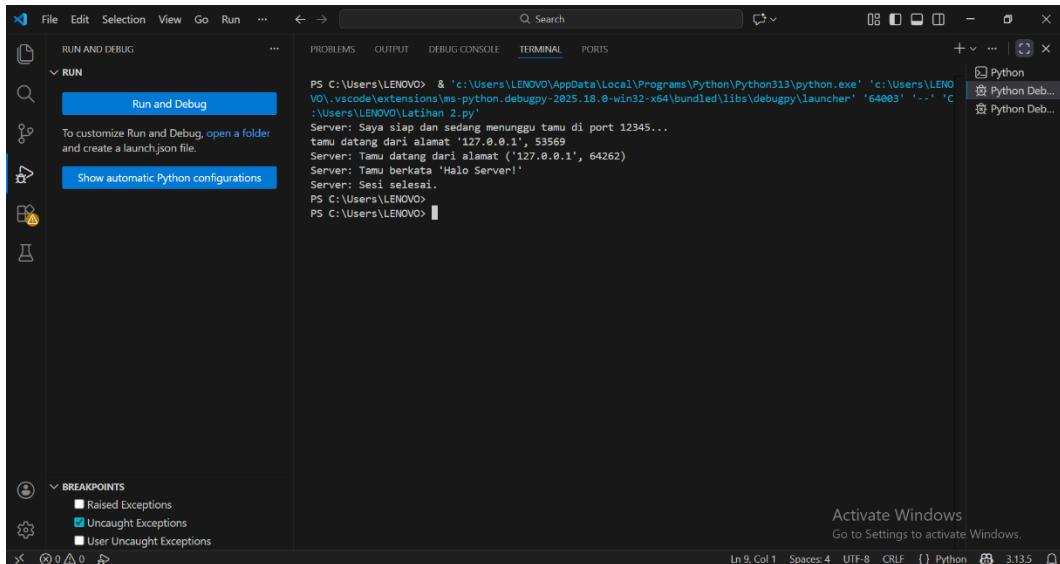
The bottom right corner of the terminal window displays a message: 'Activate Windows Go to Settings to activate Windows.'

BAB II

Socket API Dasar

Praktikum Bab 2 Menampilkan proses pembuatan socket, dimana server mengundang tamu yaitu client kemudian client siap menerima pesan.

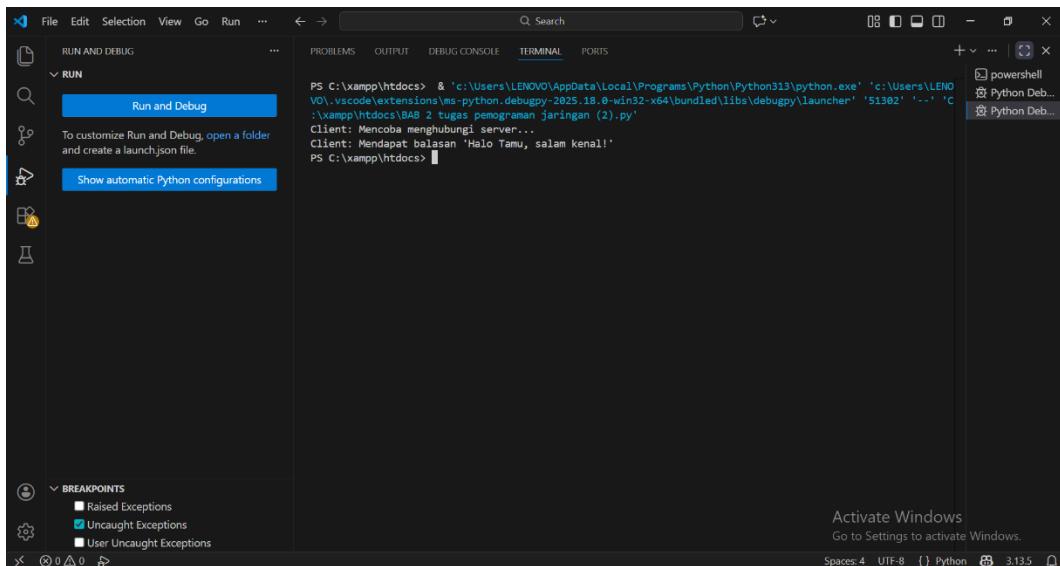
Hasil :



The screenshot shows the VS Code interface with the terminal tab active. The terminal window displays the following Python code and its execution:

```
PS C:\Users\LENOVO> & 'c:\Users\LENOVO\AppData\Local\Programs\Python\Python313\python.exe' 'c:\Users\LENOVO\vscode\extensions\ms-python.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '64803' '' 'C:\Users\LENOVO\Latihan 2.py'
Server: Saya siap dan sedang menunggu tamu di port 12345...
tamu datang dari alamat '127.0.0.1', 53569
Server: Tamu datang dari alamat ('127.0.0.1', 64262)
Server: Tamu berkata 'Halo Server!'
Server: Seisi selesai.
PS C:\Users\LENOVO>
PS C:\Users\LENOVO>
```

The terminal also shows a message from Microsoft about activating Windows.



The second screenshot shows the VS Code interface with the terminal tab active. The terminal window displays the following Python code and its execution:

```
PS C:\xampp\htdocs> & 'c:\Users\LENOVO\AppData\Local\Programs\Python\Python313\python.exe' 'c:\Users\LENOVO\vscode\extensions\ms-python.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '51302' '' 'C:\xampp\htdocs\BAB 2 tugas pemrograman jaringan (2).py'
Client: Mencoba menghubungi server...
Client: Mendapat balasan 'Halo Tamu, salam kenal!'
PS C:\xampp\htdocs>
```

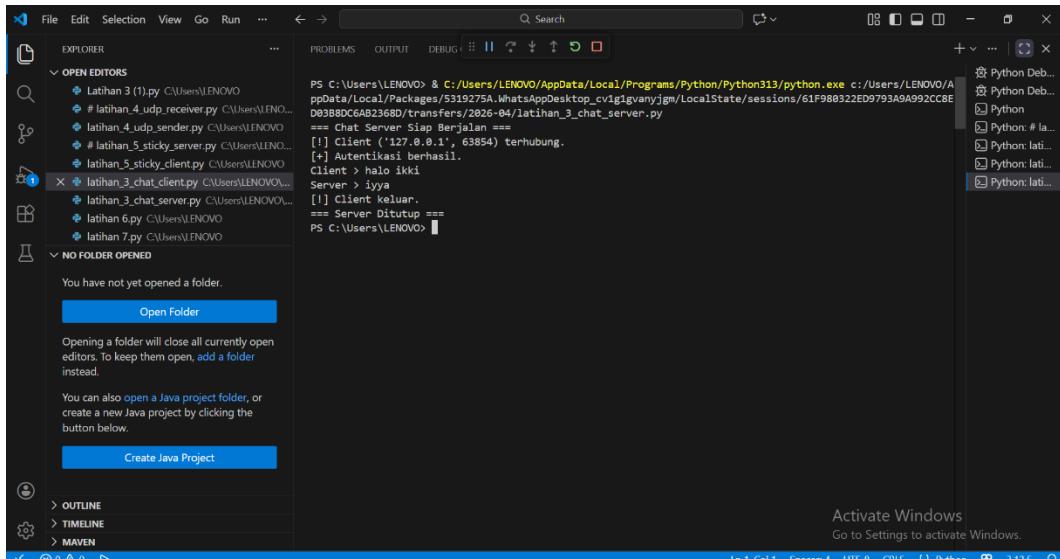
The terminal also shows a message from Microsoft about activating Windows.

BAB III

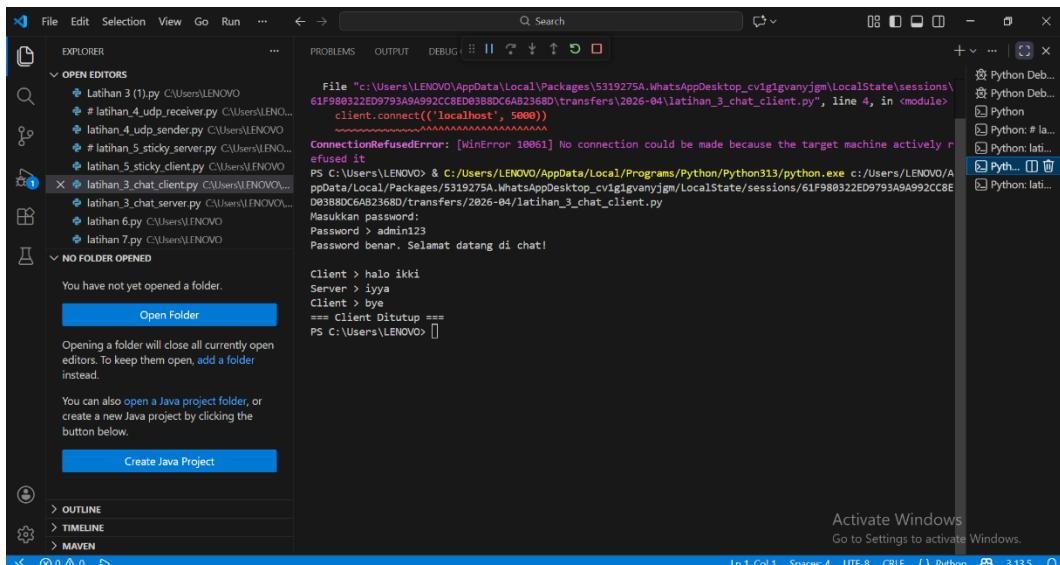
Protokol TCP (Aplikasi Chat)

Praktikum Bab 3 dimana membangun aplikasi chat sederhana dua arah (client-server) menggunakan protokol TCP, aplikasi ini berjalan seperti mengirim surat : Client mengirim pesan, kemudian server menerima dan membalas, lalu koneksi ditutup (hang up) selesai.

Hasil :



```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CCEB D93880C6AB236BD/transfers/2026-04/latihan_3_chat_server.py
==> Chat Server Siap Berjalan ===
[!] Client ('127.0.0.1', 63854) terhubung.
[+] Autentikasi berhasil.
Client > halo ikki
Server > iyya
[!] Client keluar.
==> Server Ditutup ===
PS C:\Users\LENOVO>
```



```
File "c:/Users/LENOVO/AppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CCEB D93880C6AB236BD/transfers/2026-04/latihan_3_chat_client.py", line 4, in <module>
    client.connect(('localhost', 5000))
ConnectionRefusedError: [WinError 10061] No connection could be made because the target machine actively refused it
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CCEB D93880C6AB236BD/transfers/2026-04/latihan_3_chat_client.py
Masukkan password:
Password > admin123
Password benar. Selamat datang di chat!

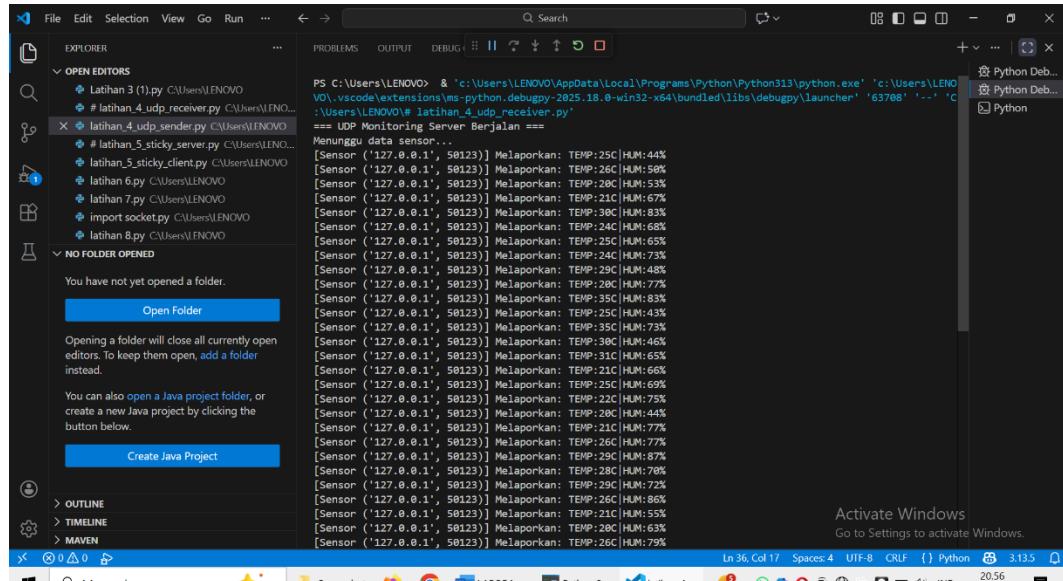
Client > halo ikki
Server > iyya
Client > bye
==> Client Ditutup ===
PS C:\Users\LENOVO>
```

BAB IV

Protokol UDP (Streaming & Broadcasting)

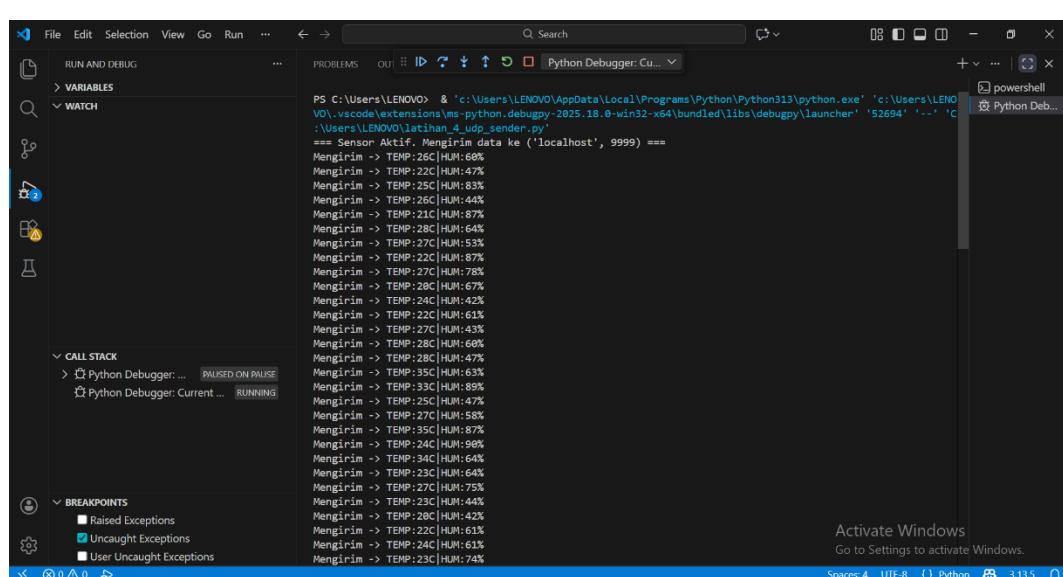
Praktikum Bab 4 kita akan menipulasikan lingkungan industri yaitu *Sender(client): Sebuah sensor suhu cerdas yang membaca data lingkungan dan menambahkannya ke server pusat setiap detik. *Recelver(server): Komputer pusat yang menampung data dari sebagai sensor. Dibawa ini adalah tampilan percobaan sederhana untuk membuktikan sifat UDP.

Hasil :



The screenshot shows the VS Code interface with the 'latihan_4_udp_receiver.py' file open in the Explorer. The terminal window displays the output of the script, which is monitoring a UDP port for sensor data. The data received consists of tuples (Sensor ID, Value) such as ('127.0.0.1', 50123). The output is as follows:

```
PS C:\Users\LENOVO & "c:\Users\LENOVO\AppData\Local\Programs\Python\Python311\python.exe" "c:\Users\LENOVO\vscode\extensions\ms-python.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher" "63788" "c:\Users\LENOVO\latihan_4_udp_receiver.py"
== UDP Monitoring Server Berjalan ==
Menunggu data sensor...
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:25|HUM:44%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:26|HUM:50%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:28|HUM:53%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:21|HUM:67%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:30|HUM:83%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:24|HUM:68%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:25|HUM:65%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:24|HUM:73%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:29|HUM:48%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:28|HUM:77%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:35|HUM:83%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:25|HUM:43%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:35|HUM:73%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:30|HUM:46%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:31|HUM:65%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:21|HUM:68%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:25|HUM:69%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:22|HUM:75%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:28|HUM:44%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:21|HUM:77%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:26|HUM:77%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:29|HUM:87%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:28|HUM:76%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:29|HUM:72%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:26|HUM:86%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:21|HUM:55%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:28|HUM:63%
[Sensor ('127.0.0.1', 50123)] Melaporkan: TEMP:26|HUM:79%
```



The screenshot shows the VS Code interface with the 'latihan_4_udp_sender.py' file open in the Explorer. The Python Debugger is active, showing a call stack and breakpoints. The terminal window displays the output of the script, which is sending sensor data to a local host. The data sent is as follows:

```
PS C:\Users\LENOVO & "c:\Users\LENOVO\AppData\Local\Programs\Python\Python311\python.exe" "c:\Users\LENOVO\vscode\extensions\ms-python.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher" "52694" "c:\Users\LENOVO\latihan_4_udp_sender.py"
== Sensor Aktif. Mengirim data ke ('localhost', 9999) ==
Mengirim -> TEMP:26|HUM:68%
Mengirim -> TEMP:22|HUM:47%
Mengirim -> TEMP:25|HUM:83%
Mengirim -> TEMP:26|HUM:44%
Mengirim -> TEMP:21|HUM:87%
Mengirim -> TEMP:28|HUM:64%
Mengirim -> TEMP:27|HUM:53%
Mengirim -> TEMP:22|HUM:87%
Mengirim -> TEMP:27|HUM:78%
Mengirim -> TEMP:28|HUM:67%
Mengirim -> TEMP:24|HUM:42%
Mengirim -> TEMP:22|HUM:61%
Mengirim -> TEMP:27|HUM:43%
Mengirim -> TEMP:28|HUM:66%
Mengirim -> TEMP:28|HUM:47%
Mengirim -> TEMP:35|HUM:63%
Mengirim -> TEMP:33|HUM:89%
Mengirim -> TEMP:25|HUM:47%
Mengirim -> TEMP:27|HUM:55%
Mengirim -> TEMP:35|HUM:87%
Mengirim -> TEMP:24|HUM:98%
Mengirim -> TEMP:34|HUM:64%
Mengirim -> TEMP:23|HUM:64%
Mengirim -> TEMP:27|HUM:75%
Mengirim -> TEMP:23|HUM:44%
Mengirim -> TEMP:28|HUM:42%
Mengirim -> TEMP:22|HUM:61%
Mengirim -> TEMP:24|HUM:61%
Mengirim -> TEMP:23|HUM:74%
```

BAB V

Error Handling & Framing Data

Praktikum Bab 5 kita belajar Framing dimana adalah seni membungkus data agar penerima tahu “oh,pesan dimulai di sini dan berakhir di sini”. Kemudian pada gambar ini akan sengaja mengirim banyak pesan dengan cepat untuk memaksa terjadinya Sticky Packet.

Hasil :

The image shows two side-by-side terminal windows in VS Code, each running a Python script related to a Sticky Packet experiment. The left terminal window shows the client side, and the right shows the server side. Both terminals output text indicating the exchange of multiple messages between them.

Client Side (Left Terminal):

```
PS C:\Users\LENOVO> & 'c:\Users\LENOVO\AppData\Local\Programs\Python\Python313\python.exe' 'c:\Users\LENOVO\vscode\extensions\ms-python.debugger-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '58767' '<< __main__.latihan_5_sticky_client.py'
*** Uji Coba Sticky Packet ===
Mengirim 10 pesan secepat kilat...
Selesai mengirim. Cek terminal Server!
PS C:\Users\LENOVO>
```

Server Side (Right Terminal):

```
PS C:\Users\LENOVO> & 'c:\Users\LENOVO\AppData\Local\Programs\Python\Python313\python.exe' 'c:\Users\LENOVO\vscode\extensions\ms-python.debugger-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '58722' '<< __main__.latihan_5_sticky_server.py'
*** Server Framing Siap (Port 5555) ===
[1] Koneksi dari ('127.0.0.1', 58777)
Terima Pesan Utuh: PesanKe-1|HaloServer
Terima Pesan Utuh: PesanKe-2|HaloServer
Error Server: [WinError 10054] An existing connection was forcibly closed by the remote host
```

BAB VI

Concurrency Part I – Threading

Praktikum Bab ini mempelajari bagaimana cara termudah menggunakan Threading, dibawah ini dimana membuat server sederhana *Fitur: Setiap pesan dari Client A akan diteruskan ke Client B, C, dan D. *Tantangan: Daftar clients adalah shared resource. Kita harus hati-hati saat menambahkan/menghapus anggota agar tidak tabrakan dengan proses broadcast. Gambar dibawa ini proses sederhana dari Thread jalankan server.

Hasil :

```
PS C:\Users\LENOVO> & C:/Users/LENOV/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOV/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61f980322ED2793A9A992CCBE D9388DC6AB236BD/transfers/2026-04/latihan_6_thread_server.py
[SERVER STARTED] Menunggu koneksi di port 5555...
[NEN CONNECTION] ('127.0.0.1', 63971) connected.
[ACTIVE CONNECTIONS] 1
[Client 63971]: selamat pagi
[Client 63971]: apa kabar ?
```

```
PS C:\Users\LENOVO> & C:/Users/LENOV/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOV/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61f980322ED2793A9A992CCBE D9388DC6AB236BD/transfers/2026-04/latihan_6_thread_client.py
Terhubung ke server. Ketik pesan, ketik 'bye' untuk keluar.
>> selamat pagi
Server: Selamat datang di Chat Room!
>> apa kabar ?
```

BAB VII

Serialisasi Data (JSON & Pickle)

Praktikum Bab ini dimana proses sederhana mengirim data yang terstruktur, JSON ini berupa karakteristik berbasis Teks dimana penggunaan melakukan pertukaran data antar aplikasi berbeda sedangkan Pickle berupa karakter berbasis Biner dimana bisa menyimpan hampir apa saja di python. Dibawah ini bagaimana kita menggunakan json.loads untuk membaca perintah dan json.dumps untuk membalas.

Hasil :

The image shows two side-by-side terminal windows from a code editor. Both terminals are running Python 3.13.5 on Windows 10. The top terminal window has a light theme and displays the following command and output:

```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CC8E D93880C6AB2368D/transfers/2026-04/latihan_7_json_server.py
*** Database Server (JSON) Berjalan di Port 6000 ***
[KONEKSI] Dari ('127.0.0.1', 64094)
[KONEKSI] Dari ('127.0.0.1', 64095)
```

The bottom terminal window has a dark theme and displays the following command and output:

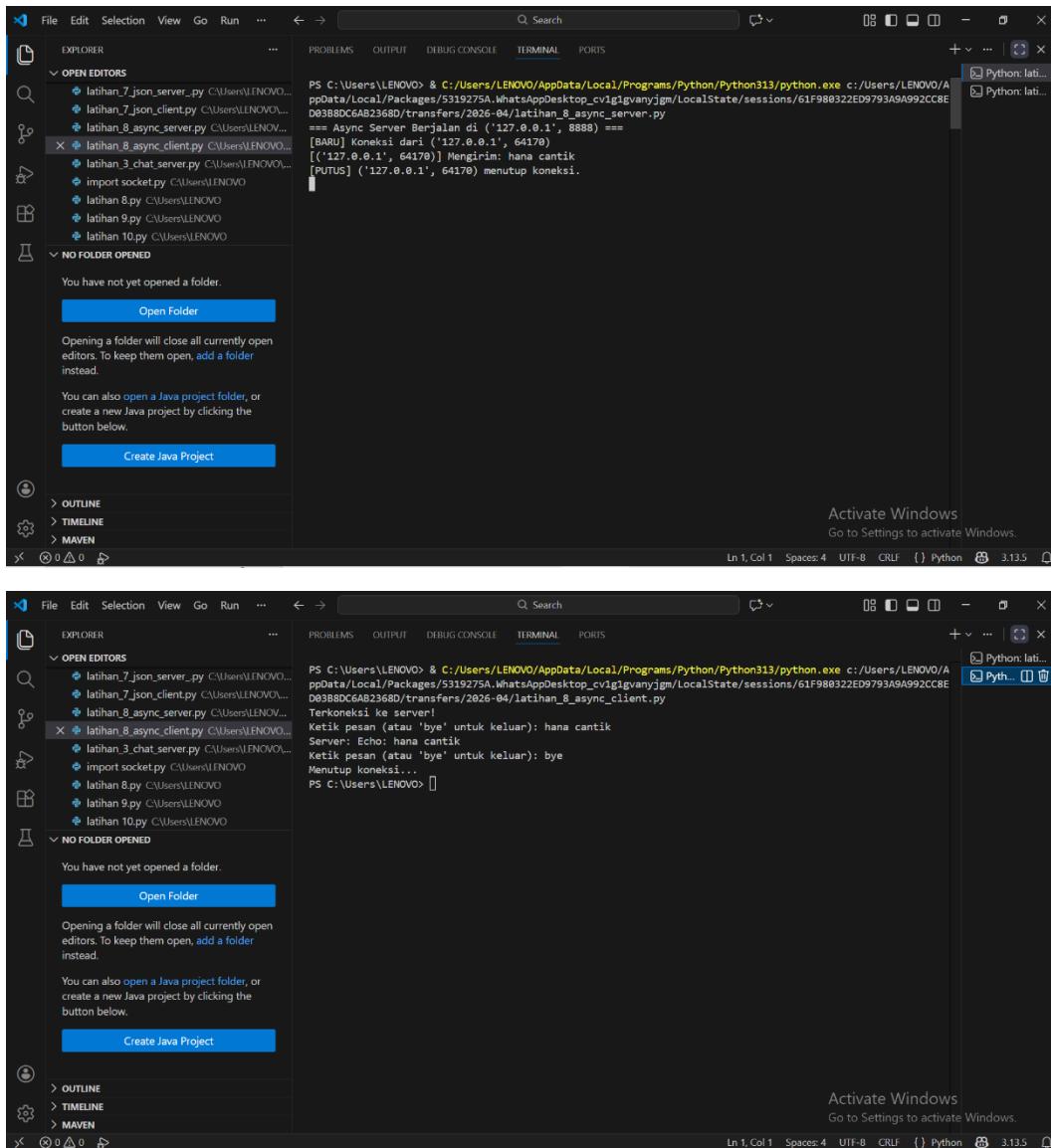
```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CC8E D93880C6AB2368D/transfers/2026-04/latihan_7_json_client.py
Mengirim request NIM: 101
Respon Server:
{
    "status": "SUKSES",
    "data": {
        "name": "Ulfa",
        "prodi": "Teknik Informatika",
        "ipk": 3.75
    }
}
-----
Mengirim request NIM: 999
Respon Server:
{
    "status": "GAGAL",
    "pesan": "NIM tidak ditemukan"
}
```

BAB VIII

Asynchronous I/O (Concurrency Part II)

Praktikum Bab 8 ini dimana mengimplementasikan server non-blocking menggunakan pustaka asyncio Python, mendiagnosa kesalahan umum dalam pemrograman async seperti Blocking Code yang memastikan Event Loop. Dibawa ini konsep Kirim pesan dari Client A lalu Client B berkomunikasi lancar tanpa jeda.

Hasil :



```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F98B322ED9793A9A992CC8E D9388DC6AB236BD/transfers/2026-04/latihan_8_async_server.py
==> Async Server Berjalan di ('127.0.0.1', 8888)
[BARU] Koneksi dari ('127.0.0.1', 64170)
[('127.0.0.1', 64170)] Mengirim: hana cantik
[PUTUS] ('127.0.0.1', 64170) menutup koneksi.

Activate Windows
Go to Settings to activate Windows.

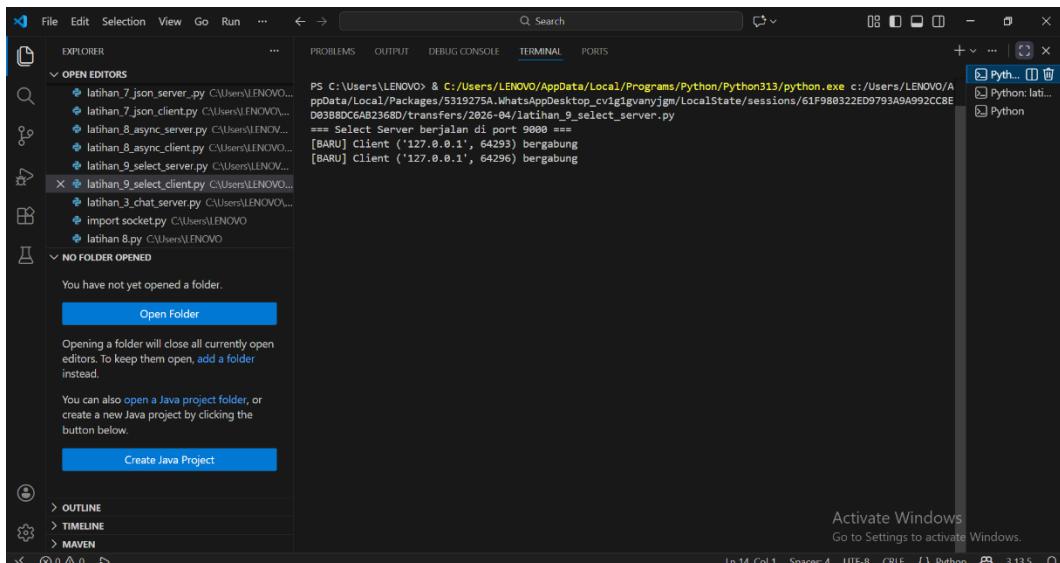
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F98B322ED9793A9A992CC8E D9388DC6AB236BD/transfers/2026-04/latihan_8_async_client.py
Terkoneksi ke server!
Ketik pesan (atau 'bye' untuk keluar): hana cantik
Server: Echo: hana cantik
Ketik pesan (atau 'bye' untuk keluar): bye
Menutup koneksi...
PS C:\Users\LENOVO>
```

BAB IX

I/O Multiplexing (select & poll)

Praktikum di Bab ini dimana menjelaskan mekanisme dasar kernel OS dalam memantau deskriptor file menggunakan select. Dibawah ini menunjukkan satu proses menangani banyak koneksi.

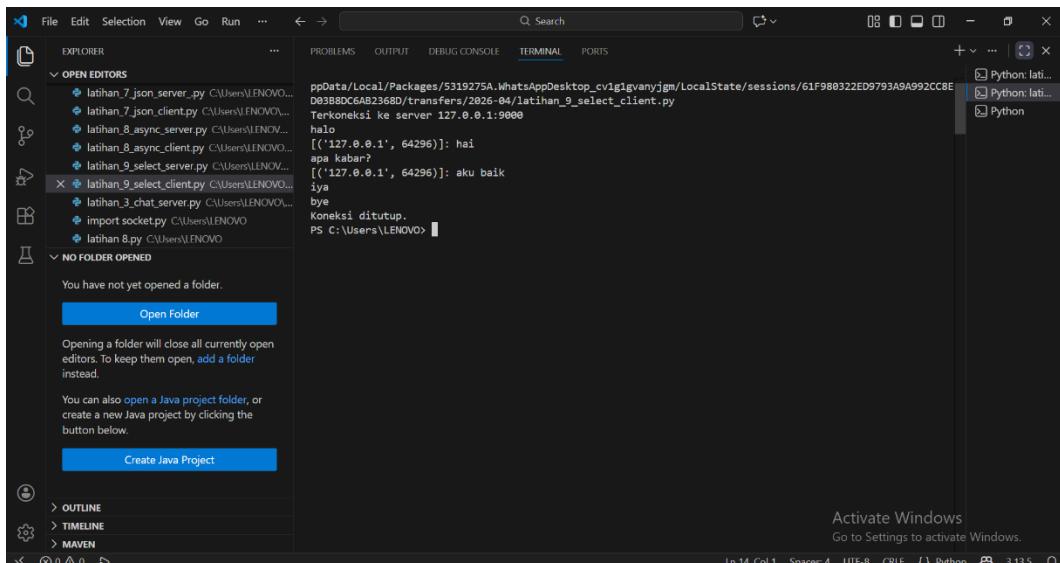
Hasil :



```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/AppData/Local/Packages/5319275A.WhatAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CCBE0388DCGAB236BD/transfers/2026-04/latihan_9_select_server.py
*** Select Server berjalan di port 9000 ***
[BARU] Client ('127.0.0.1', 64293) bergabung
[BARU] Client ('127.0.0.1', 64296) bergabung
```

Activate Windows
Go to Settings to activate Windows.

Ln 14, Col 1 Spaces: 4 UTF-8 CRLF { } Python 3:13.5



```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Packages/5319275A.WhatAppDesktop_cvg1gvanyjgm/LocalState/sessions/61F980322ED9793A9A992CCBE0388DCGAB236BD/transfers/2026-04/latihan_9_select_client.py
Terkoneksi ke server 127.0.0.1:9000
hai
apa kabar?
aku baik
iyah
bye
Koneksi ditutup.
PS C:\Users\LENOVO>
```

Activate Windows
Go to Settings to activate Windows.

Ln 14, Col 1 Spaces: 4 UTF-8 CRLF { } Python 3:13.5

The screenshot shows the Visual Studio Code (VS Code) interface. The terminal window at the bottom displays a Python session:

```
PS C:\Users\LENOVO> & C:/Users/LENOVO/AppData/Local/Programs/Python/Python313/python.exe c:/Users/LENOVO/A
ppData/Local/Packages/5319275A.WhatsAppDesktop_cvg1gvanyjgm/LocalState/sessions/61f988322ED9793A0A992CCBE
D9388DC6AB2368D/transfers/2026-04/latihan_9_select_client.py
Terkoneksi ke server 127.0.0.1:9000
hai
[("127.0.0.1", 64293)]: apa kabar?
aku baik
bye
Koneksi ditutup.
PS C:\Users\LENOVO>
```

The Explorer sidebar on the left lists several Python files:

- latihan_7_json_server.py
- latihan_7_json_client.py
- latihan_8_async_server.py
- latihan_8_async_client.py
- latihan_9_select_server.py
- latihan_9_select_client.py
- latihan_3_chat_server.py
- import socket.py
- latihan_8.py

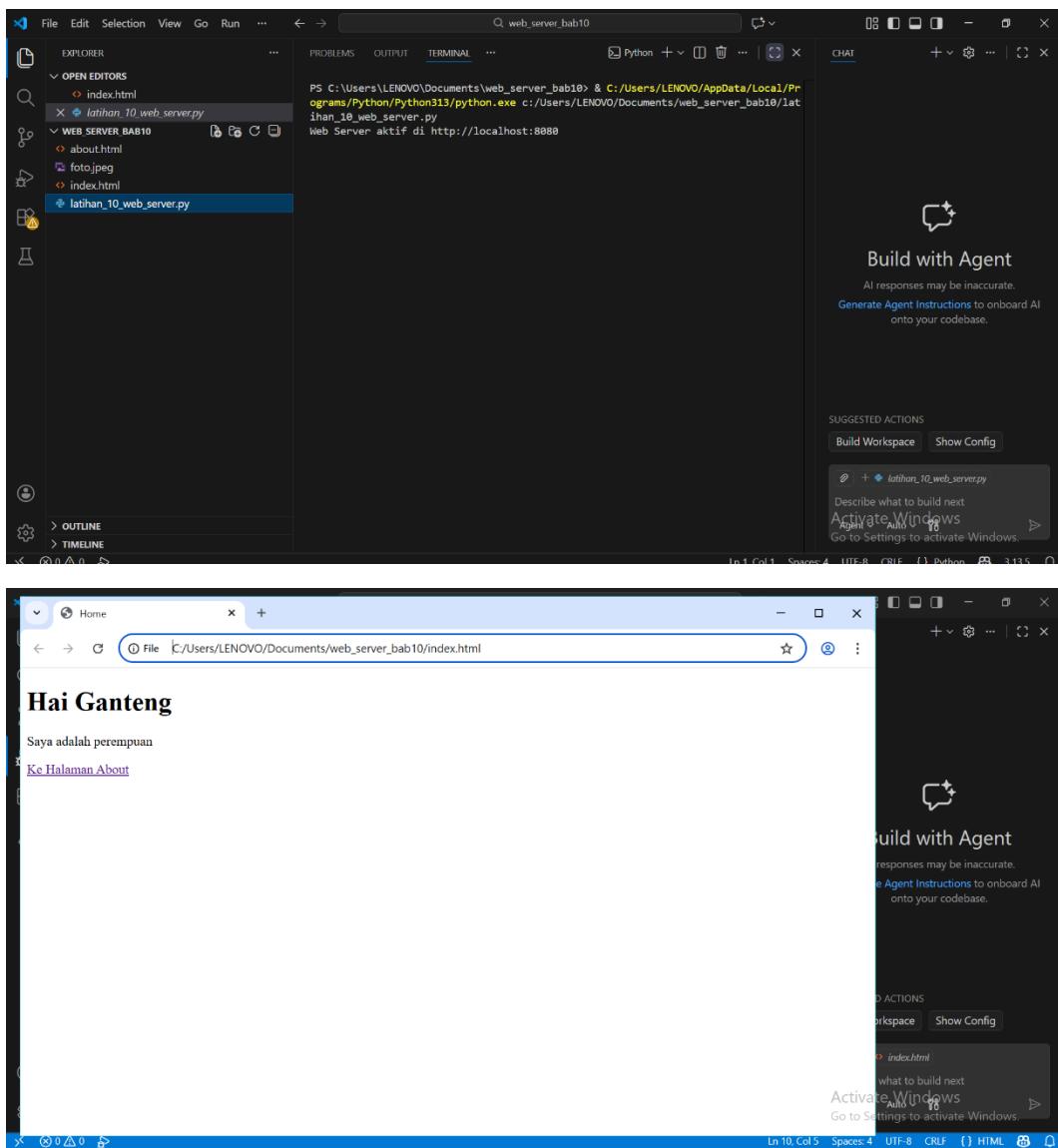
The status bar at the bottom right shows "Activate Windows" and "Go to Settings to activate Windows". It also displays "Ln 14, Col 1" and "Spaces: 4" along with other terminal settings.

BAB X

Protokol HTTP & Web Server

Pada praktikum Bab 10 ini kita membangun Web server sederhana, kemudian menguraikan struktur paket HTTP (header, body, status code, methods) secara mendetail. Dibawah ini HTTP bekerja dengan model request-response, gambar dibawah ini berhasil menyajikan dan memodifikasi server dengan format.

Hasil :

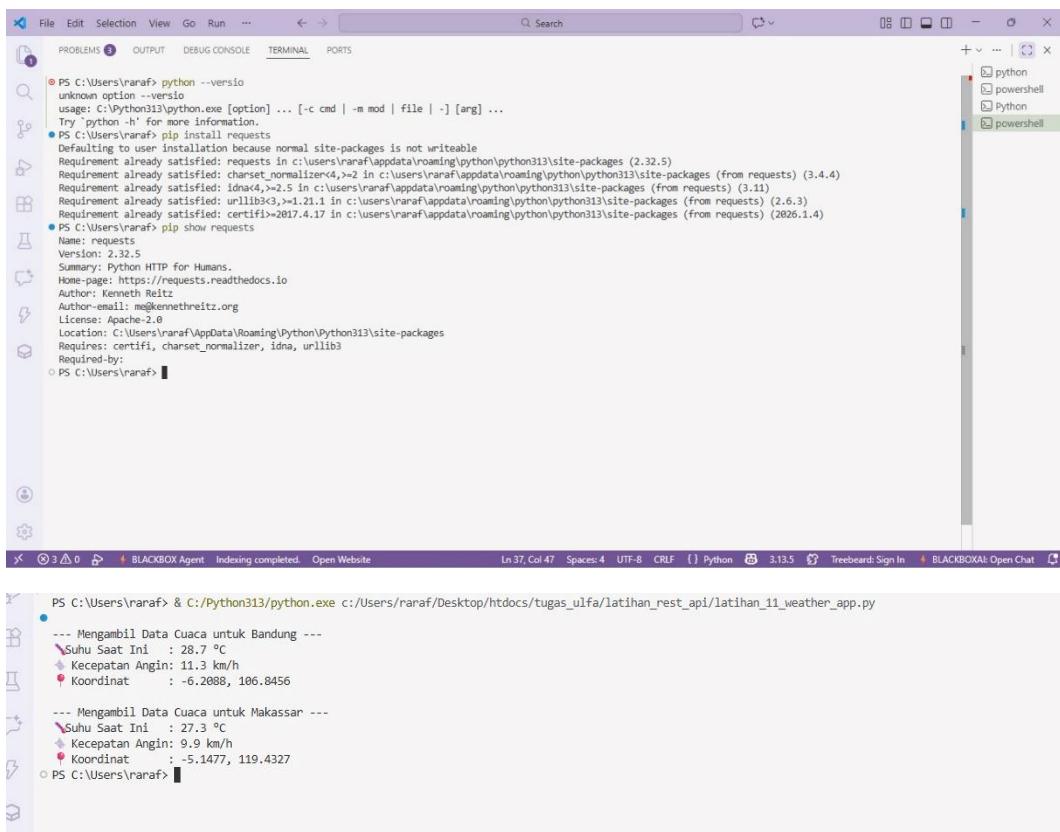


BAB XI

REST API & Web Services

Pada praktikum Bab ini dimana menjelaskan konsep dasar Web Service dan aritektur REST (representational state transfer). Gambar dibawa ini menunjukkan bahwa tampilan respons server terhadap permintaan client.

Hasil :



```
PS C:\Users\raraf> python --version
unknown option --versio
usage: C:/Python313/python.exe [option] ... [-c cmd | -m mod | file | -] [arg] ...
Try "python -h" for more information.

PS C:\Users\raraf> pip install requests
Defaulting to user installation because normal site-packages is not writable
Requirement already satisfied: requests in c:/users\raraf\appdata\roaming\python\python313\site-packages (2.32.5)
Requirement already satisfied: charset_normalizer<4,>=2 in c:/users\raraf\appdata\roaming\python\python313\site-packages (from requests) (3.4.4)
Requirement already satisfied: idna<4,>=2.5 in c:/users\raraf\appdata\roaming\python\python313\site-packages (from requests) (3.11)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:/users\raraf\appdata\roaming\python\python313\site-packages (from requests) (2.6.3)
Requirement already satisfied: certifi>=2017.4.17 in c:/users\raraf\appdata\roaming\python\python313\site-packages (from requests) (2026.1.4)
Requirement already satisfied: certifi, charset_normalizer, idna, urllib3
Required-by:
PS C:\Users\raraf> pip show requests
Name: requests
Version: 2.32.5
Summary: Python HTTP for Humans.
Home-page: https://requests.readthedocs.io
Author: Kenneth Reitz
Author-email: me@kennethreitz.org
License: Apache-2.0
Location: C:/Users/raraf/AppData/Roaming/Python/Python313/site-packages
Requires: certifi, charset_normalizer, idna, urllib3
Required-by:
PS C:\Users\raraf>

PS C:\Users\raraf> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/tugas_ulfat/latihan_rest_api/latihan_11_weather_app.py
--- Mengambil Data Cuaca untuk Bandung ---
Suhu Saat Ini : 28.7 °C
Kecepatan Angin: 11.3 km/h
Koordinat      : -6.2088, 106.8456

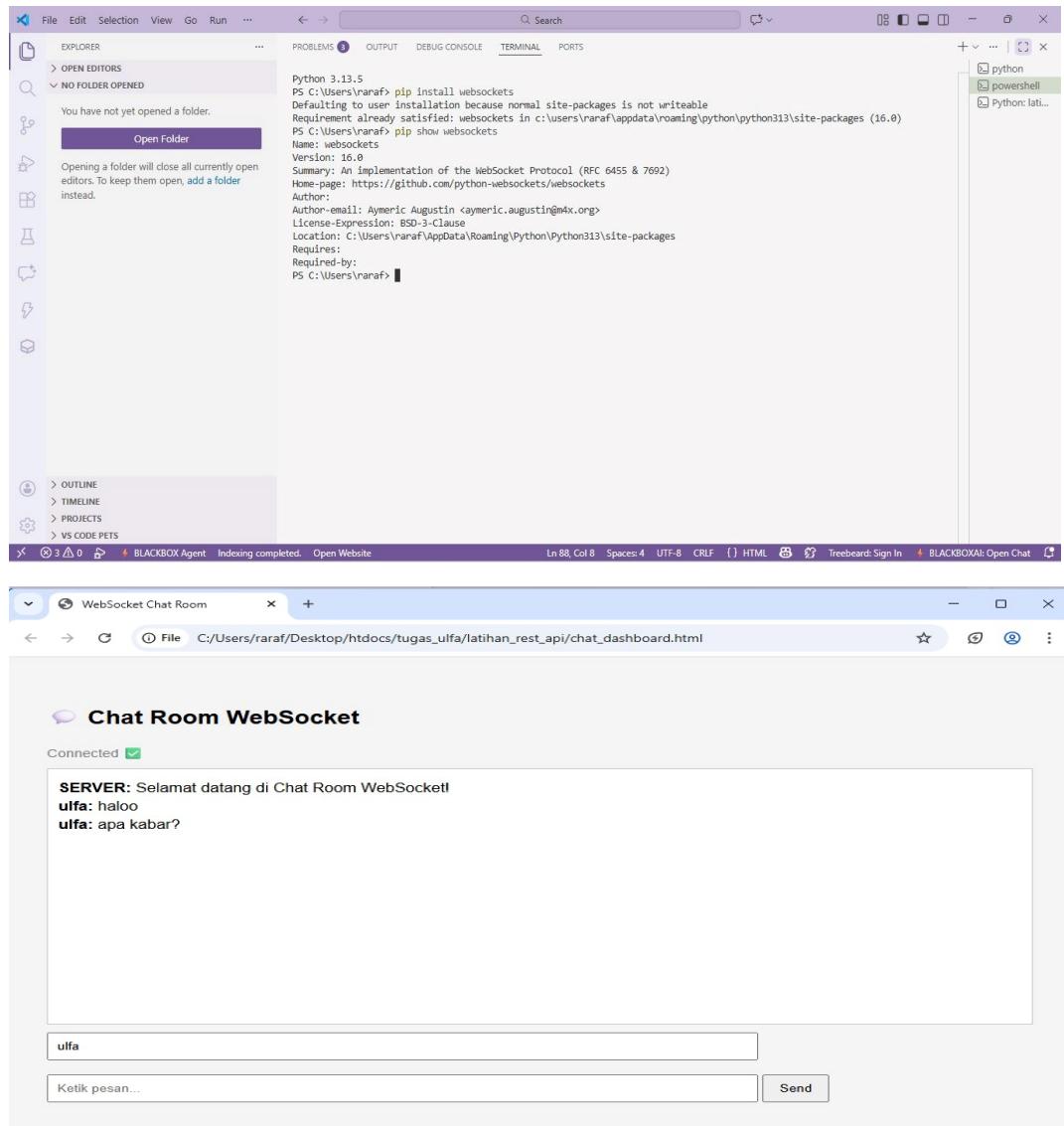
--- Mengambil Data Cuaca untuk Makassar ---
Suhu Saat Ini : 27.3 °C
Kecepatan Angin: 9.9 km/h
Koordinat      : -5.1477, 119.4327
PS C:\Users\raraf>
```

BAB XII

Real-time Communication (WebSocket)

Praktikum Bab 12 ini dimana membangun server WebSocket yang mampu melakukan Push Notification data secara real-time, dibawah ini mengintegrasikan Backend python dengan Frontend HTML/JS untuk visualisasi data langsung. Gambar dibawa ini adalah desain untuk dokumentasi statis client minta server.

Hasil :



The screenshot shows a terminal window within a code editor interface. The terminal tab is active, displaying the following log output:

```
PS C:\Users\raraf> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/tugas_ulfa/latihan_rest_api/latihan_12_ws_chat_server.py
*** WebSocket Chat Server running on ws://localhost:6789 ***
[NEW] Client terhubung
[RECEIVED] {"sender": "ulfa", "message": "haloo"}
[RECEIVED] {"sender": "ulfa", "message": "apa kabar?"}
[INFO] Client dihapus dari daftar
```

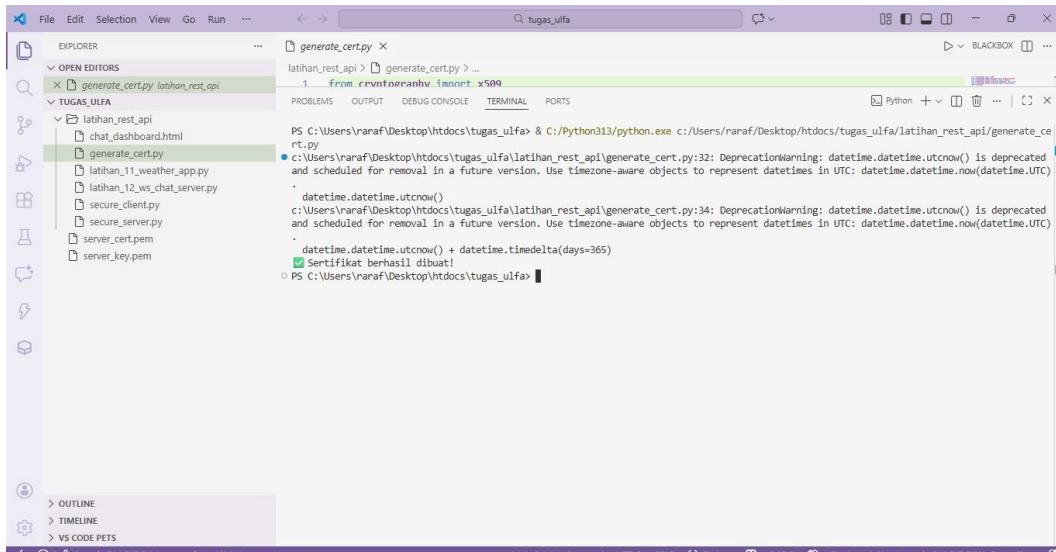
The terminal window has tabs for PROBLEMS, OUTPUT, DEBUG CONSOLE, TERMINAL, and PORTS. The right sidebar shows project navigation with sections for python, powershell, and Python. The bottom status bar shows file paths, line numbers, and other system information.

BAB XIII

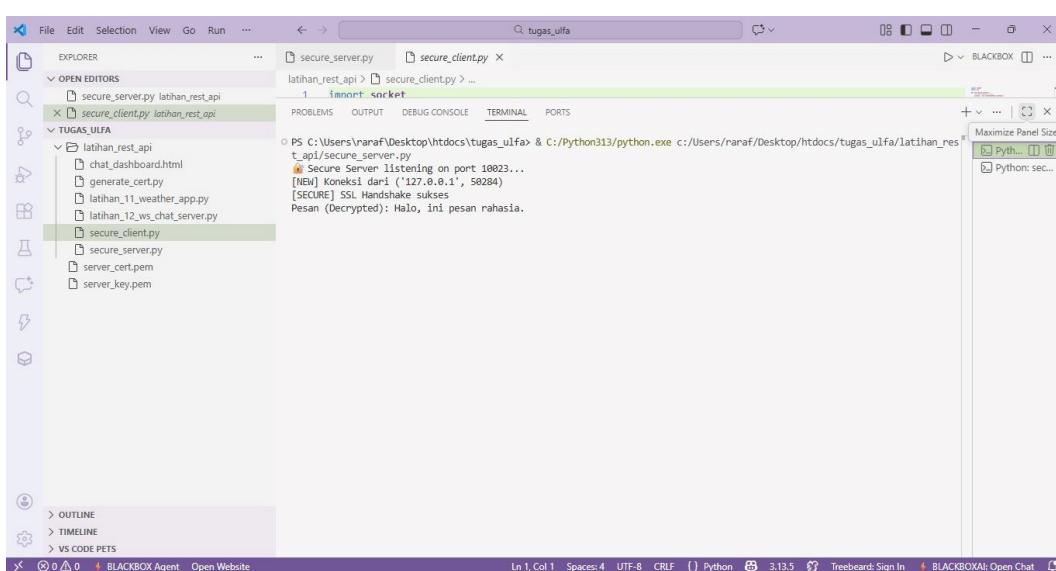
Keamanan Jaringan (Network Security)

Praktikum Bab ini menganalisis kerentanan komunikasi data plaintext terhadap serangan sniffing dan man-in-the-meddle. Dibawah ini tampilan mendemonstrasikan penggunaan modul python untuk mengenkripsi lalu lintas aplikasi Client-Server.

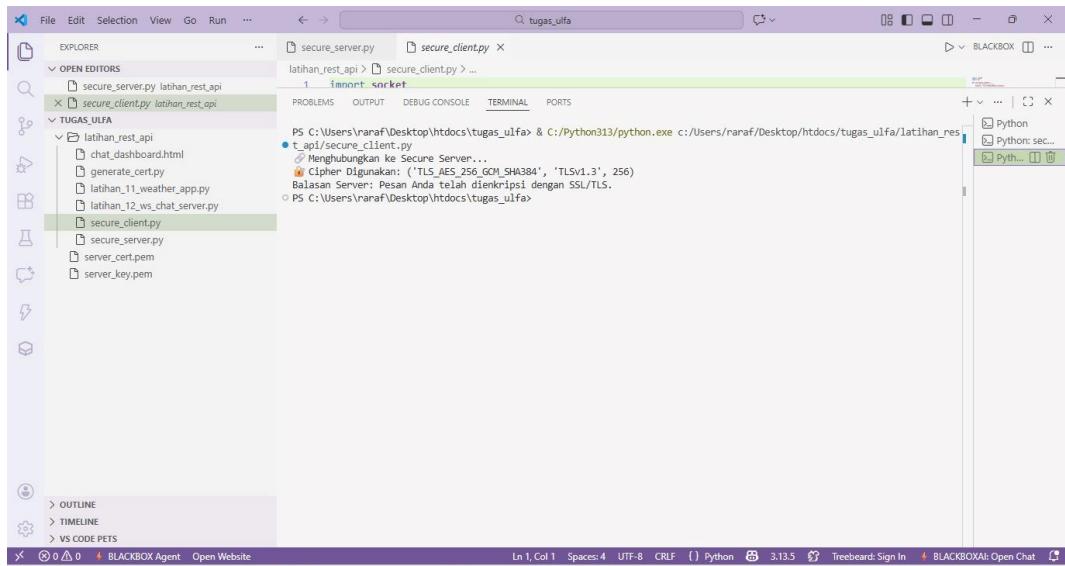
Hasil :



The screenshot shows the VS Code interface with the file `generate_cert.py` open in the editor. The terminal window displays the command `python generate_cert.py` being run, which generates a certificate. A message in the terminal says "Sertifikat berhasil dibuat!" (Certificate successfully created!).



The second screenshot shows the VS Code interface with the files `secure_server.py` and `secure_client.py` open. The terminal window shows a client connecting to a server on port 10022. The server responds with "Koneksi dari ('127.0.0.1', 50284)" and "[SECURE] SSL Handshake sukses". The client then sends a message "Pesan (Decrypted): Halo, ini pesan rahasia."



BAB XIV

Arsitektur Sistem Terdistribusi & IoT (MQTT)

Praktikum Bab ini dimana pelaksanaan proses sederhana dalam peran Broker sebagai perantara pesan dalam sistem terdistribusi. Gambar ini menunjukkan pengimplementasian komunikasi data sensor menggunakan protokol MQLL dan pustaka paho-mqtt dan mengevaluasi tingkat keandalan data.

Hasil :

The image shows two side-by-side terminal windows from a code editor interface. Both windows have the title bar "tugas_uifa" and the command "PS C:\Users\raraf\Desktop\htdocs\tugas_uifa> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/tugas_uifa/latihan_res_t_api/latihan_14_mqtt_pub.py".

Terminal 1 (Left):

```
PS C:\Users\raraf\Desktop\htdocs\tugas_uifa> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/tugas_uifa/latihan_res_t_api/latihan_14_mqtt_pub.py
c:/Users/raraf/Desktop/htdocs/tugas_uifa\latihan_res_t_api\latihan_14_mqtt_pub.py:15: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  client = mqtt.Client()
[SIKSES] Terhubung ke broker.hivemq.com...
```

Terminal 2 (Right):

```
PS C:\Users\raraf\Desktop\htdocs\tugas_uifa> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/tugas_uifa/latihan_res_t_api/latihan_14_mqtt_sub.py
c:/Users/raraf/Desktop/htdocs/tugas_uifa\latihan_res_t_api\latihan_14_mqtt_sub.py:32: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  on_message = on_message
    client = mqtt.Client()
Menghubungkan ke broker.broken.hivemq.com...
```

Data Exchange:

Terminal 1 (Pub):

- Data Masuk dari [Lab_komputer]: 23.09°C
- Data Masuk dari [Lab_komputer]: 22.66°C
- Data Masuk dari [Kantin]: 31.47°C
- Data Masuk dari [Kantin]: 29.80°C
- Data Masuk dari [Lab_komputer]: 24.62°C
- Data Masuk dari [Kantin]: 31.50°C
- Data Masuk dari [Lab_komputer]: 28.71°C
- Data Masuk dari [Kantin]: 31.28°C
- Data Masuk dari [Lab_komputer]: 23.26°C
- Data Masuk dari [Kantin]: 31.31°C
- Data Masuk dari [Lab_komputer]: 24.40°C
- Data Masuk dari [Lab_komputer]: 28.77°C
- Data Masuk dari [Kantin]: 28.03°C
- Data Masuk dari [Lab_komputer]: 24.01°C
- Data Masuk dari [Kantin]: 31.63°C
- Data Masuk dari [Lab_komputer]: 23.88°C
- Data Masuk dari [Kantin]: 29.52°C
- Data Masuk dari [Lab_komputer]: 24.15°C
- Data Masuk dari [Kantin]: 29.67°C
- Data Masuk dari [Lab_komputer]: 21.73°C
- Data Masuk dari [Kantin]: 30.94°C
- Data Masuk dari [Lab_komputer]: 22.73°C
- Data Masuk dari [Kantin]: 30.40°C
- Data Masuk dari [Lab_komputer]: 23.08°C
- Data Masuk dari [Kantin]: 30.50°C
- Data Masuk dari [Lab_komputer]: 22.21°C
- Data Masuk dari [Kantin]: 28.81°C
- Data Masuk dari [Lab_komputer]: 22.71°C

Terminal 2 (Sub):

- Mengirim 23.09°C ke Lab Komputer
- Mengirim 31.47°C ke Kantin
- Mengirim 22.66°C ke Lab Komputer
- Mengirim 29.80°C ke Kantin
- Mengirim 24.62°C ke Lab Komputer
- Mengirim 31.50°C ke Kantin
- Mengirim 28.71°C ke Lab Komputer
- Mengirim 23.28°C ke Kantin
- Mengirim 23.26°C ke Lab Komputer
- Mengirim 31.31°C ke Kantin
- Mengirim 24.04°C ke Lab Komputer
- Mengirim 30.74°C ke Kantin
- Mengirim 28.77°C ke Lab Komputer
- Mengirim 28.03°C ke Kantin
- Mengirim 24.01°C ke Lab Komputer
- Mengirim 31.63°C ke Kantin
- Mengirim 23.88°C ke Lab Komputer
- Mengirim 29.52°C ke Kantin
- Mengirim 24.15°C ke Lab Komputer
- Mengirim 29.67°C ke Kantin
- Mengirim 21.73°C ke Lab Komputer
- Mengirim 30.94°C ke Kantin
- Mengirim 22.73°C ke Lab Komputer
- Mengirim 28.49°C ke Kantin
- Mengirim 23.08°C ke Lab Komputer
- Mengirim 30.50°C ke Kantin
- Mengirim 22.21°C ke Lab Komputer
- Mengirim 28.81°C ke Kantin
- Mengirim 22.71°C ke Lab Komputer
- Mengirim 31.08°C ke Kantin

BAB XV

Penutup & Proyek Akhir (Capstone Project)

Praktikum pada Bab 15 ini dimana proses sederhana merancang arsitektur sistem jaringan berskala kompleks yang mengintegrasikan minimal 3 protokol berbeda (HTTP, WebSocket, TCP), Gambar dibawah ini menunjukkan berhasilnya mengevaluasi performa dan keamanan sistem jaringan yang telah dibangun hasil susunan rancang dari pengembangan diri untuk karier dibidang Network Engineering atau Backend Development.

Hasil :

```
PS C:\Users\raraf\Desktop\htdocs\tugas_uifa>
PS C:\Users\raraf\Desktop\htdocs\tugas_uifa> & C:/Python33/python.exe c:/Users/raraf/Desktop\htdocs\tugas_uifa\latihan_rest_api/generate_cert.py
c:/Users/raraf/Desktop\htdocs\tugas_uifa\latihan_rest_api/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()
[...]
[SERVER] REST API aktif di port 8000
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 62.7, 'suhu': 32.08, 'timestamp': '2026-01-28 13:53:08'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 23.34, 'suhu': 30.49, 'timestamp': '2026-01-28 13:53:10'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 54.94, 'suhu': 28.11, 'timestamp': '2026-01-28 13:53:12'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 60.61, 'suhu': 25.91, 'timestamp': '2026-01-28 13:53:14'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 43.46, 'suhu': 29.77, 'timestamp': '2026-01-28 13:53:16'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 55.11, 'suhu': 31.01, 'timestamp': '2026-01-28 13:53:18'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 28.23, 'suhu': 29.78, 'timestamp': '2026-01-28 13:53:20'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 24.66, 'suhu': 34.35, 'timestamp': '2026-01-28 13:53:22'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 63.6, 'suhu': 30.59, 'timestamp': '2026-01-28 13:53:24'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 61.55, 'suhu': 26.0, 'timestamp': '2026-01-28 13:53:26'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 52.86, 'suhu': 27.0, 'timestamp': '2026-01-28 13:53:28'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 49.2, 'suhu': 32.37, 'timestamp': '2026-01-28 13:53:30'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 34.17, 'suhu': 29.89, 'timestamp': '2026-01-28 13:53:31'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 36.0, 'suhu': 32.63, 'timestamp': '2026-01-28 13:53:33'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 68.43, 'suhu': 33.43, 'timestamp': '2026-01-28 13:53:37'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 51.0, 'suhu': 30.94, 'timestamp': '2026-01-28 13:53:39'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 67.43, 'suhu': 34.7, 'timestamp': '2026-01-28 13:53:42'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 49.31, 'suhu': 26.55, 'timestamp': '2026-01-28 13:53:44'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 28.27, 'suhu': 25.77, 'timestamp': '2026-01-28 13:53:46'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 62.56, 'suhu': 27.49, 'timestamp': '2026-01-28 13:53:48'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 20.24, 'suhu': 26.72, 'timestamp': '2026-01-28 13:53:50'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 41.12, 'suhu': 27.7, 'timestamp': '2026-01-28 13:53:52'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 58.99, 'suhu': 30.23, 'timestamp': '2026-01-28 13:53:54'}
[SERVER] Data diterima: {'agent': 'agent1', 'cpu': 69.49, 'suhu': 25.53, 'timestamp': '2026-01-28 13:53:56'}
127.0.0.1 - - [28/Jan/2026 13:53:57] "OPTIONS /login HTTP/1.1" 501 -
127.0.0.1 - - [28/Jan/2026 13:53:57] "OPTIONS /login HTTP/1.1" 501 -
```

The screenshot shows a terminal window titled "tugas_ufa" with the following content:

```
PS C:\Users\raraF\Desktop\htdocs\tugas_ufa> & C:/Python313/python.exe c:/Users/raraF/Desktop/htdocs\tugas_ufa\capstone_project\agent.py:10: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  client = mqtt.Client()
[AGENT] Sensor berjalan...
[AGENT] Kirim: ('agent1', 'cpu': 62.7, 'suhu': 32.03, 'timestamp': '2026-01-28 13:53:08')
[AGENT] Kirim: ('agent1', 'cpu': 23.34, 'suhu': 30.49, 'timestamp': '2026-01-28 13:53:08')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 54.94, 'suhu': 28.11, 'timestamp': '2026-01-28 13:53:12')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 68.61, 'suhu': 28.91, 'timestamp': '2026-01-28 13:53:14')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 43.46, 'suhu': 29.77, 'timestamp': '2026-01-28 13:53:16')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 55.11, 'suhu': 31.61, 'timestamp': '2026-01-28 13:53:18')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 38.23, 'suhu': 28.78, 'timestamp': '2026-01-28 13:53:20')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 54.35, 'suhu': 34.35, 'timestamp': '2026-01-28 13:53:22')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 63.6, 'suhu': 30.39, 'timestamp': '2026-01-28 13:53:24')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 61.55, 'suhu': 26.8, 'timestamp': '2026-01-28 13:53:26')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 52.86, 'suhu': 27.8, 'timestamp': '2026-01-28 13:53:28')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 47.75, 'suhu': 32.37, 'timestamp': '2026-01-28 13:53:31')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 34.17, 'suhu': 29.89, 'timestamp': '2026-01-28 13:53:33')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 36.9, 'suhu': 32.03, 'timestamp': '2026-01-28 13:53:35')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 60.43, 'suhu': 33.43, 'timestamp': '2026-01-28 13:53:37')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 51.8, 'suhu': 38.94, 'timestamp': '2026-01-28 13:53:39')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 67.43, 'suhu': 34.7, 'timestamp': '2026-01-28 13:53:42')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 49.31, 'suhu': 26.55, 'timestamp': '2026-01-28 13:53:44')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 28.27, 'suhu': 25.77, 'timestamp': '2026-01-28 13:53:46')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 62.56, 'suhu': 27.49, 'timestamp': '2026-01-28 13:53:48')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 28.24, 'suhu': 28.72, 'timestamp': '2026-01-28 13:53:50')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 41.12, 'suhu': 27.7, 'timestamp': '2026-01-28 13:53:52')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 58.99, 'suhu': 30.23, 'timestamp': '2026-01-28 13:53:54')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 59.4, 'suhu': 28.53, 'timestamp': '2026-01-28 13:53:56')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 31.95, 'suhu': 31.0, 'timestamp': '2026-01-28 13:53:58')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 57.03, 'suhu': 30.15, 'timestamp': '2026-01-28 13:54:00')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 33.26, 'suhu': 31.28, 'timestamp': '2026-01-28 13:54:02')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 50.5, 'suhu': 34.09, 'timestamp': '2026-01-28 13:54:04')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 36.03, 'suhu': 31.77, 'timestamp': '2026-01-28 13:54:07')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 49.79, 'suhu': 27.48, 'timestamp': '2026-01-28 13:54:09')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 58.8, 'suhu': 31.45, 'timestamp': '2026-01-28 13:54:11')
[AGENT] Kirim: ('agent': 'agent1', 'cpu': 21.55, 'suhu': 32.17, 'timestamp': '2026-01-28 13:54:13')
```