

## Project Report

Title: Socket Programming Project 2 - TCP/IP Programming

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## Installation of the Program

- Download CS372\_Project2.zip and extract it to the CS372\_Project2 folder.
- Open the terminal and navigate to this folder using the cd command:

```
cd CS372_Project2
```

Ensure Python is installed (skip installation instructions).

Install all required modules using the following command:

```
pip install -r requirements.txt
```

Run the Management Service (server) program using the command:

```
python server.py
```

Open two terminals and run the monitoring services in each terminal. Navigate to the project folder and run client.py.

```
cd CS372_Project1  
python server.py
```

In this project sometimes we call Management Service software as server and Monitoring Service software as client.

## Management Service Software

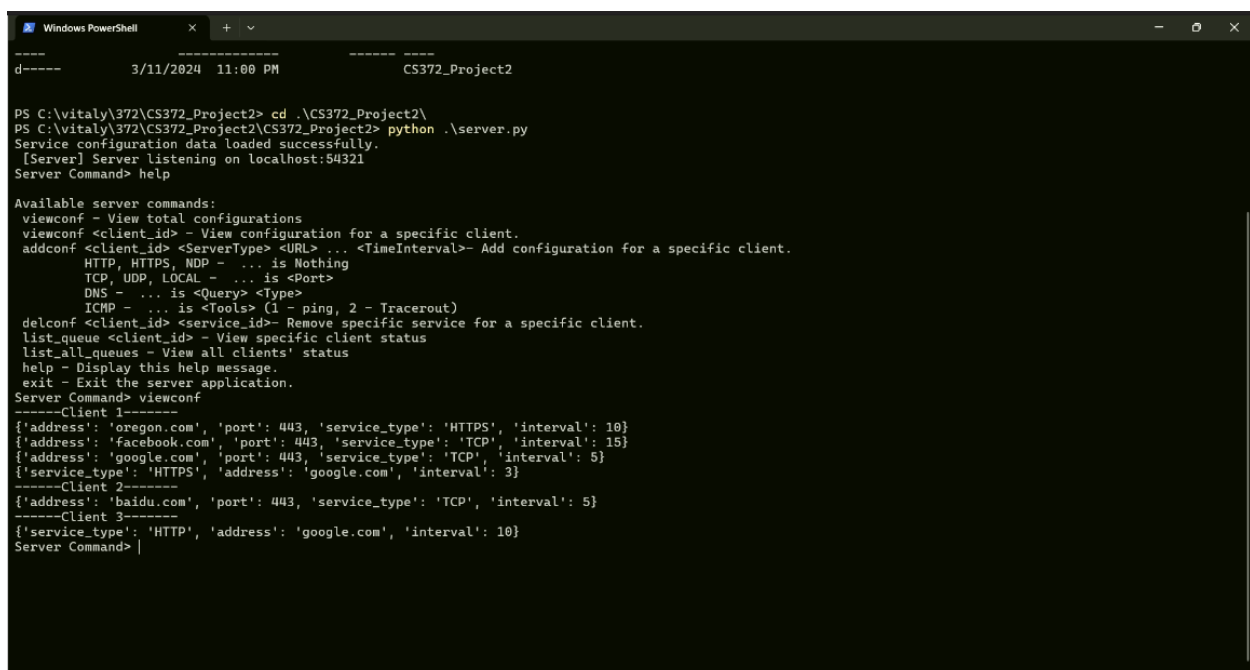
### 1. Management Service monitoring management

1.1. This program listens on localhost:54321 for Monitoring Service connections and responds to monitoring service's requests.

Use the 'help' command to view available Management Service commands.

The Management Service program loads Monitoring Service configuration from data.json file and saves last configuration to that file, this enables to perform previous tasks.

Use 'viewconf' command to view service configurations for the monitoring services. To view the service configuration for a specific monitoring service, enter the command 'viewconf <client\_id>'. The client\_id starts from 1, where the first connected Monitoring Service is assigned 1, the next Monitoring Service 2, and so forth.



```
-----
d----- 3/11/2024 11:00 PM CS372_Project2

PS C:\vitaly\372\CS372_Project2> cd .\CS372_Project2\
PS C:\vitaly\372\CS372_Project2\CS372_Project2> python .\server.py
Service configuration data loaded successfully.
[Server] Server listening on localhost:54321
Server Command> help

Available server commands:
viewconf - View total configurations
viewconf <client_id> - View configuration for a specific client.
addconf <client_id> <ServerType> <URL> ... <TimeInterval>- Add configuration for a specific client.
        HTTP, HTTPS, NDP - ... is Nothing
        TCP, UDP, LOCAL - ... is <Port>
        DNS - ... is <Query> <Type>
        ICMP - ... is <Tools> (1 - ping, 2 - Tracerout)
delconf <client_id> <service_id>- Remove specific service for a specific client.
list_queue <client_id> - View specific client status
list_all_queues - View all clients' status
help - Display this help message.
exit - Exit the server application.
Server Command> viewconf
-----Client 1-----
{'address': 'oregon.com', 'port': 443, 'service_type': 'HTTPS', 'interval': 10}
{'address': 'facebook.com', 'port': 443, 'service_type': 'TCP', 'interval': 15}
{'address': 'google.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
{'service_type': 'HTTPS', 'address': 'google.com', 'interval': 3}
-----Client 2-----
{'address': 'baidu.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
-----Client 3-----
{'service_type': 'HTTP', 'address': 'google.com', 'interval': 10}
Server Command> |
```

This example shows monitoring configurations for 3 monitoring services. When the Monitoring Service connects to the management server it receives configuration data from the management server and runs monitoring tasks.

## 2. Connection Management

2.1. The Management Service is capable of establishing and maintaining persistent TCP connections to multiple monitoring services, each identified by IP and port numbers.

2.2. The Management Service Implemented TCP keepalive mechanisms to ensure long-term connection stability.

2.3. The Management Service can recover the connection to a failed Monitoring Service when this Monitoring Service requires connection.

2.4. Management Service has a saved configuration that contains the list of Monitoring Services (json file).

### 3. Configuration Management

3.1. The Management Service is holding all configuration information for monitoring tasks, including service types to monitor (HTTP, HTTPS, ICMP, DNS, NTP, TCP, UDP), parameters for checks (URLs, server addresses, port numbers), and check frequencies.

Use 'addconf' command to add monitored service information and 'removeconf' command to remove any existing information.

For example `addconf 1 TCP baidu.com 443 5` command adds TCP monitoring for baidu.com 443 port to the Monitoring Service 2.

`delconf 2 2` command removes the second configuration for the Monitoring Service 2.

```
Windows PowerShell
Service configuration data loaded successfully.
[Server] Server listening on localhost:54321
Server Command> viewconf
-----Client 1-----
{'address': 'oregon.com', 'port': 443, 'service_type': 'HTTPS', 'interval': 10}
{'address': 'facebook.com', 'port': 443, 'service_type': 'TCP', 'interval': 15}
{'address': 'google.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
{'service_type': 'HTTPS', 'address': 'google.com', 'interval': 3}
-----Client 2-----
{'address': 'baidu.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
{'service_type': 'TCP', 'address': 'chat.openai.com', 'port': 443, 'interval': 10}
-----Client 3-----
{'service_type': 'HTTP', 'address': 'google.com', 'interval': 10}
Server Command> addconf 3 HTTPS bing.com 10
configuration data added to the client 3
Server Command>
Server Command> viewconf
-----Client 1-----
{'address': 'oregon.com', 'port': 443, 'service_type': 'HTTPS', 'interval': 10}
{'address': 'facebook.com', 'port': 443, 'service_type': 'TCP', 'interval': 15}
{'address': 'google.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
{'service_type': 'HTTPS', 'address': 'google.com', 'interval': 3}
-----Client 2-----
{'address': 'baidu.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
{'service_type': 'TCP', 'address': 'chat.openai.com', 'port': 443, 'interval': 10}
-----Client 3-----
{'service_type': 'HTTP', 'address': 'google.com', 'interval': 10}
{'service_type': 'HTTPS', 'address': 'bing.com', 'interval': 10}
Server Command> removeconf 2 2
configuration data removed to the client 2
Server Command> viewconf
-----Client 1-----
{'address': 'oregon.com', 'port': 443, 'service_type': 'HTTPS', 'interval': 10}
{'address': 'facebook.com', 'port': 443, 'service_type': 'TCP', 'interval': 15}
{'address': 'google.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
{'service_type': 'HTTPS', 'address': 'google.com', 'interval': 3}
-----Client 2-----
{'address': 'baidu.com', 'port': 443, 'service_type': 'TCP', 'interval': 5}
-----Client 3-----
{'service_type': 'HTTP', 'address': 'google.com', 'interval': 10}
```

3.2. The Management Service gives 'client\_id' to the Monitoring Service and differentiate monitoring services by these numbers when sends configuration data and receives monitoring data. And also the Management Service maintain monitoring services' addresses and port information to identify them.

## 4. Status Display

4.1. The Management Service provides real-time status updates of all connected monitoring services, including their operational and any anomalies detected (i.e. "Reconnecting", etc.).

4.1.1. The Management Service prints critical messages to the console.

4.1.2. The Management Service prints status message to console.

## 5. Task Distribution and Validation

## 5.1. The Management Service distributes monitoring tasks to connected monitoring services

It Retrieves monitoring service's unique ID and receives confirmations from monitoring services for each task.

```
Windows PowerShell
[Server] Accepted connection from ('127.0.0.1', 56501)
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:00]: HTTPS URL: oregon.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'oregon.com': No scheme supplied. Perhaps you meant https://oregon.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:00]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:00]: TCP: Server: facebook.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on facebook.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:00]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:03]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:05]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:06]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:09]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:10]: HTTPS URL: oregon.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'oregon.com': No scheme supplied. Perhaps you meant https://oregon.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:10]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:12]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:15]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:15]: TCP: Server: facebook.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on facebook.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:15]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:18]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:20]: HTTPS URL: oregon.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'oregon.com': No scheme supplied. Perhaps you meant https://oregon.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:20]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:21]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:24]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56501) :: [2024-03-12 00:27:25]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com
```

To exit the program, use the 'exit' command. Management Service software saves current configurations to the json file.

## Monitoring Service program

```
cd CS372_Project1
python client.py
```

### 1. Monitoring Service monitoring actions

The Monitoring Service receives configuration data from the Management Service after connection and performs those monitoring tasks.

```
C:\Windows\System32\cmd.exe + v
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Socket connection error: [WinError 10061] No connection could be made because the target machine actively refused it. Attempting to reconnect...
[Client] Attempting to reconnect to the server...
[Client] Connected to server.

[Client] Message from server: {'type': 'configuration', 'data': [{'address': 'oregon.com', 'port': 443, 'service_type': 'TCP', 'interval': 10}], {'address': 'facebook.com', 'port': 443, 'service_type': 'TCP', 'interval': 15}]
[Client] Received configuration from server: {'address': 'oregon.com', 'port': 443, 'service_type': 'TCP', 'interval': 10}, {'address': 'facebook.com', 'port': 443, 'service_type': 'TCP', 'interval': 15}]
[2024-03-11 04:16:13]: TCP: Server: oregon.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on oregon.com is open.
[2024-03-11 04:16:13]: TCP: Server: facebook.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on facebook.com is open.
```

## 2. Unique Identification

Monitoring Service use a unique identifier for interacting with the Management Service.

This identifier is generated by the Management Service.

### 3. Task Management

Monitoring Service uses unique identifier to perform task management with Management Service.

It receives all monitoring tasks with the Management Service and performs assigned monitoring tasks according to the received configurations and frequencies.

## 4. Result Reporting

Monitoring Service uses unique identifier (R2.1) to perform result reporting with Management Service and Sends the results of service tests back to the Management Service immediately for real-time reporting.

It Maintains timestamps for all monitoring results (transferred to Management Service as part of the result for accurate reporting).

## 5. Resilience and Recovery

5.1. Monitoring Service is able to allow for the Management Service to reconnect without needing to restart the Monitoring Service.

We have run one Management Service and three Monitoring Services and tested.

```
Windows PowerShell
is open.
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:30]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 63414) :: [2024-03-12 03:30:30]: HTTPS URL: bing.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'bing.com': No scheme supplied. Perhaps you meant https://bing.com?
[Server] ('127.0.0.1', 63414) :: [2024-03-12 03:30:30]: HTTP URL: google.com, HTTP server status: False, Status Code: N/A
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:31]: HTTPS URL: oregon.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'oregon.com': No scheme supplied. Perhaps you meant https://oregon.com?
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:31]: TCP: Server: facebook.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on facebook.com is open.
[Server] ('127.0.0.1', 63363) :: [2024-03-12 03:30:31]: TCP: Server: baidu.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on baidu.com is open.
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:33]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:33]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:36]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 63363) :: [2024-03-12 03:30:37]: TCP: Server: baidu.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on baidu.com is open.
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:38]: TCP: Server: google.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on google.com is open.
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:39]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 63414) :: [2024-03-12 03:30:40]: HTTPS URL: bing.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'bing.com': No scheme supplied. Perhaps you meant https://bing.com?
[Server] ('127.0.0.1', 63414) :: [2024-03-12 03:30:40]: HTTP URL: google.com, HTTP server status: False, Status Code: N/A
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:41]: HTTPS URL: oregon.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'oregon.com': No scheme supplied. Perhaps you meant https://oregon.com?
[Server] ('127.0.0.1', 56581) :: [2024-03-12 03:30:42]: HTTPS URL: google.com, HTTPS server status: False, Status Code: N/A, Description: Error during request: Invalid URL 'google.com': No scheme supplied. Perhaps you meant https://google.com?
[Server] ('127.0.0.1', 63363) :: [2024-03-12 03:30:42]: TCP: Server: baidu.com, TCP Port: 443, TCP Port Status: True, Description: Port 443 on baidu.com is open.
Server Command> |
```

Management Service



[illegible]

## Monitoring Service 1

[illegible]

## Monitoring Service 2

[illegible]

### Monitoring Service 3