

Shrish Tripathi
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CS303-Operating Systems

About → This program doesn't expect more than 2 functional arguments. It would work for the math library, for those functions which need at most 2 double/integer arguments and return 1 double/integer. The program has successfully worked for the following functions → sqrt , floor, ceil , pow, log10.

FLOW OF THE PROGRAM →

- An AF_LOCAL socket will be used for incoming sessions.
- Initially, a queue of max_capacity of 50 has been taken, (which one can change by changing the value of variable queue_size(line-22)) and a Thread pool of size 8 (which one can change by changing the value of variable thread_pool (line-26)).
- server socket is started by calling the function start_server_socket(), all the threads in the thread pool are initialized by calling pthread_create API, in which thread function is passed, and they start waiting for the connection.
- As the client requests hit, this is enqueued in a queue. Pthread condition initializer is used to signal the threads about the requests.
- Threads keep on dequeing and process the requests until the queue is empty. Meanwhile pthread_mutex_initializer to avoid bad pointers (as multiple threads try to deque at the same time i.e race condition) .
- The requests are sent to handle_connection function which extracts the dll_name, function_name, and function_arguments.
- The handle_connection function further checks the validity of arguments before casting them into double.
- Handle_connection further calls the dll_invoker function, which returns the double data type for valid arguments. dll_invoker uses dlopen, dlsym etc, APIs.
- The valid result is written back into the file and the server sends the result back to the client.

COMPILATION→

For the compilation of the main file →

```
gcc main.c -lpthread -ldl -o main .
```

Run→

Server →

- for starting server socket run the following command → *./main server file_path*
example→ *./main server ./cs303_sock*

Client →

- for the client socket run the following command →
this expects a dll_name, function name, and function arguments (all three commas separated)

The request should strictly be in the comma-separated format as mentioned below

./main client file_path DLL_NAME,FUNCTION_NAME,Funtion_Arguments

example→ *./main client ./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,pow,2,4*

For the compilation of the test file →

In this file, various functions have been called and tested.

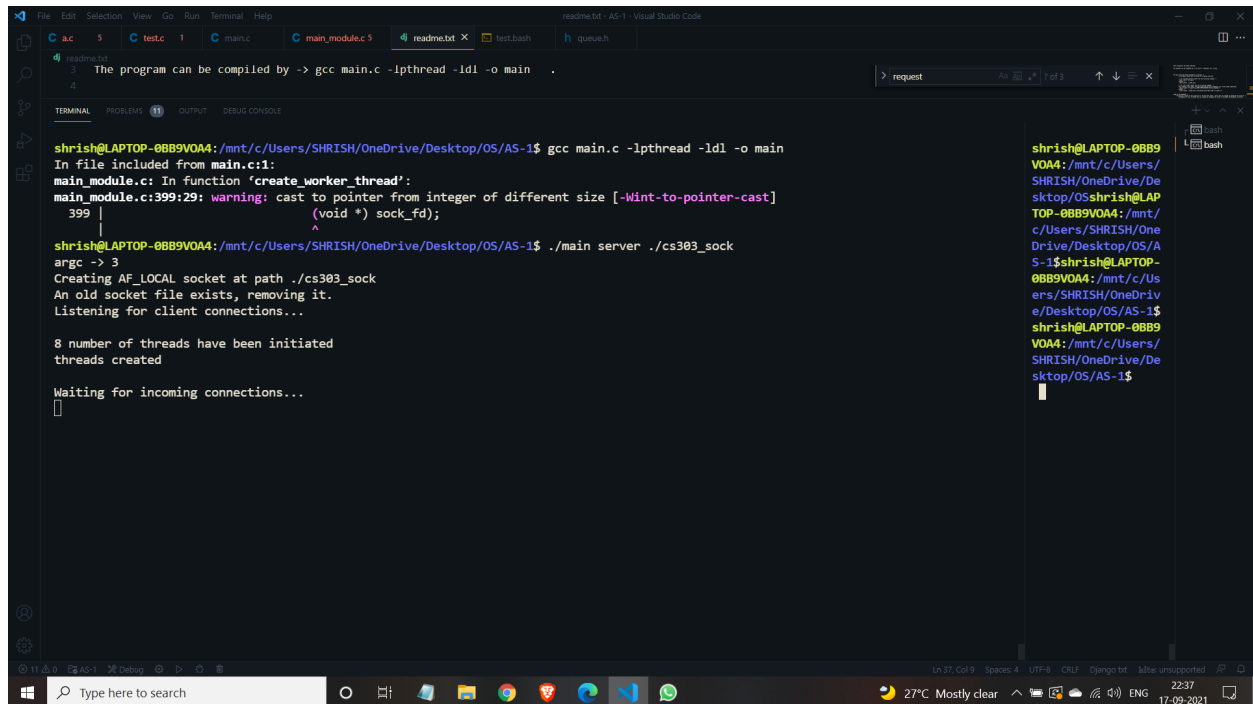
For compilation → gcc test.c -lpthread -ldl -o test

Run → ./test

SAMPLE RUN→

Here the program has been successfully compiled.

The server has been successfully initialized→



```
shrish@LAPTOP-08B9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ gcc main.c -lpthread -ldl -o main
In file included from main.c:1:
main_module.c: In function 'create_worker_thread':
main_module.c:399:29: warning: cast to pointer from integer of different size [-Wint-to-pointer-cast]
    399 |         (void *) sock_fd);
        |             ^
shrish@LAPTOP-08B9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main server ./cs303_sock
argc -> 3
Creating AF_LOCAL socket at path ./cs303_sock
An old socket file exists, removing it.
Listening for client connections...

8 number of threads have been initiated
threads created

Waiting for incoming connections...

```

Here the client request has been successfully sent and the server has responded successfully to the request.

```
test.c
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <unistd.h>
4 #include <sys/types.h>
5 #include <sys/socket.h>
6 #include <pthread.h>
7 #include <math.h>
8
9 int main()
10 {
11     for N in {1..50}
12     do
13         ./a.out client ./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
14     done
15     wait
16 }
17
18
```

```
shrish@LAPTOP-08B9VOA4: /mnt/c/Users/SHRISH/OneDrive/Desktop/OSshrish@LAPTOP-08B9VOA4: /mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main server ./cs303_sock
argc -> 3
Creating AF_LOCAL socket at path ./cs303_sock
An old socket file exists, removing it.
Listening for client connections...

8 number of threads have been initiated
threads created

Waiting for incoming connections...
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,3,4
num1-->3
num2-->4
[]

shrish@LAPTOP-08B9VOA4: /mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```

Here the client has requested for power function for arguments 3,4 $\rightarrow 3^4$. From the server, the client has received 81.0000 which is the expected result.

```
test.c
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <unistd.h>
4 #include <sys/types.h>
5 #include <sys/socket.h>
6 #include <pthread.h>
7 #include <math.h>
8
9 int main()
10 {
11     for N in {1..50}
12     do
13         ./a.out client ./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
14     done
15     wait
16 }
17
18
```

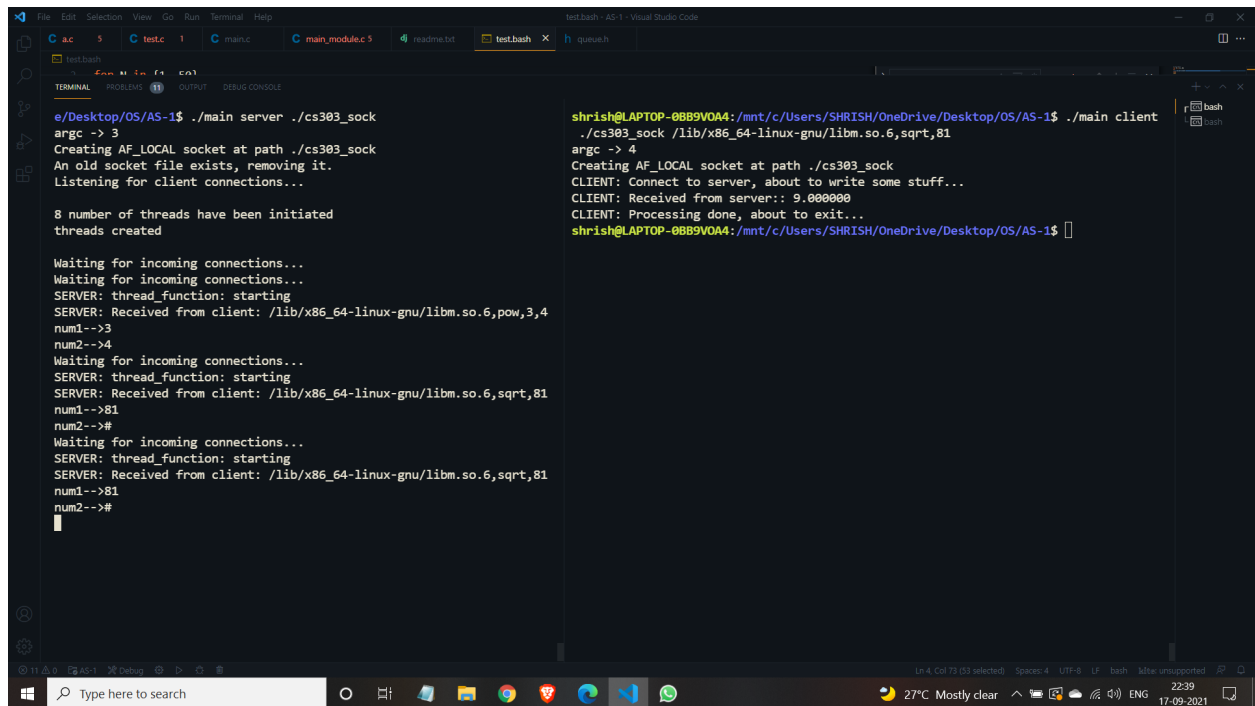
```
shrish@LAPTOP-08B9VOA4: /mnt/c/Users/SHRISH/OneDrive/Desktop/OSshrish@LAPTOP-08B9VOA4: /mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main server ./cs303_sock
argc -> 3
Creating AF_LOCAL socket at path ./cs303_sock
An old socket file exists, removing it.
Listening for client connections...

8 number of threads have been initiated
threads created

Waiting for incoming connections...
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,3,4
num1-->3
num2-->4
[]

shrish@LAPTOP-08B9VOA4: /mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```

Here the client has requested for square root function for arguments 81. From the server, the client has received 9.0000 which is the expected result.



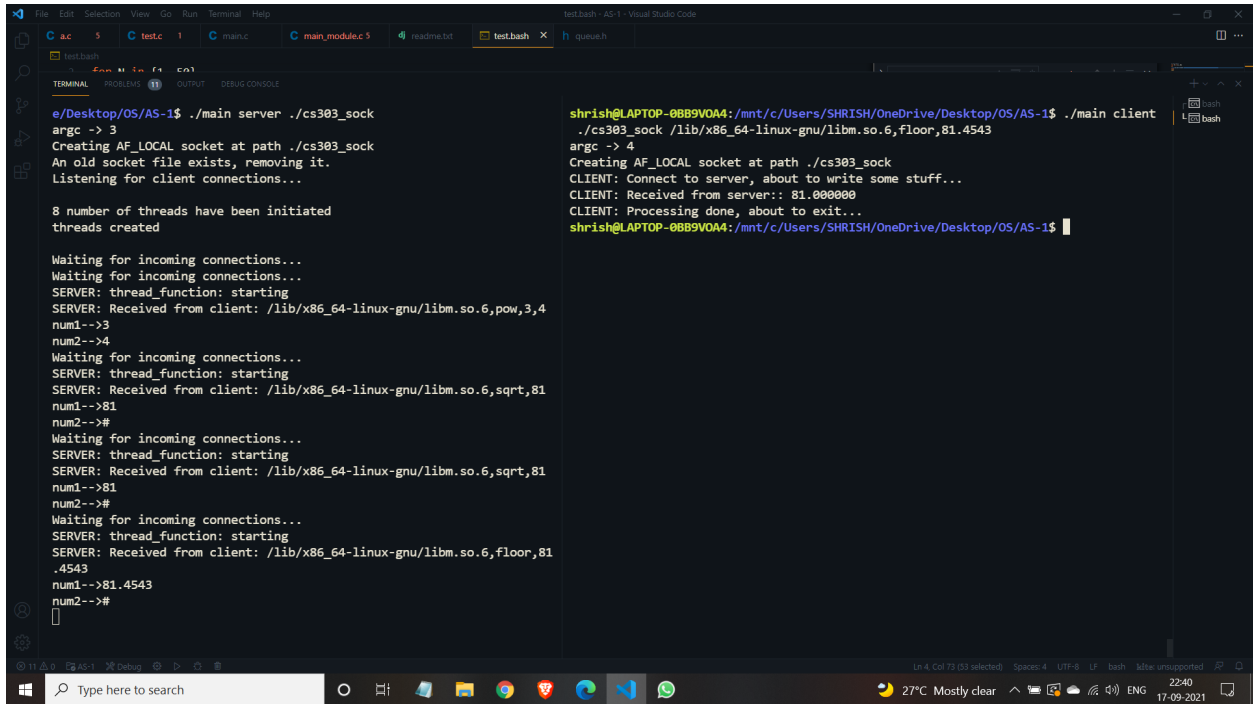
```
e/Desktop/OS/AS-1$ ./main server ./cs303_sock
argc -> 3
Creating AF_LOCAL socket at path ./cs303_sock
An old socket file exists, removing it.
Listening for client connections...

8 number of threads have been initiated
threads created

Waiting for incoming connections...
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,3,4
num1-->3
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#

shrish@LAPTOP-0BB9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main client
./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 9.000000
CLIENT: Processing done, about to exit...
shrish@LAPTOP-0BB9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```

Here the client has requested for floor function for argument 81.4543. From the server, the client has received 81.0000 which is the expected result.



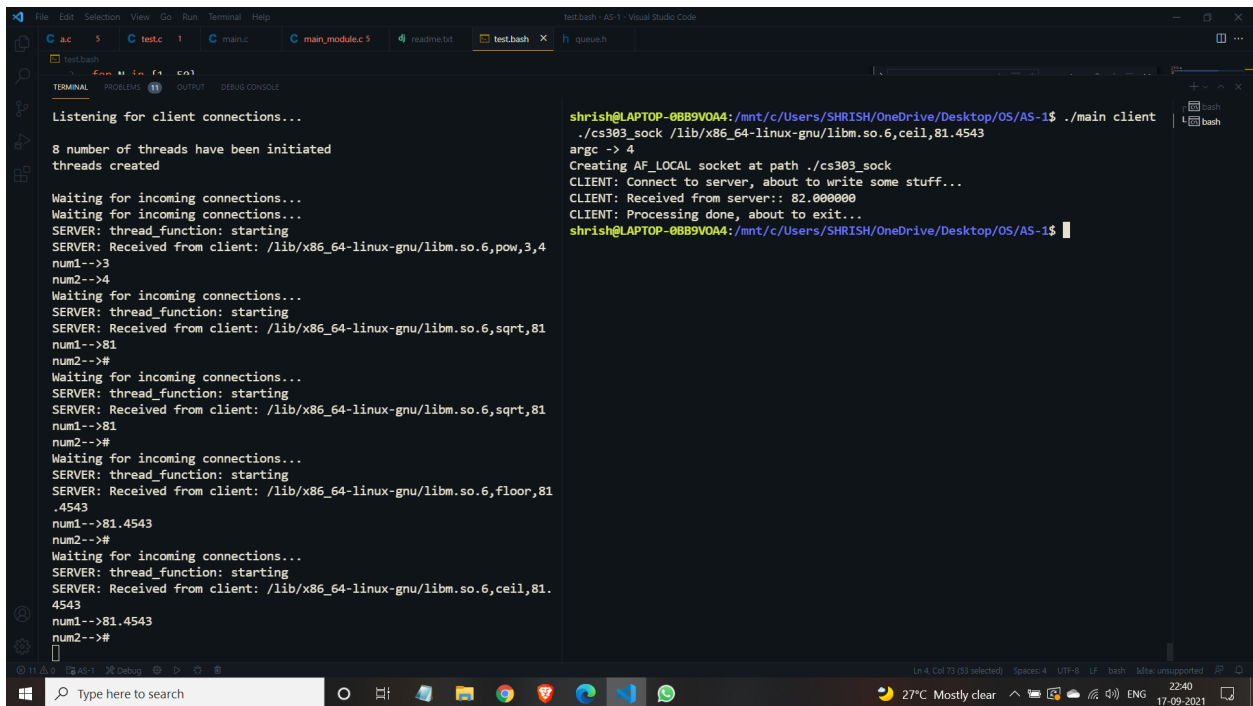
```
e/Desktop/OS/AS-1$ ./main server ./cs303_sock
argc -> 3
Creating AF_LOCAL socket at path ./cs303_sock
An old socket file exists, removing it.
Listening for client connections...

8 number of threads have been initiated
threads created

Waiting for incoming connections...
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,3,4
num1-->3
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,floor,81
.4543
num1-->81.4543
num2-->#
[]

shrish@LAPTOP-08B9VQ04:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main client
./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,floor,81.4543
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 81.000000
CLIENT: Processing done, about to exit...
shrish@LAPTOP-08B9VQ04:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```

Here the client has requested for ceil function for arguments 81.4543. From the server, the client has received 82.0000 which is the expected result.



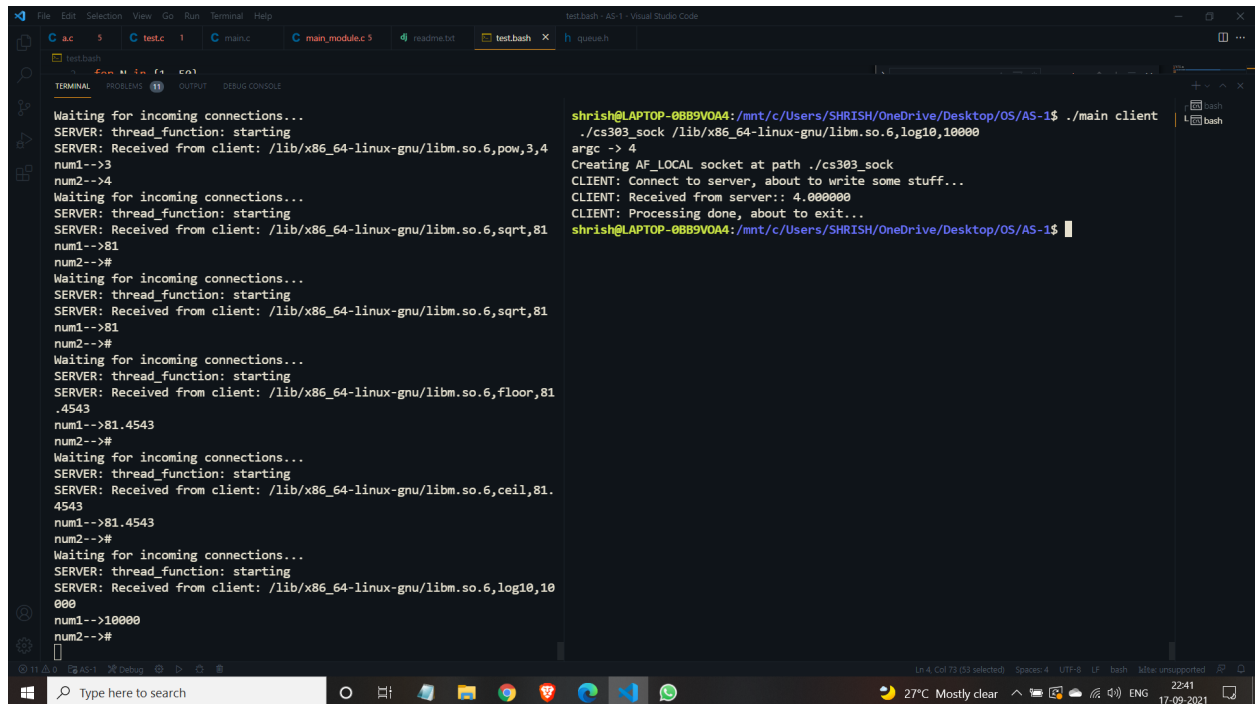
```
Listening for client connections...

8 number of threads have been initiated
threads created

Waiting for incoming connections...
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,3,4
num1-->3
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,floor,81
.4543
num1-->81.4543
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,ceil,81.
4543
num1-->81.4543
num2-->#
[]

shrish@LAPTOP-08B9VQ04:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main client
./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,ceil,81.4543
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 82.000000
CLIENT: Processing done, about to exit...
shrish@LAPTOP-08B9VQ04:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```

Here the client has requested for log10 function for arguments 10000. From the server, the client has received 4.0000 which is the expected result.



```
test: bash - AS-1 - Visual Studio Code
C ac 3 C testc 1 C main.c C main_module.c 3 readme.txt test: bash x h quresh
test: bash
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,3,4
num1-->3
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,sqrt,81
num1-->81
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,floor,81
.4543
num1-->81.4543
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,ceil,81.
4543
num1-->81.4543
num2-->#
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,log10,10
000
num1-->10000
num2-->#
[]

shrish@LAPTOP-08B9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$ ./main client
./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,log10,10000
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 4.0000000
CLIENT: Processing done, about to exit...
shrish@LAPTOP-08B9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```

The server has received 500 client requests using the bash file (visible in the image) and it responded→

```
File Edit Selection View Go Run Terminal Help
testbash - AS-1 Visual Studio Code
testbash x
testbash
2 for N in {1..500}
3 do
4     ./main client ./cs303_sock /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
5 done
6 wait
7
8
9

TERMINAL PROBLEMS OUTPUT DEBUG CONSOLE
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
num1-->2
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
num1-->2
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
num1-->2
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
num1-->2
num2-->4
Waiting for incoming connections...
SERVER: thread_function: starting
SERVER: Received from client: /lib/x86_64-linux-gnu/libm.so.6,pow,2,4
num1-->2
num2-->4

CLIENT: Processing done, about to exit...
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 16.000000
CLIENT: Processing done, about to exit...
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 16.000000
CLIENT: Processing done, about to exit...
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 16.000000
CLIENT: Processing done, about to exit...
argc -> 4
Creating AF_LOCAL socket at path ./cs303_sock
CLIENT: Connect to server, about to write some stuff...
CLIENT: Received from server:: 16.000000
CLIENT: Processing done, about to exit...
real    0m5.105s
user    0m0.188s
sys     0m2.828s
shrish@LAPTOP-08B9VOA4:/mnt/c/Users/SHRISH/OneDrive/Desktop/OS/AS-1$
```