

CS 558: Computer Systems Lab

Assignment–2: Socket Programming

Submitted by:

Dhruvilkumar Megha (214101028)

Mayank Singh Parmar (214101027)

Kumar Sandip Roy (214101026)

Application #4:

Multi-stage DNS Resolving System using Client-Server socket programming

In this application, we implemented three C++ programs, namely Client, Proxy Server (which will act both as client and server) and DNS Server, which communicate with each other based on TCP sockets.

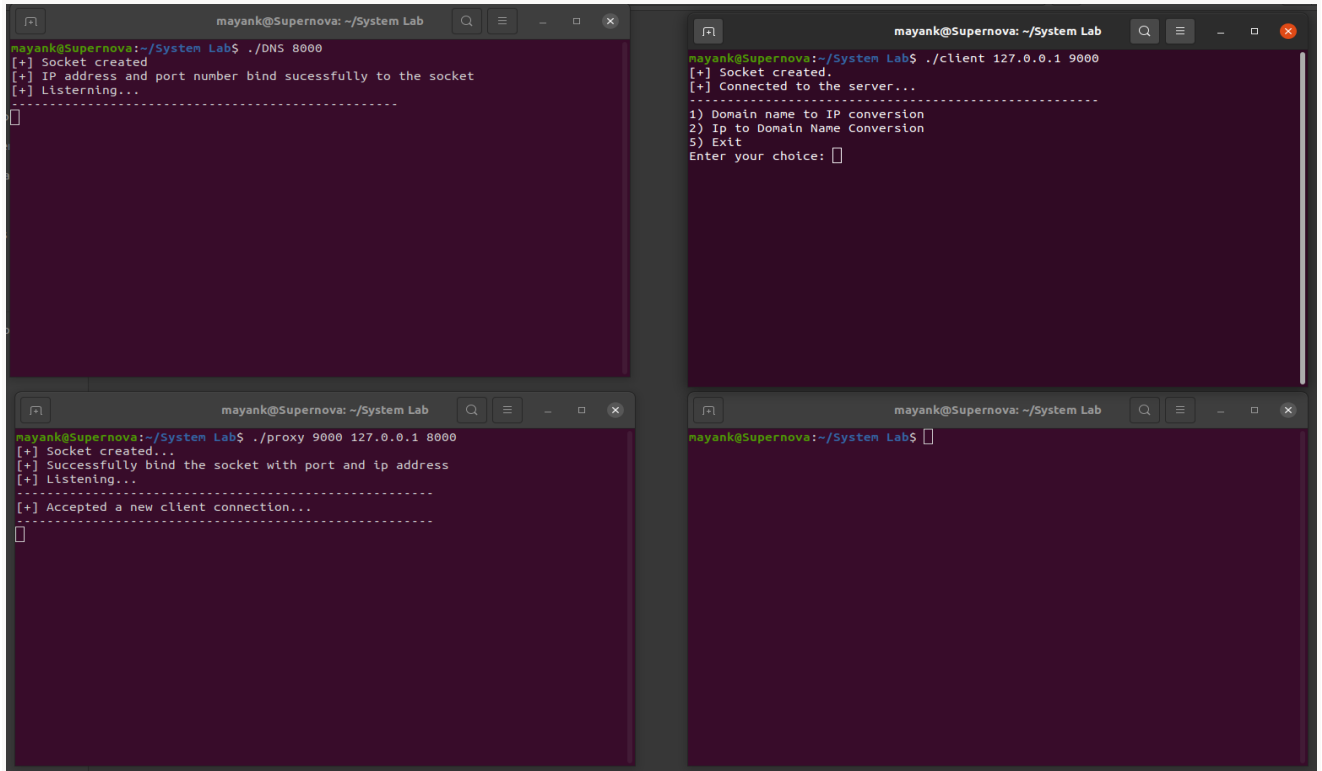
The other two files are “*database.txt*” and “*cache.txt*”. The first file contains the mapping of DNS to IP in the server while the later is used by the proxy to maintain the same mappings, although the size of the cache is capped to 3.

Program Flow:

1. Compile and run all the 3 program files by command:
 - `g++ dns.cpp -o dns`
 - `g++ proxy.cpp -o proxy`
 - `g++ client.cpp -o client`
2. Open 4 new terminals(one each for dns and Proxy and 2 for clients)
Write the following command in the terminal:
 - `./dns 8000`
8000 is the port number of dns, we can allot any other port also.
 - `./proxy 9000 127.0.0.1 8000`
9000: port number of proxy
127.0.0.1: Loopback address(IP address)
8000: port number of DNS server
 - `./client 127.0.0.1 9000`
9000: port number of the proxy server

(Open two-terminal and execute the above command to imitate multi-client. We have used fork system call to fork the proxy server each time a new client connection request is received.)

When the client is connected to the proxy server, the proxy server terminal shows the message of a new client connection. However, the DNS server is still listening and no connection request is sent to the DNS server.

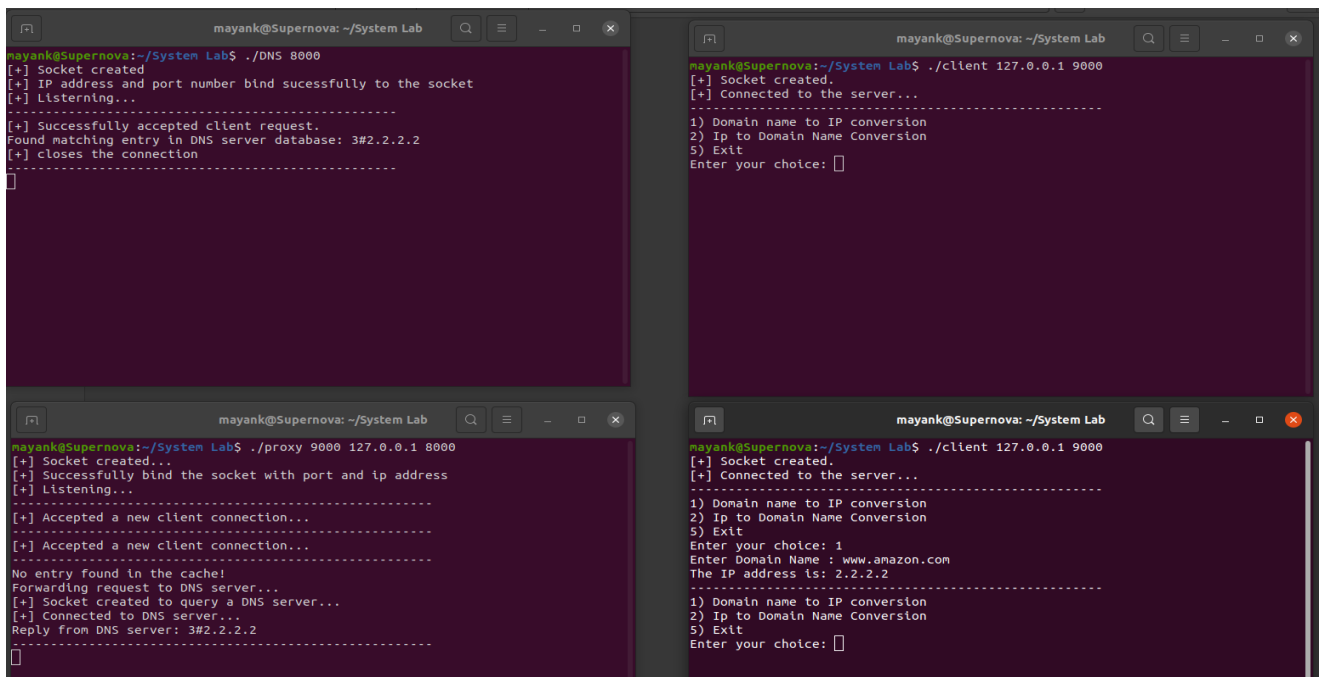


```
mayank@Supernova: ~/System Lab
mayank@Supernova:~/System Lab$ ./DNS 8000
[+] Socket created
[+] IP address and port number bind successfully to the socket
[+] Listening...

mayank@Supernova:~/System Lab$ ./proxy 9000 127.0.0.1 8000
[+] Socket created...
[+] Successfully bind the socket with port and ip address
[+] Listening...
[+] Accepted a new client connection...

mayank@Supernova:~/System Lab$ ./client 127.0.0.1 9000
[+] Socket created.
[+] Connected to the server...
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 
```

3.



```
mayank@Supernova:~/System Lab
mayank@Supernova:~/System Lab$ ./DNS 8000
[+] Socket created
[+] IP address and port number bind successfully to the socket
[+] Listening...
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#2.2.2.2
[+] closes the connection

mayank@Supernova:~/System Lab$ ./proxy 9000 127.0.0.1 8000
[+] Socket created...
[+] Successfully bind the socket with port and ip address
[+] Listening...
[+] Accepted a new client connection...
[+] Accepted a new client connection...
No entry found in the cache!
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 3#2.2.2.2

mayank@Supernova:~/System Lab$ ./client 127.0.0.1 9000
[+] Socket created.
[+] Connected to the server...
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.amazon.com
The IP address is: 2.2.2.2
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 
```

On one of the client terminal, select option 1

Enter the domain name: “www.amazon.com”

Since the cache does not contain the IP address of amazon.com, it will connect to the DNS server and request IP address mapping.

DNS sends the mapping and the connection between proxy and DNS is closed. Proxy updates its cache and sends the IP address to the client.

There are two response types in response from the server.

#3: Message field contains Domain Name/IP address.

#4: Message field contains the error message “entry not found in the database”.

4.

The image displays four terminal windows from a Linux environment, showing the execution of a proxy server and its interactions with a DNS server and clients.

- Top Left Terminal:** Shows the proxy server running as a DNS server on port 8080. It successfully accepts two client requests. For the first, it finds a matching entry in its DNS server database (3#2.2.2.2) and closes the connection. For the second, it finds a matching entry in its DNS server database (3#5.5.5.5) and closes the connection.
- Top Right Terminal:** Shows a client connected to the proxy server at 127.0.0.1:9080. The client selects option 1 (Domain name to IP conversion) and enters the domain name "www.amazon.com". The proxy server responds with the IP address "2.2.2.2".
- Bottom Left Terminal:** Shows the proxy server running as a proxy on port 9080, listening on 127.0.0.1:8080. It accepts two new client connections. For the first, it finds no entry in its cache, forwards the request to the DNS server, receives a response (3#2.2.2.2), and then finds a matching entry in its cache. For the second, it finds no entry in its cache, forwards the request to the DNS server, receives a response (3#5.5.5.5), and then finds a matching entry in its cache.
- Bottom Right Terminal:** Shows a client connected to the proxy server at 127.0.0.1:9080. The client selects option 1 (Domain name to IP conversion) and enters the domain name "www.amazon.com". The proxy server responds with the IP address "2.2.2.2".

On another client, select type 1 and search for “www.amazon.com”

Since in past some other client has already requested the same IP address, the proxy has it stored in the cache and thus need not connect to the DNS server to get the same.

Hence, we get the message “Found matching entry in cache” from the proxy terminal.

5. On the client terminal, select option 1 and search “www.flipcart.com”

Since the domain name is wrong, “flipcart” instead of “flipkart”, the DNS also respond with type 4 message, which implies that DNS does not have an entry with that name.

```

mayank@Supernova: ~/System Lab
mayank@Supernova:~/System Lab$ ./DNS 8000
[+] Socket created
[+] IP address and port number bind successfully to the socket
[+] Listening...
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#2.2.2.2
[+] closes the connection
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#5.5.5.5
[+] closes the connection
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#www.youtube.com
[+] closes the connection
-----
[+] Successfully accepted client request.
4#No entry found in DNS server database!
[+] closes the connection
-----
[]

mayank@Supernova:~/System Lab
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 3#5.5.5.5
-----
Found matching entry in the cache: 3#2.2.2.2
-----
Found matching entry in the cache: 3#www.irc.tc.in
-----
No entry found in the cache!
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 3#www.youtube.com
-----
Found matching entry in the cache: 3#2.2.2.2
-----
No entry found in the cache!
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 4#No entry found in DNS server database!
-----
[]

mayank@Supernova:~/System Lab
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 2
Enter IP Address: 8.8.8.8
The domain name is: www.youtube.com
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.amazon.com
The IP address is: 2.2.2.2
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.flipkart.com
No entry found in DNS server database!
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1

mayank@Supernova:~/System Lab
mayank@Supernova:~/System Lab$ ./client 127.0.0.1 9000
[+] Socket created.
[+] Connected to the server...
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.amazon.com
The IP address is: 2.2.2.2
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.irc.tc.in
The IP address is: 5.5.5.5
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1

```

6.

```

mayank@Supernova: ~/System Lab
Found matching entry in DNS server database: 3#5.5.5.5
[+] closes the connection
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#www.youtube.com
[+] closes the connection
-----
[+] Successfully accepted client request.
4#No entry found in DNS server database!
[+] closes the connection
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#3.3.3.3
[+] closes the connection
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#2.2.2.2
[+] closes the connection
-----
[+] Successfully accepted client request.
Found matching entry in DNS server database: 3#5.5.5.5
[+] closes the connection
-----
[]

mayank@Supernova:~/System Lab
[+] Connected to DNS server...
Reply from DNS server: 4#No entry found in DNS server database!
No entry found in the cache!
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 3#3.3.3.3
-----
Found matching entry in the cache: 3#8.8.8.8
-----
No entry found in the cache!
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 3#2.2.2.2
-----
No entry found in the cache!
Forwarding request to DNS server...
[+] Socket created to query a DNS server...
[+] Connected to DNS server...
Reply from DNS server: 3#5.5.5.5
-----
[]

mayank@Supernova:~/System Lab
mayank@Supernova:~/System Lab$ ./client 127.0.0.1 9000
[+] Socket created.
[+] Connected to the server...
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.amazon.com
The IP address is: 2.2.2.2
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.irc.tc.in
The IP address is: 5.5.5.5
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.flipcart.com
The IP address is: 3.3.3.3
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.youtube.com
The IP address is: 8.8.8.8
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.amazon.com
The IP address is: 2.2.2.2
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1
Enter Domain Name : www.irc.tc.in
The IP address is: 5.5.5.5
-----
1) Domain name to IP conversion
2) Ip to Domain Name Conversion
5) Exit
Enter your choice: 1

```

On client terminal, search type 1: “www.irc.tc.in”

The proxy server cache at this moment is full and does not have the “irc.tc.in” Ip address mapping, thus it connects to the DNS server and requests for mapping.

DNS responds with the IP address and the proxy removes the least frequently used mapping from its cache and updates the new mapping in the cache.

Thus, once the cache is full, the proxy server updates its least frequently used mapping with new mappings to keep the cache updated.

The size of the cache is capped to 3, but it can be updated in the proxy.cpp program file.