

CS 5060 : ADVANCED COMPUTER NETWORKS

PROGRAMMING ASSIGNMENT # 2

Submitted By : Group 2

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Date: 03.11.23

Signature: A.J

:A.P

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TASK-1

SIMPLE WEB CLIENT

- **Functionality** : our web client is able to connect to any website like cse.iith.ac.in or our own web server made in task-3 . It opens non persistent tcp connection to the website then it makes http get request to get the base html file then it uses the beautiful SOAP library of python to parse and retrieve the references objects. The referenced objects to be parsed are images ,icons and scripts.it also makes use of the PIL library of python to display the images as they are downloaded. Furthermore we also save the received object data like images,scripts,icons in separate files on our PC.
- **How to give input arguments to client program** :
 For client programs we have two choices connecting directly to the server or connecting via proxy both have different ways of giving input arguments. To connect directly to the server open the terminal where Client.py is stored and enter "python3 Client.py hostname port_no path" and press enter and then select choice 0 when asked. For example, to connect to cse.iith.ac.in directly :

```
python3 Client.py cse.iith.ac.in 443 / " Enter.
```

```
      : enter 0 (choice) and Enter
```

 Before connecting Client via proxy make sure proxy server is running
 To connect to cse.iith.ac.in via Proxy : " python3 Client.py " Enter

```
      : Enter choice 1 and press enter
```

```
      : Enter Proxy IP = "127.0.0.1" Enter
```

```
      : Enter port on which proxy is listening = "15000" Enter
```

```
      : Enter server hostname or IP = " cse.iith.ac.in " Enter
```

```
      : Enter port no of server = " 443 " Enter
```

```
      : Enter the file path = " / " Enter
```
- **Flow path of client program** :
 If the user chooses 0 in step 2 then the client program directly connects to the web server, not implicating a proxy in between. And then it checks if the server port is 443 or not. If it is 443 then our client program connects using a ssl socket otherwise it connects to a web server using normal socket. However if the choice user selects is 1 then our client program connects to the web server via our own webproxy made as part of task 2. And to do so it connects to the proxy using a normal socket, and then the proxy then connects to the web server and returns the response back to the client.

- **Outputs of client program:**

Our client program first displays the html base file and also saves all the image,icon,scripts and finally we also output the latency ,so that we can compare the speedy web client program done as part of our extension.

TASK-2

SIMPLE WEB PROXY

- **Functionality:** our web proxy perform functionality of web server and also some functionality of our web client basically it receive the http get requests from the client and forward to the web server then it receive the response from the web server then it checks the status code of http response message and than it create http response header based on the status code ,appends the http response data to the headers and sends it to the client. Our web proxy can be connected to any web browser(client) and also it can connect to any web server.
- **How to give input arguments to proxy program :**
The server host name and the server port to which proxy needs to connect to are extracted from the http get request received from the client itself so there is no explicit argument we need to pass to proxy. Just make sure to bind the proxy to correct ip as the ip changes depending upon the network to which we are connected to. And this ip can be found using the ifconfig command in linux.
- **Flow path of proxy program :**
In proxy there is always one socket open to serve incoming tcp connection requests, it makes a separate new thread for every new client . It receives the http get request from the client and extracts server host name and server port number from it. If the port number is 443 then it connects using an ssl socket to the server otherwise using a normal socket. Then it waits for the response from the server, checks the status code of the response and sends back the appropriate http response to the client.

Outputs of proxy program:

Because we were not suppose to do catching, we are not saving any object as files on the proxy side.output of the proxy is simply the response sent back to the client.

TASK-3

SIMPLE WEB SERVER

- **Functionality:** our server is always in listening state to the incoming client requests, making a separate thread for each client. It extracts the file path from the http get request, searches the file path in the directory and returns back the file if present otherwise it returns 404 not found http response message. Also our server can be connected using any web browser or our own web client program.
- **How to give input arguments to server program :**
There are no input arguments to the server program.
- **Flow path of server program :**
Once the server receives the tcp connection request it opens a new thread for that client, upon receiving the http get request it extracts the file path and then reads the file data. It makes the appropriate http response header, appends file data to the header and sends back the response client.
- **Outputs of server program:**
Output of the server program is simply a requested file by the client, sent back as response.

TASK-4

SPEEDY WEB CLIENT (EXTENSION 5 PART 4)

- **Functionality:** it has all the functionality which our simple web client had to offer ,additionally in speedy web client to get the referenced objects from the server we make multiple parallel tcp connections using ThreadPoolExecutor() functionality of concurrent.futures library of python. Our speedy web client can also connect to any web server.

- **How to give input arguments to speedy web client program :**

For speedy web client programs we have two choices: connecting directly to the server or connecting via proxy both have different ways of giving input arguments. To connect directly to the server open the terminal where Client.py is stored and enter "python3 SpeedyWebClient .py hostname port_no path" and press enter and then select choice 0 when asked. For example, to connect to cse.iith.ac.in directly : " python3 SpeedyWebClient.py cse.iith.ac.in 443 / " Enter.

: enter 0 (choice) and Enter

Before connecting Client via proxy make sure proxy server is running

To connect to cse.iith.ac.in via Proxy : " python3 SpeedyWebClient.py " Enter

: Enter choice 1 and press enter

: Enter Proxy IP = "127.0.0.1" Enter

: Enter port on which proxy is listening = "15000" Enter

: Enter server hostname or IP = " cse.iith.ac.in " Enter

: Enter port no of server = " 443 " Enter

: Enter the file path = " / " Enter

- **Flow path of speedy web client program :**

If the user chooses 0 in step 2 then the speedy web client program directly connects to the web server, not implicating a proxy in between. And then it checks if the server port is 443 or not. If it is 443 then our client program connects using a ssl socket otherwise it connects to a web server using normal socket. However if the choice user selects is 1 then our speedy web client program connects to the web server via our own webproxy made as part of task 2. And to do so it connects to the proxy using a normal socket, and then the proxy then connects to the web server and returns the response back to the speedy web client. Once the speedy web client receives the base html file it parses html file for icons, scripts and images and stores all their respective urls in a list. This list is given as the one of the input arguments of the executor object of ThreadPoolExecutor(). The target function of the ThreadPoolExecutor() function is the getObject() function which takes server hostname, server port no and complete urls as arguments and sends the http get request to server. Because the ThreadPoolExecutor() makes multiple instances of getObject() function and in each instance we make a new tcp connection so multiple parallel connections are made in this way. We can also fix the max number of parallel tcp connections.

- **Outputs of speedy web client program:**

Output of the speedy web client program is that it saves all the retrieved objects from the server, and it also outputs the latency to retrieve those objects.

{demonstrations from the next page}

Demonstrations:

CLIENT<->WEB SERVER (CONNECTING TO CSE.IITH):

Activities | Image Viewer | Nov 4 01:15


anirudh@anirudh-Lenovo-Legion-Y540-15IRH-PG0: ~/Prg_Assi... | 72% | LYD01882.jpg

```
dropdown-btn
<i class="fa fa-graduation-cap"></i>Academics
</button>
<div class="dropdown-tabs"
>

<a href="/academics/tineTable.html">Time Table</a>
<a href="/academics/courses.html">Courses</a>
<a href="/academics/curriculum.html">Curriculum and Guidelines</a>
<a href="/academics/plagiarism-policy.html">Anti-Plagiarism Policy</a>
<a href="/academics/faqs.html">Rules and FAQs</a>

</div>
</li>
<li>
<button class="
dropdown-btn
">
<i class="fa fa-user-plus"></i>Admissions
</button>
<div class="dropdown-tabs"
>

<a href="/admissions/btech.html">B. Tech</a>
<a href="/admissions/dualDegree.html">Dual Degree</a>
<a href="/admissions/internships.html">Internships 2022</a>
<a href="/admissions/mtech.html">M.Tech. Admissions</a>
<a href="/admissions/mtechInDataScience.html">M.Tech in Data Science (
for Industry professionals) </a>
<a href="/admissions/phd.html">Ph.D</a>
```



Activities | Terminal | Nov 4 01:14


anirudh@anirudh-Lenovo-Legion-Y540-15IRH-PG0: ~/Prg_Assi... | 72% | LYD01709.jpg

```
anirudh@anirudh-Lenovo-Legion-Y540-15IRH-PG0: ~/Prg_Assi...$ python3 Client_
ver3.py cse.iith.ac.in 443 /
How would you like to get the file?
if directly from server : enter choice 0
if through proxy : enter choice 1
0
Total number of arguments passed : 4
/home/anirudh/Prg_Assignment_2/Client_ver3.py:38: DeprecationWarning: ssl.PROTOC
OL_TLS is deprecated
ssl_context = ssl.SSLContext(ssl.PROTOCOL_TLS)
Response code : 200
<!DOCTYPE HTML>
<html><head><!-- Robots -->
<meta name="robots" content="index, follow" /><link rel="canonical" href="/" /
><!-- Title, description, author --><title>Home | Department of CSE, IIT Hyderab
ad</title>
<meta name="description" content="CSE Website Tryouts" />
<meta name="author" content="Sai Harsha Kottapalli and Tanmay Renuguntta" />

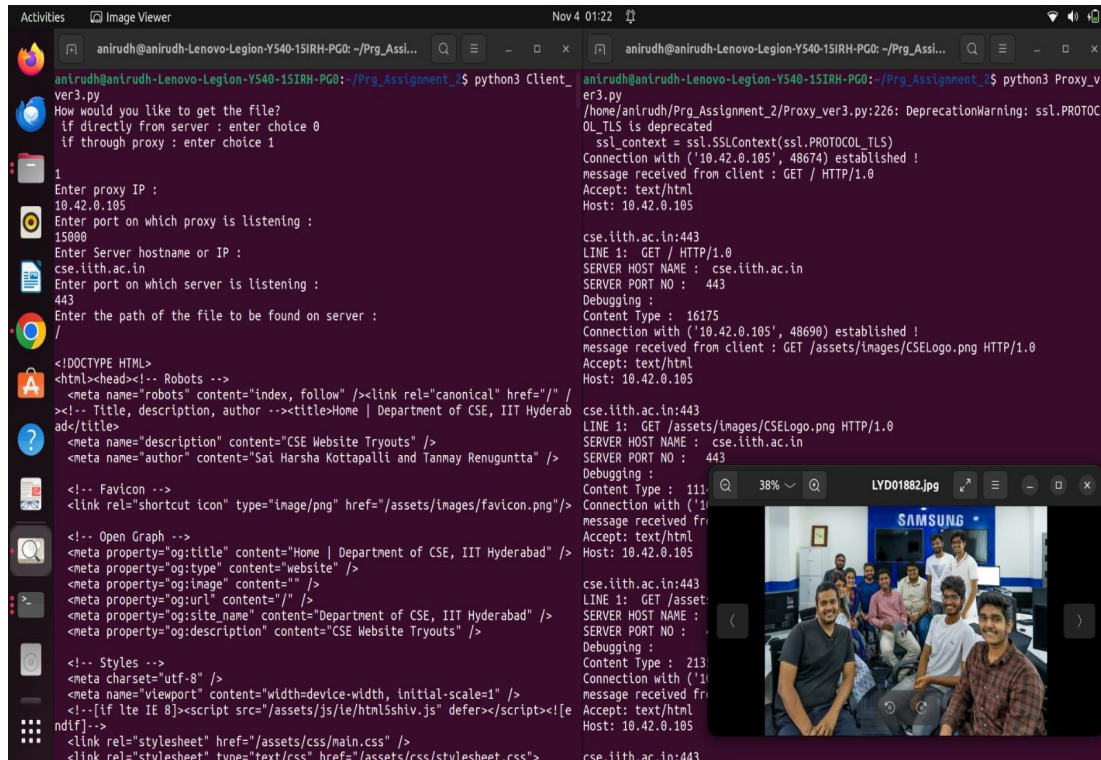
<!-- Favicon -->
<link rel="shortcut icon" type="image/png" href="/assets/images/favicon.png"/>

<!-- Open Graph -->
<meta property="og:title" content="Home | Department of CSE, IIT Hyderabad" />
<meta property="og:type" content="website" />
<meta property="og:image" content="/" />
<meta property="og:url" content="/" />
<meta property="og:site_name" content="Department of CSE, IIT Hyderabad" />
<meta property="og:description" content="CSE Website Tryouts" />

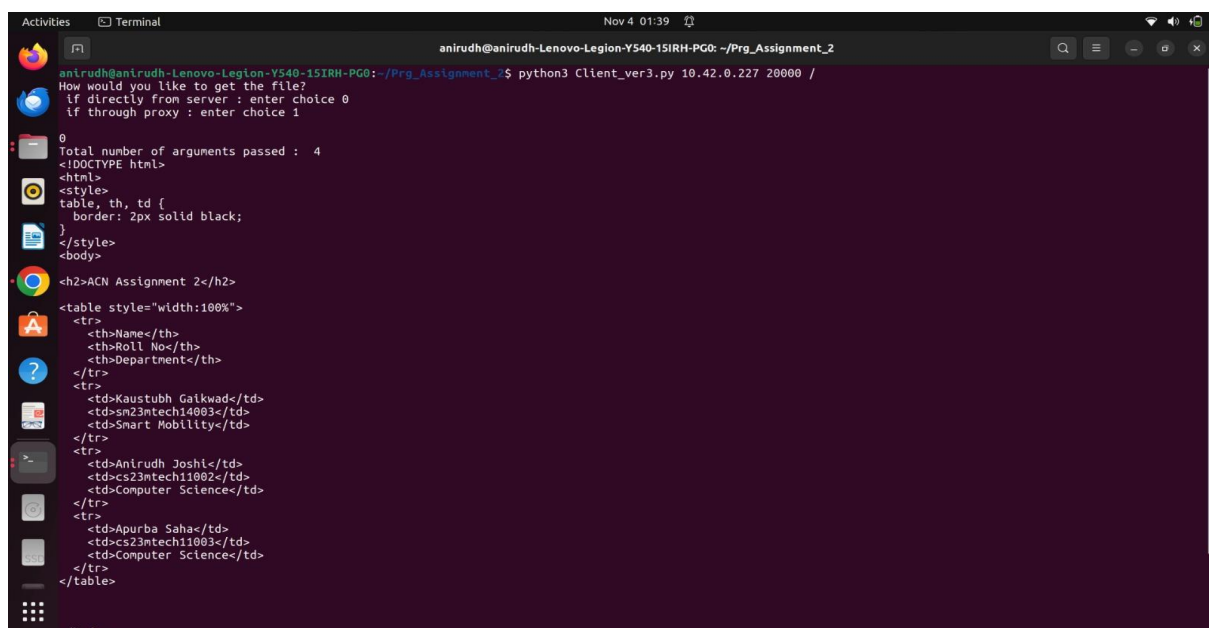
<!-- Styles -->
<meta charset="utf-8" />
<meta name="viewport" content="width=device-width, initial-scale=1" />
<!--[if lte IE 8]><script src="/assets/js/ie/html5shiv.js" defer></script><![e
ndif]>
<link rel="stylesheet" href="/assets/css/main.css" />
<link rel="stylesheet" type="text/css" href="/assets/css/stylesheet.css">
<!--[if lte IE 8]><link rel="stylesheet" href="/assets/css/ie8.css" /><![endif
]>
<!--[if lte IE 9]><link rel="stylesheet" href="/assets/css/ie9.css" /><![endif
]>
<!-- Global site tag (gtag.js) - Google Analytics -->
<script async src="https://www.google.com/gtag/js?id=UA-137608318-2"
```



CLIENT<->PROXY<->WEB SERVER (CONNECTING TO CSE.IITH):



CLIENT<->OUR OWN WEB SERVER (ON DIFFERENT MACHINE):




```
C:\WINDOWS\py.exe
Connection with ('10.42.0.105', 43052) established !
message received from client : GET / HTTP/1.0
Accept: text/html
Host: 10.42.0.227

Requested URL : /
```

BROWSER TO OUR OWN SERVER (ON DIFFERENT MACHINE):

The screenshot shows a Google Chrome browser window displaying a web page titled "ACN Assignment 2". The browser's address bar shows the URL "10.42.0.105:20000". To the left of the browser, a terminal window is open, showing the output of a Python script running on a server. The terminal output indicates that the server has successfully established a connection with the browser (10.42.0.105) and received a GET request for the root URL (/). The browser's developer tools (F12) are open, showing the network tab with a request to "http://10.42.0.105:20000/" and a response from the server. The response status is 200 OK, and the content type is text/html. The response body contains the HTML content of the web page, which includes a table with three columns: Name, Roll No, and Department. The table lists three students: Kaustubh Gaikwad, Anirudh Joshi, and Apurba Saha, along with their respective Roll Nos and Departments.

Name	Roll No	Department
Kaustubh Gaikwad	sm23mtech14003	Smart Mobility
Anirudh Joshi	cs23mtech11002	Computer Science
Apurba Saha	cs23mtech11003	Computer Science

CLIENT PROXY OUR OWN WEB SERVER (ON DIFFERENT MACHINE):

```
apurbha@apurbha-VivoBook-ASUSLaptop-X509DA-H509DA:~/ACN_NEW_ASSIGNMENT$ python3 Client_ver3.py
How would you like to get the file?
1f directly from server : enter choice 0
1f through proxy : enter choice 1
1
Enter proxy IP :
10.42.0.105
Enter port on which proxy is listening :
15800
Enter Server hostname or IP :
10.42.0.227
Enter port on which server is listening :
20000
Enter the path of the file to be found on server :
/

<!DOCTYPE html>
<html>
<style>
table, th, td {
border: 2px solid black;
}
</style>
<body>
<h2>ACN Assignment 2</h2>
<table style="width:100%">
<tr>
<th>Name</th>
<th>Roll No</th>
<th>Department</th>
</tr>
<tr>
<td>Kautubh Gaikwad</td>
<td>sm23mtech14003</td>
<td>Smart Mobility</td>
</tr>
<tr>
<td>Anirudh Joshi</td>
<td>cs23mtech11002</td>
<td>Computer Science</td>
</tr>
<tr>
<td>Apurba Saha</td>
<td>cs23mtech11003</td>
<td>Computer Science</td>
</tr>
</table>
</body>
</html>
```

```
anirudh@anirudh-Lenovo-Legion-Y540-15IRH-PG0:~/Prg_Assignment_2$ python3 Proxy_ver3.py
/home/anirudh/Prg_Assignment_2/Proxy_ver3.py:226: DeprecationWarning: ssl.PROTOCOL_TLS
ssl_context = ssl.SSLContext(ssl.PROTOCOL_TLS)
Connection with ('10.42.0.1', 55806) established !
message received from client : GET / HTTP/1.0
Accept: text/html
Host: 10.42.0.105

10.42.0.227:20000
LINE 1: GET / HTTP/1.0
SERVER HOST NAME : 10.42.0.227
SERVER PORT NO : 20000
Debugging :
Content Type : text/html
```

```
C:\WINDOWS\py.exe
Connection with ('10.42.0.105', 44386) established !
message received from client : GET / HTTP/1.0
Accept: text/html
Host: 10.42.0.227

Requested URL : /
```

BROWSER<-> PROXY<-> OUR OWN WEB SERVER (ON DIFFERENT MACHINE):

```
anirudh@anirudh-Lenovo-Legion-Y540-15IRH-PG0:~/Prg_Assignment_2$ python3 Proxy_ver3.py
/home/anirudh/Prg_Assignment_2/Proxy_ver3.py:226: DeprecationWarning: ssl.PROTOCOL_TLS is de
ssl_context = ssl.SSLContext(ssl.PROTOCOL_TLS)
Connection with ('10.42.0.1', 55210) established !
message received from client : CONNECT www.google.com:443 HTTP/1.1
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:109.0) Gecko/20100101 Firefox/119.0
Proxy-Connection: keep-alive
Connection: keep-alive
Host: www.google.com:443

LINE 1: CONNECT www.google.com:443 HTTP/1.1
Exception ignored in thread started by: <function newClientToServer at 0x7fcc730793f0>
Traceback (most recent call last):
  File "/home/anirudh/Prg_Assignment_2/Proxy_ver3.py", line 96, in newClientToServer
    serverPort = int(serverAddr[1])
IndexError: list index out of range
Connection with ('10.42.0.1', 56396) established !
message received from client : GET http://10.42.0.227:20000/ HTTP/1.1
Host: 10.42.0.227:20000
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:109.0) Gecko/20100101 Firefox/119.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8
Accept-Language: en-US,en;q=0.5
Accept-Encoding: gzip, deflate
Connection: keep-alive
Upgrade-Insecure-Requests: 1

LINE 1: GET http://10.42.0.227:20000/ HTTP/1.1
SERVER HOST NAME : 10.42.0.227
SERVER PORT NO : 20000
Debugging :
Content Type : text/html
Connection with ('10.42.0.1', 56398) established !
message received from client : CONNECT incoming.telemetry.mozilla.org:443 HTTP/1.1
User-Agent: Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:109.0) Gecko/20100101 Firefox/119.0
Proxy-Connection: keep-alive
Connection: keep-alive
Host: incoming.telemetry.mozilla.org:443
```

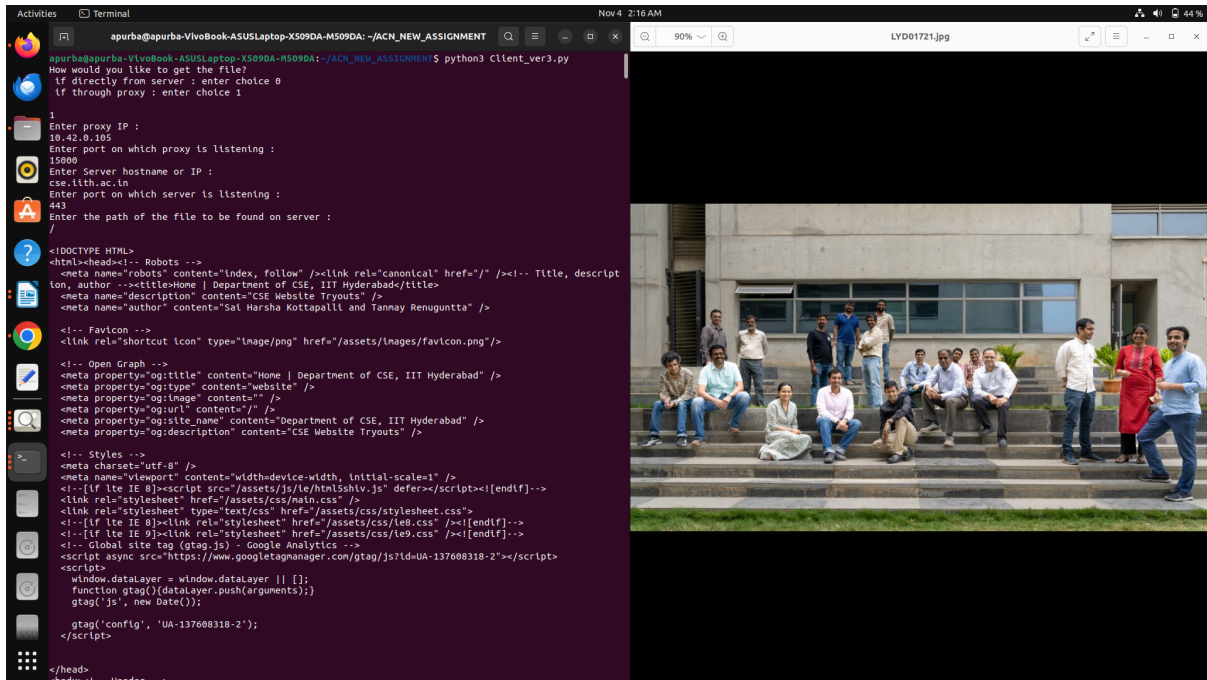
```
10.42.0.227:20000/ x +
10.42.0.227:20000
ACN Assignment 2
```

Name	Roll No	Department
Kautubh Gaikwad	sm23mtech14003	Smart Mobility
Anirudh Joshi	cs23mtech11002	Computer Science
Apurba Saha	cs23mtech11003	Computer Science

```
C:\WINDOWS\py.exe
Connection with ('10.42.0.105', 44774) established !
message received from client : GET http://10.42.0.227:20000/ HTTP/1.1
Host: 10.42.0.227:20000
Host: 10.42.0.227

Requested URL : /
Connection with ('10.42.0.105', 44790) established !
message received from client : GET http://10.42.0.227:20000/favicon.ico HTTP/1.1
Host: 10.42.0.227:20000
Host: 10.42.0.227
```

BROWSER<->PROXY<->WEB SERVER (ON DIFFERENT MACHINE):



```
anirudh@anirudh-Lenovo-Legion-Y540-15IRH-PG0: ~/Prg_Assignment_2$ python3 Proxy_ver3.py
/home/anirudh/Prg_Assignment_2/Proxy_ver3.py:226: DeprecationWarning: ssl.PROTOCOL_TLS is deprecated
  ssl_context = ssl.SSLContext(ssl.PROTOCOL_TLS)
Connection with ('10.42.0.1', 36226) established !
message received from client : GET / HTTP/1.0
Accept: text/html
Host: 10.42.0.105

cse.iith.ac.in:443
LINE 1: GET / HTTP/1.0
SERVER HOST NAME : cse.iith.ac.in
SERVER PORT NO : 443
Debugging :
Content Type : 16175
Connection with ('10.42.0.1', 36234) established !
message received from client : GET /assets/images/CSELogo.png HTTP/1.0
Accept: text/html
Host: 10.42.0.105

cse.iith.ac.in:443
LINE 1: GET /assets/images/CSELogo.png HTTP/1.0
SERVER HOST NAME : cse.iith.ac.in
SERVER PORT NO : 443
Debugging :
Content Type : 11149
Connection with ('10.42.0.1', 36250) established !
message received from client : GET /assets/images/gallery/LYD01709.jpg HTTP/1.0
Accept: text/html
Host: 10.42.0.105

cse.iith.ac.in:443
LINE 1: GET /assets/images/gallery/LYD01709.jpg HTTP/1.0
SERVER HOST NAME : cse.iith.ac.in
SERVER PORT NO : 443
Debugging :
Content Type : 213528
Connection with ('10.42.0.1', 36258) established !
message received from client : GET /assets/images/gallery/LYD01882.jpg HTTP/1.0
Accept: text/html
Host: 10.42.0.105

cse.iith.ac.in:443
LINE 1: GET /assets/images/gallery/LYD01882.jpg HTTP/1.0
SERVER HOST NAME : cse.iith.ac.in
```

SPEEDY WEB CLIENT VS NORMAL WEB CLIENT (LATENCY COMPARISON):

```

for (i = 0; i < defTab.length; i++) {
    defTab[i].click();
}

// search bar
var searchBar;
key = "key=";

// assign value - search page
var posKey = location.href.lastIndexOf(0key) + key.length;
if (posKey != key.length - 1) {
    searchBar = location.href.slice(posKey);
    document.getElementById("search-input").value = searchBar;
    setTimeout(function() {
        document
            .getElementById("search-input")
            .dispatchEvent(new KeyboardEvent("keyup", { key: 13 }));
    }, 100);
}

function search(evt) {
    searchBar = document.getElementById("search-input").value;
    if (evt.keyCode === 13) {
        // redirect to search page
        redirectSearch();
    }
}

function redirectSearch() {
    if (searchBar != "")
        window.location.href = baseUrl + "/search.html" + key + searchBar;
}

document
    .getElementById("search-input")
    .addEventListener("keydown", search, false);

document
    .getElementById("search-button")
    .addEventListener("click", redirectSearch, false);

latency: 8.954385171966553 seconds
antrudh@antrudh-Lenovo-Legion-Y540-15IRH-PG0: ~/Prj_Assignment_2$

```


References:

<https://pythonprogramming.net/sockets-tutorial-python-3/>.

<https://pynative.com/python-timestamp/>

<https://pythontic.com/modules/socket/introduction>.

<https://www.beej.us/guide/bgnet/>

https://en.wikipedia.org/wiki/Proxy_server

LLM References:

A

http response codes and their respective messages



HTTP response codes, also known as HTTP status codes, indicate the outcome of an HTTP request. Each response code is accompanied by a corresponding message that provides a brief explanation of the code's meaning. Here are some common HTTP response codes and their respective messages:

```
# Specify the URL components: scheme, netloc, path, query, and fragment
scheme = 'http' # You can use 'https' for secure connections
netloc = hostname
query = '' # Query parameters (if any)
fragment = '' # Fragment (if any)

# Use urlunsplit to construct the complete URL
complete_url = urlunsplit((scheme, netloc, path, query, fragment))
```

A

how to get complete url from hostname and path of file



To construct a complete URL from a hostname and a path of a file, you need to combine these two components while ensuring proper formatting. In Python, you can use the `urllib.parse.urlunsplit` function from the `urllib.parse` module to accomplish this. Here's how you can do it:

```
# Fetch objects in parallel using ThreadPoolExecutor
with concurrent.futures.ThreadPoolExecutor(max_workers=max_connections) as executor:
    executor.map(fetch_object, object_urls)
else:
    print(f"Failed to fetch base HTML with status code: {response.status_code}")
except Exception as e:
    print(f"Error: {e}")
```