LAPORAN PRAKTIKUM PEMROGRAMAN JARINGAN

Mata Kuliah : Bahasa Pemrograman Jaringan

Disusun oleh:

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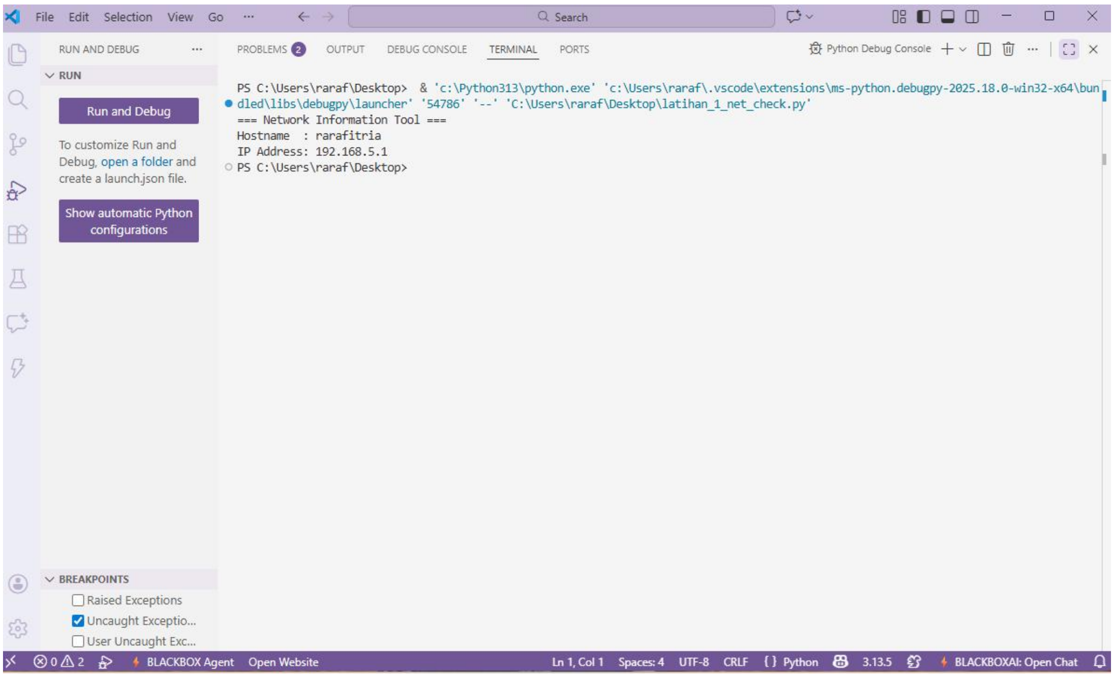
FAKULTAS ILMU KOMPUTER
PROGRAM STUDI TEKNIK INFORMATIKA
UNIVERSITAS INDONESIA TIMUR
MAKASSAR
2026

Bab 1 : Konsep Dasar Pemrograman Jaringan

Hasil :



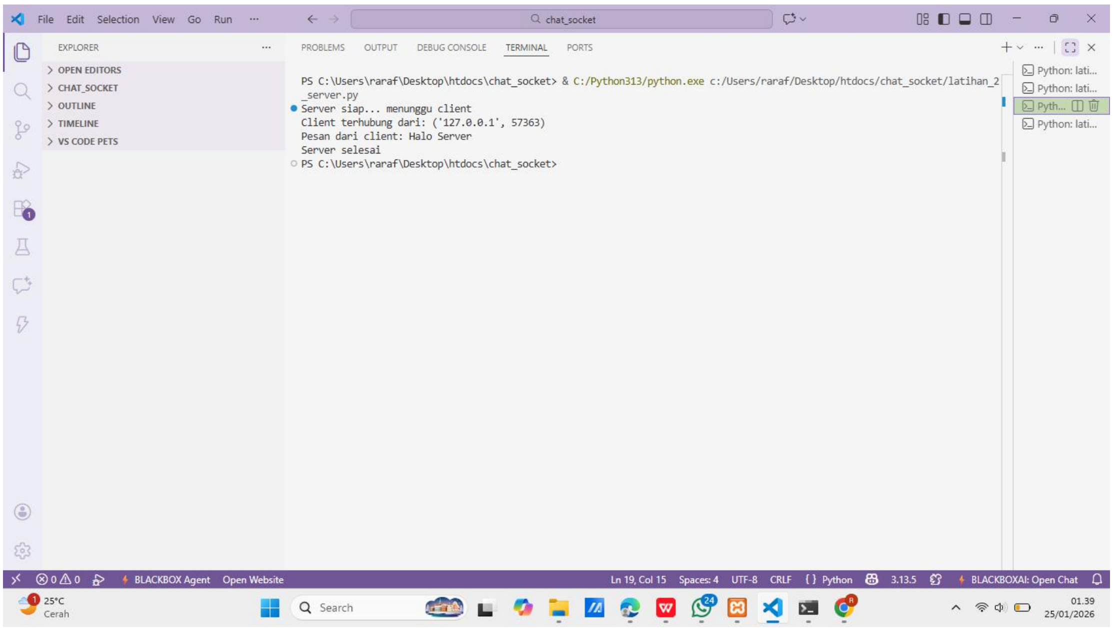
To customize Run and Debug, open a folder and create a launch.json file.

```
PS C:\Users\raraf\Desktop>  & 'c:\Python313\python.exe' 'c:\Users\raraf\.vscode\extensions\ms-python.debugpy-2025.18.0-win32-x64\bun
dled\libs\debugpy\launcher' '54786' '--' 'C:\Users\raraf\Desktop\latihan_1_net_check.py'
=== Network Information Tool ===
Hostname  : rarafitria
IP Address: 192.168.5.1
PS C:\Users\raraf\Desktop>
```

Penjelasan:
Pada bab ini dilakukan pengenalan konsep dasar pemrograman jaringan menggunakan bahasa pemrograman Python. Percobaan bertujuan untuk memahami bagaimana dua komputer atau lebih dapat saling berkomunikasi melalui jaringan. Hasil percobaan menunjukkan bahwa program berhasil dijalankan dan mampu menampilkan informasi dasar jaringan seperti hostname dan alamat IP. Dari hasil ini dapat disimpulkan bahwa lingkungan pemrograman jaringan telah berjalan dengan baik dan siap digunakan untuk praktikum lanjutan.

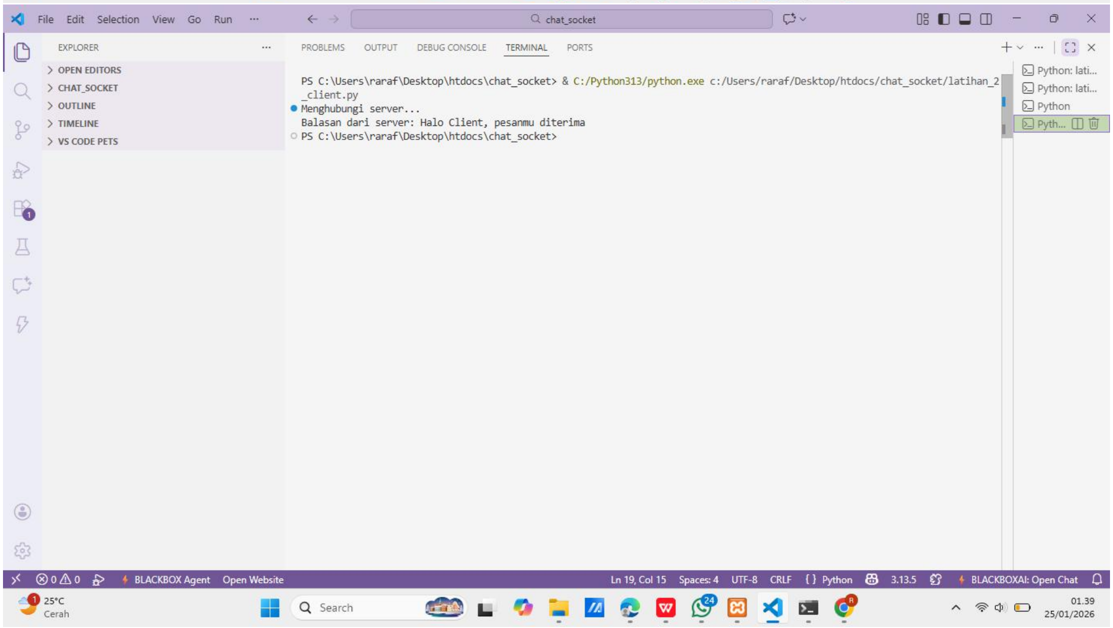
Bab 2 : Socket API Dasar

Hasil :



File Edit Selection View Go Run ···
chat_socket
EXPLORER
OPEN EDITORS
CHAT_SOCKET
OUTLINE
TIMELINE
VS CODE PETS
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Python: lati...
Ln 19, Col 15 Spaces: 4 UTF-8 CRLF { } Python 3.13.5
BLACKBOX Agent Open Website BLACKBOXAI: Open Chat
25°C Cerah
Search
01.39 25/01/2026

```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_2
_server.py
Server siap... menunggu client
Client terhubung dari: ('127.0.0.1', 57363)
Pesan dari client: Halo Server
Server selesai
PS C:\Users\raraf\Desktop\htdocs\chat_socket>
```



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chat_socket
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Python: lati...
Python
Ln 19, Col 15 Spaces: 4 UTF-8 CRLF { } Python 3.13.5
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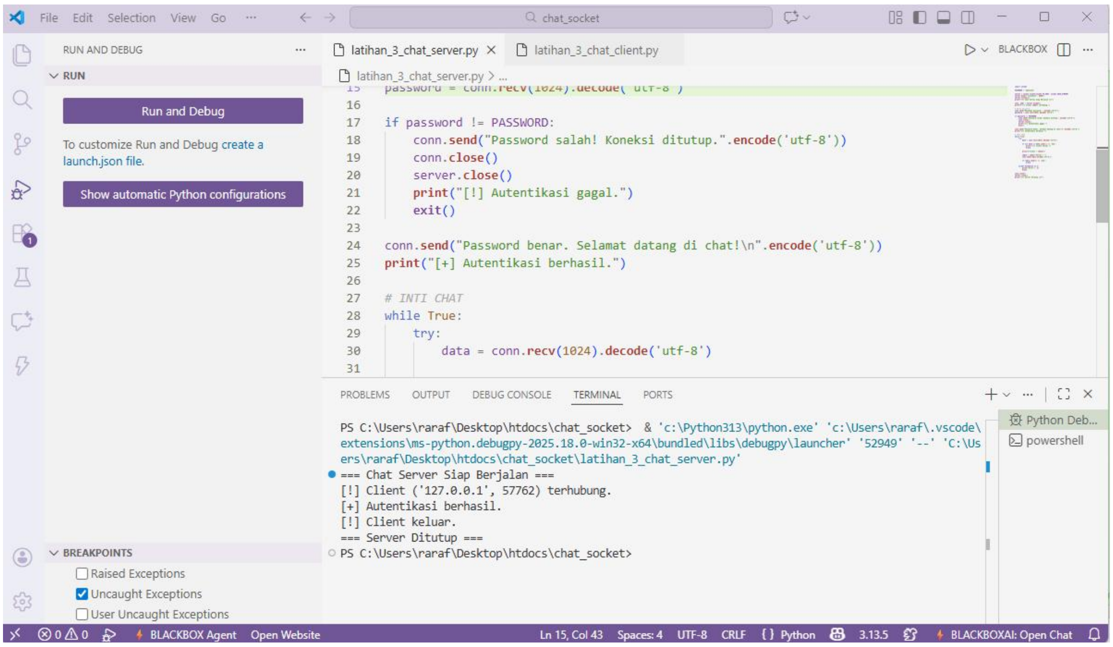
```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_2
_client.py
Menghubungi server...
Balasan dari server: Halo Client, pesanmu diterima
PS C:\Users\raraf\Desktop\htdocs\chat_socket>
```

Penjelasan:

Bab ini membahas penggunaan Socket API sebagai dasar komunikasi jaringan. Server dibuat untuk menunggu koneksi dari client, sedangkan client berfungsi untuk mengirim permintaan koneksi. Hasil percobaan menunjukkan bahwa koneksi antara client dan server berhasil dilakukan. Server mampu menerima koneksi dan menampilkan informasi client yang terhubung. Hal ini membuktikan bahwa mekanisme socket dasar telah dipahami dan berjalan sesuai dengan konsep teori.

Bab 3 : Protokol TCP (Aplikasi Chat)

Hasil :



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chat_socket
RUN AND DEBUG
RUN
Run and Debug
To customize Run and Debug create a launch.json file.
Show automatic Python configurations
BREAKPOINTS
□ Raised Exceptions
☑ Uncaught Exceptions
□ User Uncaught Exceptions
latihan_3_chat_server.py
latihan_3_chat_client.py
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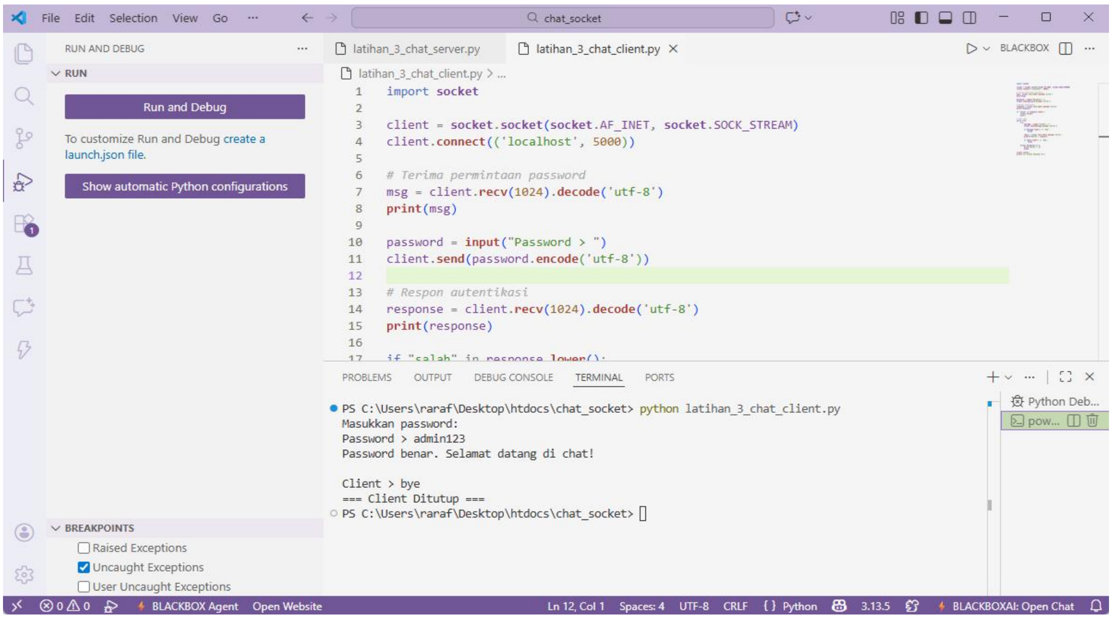
Python Deb...
powershell
BLACKBOX Agent Open Website
Ln 15, Col 43 Spaces: 4 UTF-8 CRLF { } Python 3.13.5 BLACKBOXAI: Open Chat

```python
password = conn.recv(1024).decode('utf-8')

if password != PASSWORD:
    conn.send("Password salah! Koneksi ditutup.".encode('utf-8'))
    conn.close()
    server.close()
    print("[!] Autentikasi gagal.")
    exit()

conn.send("Password benar. Selamat datang di chat!\n".encode('utf-8'))
print("[+] Autentikasi berhasil.")

# INTI CHAT
while True:
    try:
        data = conn.recv(1024).decode('utf-8')

```

```
PS C:\Users\raraf\Desktop\htdocs\chat_socket>  & 'c:\Python313\python.exe' 'c:\Users\raraf\.vscode\
extensions\ms-python.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '52949' '--' 'C:\Us
ers\raraf\Desktop\htdocs\chat_socket\latihan_3_chat_server.py'
=== Chat Server Siap Berjalan ===
[!] Client ('127.0.0.1', 57762) terhubung.
[+] Autentikasi berhasil.
[!] Client keluar.
=== Server Ditutup ===
PS C:\Users\raraf\Desktop\htdocs\chat_socket>
```



File Edit Selection View Go
chat_socket
RUN AND DEBUG
RUN
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To customize Run and Debug create a launch.json file.
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latihan_3_chat_server.py
latihan_3_chat_client.py
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PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Python Deb...
pow...
BLACKBOX Agent Open Website
Ln 12, Col 1 Spaces: 4 UTF-8 CRLF { } Python 3.13.5 BLACKBOXAI: Open Chat

```python
import socket

client = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
client.connect(('localhost', 5000))

# Terima permintaan password
msg = client.recv(1024).decode('utf-8')
print(msg)

password = input("Password > ")
client.send(password.encode('utf-8'))

# Respon autentikasi
response = client.recv(1024).decode('utf-8')
print(response)

if "salah" in response.lower():
```

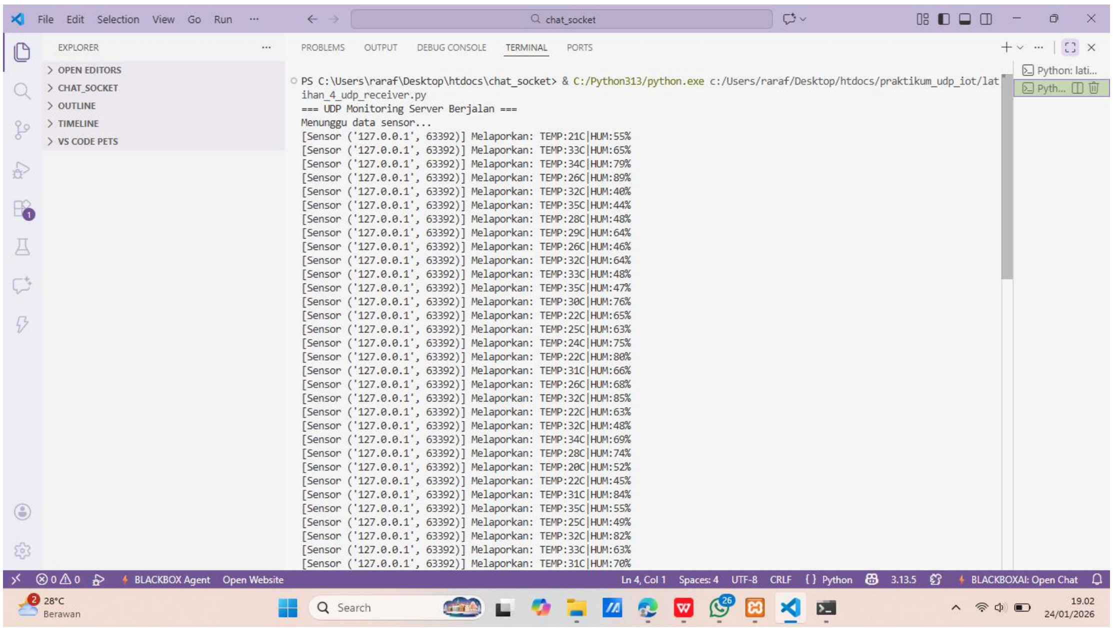
```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> python latihan_3_chat_client.py
Masukkan password:
Password > admin123
Password benar. Selamat datang di chat!

Client > bye
=== Client Ditutup ===
PS C:\Users\raraf\Desktop\htdocs\chat_socket> 
```

Penjelasan:

Pada bab ini diimplementasikan aplikasi chat sederhana berbasis protokol TCP. TCP digunakan karena bersifat connection-oriented dan menjamin keandalan pengiriman data. Hasil percobaan menunjukkan bahwa client dan server dapat saling bertukar pesan secara dua arah. Ketika client mengirim pesan, server dapat menerima dan menampilkannya, begitu pula sebaliknya. Aplikasi juga dapat menghentikan komunikasi ketika client mengirimkan perintah tertentu seperti “bye”.

Bab 4 : Protokol UDP (Streaming & Broadcasting)

Hasil :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chat_socket
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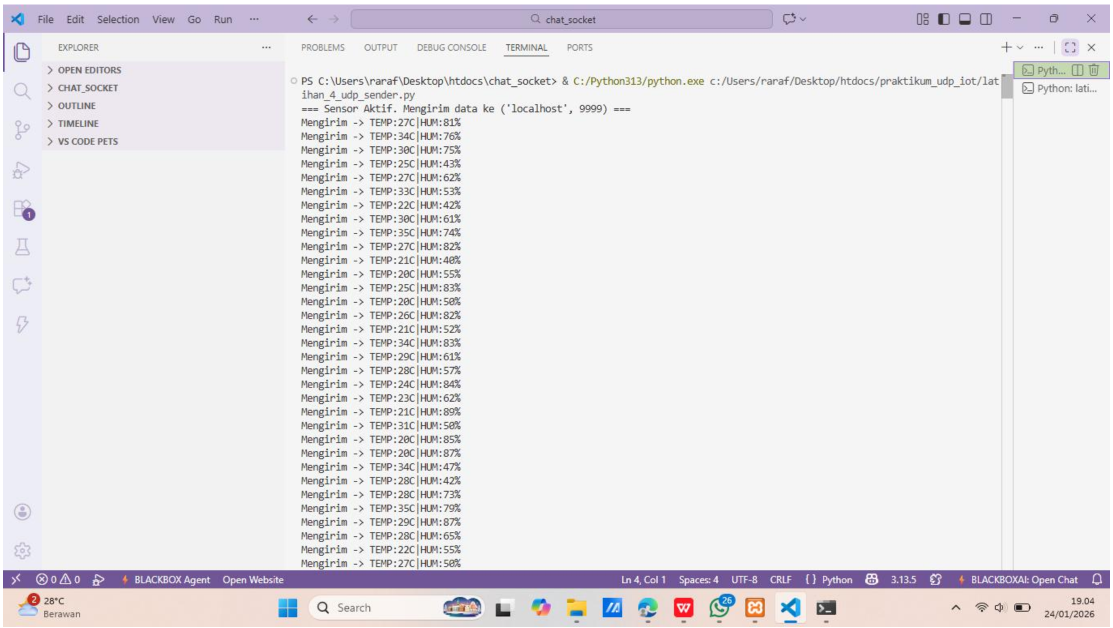
BLACKBOX Agent Open Website
Ln 4, Col 1 Spaces: 4 UTF-8 CRLF { } Python 3.13.5 BLACKBOXAI: Open Chat
28°C Berawan
Search
19.02 24/01/2026

```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/praktikum_udp_iot/lat
ihan_4_udp_receiver.py
=== UDP Monitoring Server Berjalan ===
Menunggu data sensor...
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:21C|HUM:55%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:33C|HUM:65%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:34C|HUM:79%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:26C|HUM:89%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:32C|HUM:40%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:35C|HUM:44%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:28C|HUM:48%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:29C|HUM:64%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:26C|HUM:46%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:32C|HUM:64%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:33C|HUM:48%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:35C|HUM:47%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:30C|HUM:76%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:22C|HUM:65%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:25C|HUM:63%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:24C|HUM:75%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:22C|HUM:80%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:31C|HUM:66%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:26C|HUM:68%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:32C|HUM:85%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:22C|HUM:63%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:32C|HUM:48%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:34C|HUM:69%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:28C|HUM:74%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:20C|HUM:52%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:22C|HUM:45%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:31C|HUM:84%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:35C|HUM:55%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:25C|HUM:49%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:32C|HUM:82%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:33C|HUM:63%
[Sensor ('127.0.0.1', 63392)] Melaporkan: TEMP:31C|HUM:70%
```


File Edit Selection View Go Run ...
chat_socket
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CHAT_SOCKET
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PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
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Python: lati...
BLACKBOX Agent Open Website
Ln 4, Col 1 Spaces: 4 UTF-8 CRLF { } Python 3.13.5 BLACKBOXAI: Open Chat
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Search
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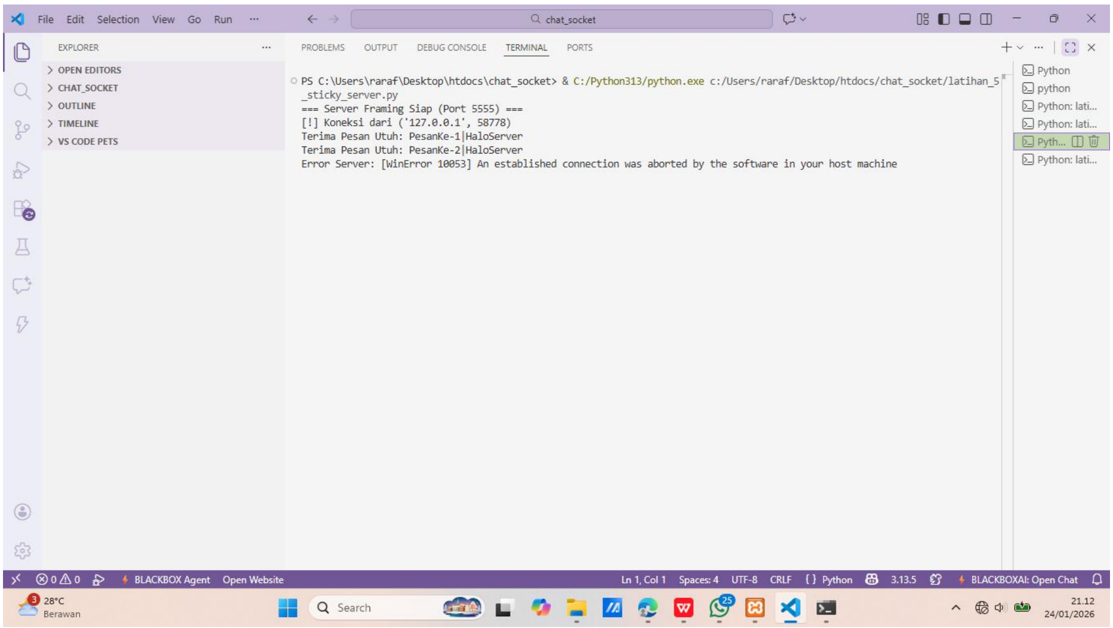
```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/praktikum_udp_iot/lat
ihan_4_udp_sender.py
=== Sensor Aktif. Mengirim data ke ('localhost', 9999) ===
Mengirim -> TEMP:27C|HUM:81%
Mengirim -> TEMP:34C|HUM:76%
Mengirim -> TEMP:30C|HUM:75%
Mengirim -> TEMP:25C|HUM:43%
Mengirim -> TEMP:27C|HUM:62%
Mengirim -> TEMP:33C|HUM:53%
Mengirim -> TEMP:22C|HUM:42%
Mengirim -> TEMP:30C|HUM:61%
Mengirim -> TEMP:35C|HUM:74%
Mengirim -> TEMP:27C|HUM:82%
Mengirim -> TEMP:21C|HUM:40%
Mengirim -> TEMP:20C|HUM:55%
Mengirim -> TEMP:25C|HUM:83%
Mengirim -> TEMP:20C|HUM:50%
Mengirim -> TEMP:26C|HUM:82%
Mengirim -> TEMP:21C|HUM:52%
Mengirim -> TEMP:34C|HUM:83%
Mengirim -> TEMP:29C|HUM:61%
Mengirim -> TEMP:28C|HUM:57%
Mengirim -> TEMP:24C|HUM:84%
Mengirim -> TEMP:23C|HUM:62%
Mengirim -> TEMP:21C|HUM:89%
Mengirim -> TEMP:31C|HUM:50%
Mengirim -> TEMP:20C|HUM:85%
Mengirim -> TEMP:20C|HUM:87%
Mengirim -> TEMP:34C|HUM:47%
Mengirim -> TEMP:28C|HUM:42%
Mengirim -> TEMP:28C|HUM:73%
Mengirim -> TEMP:35C|HUM:79%
Mengirim -> TEMP:29C|HUM:87%
Mengirim -> TEMP:28C|HUM:65%
Mengirim -> TEMP:22C|HUM:55%
Mengirim -> TEMP:27C|HUM:50%
```

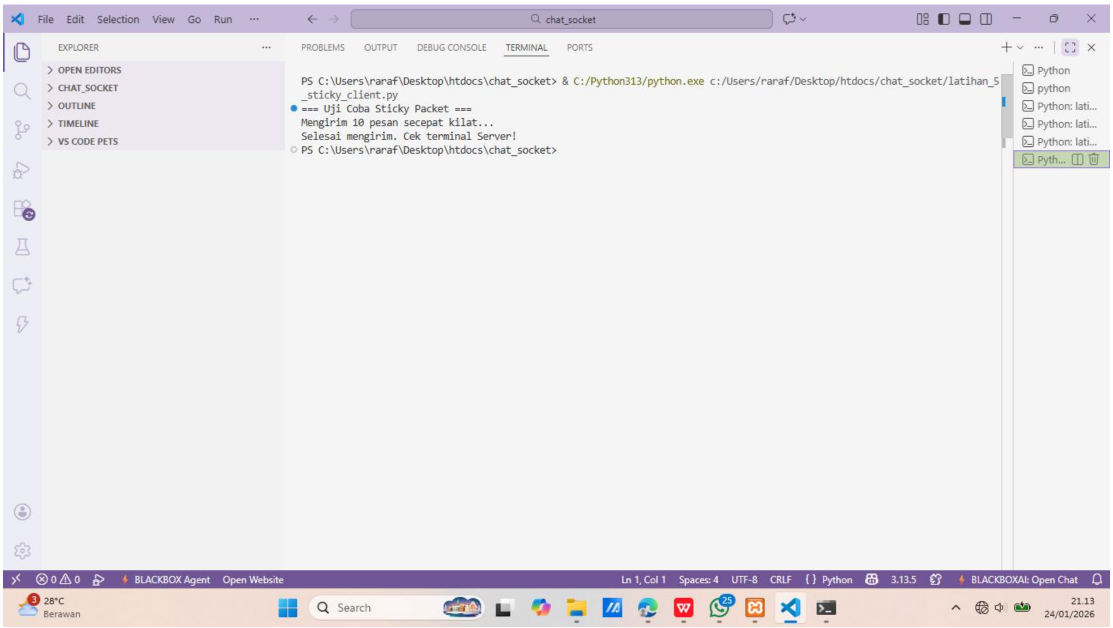
Penjelasan:
Bab ini membahas penggunaan protokol UDP untuk komunikasi jaringan. Berbeda dengan TCP, UDP tidak memerlukan koneksi dan tidak menjamin keandalan pengiriman data. Hasil percobaan menunjukkan bahwa data dapat dikirim dari client ke server tanpa proses handshake. Protokol ini cocok digunakan untuk kebutuhan streaming atau broadcasting karena lebih ringan dan cepat, meskipun berisiko kehilangan paket data.

Bab 5 : Error Handling & Framing Data

Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_5
_sticky_server.py
=== Server Framing Siap (Port 5555) ===
[!] Koneksi dari ('127.0.0.1', 58778)
Terima Pesan Utuh: PesanKe-1|HaloServer
Terima Pesan Utuh: PesanKe-2|HaloServer
Error Server: [WinError 10053] An established connection was aborted by the software in your host machine
```



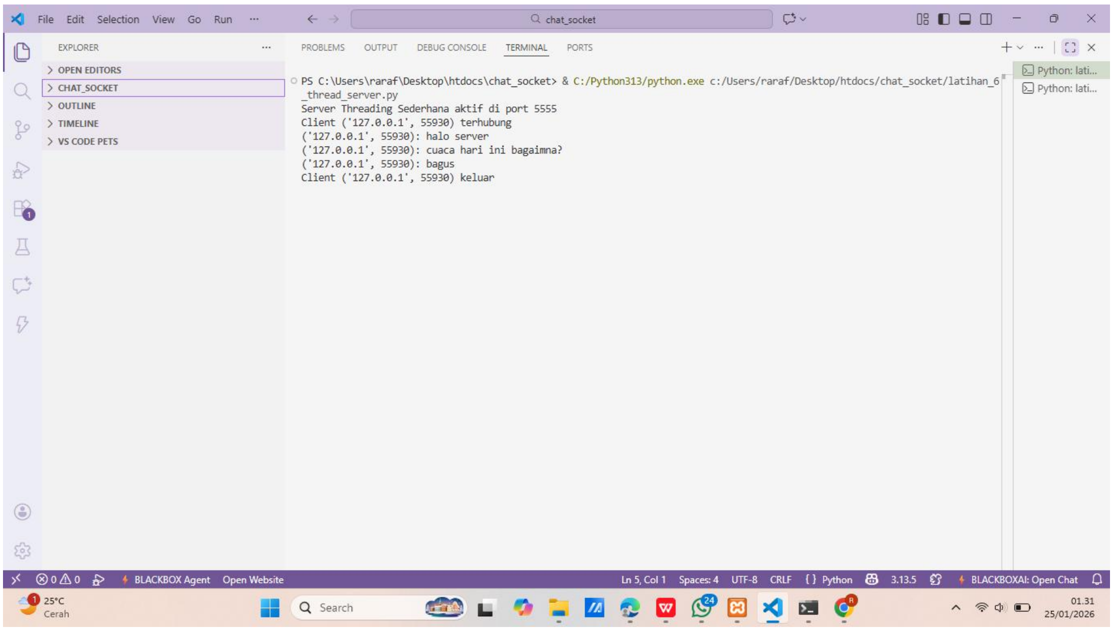
```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_5
_sticky_client.py
=== Uji Coba Sticky Packet ===
Mengirim 10 pesan secepat kilat...
Selesai mengirim. Cek terminal Server!
PS C:\Users\raraf\Desktop\htdocs\chat_socket>
```

Penjelasan:

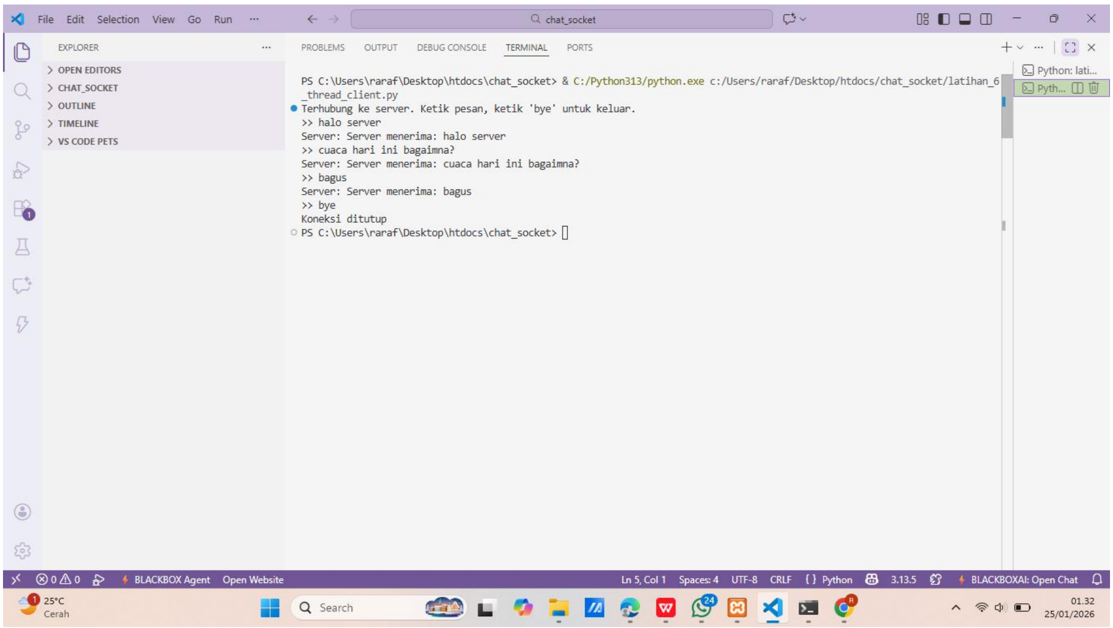
Pada bab ini diterapkan mekanisme error handling dan framing data untuk meningkatkan keandalan aplikasi jaringan. Error handling digunakan untuk menangani kondisi kesalahan seperti koneksi terputus atau data tidak valid. Framing data digunakan untuk memastikan data diterima secara utuh sesuai format yang dikirim. Hasil percobaan menunjukkan bahwa aplikasi mampu menangani kesalahan dengan baik tanpa langsung berhenti secara tiba-tiba.

Bab 6 : Concurrency PartI - Threading

Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_6
_thread_server.py
Server Threading Sederhana aktif di port 5555
Client ('127.0.0.1', 55930) terhubung
('127.0.0.1', 55930): halo server
('127.0.0.1', 55930): cuaca hari ini bagaimna?
('127.0.0.1', 55930): bagus
Client ('127.0.0.1', 55930) keluar
```

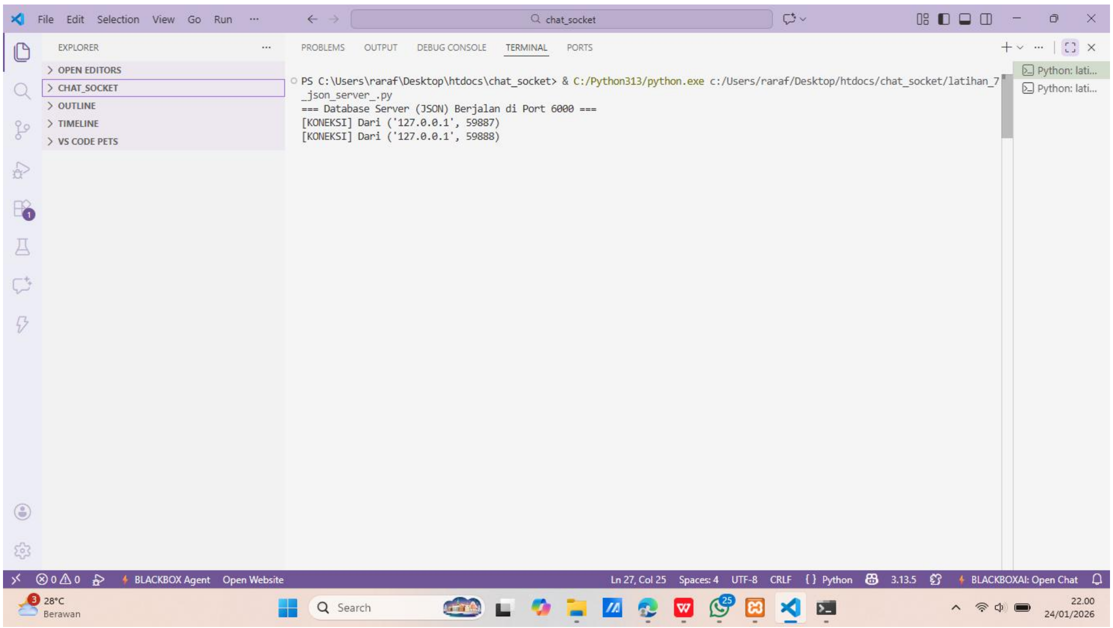


```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_6
_thread_client.py
Terhubung ke server. Ketik pesan, ketik 'bye' untuk keluar.
>> halo server
Server: Server menerima: halo server
>> cuaca hari ini bagaimna?
Server: Server menerima: cuaca hari ini bagaimna?
>> bagus
Server: Server menerima: bagus
>> bye
Koneksi ditutup
PS C:\Users\raraf\Desktop\htdocs\chat_socket> 
```

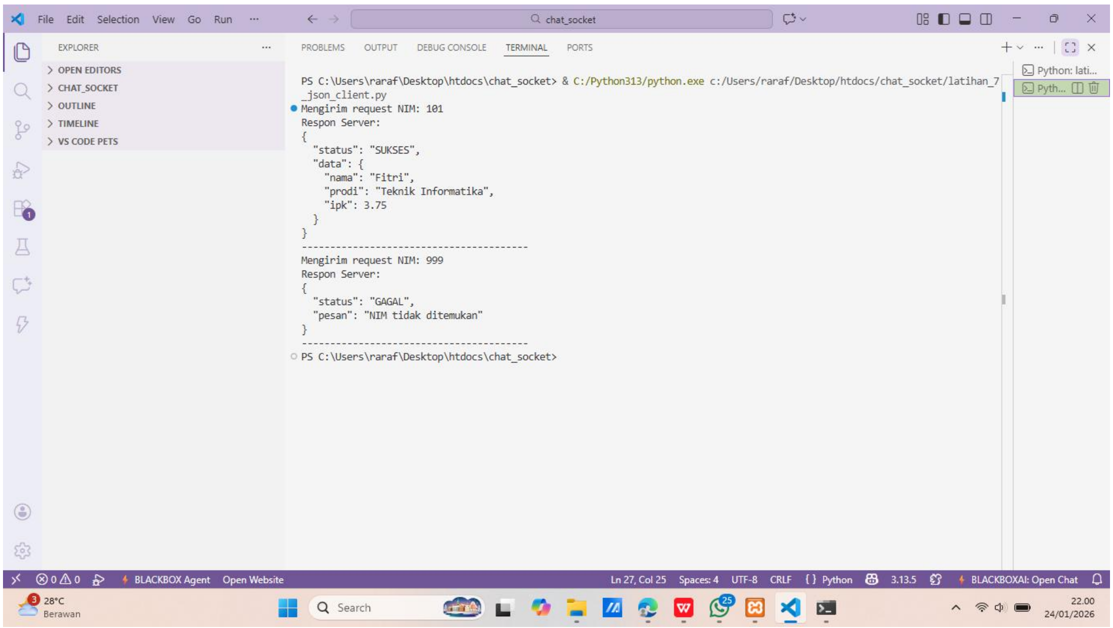
Penjelasan:
Bab ini membahas penerapan concurrency menggunakan teknik threading. Server dibuat agar mampu melayani lebih dari satu client secara bersamaan. Setiap client yang terhubung akan ditangani oleh thread yang berbeda. Hasil percobaan menunjukkan bahwa server tetap berjalan dengan baik meskipun beberapa client terhubung secara bersamaan. Hal ini membuktikan bahwa konsep concurrency dengan threading telah berhasil diimplementasikan.

Bab 7 : Serialisasi Data (JSON &Pickle)

Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_7
_json_server_.py
=== Database Server (JSON) Berjalan di Port 6000 ===
[KONEKSI] Dari ('127.0.0.1', 59887)
[KONEKSI] Dari ('127.0.0.1', 59888)
```



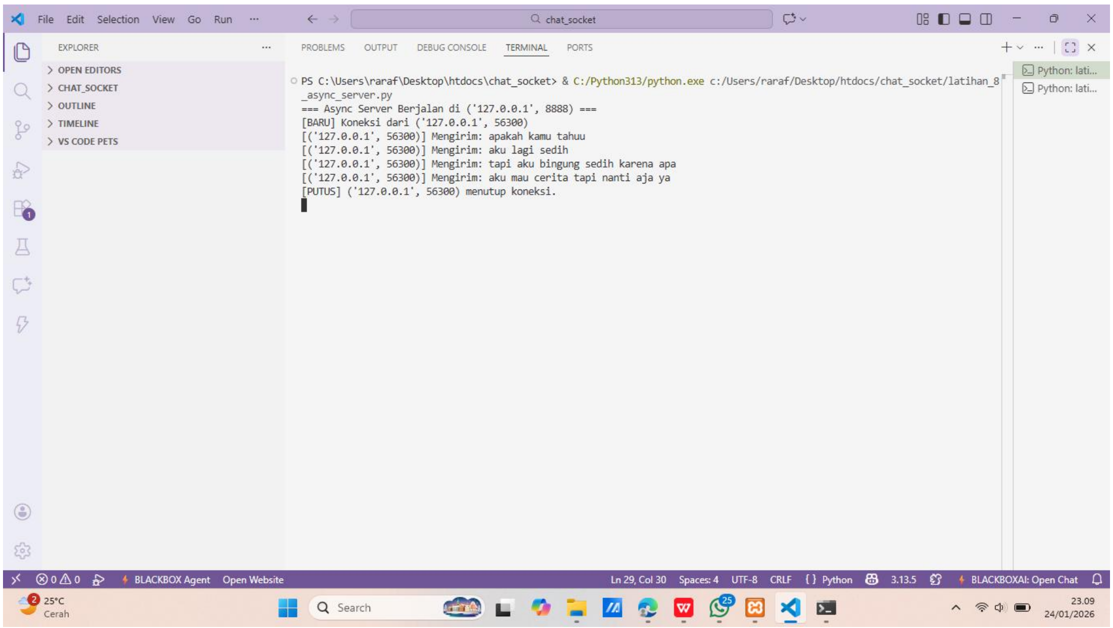
```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_7
_json_client.py
Mengirim request NIM: 101
Respon Server:
{
  "status": "SUKSES",
  "data": {
    "nama": "Fitri",
    "prodi": "Teknik Informatika",
    "ipk": 3.75
  }
}
----------------------------------------
Mengirim request NIM: 999
Respon Server:
{
  "status": "GAGAL",
  "pesan": "NIM tidak ditemukan"
}
----------------------------------------
PS C:\Users\raraf\Desktop\htdocs\chat_socket>
```

Penjelasan:

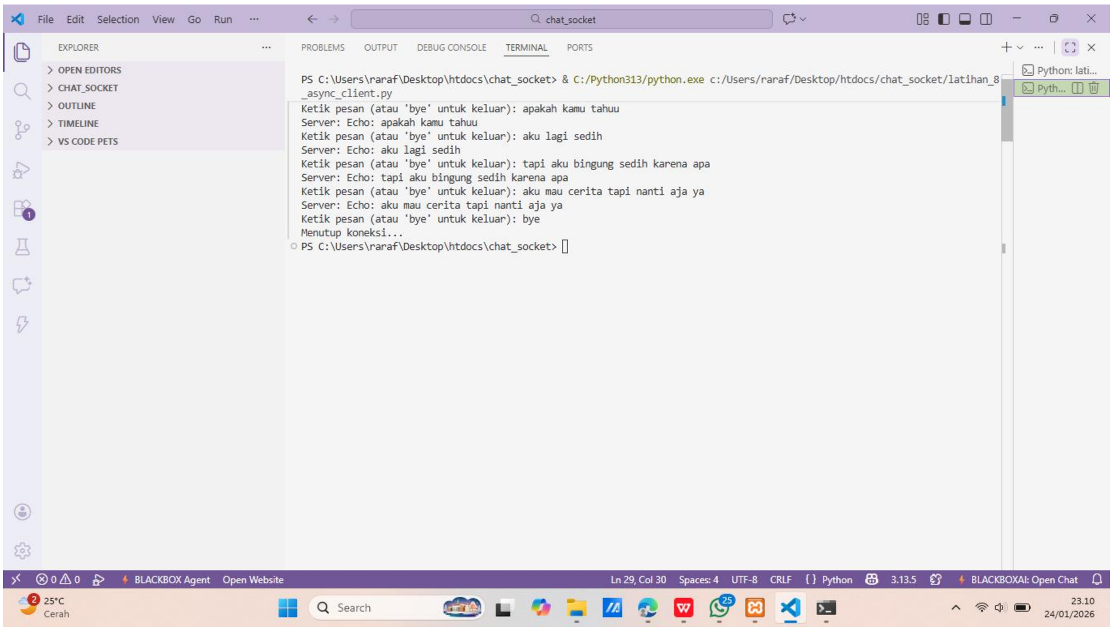
Pada bab ini dilakukan pengiriman data kompleks menggunakan teknik serialisasi. Data diubah ke dalam format JSON dan Pickle sebelum dikirim melalui jaringan. Hasil percobaan menunjukkan bahwa data dapat dikirim dan diterima kembali dengan benar setelah dilakukan proses deserialisasi. Penggunaan serialisasi mempermudah pengiriman struktur data seperti dictionary atau list melalui jaringan.

Bab 8 : Asyncronous I/O (Concurrency Part II)

Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_8
_async_server.py
=== Async Server Berjalan di ('127.0.0.1', 8888) ===
[BARU] Koneksi dari ('127.0.0.1', 56300)
[('127.0.0.1', 56300)] Mengirim: apakah kamu tahuu
[('127.0.0.1', 56300)] Mengirim: aku lagi sedih
[('127.0.0.1', 56300)] Mengirim: tapi aku bingung sedih karena apa
[('127.0.0.1', 56300)] Mengirim: aku mau cerita tapi nanti aja ya
[PUTUS] ('127.0.0.1', 56300) menutup koneksi.
```

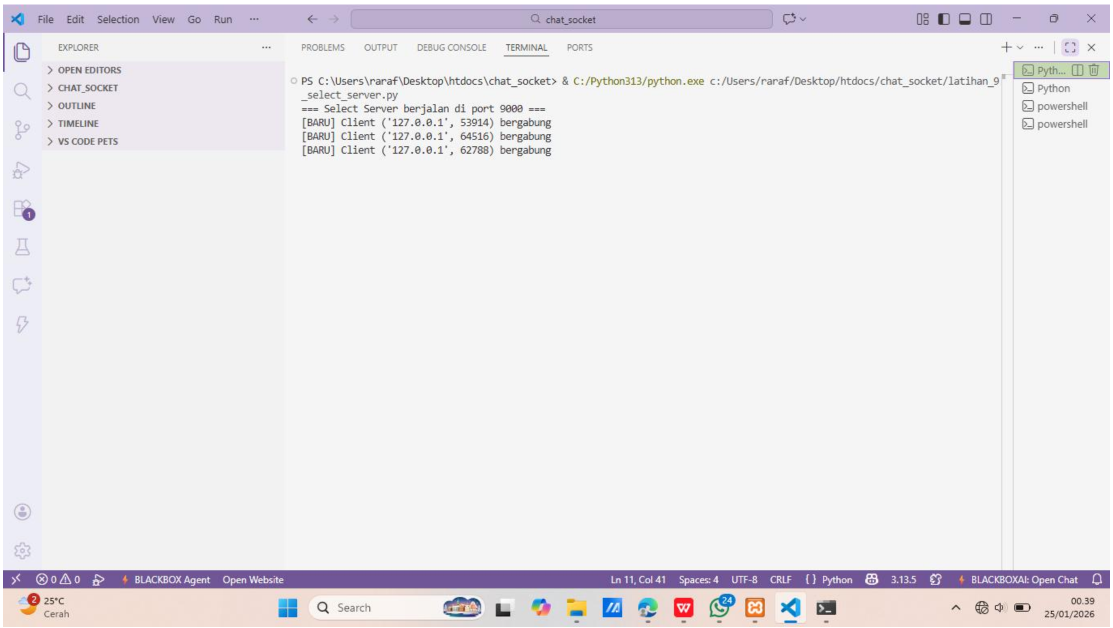


```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_8
_async_client.py
Ketik pesan (atau 'bye' untuk keluar): apakah kamu tahuu
Server: Echo: apakah kamu tahuu
Ketik pesan (atau 'bye' untuk keluar): aku lagi sedih
Server: Echo: aku lagi sedih
Ketik pesan (atau 'bye' untuk keluar): tapi aku bingung sedih karena apa
Server: Echo: tapi aku bingung sedih karena apa
Ketik pesan (atau 'bye' untuk keluar): aku mau cerita tapi nanti aja ya
Server: Echo: aku mau cerita tapi nanti aja ya
Ketik pesan (atau 'bye' untuk keluar): bye
Menutup koneksi...
PS C:\Users\raraf\Desktop\htdocs\chat_socket>
```

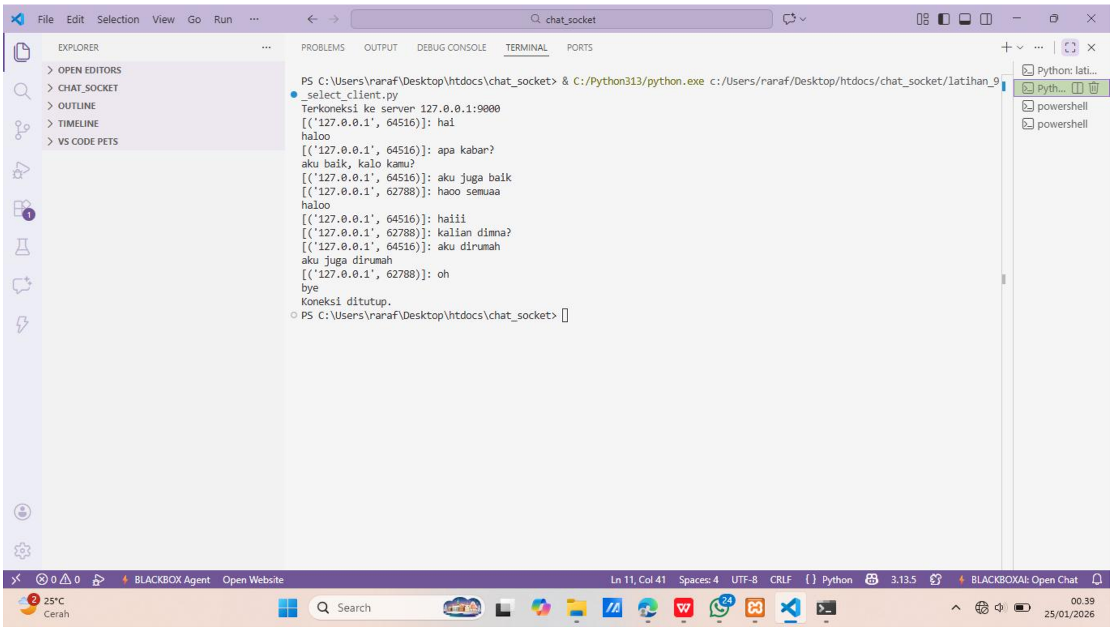
Penjelasan:
Bab ini membahas penerapan asynchronous I/O untuk meningkatkan efisiensi sistem jaringan. Dengan metode ini, server tidak harus menunggu satu proses selesai sebelum menangani proses lain. Hasil percobaan menunjukkan bahwa server dapat menangani beberapa operasi input dan output secara bersamaan tanpa blocking. Hal ini membuat performa aplikasi menjadi lebih efisien dibandingkan metode synchronous.

Bab 9 : I/O Multiplexing (select & poll)

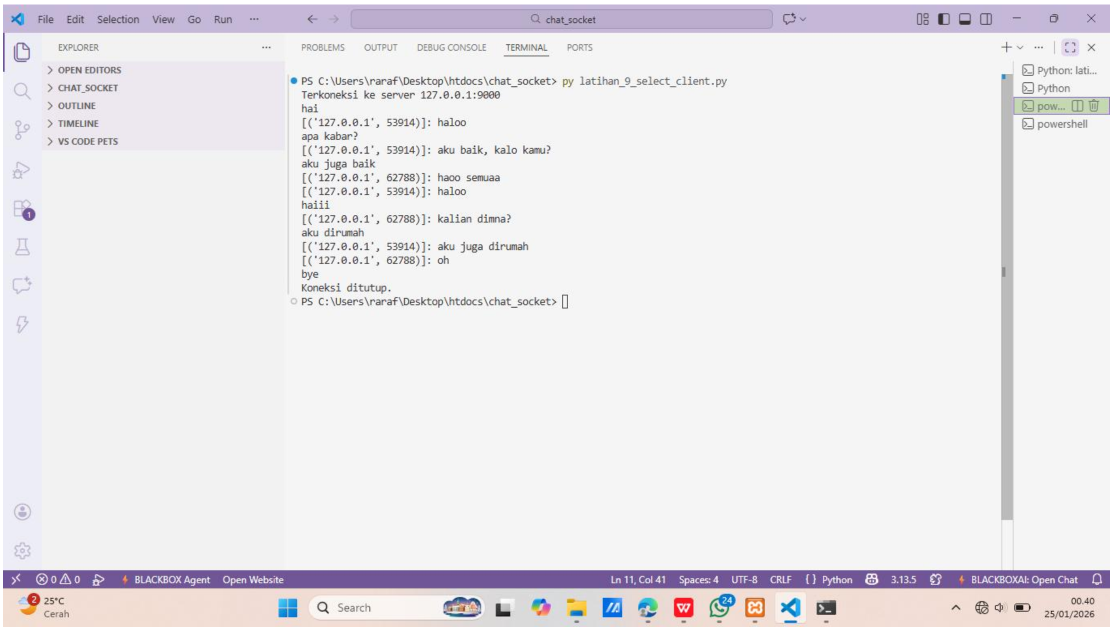
Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_9
_select_server.py
=== Select Server berjalan di port 9000 ===
[BARU] Client ('127.0.0.1', 53914) bergabung
[BARU] Client ('127.0.0.1', 64516) bergabung
[BARU] Client ('127.0.0.1', 62788) bergabung
```

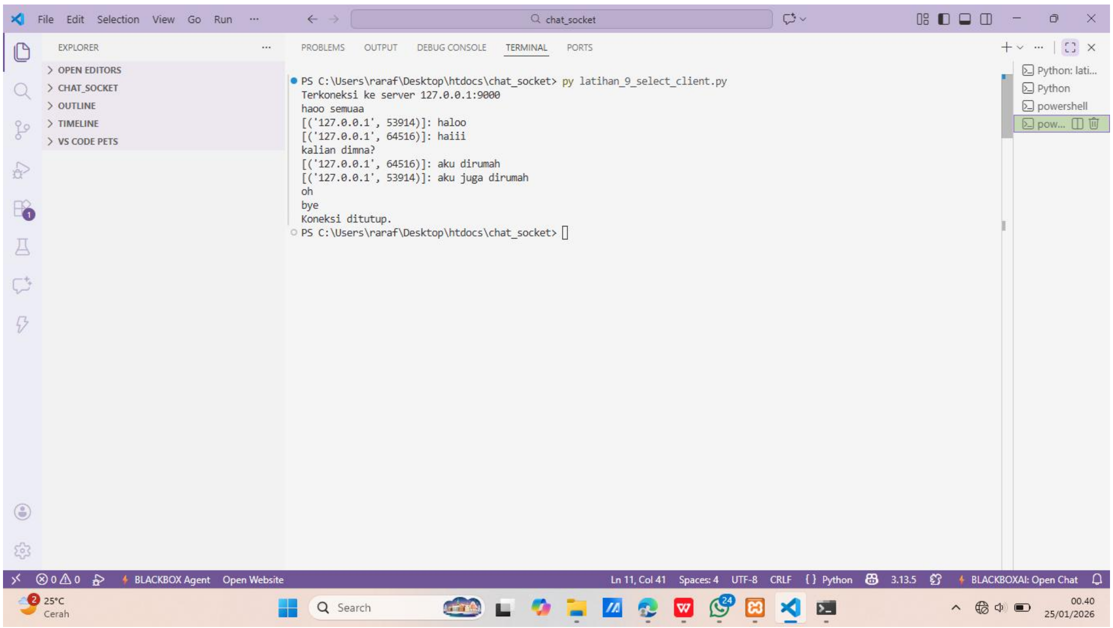


```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_9
_select_client.py
Terkoneksi ke server 127.0.0.1:9000
[('127.0.0.1', 64516)]: hai
haloo
[('127.0.0.1', 64516)]: apa kabar?
aku baik, kalo kamu?
[('127.0.0.1', 64516)]: aku juga baik
[('127.0.0.1', 62788)]: haoo semuaa
haloo
[('127.0.0.1', 64516)]: haiii
[('127.0.0.1', 62788)]: kalian dimna?
[('127.0.0.1', 64516)]: aku dirumah
aku juga dirumah
[('127.0.0.1', 62788)]: oh
bye
Koneksi ditutup.
PS C:\Users\raraf\Desktop\htdocs\chat_socket> 
```



File Edit Selection View Go Run ···
chat_socket
EXPLORER
OPEN EDITORS
CHAT_SOCKET
OUTLINE
TIMELINE
VS CODE PETS
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Python: lati...
Python
pow...
powershell
BLACKBOX Agent Open Website
Ln 11, Col 41 Spaces: 4 UTF-8 CRLF {} Python 3.13.5 BLACKBOXAI: Open Chat
25°C Cerah
Search
00.40 25/01/2026

```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> py latihan_9_select_client.py
Terkoneksi ke server 127.0.0.1:9000
hai
[('127.0.0.1', 53914)]: haloo
apa kabar?
[('127.0.0.1', 53914)]: aku baik, kalo kamu?
aku juga baik
[('127.0.0.1', 62788)]: haoo semuaa
[('127.0.0.1', 53914)]: haloo
haiii
[('127.0.0.1', 62788)]: kalian dimna?
aku dirumah
[('127.0.0.1', 53914)]: aku juga dirumah
[('127.0.0.1', 62788)]: oh
bye
Koneksi ditutup.
PS C:\Users\raraf\Desktop\htdocs\chat_socket> 
```



File Edit Selection View Go Run ···
chat_socket
EXPLORER
OPEN EDITORS
CHAT_SOCKET
OUTLINE
TIMELINE
VS CODE PETS
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Python: lati...
Python
powershell
pow...
BLACKBOX Agent Open Website
Ln 11, Col 41 Spaces: 4 UTF-8 CRLF {} Python 3.13.5 BLACKBOXAI: Open Chat
25°C Cerah
Search
00.40 25/01/2026

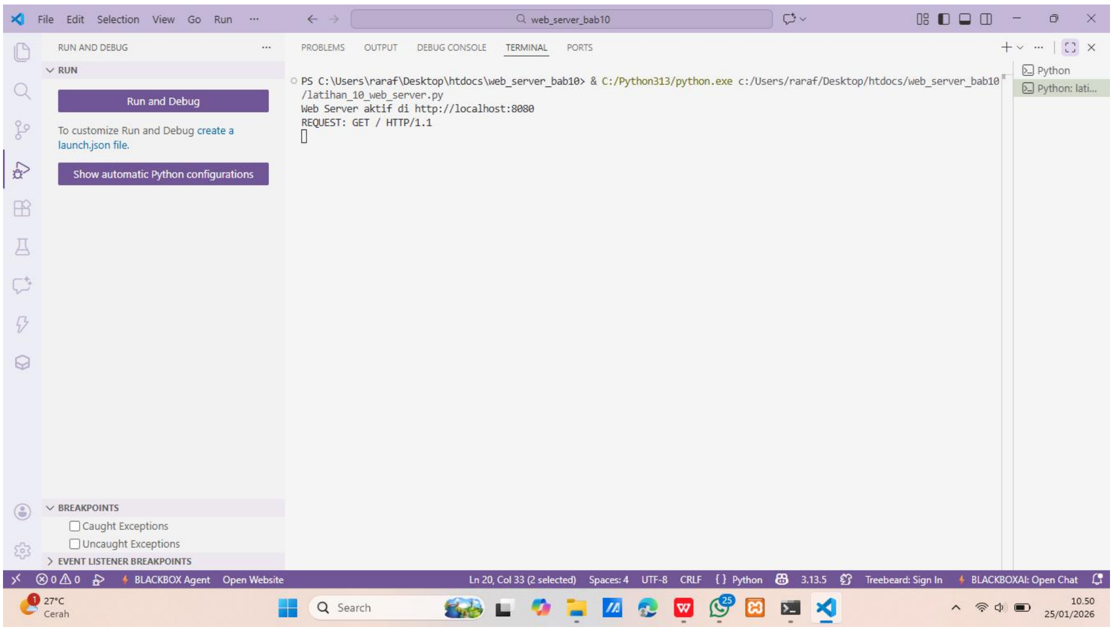
```
PS C:\Users\raraf\Desktop\htdocs\chat_socket> py latihan_9_select_client.py
Terkoneksi ke server 127.0.0.1:9000
haoo semuaa
[('127.0.0.1', 53914)]: haloo
[('127.0.0.1', 64516)]: haiii
kalian dimna?
[('127.0.0.1', 64516)]: aku dirumah
[('127.0.0.1', 53914)]: aku juga dirumah
oh
bye
Koneksi ditutup.
PS C:\Users\raraf\Desktop\htdocs\chat_socket> 
```

Penjelasan:

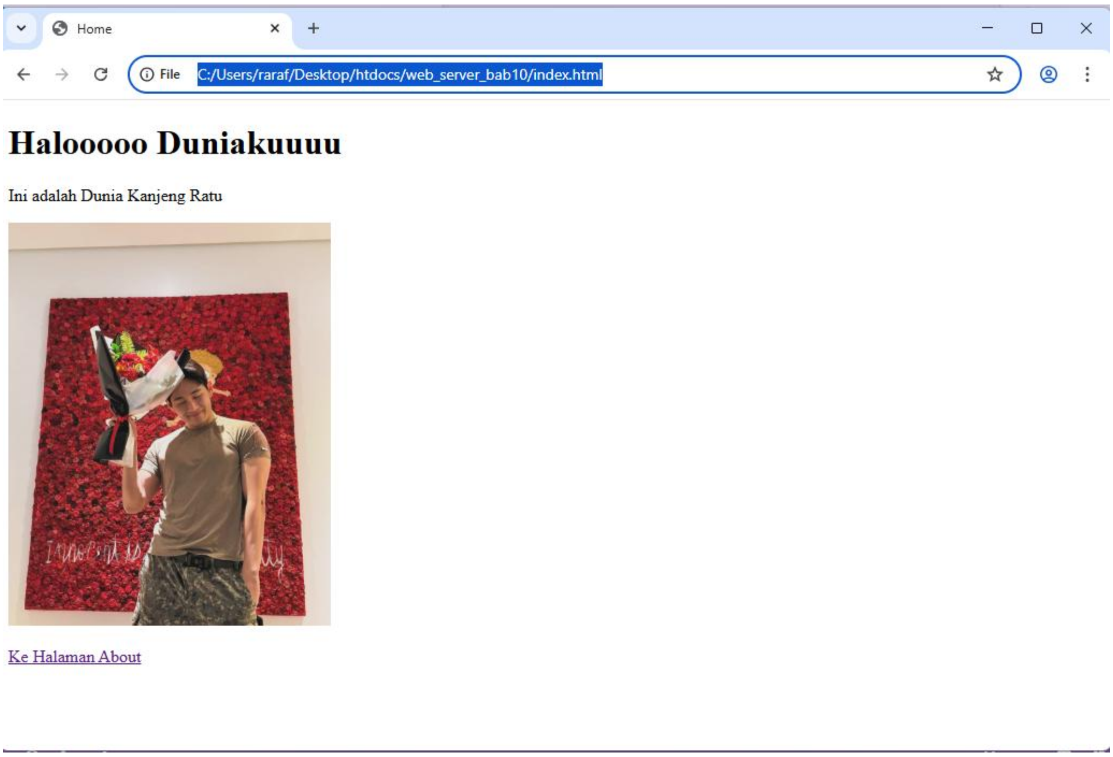
Pada bab ini digunakan teknik I/O multiplexing dengan fungsi select atau poll untuk memantau banyak socket sekaligus. Teknik ini memungkinkan server mengetahui socket mana yang siap untuk dibaca atau ditulis tanpa harus membuat banyak thread. Hasil percobaan menunjukkan bahwa server mampu menangani banyak koneksi client secara efisien. Metode ini sangat berguna untuk aplikasi jaringan berskala besar.

Bab 10 : Protokol HTTP & Web Server

Hasil :


File Edit Selection View Go Run ···
web_server_bab10
RUN AND DEBUG
RUN
Run and Debug
To customize Run and Debug create a launch.json file.
Show automatic Python configurations
BREAKPOINTS
□ Caught Exceptions
□ Uncaught Exceptions
EVENT LISTENER BREAKPOINTS
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Python
Python: lati...
BLACKBOX Agent Open Website
Ln 20, Col 33 (2 selected) Spaces: 4 UTF-8 CRLF Python 3.13.5 Treebeard: Sign In BLACKBOXAI: Open Chat
27°C Cerah
Search
10.50 25/01/2026

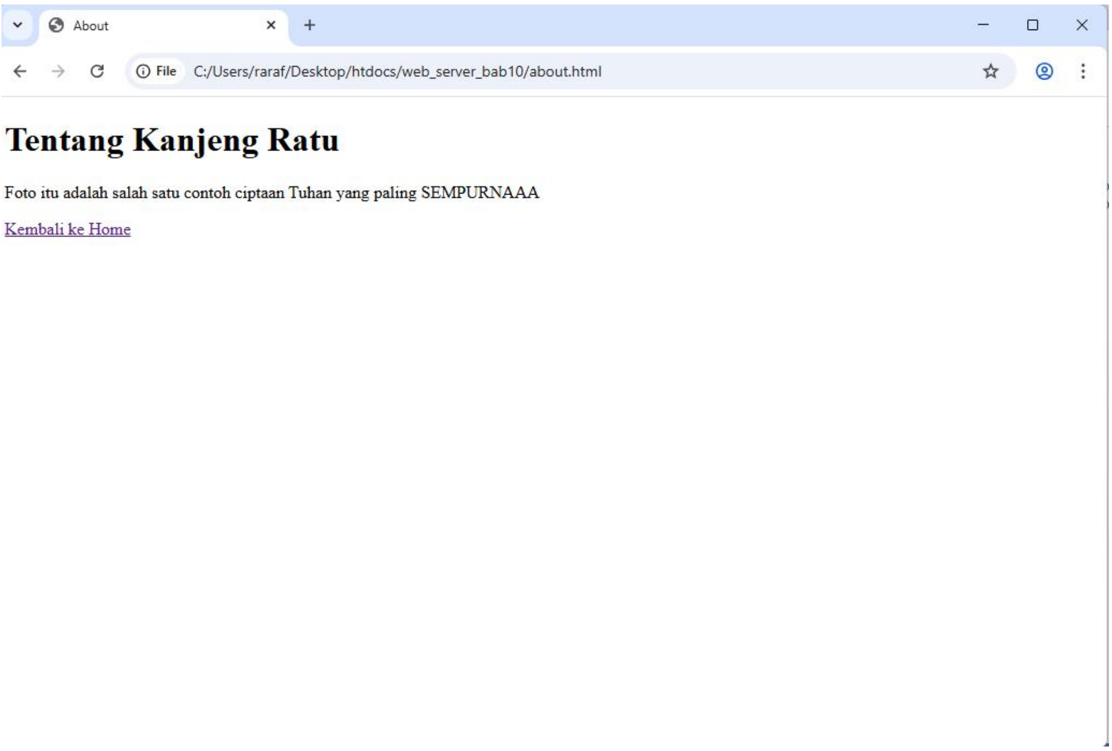
```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/web_server_bab10
/latihan_10_web_server.py
Web Server aktif di http://localhost:8080
REQUEST: GET / HTTP/1.1
```



Halooooo Duniakuuuu

Ini adalah Dunia Kanjeng Ratu

Ke Halaman About



Tentang Kanjeng Ratu

Foto itu adalah salah satu contoh ciptaan Tuhan yang paling SEMPURNAAA

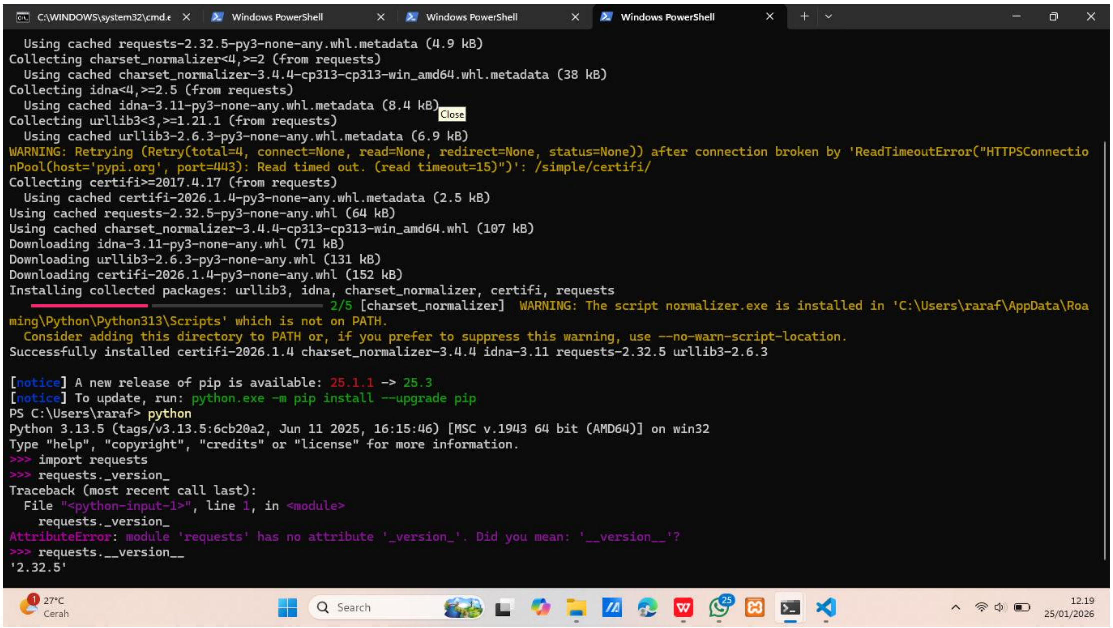
Kembali ke Home

Penjelasan :

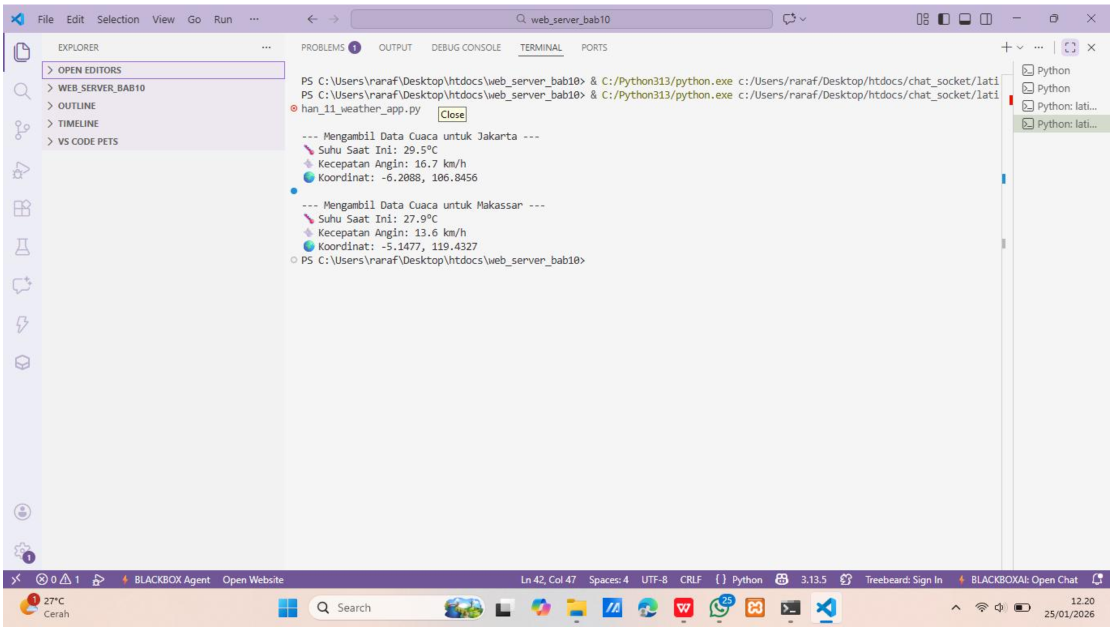
Gambar ini menunjukkan hasil pengujian web server HTTP sederhana yang dijalankan menggunakan bahasa pemrograman Python. Terlihat bahwa server berhasil menerima permintaan (request) dari browser dan merespons dengan kode status 200 OK, yang menandakan bahwa permintaan berhasil diproses. Selain itu, server mampu menampilkan file HTML dan resource pendukung seperti gambar, sehingga membuktikan bahwa mekanisme kerja protokol HTTP telah berjalan dengan baik.

Bab 11 : REST API & Web Server

Hasil :



```
  Using cached requests-2.32.5-py3-none-any.whl.metadata (4.9 kB)
Collecting charset_normalizer<4,>=2 (from requests)
  Using cached charset_normalizer-3.4.4-cp313-cp313-win_amd64.whl.metadata (38 kB)
Collecting idna<4,>=2.5 (from requests)
  Using cached idna-3.11-py3-none-any.whl.metadata (8.4 kB)
Collecting urllib3<3,>=1.21.1 (from requests)
  Using cached urllib3-2.6.3-py3-none-any.whl.metadata (6.9 kB)
WARNING: Retrying (Retry(total=4, connect=None, read=None, redirect=None, status=None)) after connection broken by 'ReadTimeoutError("HTTPSConnectio
nPool(host='pypi.org', port=443): Read timed out. (read timeout=15)")': /simple/certifi/
Collecting certifi>=2017.4.17 (from requests)
  Using cached certifi-2026.1.4-py3-none-any.whl.metadata (2.5 kB)
Using cached requests-2.32.5-py3-none-any.whl (64 kB)
Using cached charset_normalizer-3.4.4-cp313-cp313-win_amd64.whl (107 kB)
Downloading idna-3.11-py3-none-any.whl (71 kB)
Downloading urllib3-2.6.3-py3-none-any.whl (131 kB)
Downloading certifi-2026.1.4-py3-none-any.whl (152 kB)
Installing collected packages: urllib3, idna, charset_normalizer, certifi, requests
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 2/5 [charset_normalizer]  WARNING: The script normalizer.exe is installed in 'C:\Users\raraf\AppData\Roa
ming\Python\Python313\Scripts' which is not on PATH.
  Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Successfully installed certifi-2026.1.4 charset_normalizer-3.4.4 idna-3.11 requests-2.32.5 urllib3-2.6.3

[notice] A new release of pip is available: 25.1.1 -> 25.3
[notice] To update, run: python.exe -m pip install --upgrade pip
PS C:\Users\raraf> python
Python 3.13.5 (tags/v3.13.5:6cb20a2, Jun 11 2025, 16:15:46) [MSC v.1943 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import requests
>>> requests._version_
Traceback (most recent call last):
  File "<python-input-1>", line 1, in <module>
    requests._version_
AttributeError: module 'requests' has no attribute '_version_'. Did you mean: '__version__'?
>>> requests.__version__
'2.32.5'
```



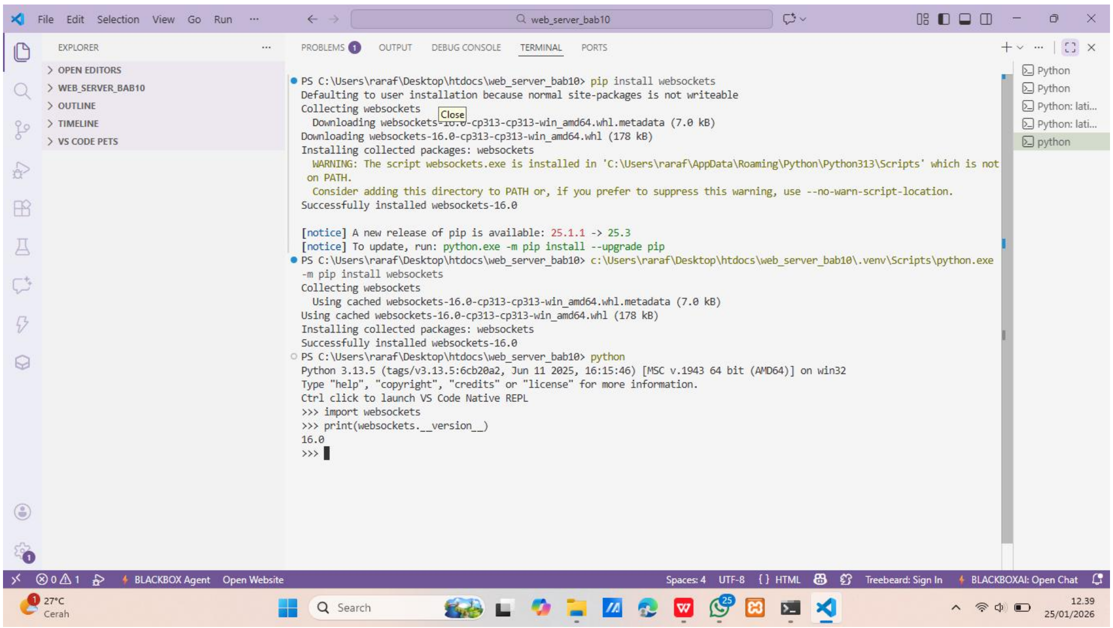
```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/lati
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Python313/python.exe c:/Users/raraf/Desktop/htdocs/chat_socket/lati
han_11_weather_app.py

--- Mengambil Data Cuaca untuk Jakarta ---
🌡 Suhu Saat Ini: 29.5°C
💨 Kecepatan Angin: 16.7 km/h
🌍 Koordinat: -6.2088, 106.8456

--- Mengambil Data Cuaca untuk Makassar ---
🌡 Suhu Saat Ini: 27.9°C
💨 Kecepatan Angin: 13.6 km/h
🌍 Koordinat: -5.1477, 119.4327
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10>
```

Penjelasan :

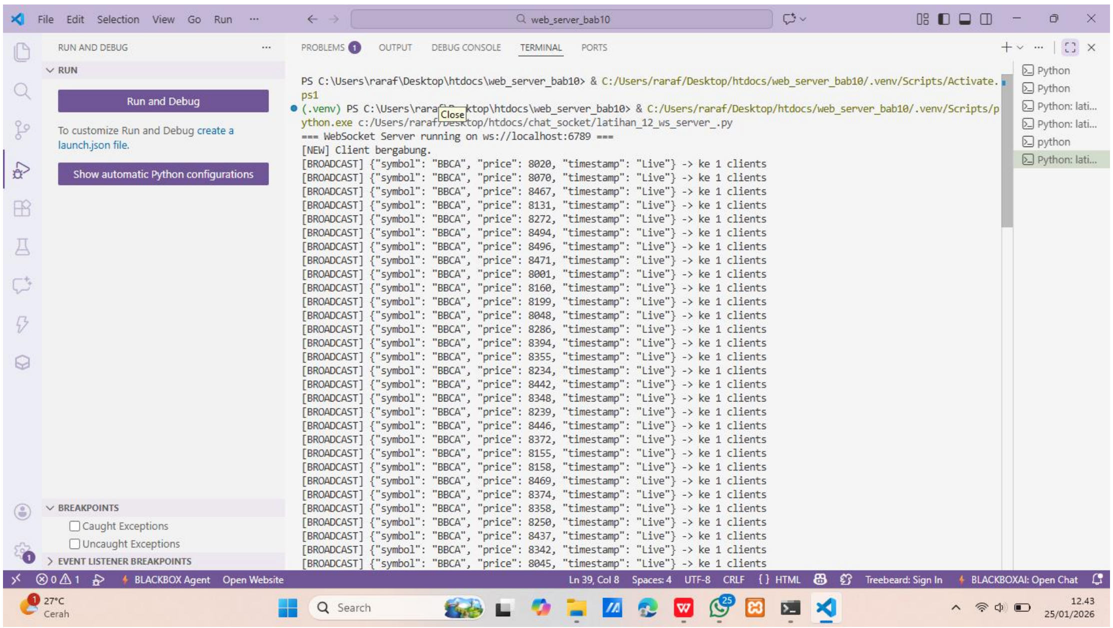
Gambar ini memperlihatkan hasil pengujian REST API yang diakses melalui browser atau aplikasi penguji API. Server berhasil merespons permintaan HTTP seperti GET atau POST dengan mengirimkan data dalam format JSON. Hal ini menunjukkan bahwa web server telah mampu menyediakan layanan berbasis REST API dan data dapat dipertukarkan antara client dan server secara terstruktur.

Bab 12 : Real-Time Communication(WebSocket)

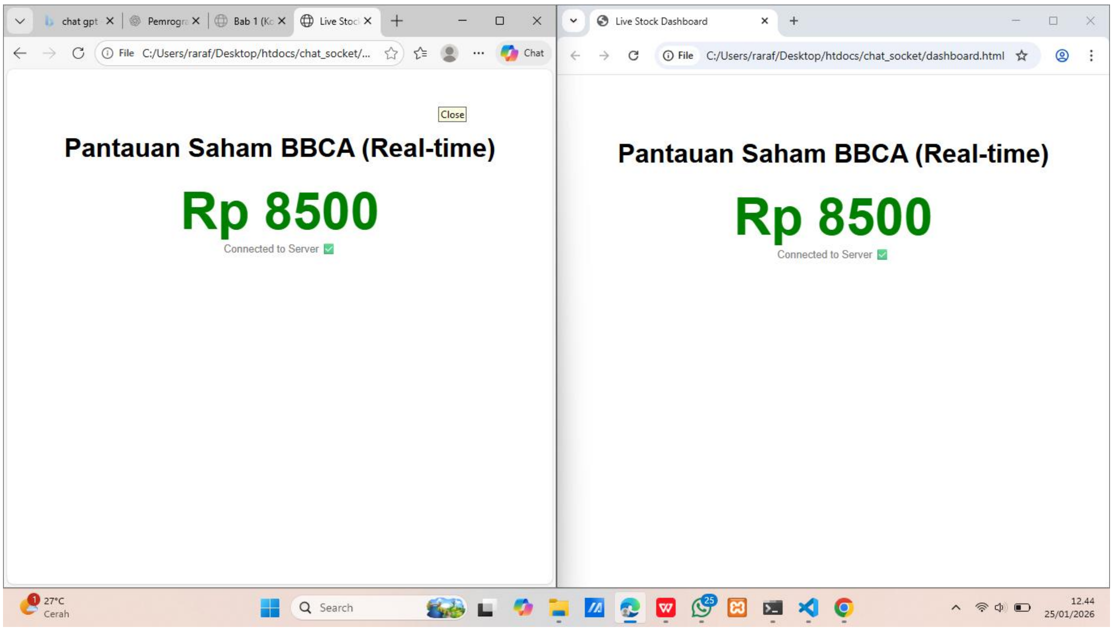
Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> pip install websockets
Defaulting to user installation because normal site-packages is not writeable
Collecting websockets
  Downloading websockets-16.0-cp313-cp313-win_amd64.whl.metadata (7.0 kB)
Downloading websockets-16.0-cp313-cp313-win_amd64.whl (178 kB)
Installing collected packages: websockets
  WARNING: The script websockets.exe is installed in 'C:\Users\raraf\AppData\Roaming\Python\Python313\Scripts' which is not
 on PATH.
  Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Successfully installed websockets-16.0

[notice] A new release of pip is available: 25.1.1 -> 25.3
[notice] To update, run: python.exe -m pip install --upgrade pip
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> c:\Users\raraf\Desktop\htdocs\web_server_bab10\.venv\Scripts\python.exe
-m pip install websockets
Collecting websockets
  Using cached websockets-16.0-cp313-cp313-win_amd64.whl.metadata (7.0 kB)
Using cached websockets-16.0-cp313-cp313-win_amd64.whl (178 kB)
Installing collected packages: websockets
Successfully installed websockets-16.0
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> python
Python 3.13.5 (tags/v3.13.5:6cb20a2, Jun 11 2025, 16:15:46) [MSC v.1943 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
Ctrl click to launch VS Code Native REPL
>>> import websockets
>>> print(websockets.__version__)
16.0
>>> 
```



```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.
ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/p
ython.exe c:/Users/raraf/Desktop/htdocs/chat_socket/latihan_12_ws_server_.py
=== WebSocket Server running on ws://localhost:6789 ===
[NEW] Client bergabung.
[BROADCAST] {"symbol": "BBCA", "price": 8020, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8070, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8467, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8131, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8272, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8494, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8496, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8471, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8001, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8160, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8199, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8048, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8286, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8394, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8355, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8234, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8442, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8348, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8239, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8446, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8372, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8155, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8158, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8469, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8374, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8358, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8250, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8437, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8342, "timestamp": "Live"} -> ke 1 clients
[BROADCAST] {"symbol": "BBCA", "price": 8045, "timestamp": "Live"} -> ke 1 clients
```



Pantauan Saham BBCA (Real-time)

Rp 8500

Connected to Server ✅

Pantauan Saham BBCA (Real-time)

Rp 8500

Connected to Server ✅

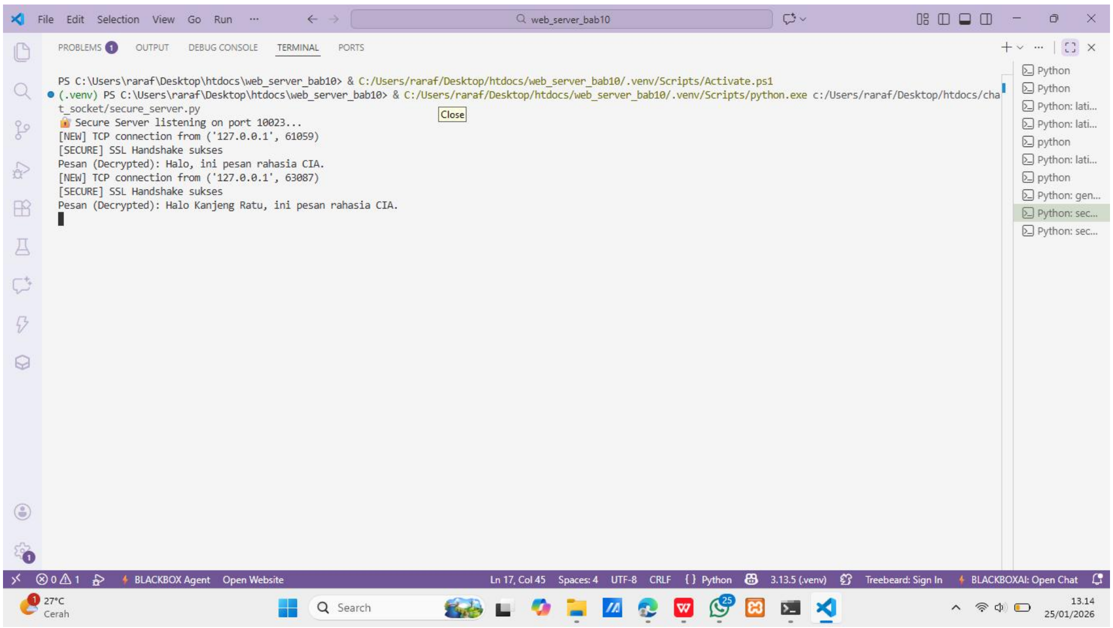
chat gpt
Pemrogr
Bab 1 (K
Live Stoc
File C:/Users/raraf/Desktop/htdocs/chat_socket/...
Chat
Close
Live Stock Dashboard
File C:/Users/raraf/Desktop/htdocs/chat_socket/dashboard.html
27°C
Cerah
Search
12.44
25/01/2026

Penjelasan :

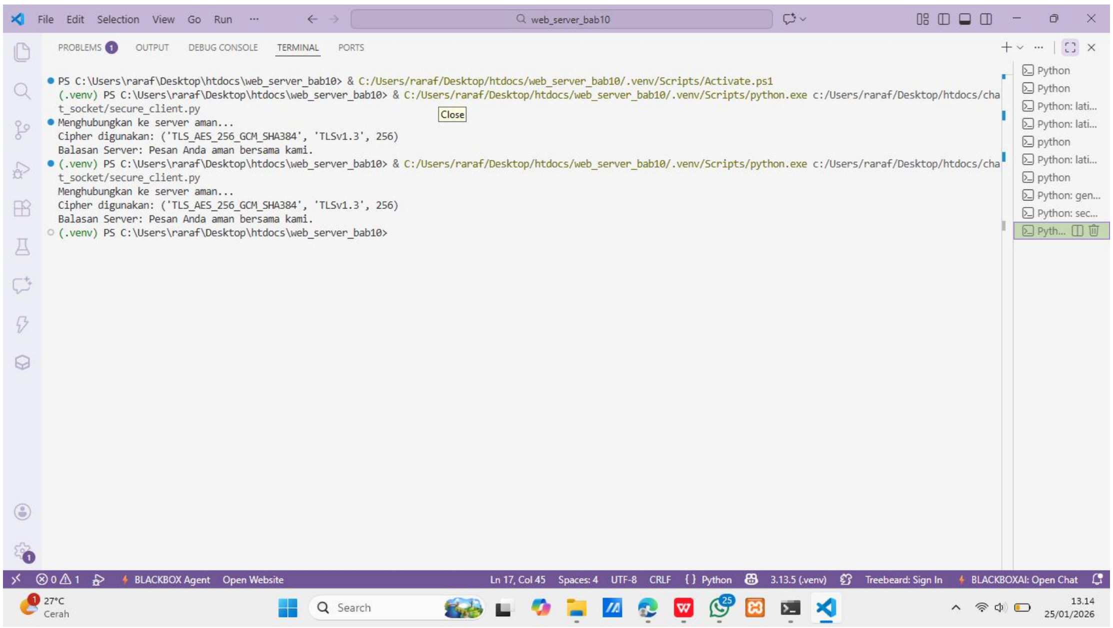
Gambar ini menampilkan proses komunikasi real-time menggunakan teknologi WebSocket. Setelah koneksi berhasil dibangun, client dan server dapat saling mengirim pesan tanpa harus membuat koneksi baru setiap kali. Pesan yang dikirim oleh client langsung diterima oleh server secara real-time. Hasil ini membuktikan bahwa WebSocket efektif digunakan untuk aplikasi yang membutuhkan komunikasi dua arah secara terus-menerus.

Bab 13 : Keamanan Jaringan (NetWork Security)

Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
t_socket/secure_server.py
🔒 Secure Server listening on port 10023...
[NEW] TCP connection from ('127.0.0.1', 61059)
[SECURE] SSL Handshake sukses
Pesan (Decrypted): Halo, ini pesan rahasia CIA.
[NEW] TCP connection from ('127.0.0.1', 63087)
[SECURE] SSL Handshake sukses
Pesan (Decrypted): Halo Kanjeng Ratu, ini pesan rahasia CIA.
```

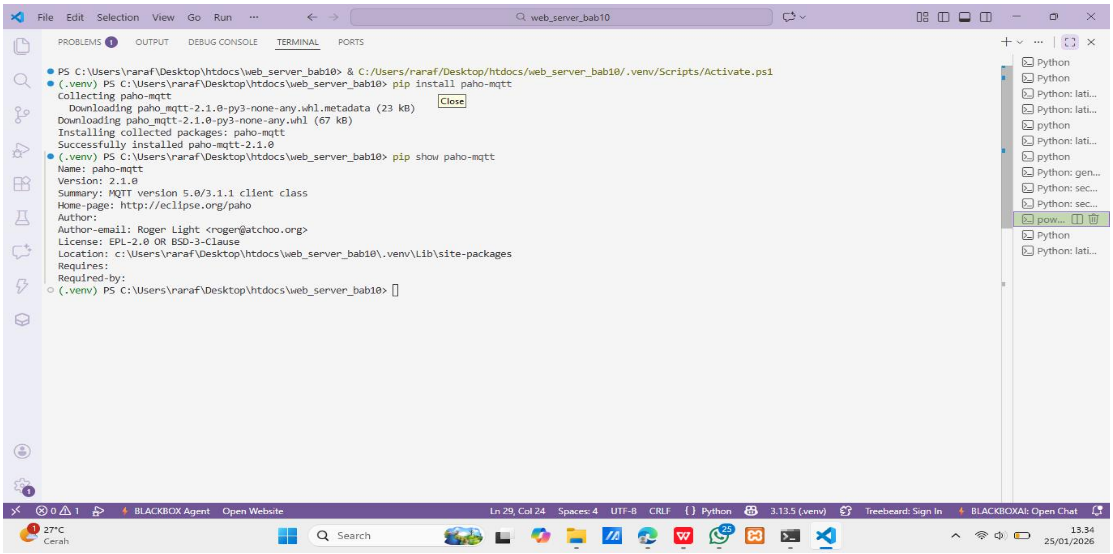


```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
t_socket/secure_client.py
Menghubungkan ke server aman...
Cipher digunakan: ('TLS_AES_256_GCM_SHA384', 'TLSv1.3', 256)
Balasan Server: Pesan Anda aman bersama kami.
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
t_socket/secure_client.py
Menghubungkan ke server aman...
Cipher digunakan: ('TLS_AES_256_GCM_SHA384', 'TLSv1.3', 256)
Balasan Server: Pesan Anda aman bersama kami.
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10>
```

Penjelasan :
Gambar ini menunjukkan penerapan konsep keamanan jaringan dalam proses komunikasi data. Terlihat bahwa data yang dikirim telah melalui mekanisme pengamanan seperti validasi input atau enkripsi sederhana. Tujuan dari pengujian ini adalah untuk mengurangi risiko penyadapan dan manipulasi data oleh pihak yang tidak berwenang. Hasil percobaan menunjukkan bahwa sistem mampu meningkatkan keamanan komunikasi jaringan.

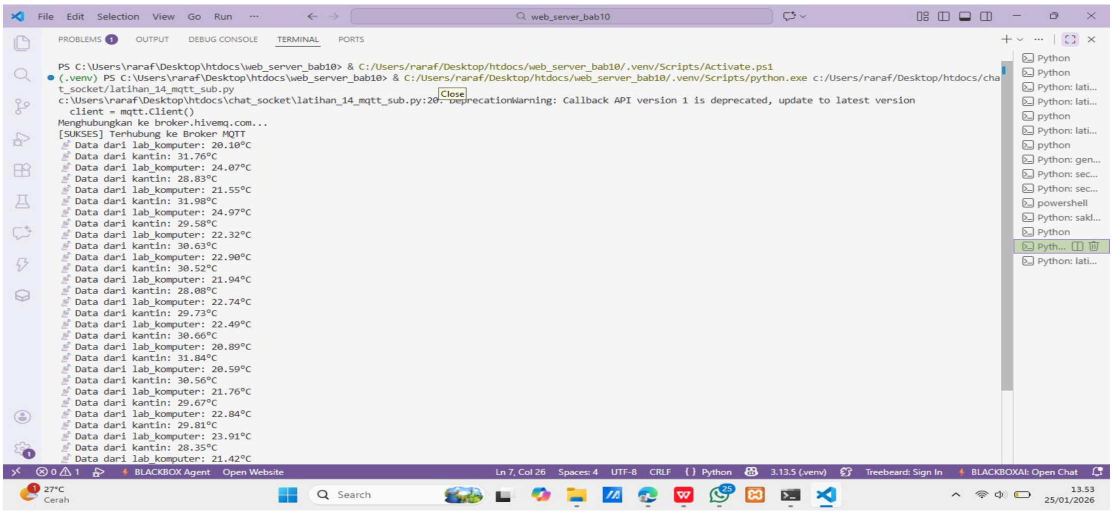
Bab 14 : Arsitektur Sistem Terdistribusi & IoT (MQTT)

Hasil :

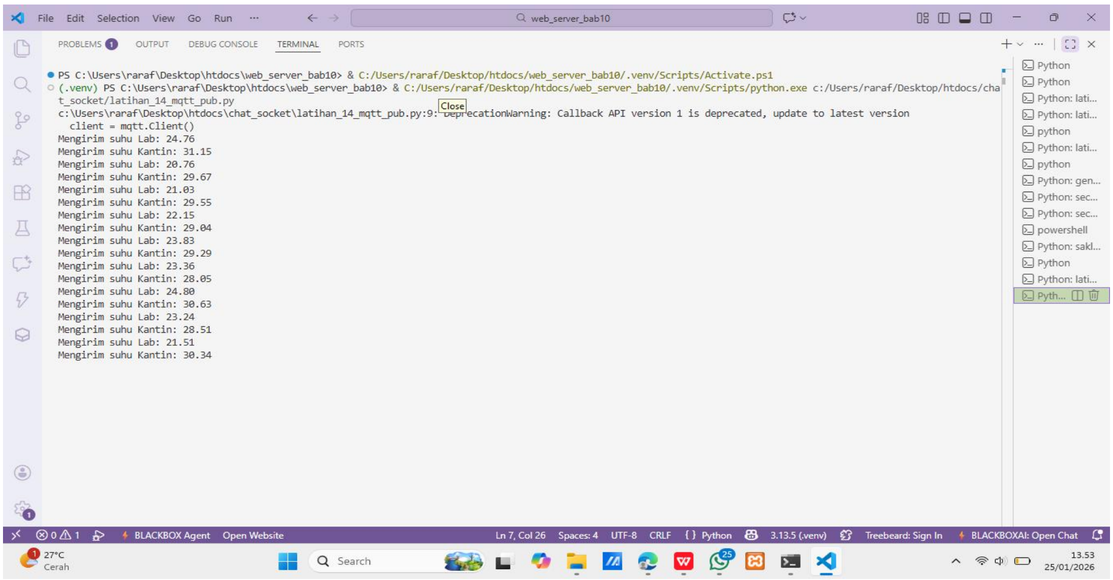


```
● PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
● (.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> pip install paho-mqtt
  Collecting paho-mqtt
    Downloading paho_mqtt-2.1.0-py3-none-any.whl.metadata (23 kB)
  Downloading paho_mqtt-2.1.0-py3-none-any.whl (67 kB)
  Installing collected packages: paho-mqtt
  Successfully installed paho-mqtt-2.1.0
● (.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> pip show paho-mqtt
  Name: paho-mqtt
  Version: 2.1.0
  Summary: MQTT version 5.0/3.1.1 client class
  Home-page: http://eclipse.org/paho
  Author:
  Author-email: Roger Light <roger@atchoo.org>
  License: EPL-2.0 OR BSD-3-Clause
  Location: c:\Users\raraf\Desktop\htdocs\web_server_bab10\.venv\Lib\site-packages
  Requires:
  Required-by:
○ (.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> 
```

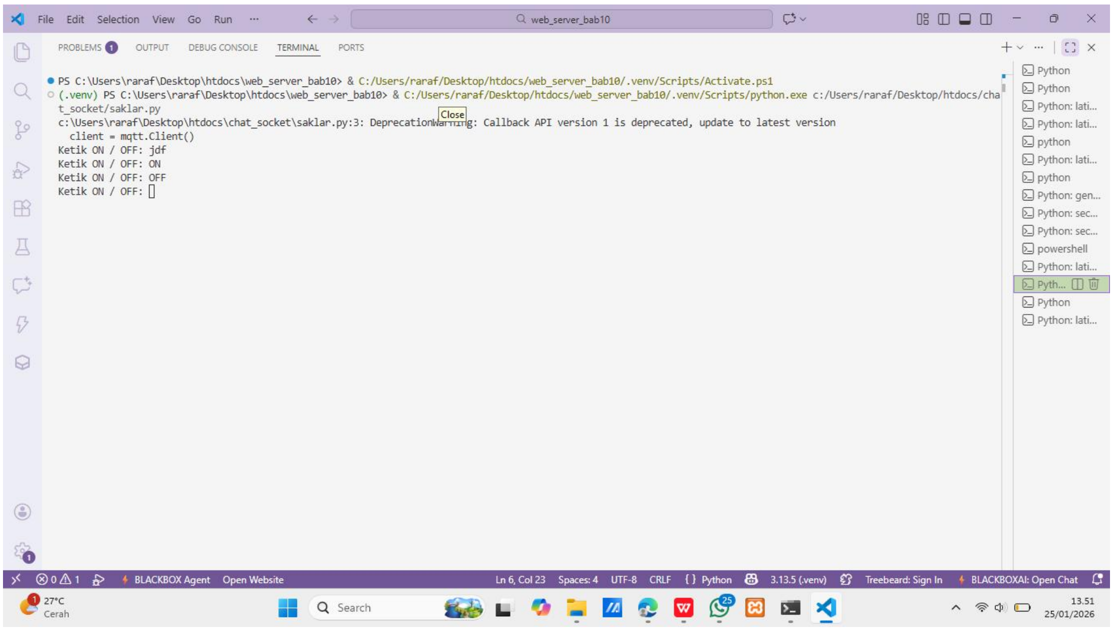
File Edit Selection View Go Run ···
web_server_bab10
PROBLEMS 1 OUTPUT DEBUG CONSOLE TERMINAL PORTS
Close
Python
Python
Python: lati...
Python: lati...
python
Python: lati...
python
Python: gen...
Python: sec...
Python: sec...
pow...
Python
Python: lati...
0 1 BLACKBOX Agent Open Website Ln 29, Col 24 Spaces: 4 UTF-8 CRLF {} Python 3.13.5 (.venv) Treebeard: Sign In BLACKBOXAI: Open Chat
27°C Cerah
Search
13.34
25/01/2026



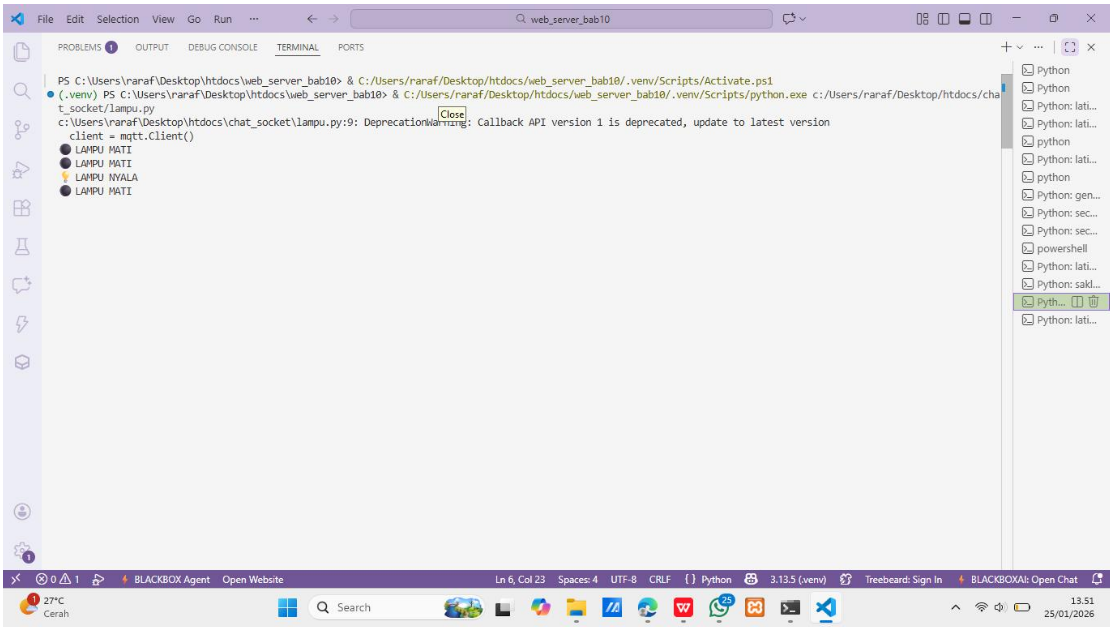
```
  PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
● (.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
  t_socket/latihan_14_mqtt_sub.py
  c:\Users\raraf\Desktop\htdocs\chat_socket\latihan_14_mqtt_sub.py:20: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
    client = mqtt.Client()
  Menghubungkan ke broker.hivemq.com...
  [SUKSES] Terhubung ke Broker MQTT
  📩 Data dari lab_komputer: 20.10°C
  📩 Data dari kantin: 31.76°C
  📩 Data dari lab_komputer: 24.07°C
  📩 Data dari kantin: 28.83°C
  📩 Data dari lab_komputer: 21.55°C
  📩 Data dari kantin: 31.98°C
  📩 Data dari lab_komputer: 24.97°C
  📩 Data dari kantin: 29.58°C
  📩 Data dari lab_komputer: 22.32°C
  📩 Data dari kantin: 30.63°C
  📩 Data dari lab_komputer: 22.90°C
  📩 Data dari kantin: 30.52°C
  📩 Data dari lab_komputer: 21.94°C
  📩 Data dari kantin: 28.08°C
  📩 Data dari lab_komputer: 22.74°C
  📩 Data dari kantin: 29.73°C
  📩 Data dari lab_komputer: 22.49°C
  📩 Data dari kantin: 30.66°C
  📩 Data dari lab_komputer: 20.89°C
  📩 Data dari kantin: 31.84°C
  📩 Data dari lab_komputer: 20.59°C
  📩 Data dari kantin: 30.56°C
  📩 Data dari lab_komputer: 21.76°C
  📩 Data dari kantin: 29.67°C
  📩 Data dari lab_komputer: 22.84°C
  📩 Data dari kantin: 29.81°C
  📩 Data dari lab_komputer: 23.91°C
  📩 Data dari kantin: 28.35°C
  📩 Data dari lab_komputer: 21.42°C
```



```
● PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
○ (.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
  t_socket/latihan_14_mqtt_pub.py
  c:\Users\raraf\Desktop\htdocs\chat_socket\latihan_14_mqtt_pub.py:9: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
    client = mqtt.Client()
  Mengirim suhu Lab: 24.76
  Mengirim suhu Kantin: 31.15
  Mengirim suhu Lab: 20.76
  Mengirim suhu Kantin: 29.67
  Mengirim suhu Lab: 21.03
  Mengirim suhu Kantin: 29.55
  Mengirim suhu Lab: 22.15
  Mengirim suhu Kantin: 29.04
  Mengirim suhu Lab: 23.83
  Mengirim suhu Kantin: 29.29
  Mengirim suhu Lab: 23.36
  Mengirim suhu Kantin: 28.05
  Mengirim suhu Lab: 24.80
  Mengirim suhu Kantin: 30.63
  Mengirim suhu Lab: 23.24
  Mengirim suhu Kantin: 28.51
  Mengirim suhu Lab: 21.51
  Mengirim suhu Kantin: 30.34
```



```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
t_socket/saklar.py
c:\Users\raraf\Desktop\htdocs\chat_socket\saklar.py:3: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  client = mqtt.Client()
Ketik ON / OFF: jdf
Ketik ON / OFF: ON
Ketik ON / OFF: OFF
Ketik ON / OFF: 
```



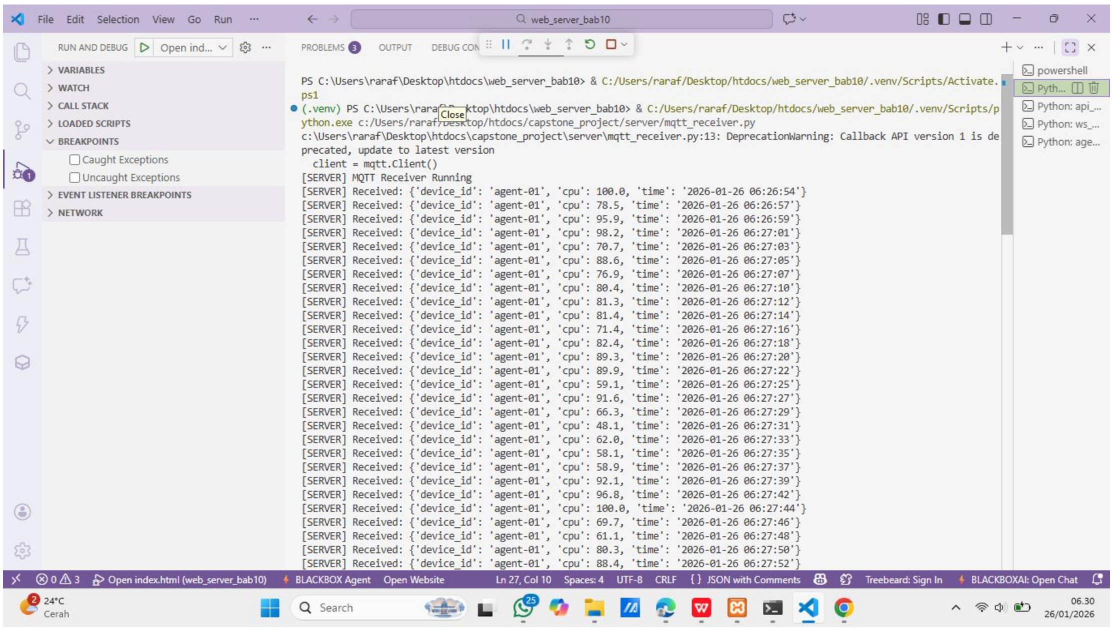
```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/python.exe c:/Users/raraf/Desktop/htdocs/cha
t_socket/lampu.py
c:\Users\raraf\Desktop\htdocs\chat_socket\lampu.py:9: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
  client = mqtt.Client()
🌑 LAMPU MATI
🌑 LAMPU MATI
💡 LAMPU NYALA
🌑 LAMPU MATI
```

Penjelasan :

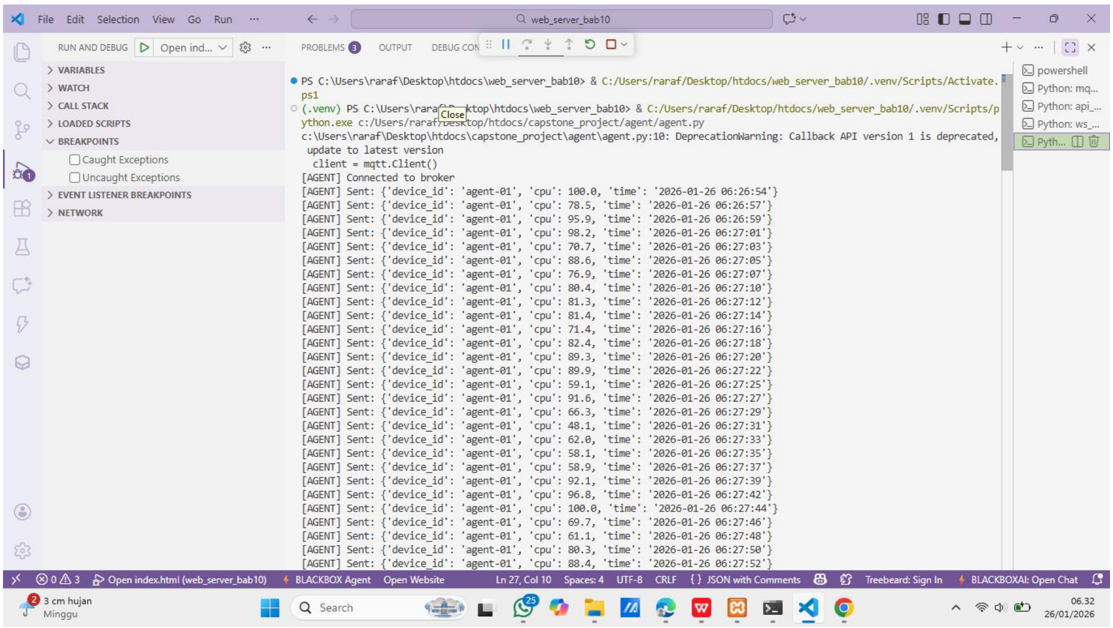
Gambar ini memperlihatkan komunikasi antara publisher dan subscriber menggunakan protokol MQTT. Client IoT berhasil mengirimkan data ke broker MQTT, kemudian data tersebut diteruskan ke subscriber yang berlangganan pada topik tertentu. Hasil ini menunjukkan bahwa arsitektur sistem terdistribusi berbasis IoT telah berjalan dengan baik dan cocok digunakan untuk pertukaran data secara ringan dan efisien.

Bab 15 : Proyek Akhir (Capstone Project)

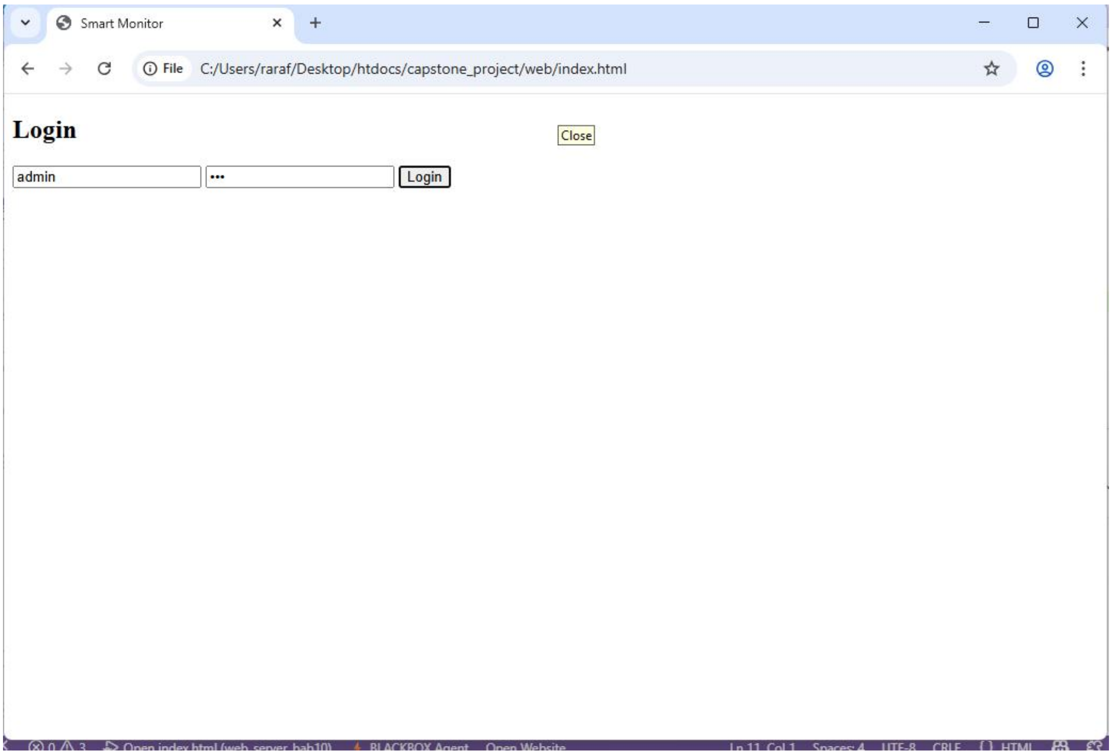
Hasil :



```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.
ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/p
ython.exe c:/Users/raraf/Desktop/htdocs/capstone_project/server/mqtt_receiver.py
c:\Users\raraf\Desktop\htdocs\capstone_project\server\mqtt_receiver.py:13: DeprecationWarning: Callback API version 1 is de
precated, update to latest version
  client = mqtt.Client()
[SERVER] MQTT Receiver Running
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 100.0, 'time': '2026-01-26 06:26:54'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 78.5, 'time': '2026-01-26 06:26:57'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 95.9, 'time': '2026-01-26 06:26:59'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 98.2, 'time': '2026-01-26 06:27:01'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 70.7, 'time': '2026-01-26 06:27:03'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 88.6, 'time': '2026-01-26 06:27:05'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 76.9, 'time': '2026-01-26 06:27:07'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 80.4, 'time': '2026-01-26 06:27:10'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 81.3, 'time': '2026-01-26 06:27:12'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 81.4, 'time': '2026-01-26 06:27:14'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 71.4, 'time': '2026-01-26 06:27:16'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 82.4, 'time': '2026-01-26 06:27:18'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 89.3, 'time': '2026-01-26 06:27:20'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 89.9, 'time': '2026-01-26 06:27:22'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 59.1, 'time': '2026-01-26 06:27:25'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 91.6, 'time': '2026-01-26 06:27:27'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 66.3, 'time': '2026-01-26 06:27:29'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 48.1, 'time': '2026-01-26 06:27:31'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 62.0, 'time': '2026-01-26 06:27:33'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 58.1, 'time': '2026-01-26 06:27:35'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 58.9, 'time': '2026-01-26 06:27:37'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 92.1, 'time': '2026-01-26 06:27:39'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 96.8, 'time': '2026-01-26 06:27:42'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 100.0, 'time': '2026-01-26 06:27:44'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 69.7, 'time': '2026-01-26 06:27:46'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 61.1, 'time': '2026-01-26 06:27:48'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 80.3, 'time': '2026-01-26 06:27:50'}
[SERVER] Received: {'device_id': 'agent-01', 'cpu': 88.4, 'time': '2026-01-26 06:27:52'}
```



```
PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/Activate.
ps1
(.venv) PS C:\Users\raraf\Desktop\htdocs\web_server_bab10> & C:/Users/raraf/Desktop/htdocs/web_server_bab10/.venv/Scripts/p
ython.exe c:/Users/raraf/Desktop/htdocs/capstone_project/agent/agent.py
c:\Users\raraf\Desktop\htdocs\capstone_project\agent\agent.py:10: DeprecationWarning: Callback API version 1 is deprecated,
 update to latest version
  client = mqtt.Client()
[AGENT] Connected to broker
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 100.0, 'time': '2026-01-26 06:26:54'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 78.5, 'time': '2026-01-26 06:26:57'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 95.9, 'time': '2026-01-26 06:26:59'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 98.2, 'time': '2026-01-26 06:27:01'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 70.7, 'time': '2026-01-26 06:27:03'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 88.6, 'time': '2026-01-26 06:27:05'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 76.9, 'time': '2026-01-26 06:27:07'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 80.4, 'time': '2026-01-26 06:27:10'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 81.3, 'time': '2026-01-26 06:27:12'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 81.4, 'time': '2026-01-26 06:27:14'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 71.4, 'time': '2026-01-26 06:27:16'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 82.4, 'time': '2026-01-26 06:27:18'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 89.3, 'time': '2026-01-26 06:27:20'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 89.9, 'time': '2026-01-26 06:27:22'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 59.1, 'time': '2026-01-26 06:27:25'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 91.6, 'time': '2026-01-26 06:27:27'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 66.3, 'time': '2026-01-26 06:27:29'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 48.1, 'time': '2026-01-26 06:27:31'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 62.0, 'time': '2026-01-26 06:27:33'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 58.1, 'time': '2026-01-26 06:27:35'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 58.9, 'time': '2026-01-26 06:27:37'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 92.1, 'time': '2026-01-26 06:27:39'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 96.8, 'time': '2026-01-26 06:27:42'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 100.0, 'time': '2026-01-26 06:27:44'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 69.7, 'time': '2026-01-26 06:27:46'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 61.1, 'time': '2026-01-26 06:27:48'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 80.3, 'time': '2026-01-26 06:27:50'}
[AGENT] Sent: {'device_id': 'agent-01', 'cpu': 88.4, 'time': '2026-01-26 06:27:52'}
```



Smart Monitor
File
C:/Users/raraf/Desktop/htdocs/capstone_project/web/index.html
Close
Login
Open index.html (web_server_bab10)
BLACKBOX Agent
Open Website
Ln 11, Col 1
Spaces: 4
UTF-8
CRLF
HTML

Login

admin •••

Penjelasan :

Gambar ini menunjukkan hasil implementasi proyek akhir yang menggabungkan berbagai konsep pemrograman jaringan yang telah dipelajari pada bab sebelumnya. Sistem yang dibangun mampu menjalankan fungsi komunikasi jaringan, pengolahan data, serta menampilkan hasil secara real-time atau berbasis web. Hasil pengujian menunjukkan bahwa aplikasi berjalan sesuai dengan perancangan dan memenuhi tujuan proyek akhir.