**Single Threaded Web Server Test Procedure**

Single threaded web server is running on port 8000. Postman is used to send different requests for 200, 304, 400, 404 tests. Python client script is used for 408 test.



Figure : Terminal of the running server on port 8000

* 200 OK

Graphical user interface, text, application, email

Description automatically generated

Figure : Postman 200 OK

* 304 Not Modified
* If-Modified-Since is added to its header
* Last modified date of test.html is Nov 22 and requested date is Nov 25. Therefore, it returns 304 Nor Modified

A picture containing calendar

Description automatically generated

Figure : Terminal showing the last modified date of test.html

Graphical user interface, text, application, email

Description automatically generated

Figure : Postman 304 Not Modified

* 400 Bad Request
* The server checks if the file exists and if true, it opens and reads the file. For the purpose of 400 Bad Request, I renamed the file name to `return400error.html` after it passed the 404 check.
* Since test.html does not exist, opening and reading the file will raise an error.
* `reply\_to\_client()` will catch the error and return 400 error to its client.

Text

Description automatically generated

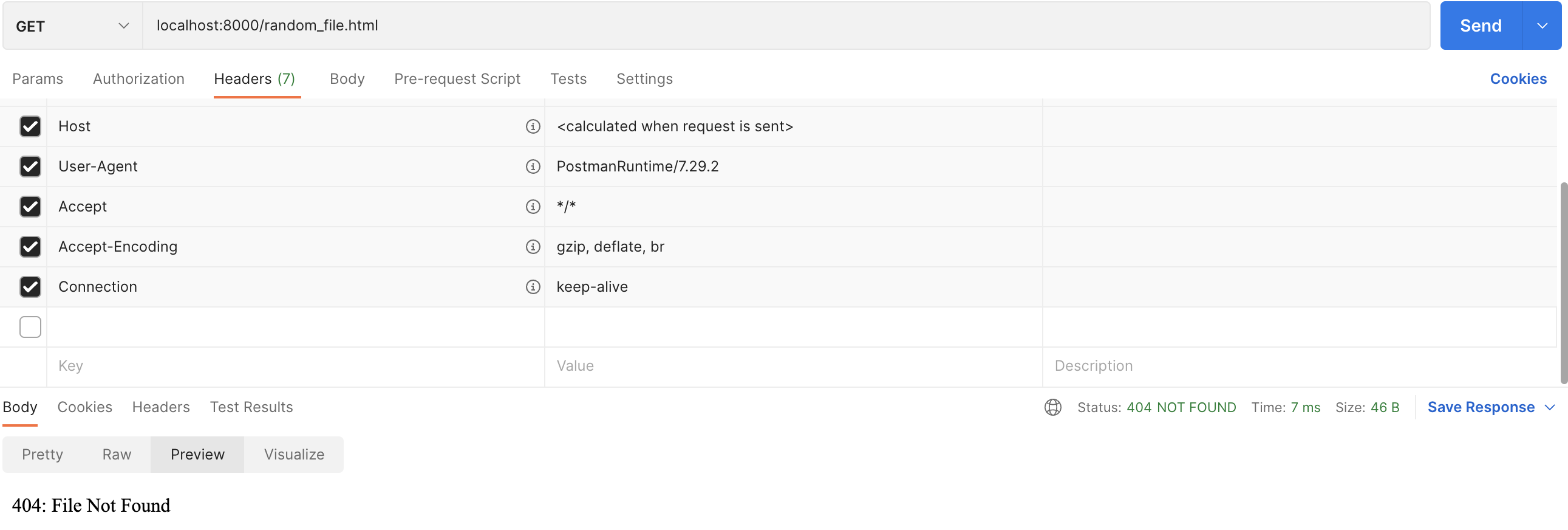
Figure : Python code changing file name after the 404 check

Graphical user interface, text, application, email

Description automatically generated

Figure : Postman 400 BAD REQUEST

* 404 Not Found
* Sent a request with non-exist file name



* 408 Request Timed Out
* Python client script connects to the server and wait for 6 seconds to send data. Cut off for 408 is 5 seconds; thus, the server returns 408 error

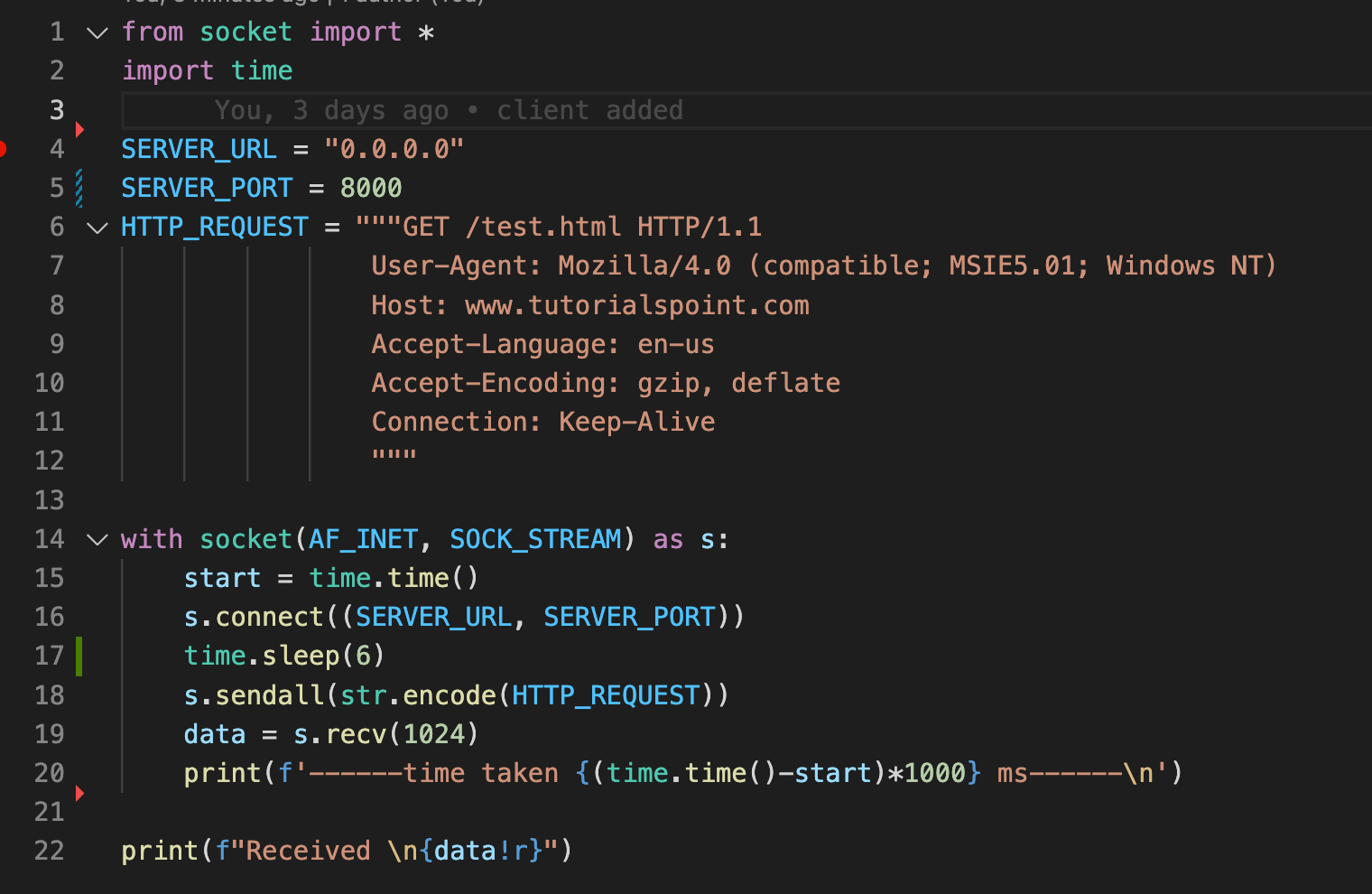


Figure : Python Client script with a delay

Text

Description automatically generated

Figure : Server return for 408 Request Timed Out

**Proxy Server Specifications**

* What is a proxy server?

A web server refers to software and hardware which uses the Hypertext Transfer Protocol (HTTP) to serve files to clients as a response to their requests. On the other hand, a proxy server sits between a web server and a client. When a user sends an HTTP request, it goes to a proxy server first and the requested data is cached in a proxy server, and a proxy server returns to the client. If not, the request is forwarded to a server if necessary.

* What is the function of a proxy server?

One of the most critical functions of a proxy server is caching. A proxy server caches previously requested files and returns them to a client directly when they are requested again. With the proxy server, the server and network load will be released.

* Test procedure

The screenshot below shows that the initial HTTP request took more than 10 times than the second request. This is because the initial request went to the main server to grab the html file, but the second request used cached data from the proxy server

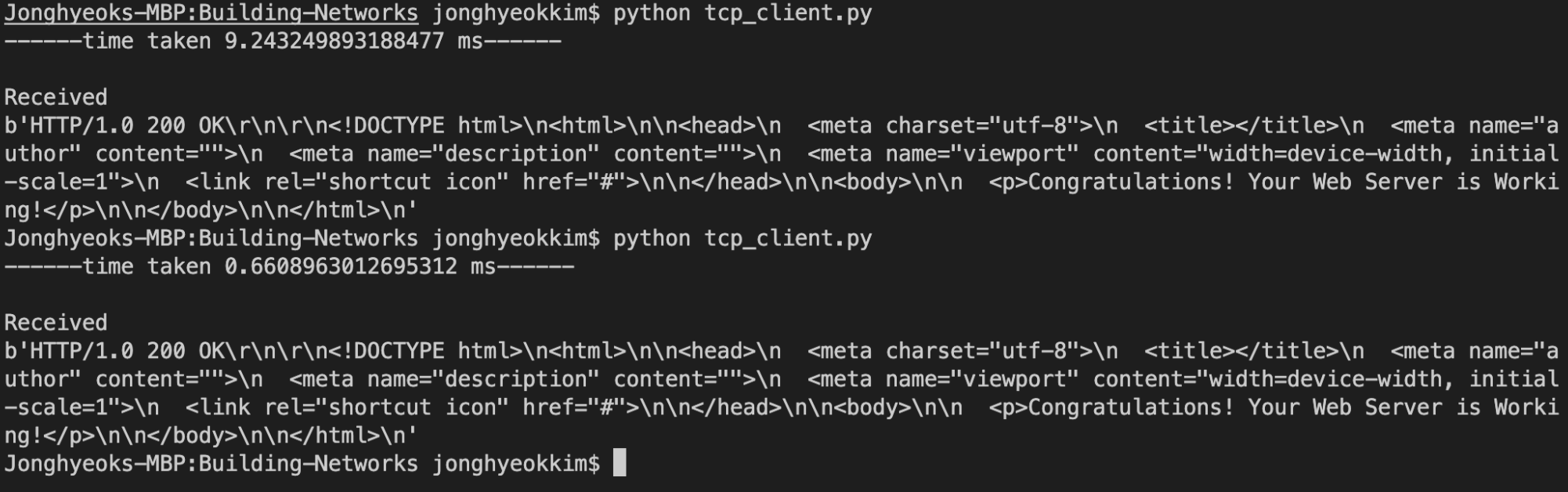


Figure 9: Comparison between the proxy server and main server response time

**Multi-Threaded Web Server Test Procedure**

Diagram

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Figure 9: Multi-threaded web server overview

Since it is a minimal server, processing a HTTP request is almost instance. As a result, multi-threading almost works like synchronously. I added some delay on a threaded server to capture the nature of multi-threading. The code below shows that it print the thread ID and port number twice before the HTTP request handling and after the handling.

Text

Description automatically generated

Figure 10: Multi-threaded web server

If it were a non-multi-threaded server, the server work synchronously, which means the server starts to handle a request and following requests wait for the proceeding requests to be done. On the other hand, a multi-threaded server does not wait for proceeding requests done. It starts to handle it as it receives a new request.Chart, waterfall chart

Description automatically generatedGraphical user interface, application

Description automatically generated

Figure 11: Single threaded server Figure 12: Multi-threaded server

The output below shows that our multi-threaded server stared multi thread as it receives a new request with a new port number. Also, it shows that requests are not waiting for proceeding requests. They start as soon as it receives a request.

Text

Description automatically generated with medium confidence

Figure 13: Our multi-threaded server result