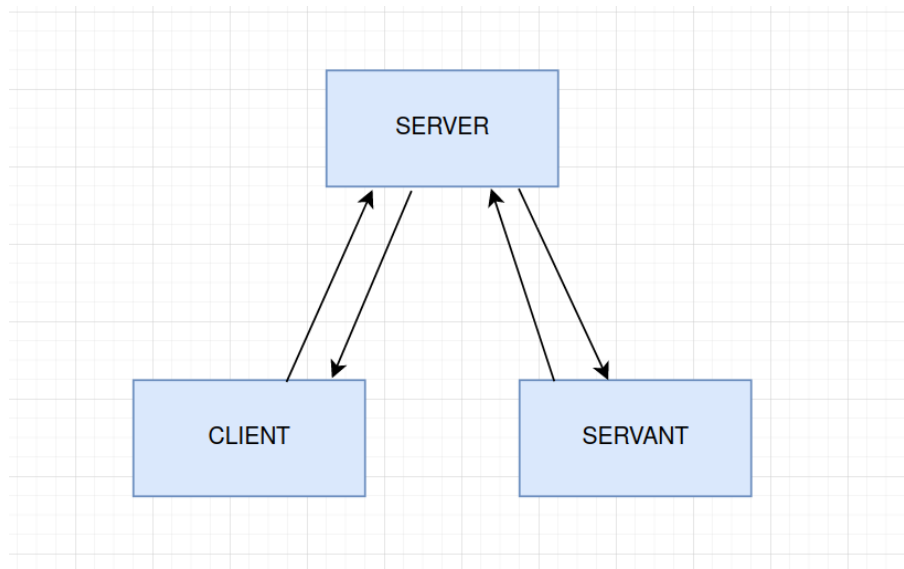


CSE344 – System Programming Final Project Report

Design Approach:

I create three main files which are client, server and servant. Also there is a helper file to increase the reusability.



General communication diagram

1. Client

To complete client tasks, first I checked the command line arguments. After that, I start with the reading input file. I checked the whether file is exist or not. I ignore the wrong request of the file. After all requests are read and saved, I create the thread which is count is same with number of proper request. After each thread is created, I joined them. To achieve the sending all request to server same time, I use condition variable. Once any thread is ready, it's waiting for the all threads thanks to cwait

function. Once the condition variable is satisfied, last thread broadcast the waiting threads, and they are sending to request to server. For the purpose of communicating with server, instead of sending line of the file, I create a proper struct and fill the informations. To determine coming request's resource, I use general message type, which contains integer type and buffer. According to integer type, I cast the buffer to proper data structure. After the request is sent to server, client waits for the answer and when It get the information, It's cleans resources and exit.

2. Server

To complete server tasks, first I checked the command line arguments. After that, I create the threads and detached them. Also I use the queue data structures to hold incoming requests. To prevent the busy waiting, I use the cwait function If there is no request. Also to synchronize the threads I use mutex. For the purpose of waking up thread, I checked the all status of threads, If any of them free to use, I call the pthread_cond_signal function the wake up only one thread. If the queue is not empty, any thread take the request by using proper descriptor and detects where the request come from. If the request coming from servant and it's type is declaration for the cities and ports, I saved the information to use it for the purpose of handle requests. Servant sends port number, process id and cities which is responsible for. If the request type client request, I checked the cities that are handling by servants and send the request to proper one. After the request sends the servant, I started to wait for response. Once the response is come, I send it to client. If the SIGINT is come, I send the proper message to servants and after than I clear resources and terminate the program.

3. Servant

To complete servant tasks, first I checked the command line arguments. If the arguments are okay, I start with finding empty port. To find empty port, I added to 2000 which is recommended from the homework file to start argument which is unique. To be sure, I open the /proc/net/tcp file. File is looking like this:

sl	local_address	rem_address	st	tx_queue	rx_queue	tr	tm->when	retrnsmt	uid	timeout	inode
0:	00000000:80E8	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	245946	1 0000000000000000 100 0 0 10 0
1:	00000000:07EC	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	241600	1 0000000000000000 100 0 0 10 0
2:	00000000:0810	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	242587	1 0000000000000000 100 0 0 10 0
3:	00000000:07D1	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	244476	1 0000000000000000 100 0 0 10 0
4:	00000000:07F5	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	242910	1 0000000000000000 100 0 0 10 0
5:	00000000:E115	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	95342	1 0000000000000000 100 0 0 10 0
6:	3500007F:0035	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	101	0	35729	1 0000000000000000 100 0 0 10 0
7:	0100007F:0277	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	0	0	195954	1 0000000000000000 100 0 0 10 0
8:	00000000:C717	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	95345	1 0000000000000000 100 0 0 10 0
9:	00000000:0819	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	246811	1 0000000000000000 100 0 0 10 0
10:	00000000:07DA	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	245262	1 0000000000000000 100 0 0 10 0
11:	00000000:07FE	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	238251	1 0000000000000000 100 0 0 10 0
12:	00000000:07E3	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	242584	1 0000000000000000 100 0 0 10 0
13:	00000000:0807	00000000:0000	0A	00000000:00000000	00:00000000	00:00000000	00000000	1000	0	245953	1 0000000000000000 100 0 0 10 0
14:	6F04500A:8CF0	F812E8C7:01B8	01	00000000:00000000	02:00000744	00000000	00000000	1000	0	288425	2 0000000000000000 28 4 16 10 -1
15:	6F04500A:B75C	E7F06D14:01B8	08	00000000:00000019	00:00000000	00000000	00000000	1000	0	115372	1 0000000000000000 52 4 30 10 10
16:	6F04500A:8EA6	6EBBFABE:01B8	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	252959	1 0000000000000000 26 4 24 23 16
17:	6F04500A:EC96	35DA3CB9:01B8	01	00000000:00000000	02:0000055C	00000000	00000000	1000	0	288882	2 0000000000000000 23 4 30 7 7
18:	6F04500A:E1BA	08C77134:01B8	01	00000000:00000000	02:000000BE	00000000	00000000	1000	0	224091	2 0000000000000000 36 4 33 8 -1
19:	6F04500A:E0FC	78B5AF43:01B8	08	00000000:00000020	02:000005A5	00000000	00000000	1000	0	282540	2 0000000000000000 22 4 28 10 -1
20:	6F04500A:9BF6	2FE0BA23:01B8	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	114795	1 0000000000000000 27 4 30 2 2
21:	6F04500A:CF44	EE11D9AC:01B8	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	289025	1 0000000000000000 26 4 29 10 38
22:	6F04500A:9FFE	EA11D9AC:01B8	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	289024	1 0000000000000000 26 4 2 6 5
23:	6F04500A:D25C	28E0BA23:01B8	01	00000000:00000000	02:00000778	00000000	00000000	1000	0	145894	2 0000000000000000 27 4 30 3 2
24:	6F04500A:B22A	C6115934:01B8	01	00000000:00000000	02:00003A63	00000000	00000000	1000	0	93672	2 0000000000000000 48 4 31 7 7
25:	6F04500A:A62F	09787034:01B8	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	139165	1 0000000000000000 27 4 30 3 2
26:	6F04500A:A992	7C41C768:0FE6	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	99557	1 0000000000000000 26 4 30 2 2
27:	6F04500A:C0DA	AABBFABE:01B8	01	00000000:00000000	00:00000000	00000000	00000000	1000	0	304471	1 0000000000000000 27 4 30 10 -1
28:	6F04500A:8CEE	F812E8C7:01B8	01	00000000:00000000	02:00000744	00000000	00000000	1000	0	282544	2 0000000000000000 28 4 22 10 -1

In the local address part, last four digit is showing us to opened ports. I checked them each by each whether is already In used or not. If It's already opened, I increase the port number until to find a proper one. To find the process number, I go through the /proc folder and I traverse the all folders that are showing process ID. I checked the argument file inside the each folder, whether they are equal with our servants argument. After I found the correct one I saved it. After than, I read the folders. As a data structure to save entries, I use hash table to access any city in O(1) time. As a key I use folder name and as a entry I use binary tree which is ordered according to dates. So this way finding proper dates will be fast. Binary tree is a consist on entries inside of the file. After dataset is created, I send the proper informations to server and start to waiting for requests. After each request has come I create another thread to handle with request as It mentioned in homework file. After the entries are counted, each thread sends response the server. Also If request type is SIGINT, thread terminates the program.

Data Structures:

1. Entry Structure

This structure represents the content of the files inside the city folders.

```
struct entry // entry represent the inside of the file
{
    date date;
    int transaction_id;
    char real_estate[CHAR_ARRAY_SIZE];
    char street_name[CHAR_ARRAY_SIZE];
    int surface;
    int price;
};
```

2. Request Structure

This structure represents the content of the request file.

```
struct request
{
    char transcationCount[ARRAY_SIZE];
    char field_type[ARRAY_SIZE];
    char city[ARRAY_SIZE];
    date start_date;
    date end_date;
};
```

3. Servant Declaration Structure

This structure represents the servant informations.

```
struct servantDeclaration
{
    int port;
    int processID;
    int total_city_number;
    char cities[BUFFER_SIZE][CHAR_ARRAY_SIZE];
};
```

4. Common Message Structure

Message structure that is used for communication. Type is representing the resource of the message.

```
struct message
{
    enum messageType type;
    uint8_t buffer[MESSAGE_BUFFER_SIZE];
};
```

5. Message Types

Message types that are used in server, servant and client.

```
enum messageType
{
    CLIENT_REQUEST,
    RESPONSE,
    EXIT,
    SERVANT_DECLARATION,
    SERVANT_RESPONSE,
    NO_CITY_RESPONSE,
};
```

Requirements That Are I Achieved:

I test the several inputs both correct and wrong. Proper ones seem correct and wrong ones are handled. There is no warning and memory leak. I think I achieve the all requirements that are mentioned in the homework file.

Outputs From The Program:

- Output 1

Server output that there is no opened servant. Output also shows the SIGINT is caught properly.

```
Sam@sam0-HP-Pavilion-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/finalProject$ ./server -p 8080 -t 5
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:33:06 2022 ---- Proper servant for ADIYAMAN is couldn't found, responding to client
Thu Jun 16 03:33:06 2022 ---- Proper servant for KILIS is couldn't found, responding to client
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:33:06 2022 ---- Proper servant for AKSARAY is couldn't found, responding to client
Thu Jun 16 03:33:06 2022 ---- Response received: 0, forwarded to client
Thu Jun 16 03:33:06 2022 ---- Proper servant for BALIKESIR is couldn't found, responding to client
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:33:06 2022 ---- Request arrived transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:33:06 2022 ---- Response received: 0, forwarded to client
Thu Jun 16 03:33:06 2022 ---- Proper servant for ISPARTA is couldn't found, responding to client
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:33:13 2022 ---- Proper servant for BALIKESIR is couldn't found, responding to client
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:33:13 2022 ---- Proper servant for AKSARAY is couldn't found, responding to client
Thu Jun 16 03:33:13 2022 ---- Proper servant for KILIS is couldn't found, responding to client
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:33:13 2022 ---- Proper servant for ISPARTA is couldn't found, responding to client
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:33:13 2022 ---- Response received: 0, forwarded to client
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:33:13 2022 ---- Request arrived transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:33:13 2022 ---- Response received: 0, forwarded to client
Thu Jun 16 03:33:14 2022 ---- Request arrived transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:33:14 2022 ---- Proper servant for ADIYAMAN is couldn't found, responding to client
^CSIGINT received
Thu Jun 16 03:33:34 2022 ---- Contacting ALL to deliver SIGINT to servants
SIGINT has been received. I handled a total of 16 requests. Goodbye.
```

Client output which is sent to mentioned server.

```
Sam@sam0-HP-Pavilion-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/finalProject$ ./client -r requestFile -q 8080 -s 127.0.0.1
Thu Jun 16 03:33:13 2022 ---- Client: I have loaded 8 requests and I'm creating 8 threads.
Thu Jun 16 03:33:13 2022 ---- Client-Thread-1: Thread-1 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-0: Thread-0 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-2: Thread-2 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-3: Thread-3 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-4: Thread-4 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-7: Thread-7 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-6: Thread-6 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-5: Thread-5 has been created
Thu Jun 16 03:33:13 2022 ---- Client-Thread-5: I am requesting transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:33:13 2022 ---- Client-Thread-3: I am requesting transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:33:13 2022 ---- Client-Thread-0: I am requesting transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:33:13 2022 ---- Client-Thread-1: I am requesting transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:33:13 2022 ---- Client-Thread-7: I am requesting transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:33:13 2022 ---- Client-Thread-5: The server's response to transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-1: The server's response to transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-4: I am requesting transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:33:13 2022 ---- Client-Thread-6: I am requesting transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:33:13 2022 ---- Client-Thread-5: terminating
Thu Jun 16 03:33:13 2022 ---- Client-Thread-1: terminating
Thu Jun 16 03:33:13 2022 ---- Client-Thread-7: The server's response to transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-7: terminating
Thu Jun 16 03:33:13 2022 ---- Client-Thread-3: The server's response to transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-3: terminating
Thu Jun 16 03:33:13 2022 ---- Client-Thread-0: The server's response to transactionCount MERA 3-2-2018 3-2-2018 is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-0: terminating
Thu Jun 16 03:33:13 2022 ---- Client-Thread-4: The server's response to transactionCount BAHCE 2-3-2005 2-3-2005 is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-4: terminating
Thu Jun 16 03:33:13 2022 ---- Client-Thread-6: The server's response to transactionCount VILLA 22-4-2049 22-4-2049 is 0
Thu Jun 16 03:33:13 2022 ---- Client-Thread-6: terminating
Thu Jun 16 03:33:14 2022 ---- Client-Thread-2: I am requesting transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:33:14 2022 ---- Client-Thread-2: The server's response to transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN is 0
Thu Jun 16 03:33:14 2022 ---- Client-Thread-2: terminating
Thu Jun 16 03:33:14 2022 ---- All threads have terminated, goodbye.
```

- **Output 2**

Server output with the several servant opened.

```

samo@samo-HP-Pavilion-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./server -p 8080 -t 10
Thu Jun 16 03:39:01 2022 ---- Servant 38086 present at port 2012 handling cities BALIKESIR - ZONGULDAK
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:39:04 2022 ---- Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:39:04 2022 ---- Proper servant for ADIYAMAN is couldn't found, responding to client
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:39:04 2022 ---- Thu Jun 16 03:39:04 2022 ---- Contacting servant 38086
Thu Jun 16 03:39:04 2022 ---- Contacting servant 38086
Thu Jun 16 03:39:04 2022 ---- Request arrived transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:39:04 2022 ---- Thu Jun 16 03:39:04 2022 ---- Contacting servant 38086
Thu Jun 16 03:39:04 2022 ---- Proper servant for AKSARAY is couldn't found, responding to client
Thu Jun 16 03:39:04 2022 ---- Response received: 1, forwarded to client
Thu Jun 16 03:39:04 2022 ---- Response received: 3, forwarded to client
Thu Jun 16 03:39:04 2022 ---- Response received: 125, forwarded to client
Thu Jun 16 03:39:04 2022 ---- Response received: 25, forwarded to client
Thu Jun 16 03:39:04 2022 ---- Response received: 4, forwarded to client
Thu Jun 16 03:39:04 2022 ---- Response received: 297, forwarded to client
^CSIGINT received
Thu Jun 16 03:39:08 2022 ---- Contacting ALL to deliver SIGINT to servants
SIGINT has been received. I handled a total of 8 requests. Goodbye.

```

Servant output that show handled requests.

```

samo@samo-HP-Pavilion-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./servant -d dataset -c 12-81 -r 127.0.0.1 -p 8080
Thu Jun 16 03:39:01 2022 ---- Servant 38086: loaded dataset cities BALIKESIR - ZONGULDAK
Thu Jun 16 03:39:01 2022 ---- Servant 38086: listening at port 2012
Thu Jun 16 03:39:08 2022 ---- Servant: 38086, termination message received, handled 6 requests in total

```

Client output that showed the requests and their response.

```

samo@samo-HP-Pavilion-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./client -r requestFile -q 8080 -s 127.0.0.1
Thu Jun 16 03:39:04 2022 ---- Client: I have loaded 8 requests and I'm creating 8 threads.
Thu Jun 16 03:39:04 2022 ---- Client-Thread-2: Thread-2 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-0: Thread-0 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-4: Thread-4 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-3: Thread-3 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-1: Thread-1 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-5: Thread-5 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-7: Thread-7 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-6: Thread-6 has been created
Thu Jun 16 03:39:04 2022 ---- Client-Thread-5: I am requesting transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:39:04 2022 ---- Client-Thread-0: I am requesting transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:39:04 2022 ---- Client-Thread-1: I am requesting transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:39:04 2022 ---- Client-Thread-2: I am requesting transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:39:04 2022 ---- Client-Thread-6: I am requesting transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:39:04 2022 ---- Client-Thread-4: I am requesting transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:39:04 2022 ---- Client-Thread-7: I am requesting transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:39:04 2022 ---- Client-Thread-3: I am requesting transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:39:04 2022 ---- Client-Thread-2: The server's response to transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN is 0
Thu Jun 16 03:39:04 2022 ---- Client-Thread-2: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-5: The server's response to transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY is 0
Thu Jun 16 03:39:04 2022 ---- Client-Thread-5: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-1: The server's response to transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS is 1
Thu Jun 16 03:39:04 2022 ---- Client-Thread-1: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-0: The server's response to transactionCount MERA 3-2-2018 3-2-2018 is 125
Thu Jun 16 03:39:04 2022 ---- Client-Thread-0: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-3: The server's response to transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR is 3
Thu Jun 16 03:39:04 2022 ---- Client-Thread-3: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-6: The server's response to transactionCount VILLA 22-4-2049 22-4-2049 is 25
Thu Jun 16 03:39:04 2022 ---- Client-Thread-6: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-7: The server's response to transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA is 4
Thu Jun 16 03:39:04 2022 ---- Client-Thread-7: terminating
Thu Jun 16 03:39:04 2022 ---- Client-Thread-4: The server's response to transactionCount BAHCE 2-3-2005 2-3-2005 is 297
Thu Jun 16 03:39:04 2022 ---- Client-Thread-4: terminating
Thu Jun 16 03:39:04 2022 ---- All threads have terminated, goodbye.

```

- **Output 3**

Given script test.

```
samo@samo-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ bash script.sh
Thu Jun 16 03:49:58 2022 ---- Servant 40036: loaded dataset cities BOLU - DUZCE
Thu Jun 16 03:49:58 2022 ---- Servant 40036: listening at port 2019
Thu Jun 16 03:49:58 2022 ---- Servant 40035: loaded dataset cities ARTVIN - BITLIS
Thu Jun 16 03:49:58 2022 ---- Servant 40036 present at port 2019 handling cities BOLU - DUZCE
Thu Jun 16 03:49:58 2022 ---- Servant 40035: listening at port 2018
Thu Jun 16 03:49:58 2022 ---- Servant 40035 present at port 2018 handling cities ARTVIN - BITLIS
Thu Jun 16 03:49:58 2022 ---- Servant 40037: loaded dataset cities EDIRNE - HAKKARI
Thu Jun 16 03:49:58 2022 ---- Servant 40037: listening at port 2028
Thu Jun 16 03:49:58 2022 ---- Servant 40037 present at port 2028 handling cities EDIRNE - HAKKARI
Thu Jun 16 03:49:58 2022 ---- Servant 40042: loaded dataset cities TEKIRDAG - ZONGULDAK
Thu Jun 16 03:49:58 2022 ---- Servant 40042: listening at port 2073
Thu Jun 16 03:49:58 2022 ---- Servant 40042 present at port 2073 handling cities TEKIRDAG - ZONGULDAK
Thu Jun 16 03:49:58 2022 ---- Servant 40038: loaded dataset cities HATAY - KARS
Thu Jun 16 03:49:58 2022 ---- Servant 40038: listening at port 2037
Thu Jun 16 03:49:58 2022 ---- Servant 40038 present at port 2037 handling cities HATAY - KARS
Thu Jun 16 03:49:58 2022 ---- Servant 40039: loaded dataset cities KASTAMONU - KUTAHYA
Thu Jun 16 03:49:58 2022 ---- Servant 40039: listening at port 2046
Thu Jun 16 03:49:58 2022 ---- Servant 40039 present at port 2046 handling cities KASTAMONU - KUTAHYA
Thu Jun 16 03:49:58 2022 ---- Servant 40040: loaded dataset cities MALATYA - ORDU
Thu Jun 16 03:49:58 2022 ---- Servant 40040: listening at port 2055
Thu Jun 16 03:49:58 2022 ---- Servant 40040 present at port 2055 handling cities MALATYA - ORDU
Thu Jun 16 03:49:58 2022 ---- Servant 40034: loaded dataset cities ADANA - ARDAHAN
Thu Jun 16 03:49:58 2022 ---- Servant 40034: listening at port 2001
Thu Jun 16 03:49:58 2022 ---- Servant 40034 present at port 2001 handling cities ADANA - ARDAHAN
Thu Jun 16 03:49:58 2022 ---- Servant 40041: loaded dataset cities OSMANIYE - SIVAS
Thu Jun 16 03:49:58 2022 ---- Servant 40041: listening at port 2064
Thu Jun 16 03:49:58 2022 ---- Servant 40041 present at port 2064 handling cities OSMANIYE - SIVAS
Thu Jun 16 03:50:01 2022 ---- Client: I have loaded 10 requests and I'm creating 10 threads.
Thu Jun 16 03:50:01 2022 ---- Client-Thread-0: Thread-0 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-1: Thread-1 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-2: Thread-2 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-3: Thread-3 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-4: Thread-4 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-5: Thread-5 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-6: Thread-6 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-8: Thread-8 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-7: Thread-7 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-9: Thread-9 has been created
Thu Jun 16 03:50:01 2022 ---- Client-Thread-6: I am requesting transactionCount FABRIKA 22-7-2004 22-7-2004 ANKARA
Thu Jun 16 03:50:01 2022 ---- Client-Thread-2: I am requesting transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:50:01 2022 ---- Client-Thread-5: I am requesting transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:50:01 2022 ---- Client-Thread-4: I am requesting transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount FABRIKA 22-7-2004 22-7-2004 ANKARA
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:50:01 2022 ---- Thu Jun 16 03:50:01 2022 ---- Contacting servant 40034
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40039
Thu Jun 16 03:50:01 2022 ---- Client-Thread-1: I am requesting transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40035
Thu Jun 16 03:50:01 2022 ---- Client-Thread-7: I am requesting transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:50:01 2022 ---- Client-Thread-9: I am requesting transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount MERA 3-2-2018 3-2-2018
```

```
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount BAHCE 2-3-2005 2-3-2005
Thu Jun 16 03:50:01 2022 ---- Thu Jun 16 03:50:01 2022 ---- Contacting servant 40034
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40039
Thu Jun 16 03:50:01 2022 ---- Client-Thread-1: I am requesting transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40035
Thu Jun 16 03:50:01 2022 ---- Client-Thread-7: I am requesting transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY
Thu Jun 16 03:50:01 2022 ---- Client-Thread-9: I am requesting transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount MERA 3-2-2018 3-2-2018
Thu Jun 16 03:50:01 2022 ---- Client-Thread-6: I am requesting transactionCount TARLA 1-1-2073 1-1-2073 ADANA
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA
Thu Jun 16 03:50:01 2022 ---- Request arrived transactionCount TARLA 1-1-2073 1-1-2073 ADANA
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40034
Thu Jun 16 03:50:01 2022 ---- Response received: 1, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Response received: 4, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40038
Thu Jun 16 03:50:01 2022 ---- Client-Thread-2: The server's response to transactionCount DUKKAN 20-4-2000 20-4-2000 KILIS is 1
Thu Jun 16 03:50:01 2022 ---- Client-Thread-2: terminating
Thu Jun 16 03:50:01 2022 ---- Contacting servant 40034
Thu Jun 16 03:50:01 2022 ---- Client-Thread-6: The server's response to transactionCount FABRIKA 22-7-2004 22-7-2004 ANKARA is 4
Thu Jun 16 03:50:01 2022 ---- Client-Thread-6: terminating
Thu Jun 16 03:50:01 2022 ---- Response received: 0, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Client-Thread-7: The server's response to transactionCount AMBAR 28-1-2044 28-1-2044 AKSARAY is 0
Thu Jun 16 03:50:01 2022 ---- Response received: 3, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Response received: 4, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Client-Thread-7: terminating
Thu Jun 16 03:50:01 2022 ---- Client-Thread-9: The server's response to transactionCount IMALATHANE 4-6-2004 4-6-2004 ISPARTA is 4
Thu Jun 16 03:50:01 2022 ---- Client-Thread-9: terminating
Thu Jun 16 03:50:01 2022 ---- Client-Thread-4: The server's response to transactionCount FIDANLIK 2-9-2016 2-9-2016 BALIKESIR is 3
Thu Jun 16 03:50:01 2022 ---- Client-Thread-4: terminating
Thu Jun 16 03:50:01 2022 ---- Response received: 3, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Client-Thread-8: The server's response to transactionCount TARLA 1-1-2073 1-1-2073 ADANA is 3
Thu Jun 16 03:50:01 2022 ---- Client-Thread-8: terminating
Thu Jun 16 03:50:01 2022 ---- Response received: 343, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Response received: 150, forwarded to client
Thu Jun 16 03:50:01 2022 ---- Client-Thread-5: The server's response to transactionCount BAHCE 2-3-2005 2-3-2005 is 343
Thu Jun 16 03:50:01 2022 ---- Client-Thread-1: The server's response to transactionCount MERA 3-2-2018 3-2-2018 is 343
Thu Jun 16 03:50:01 2022 ---- Client-Thread-5: terminating
ls
Thu Jun 16 03:50:01 2022 ---- Client-Thread-1: terminating
Thu Jun 16 03:50:02 2022 ---- Client-Thread-3: I am requesting transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:50:02 2022 ---- Client-Thread-8: I am requesting transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:50:02 2022 ---- Request arrived transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN
Thu Jun 16 03:50:02 2022 ---- Request arrived transactionCount VILLA 22-4-2049 22-4-2049
Thu Jun 16 03:50:02 2022 ---- Thu Jun 16 03:50:02 2022 ---- Contacting servant 40034
Thu Jun 16 03:50:02 2022 ---- Response received: 5, forwarded to client
Thu Jun 16 03:50:02 2022 ---- Client-Thread-3: The server's response to transactionCount BAG 1-12-2004 1-12-2004 ADIYAMAN is 5
Thu Jun 16 03:50:02 2022 ---- Client-Thread-3: terminating
Thu Jun 16 03:50:02 2022 ---- Response received: 29, forwarded to client
Thu Jun 16 03:50:02 2022 ---- Client-Thread-8: The server's response to transactionCount VILLA 22-4-2049 22-4-2049 is 29
Thu Jun 16 03:50:02 2022 ---- Client-Thread-8: terminating
Thu Jun 16 03:50:02 2022 ---- All threads have terminated, goodbye.
```

- **Some error outputs**

Thread number that is lower t.

```
samo@samo-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./server -p 8080 -t 1
Number of threads must be greater than 5
```

Invalid argument.

```
samo@samo-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./server -p 8080 -t
Invalid argument number
```


Trying to connect non existing server from servant.

```
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./servant -d dataset -c 12-81 -r 127.0.0.1 -p 8080
Thu Jun 16 03:59:09 2022 ---- Servant 40608: loaded dataset cities BALIKESIR - ZONGULDAK
Thu Jun 16 03:59:09 2022 ---- Servant 40608: listening at port 2012
Connection failed!
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$
```

Trying to connect non existing server from client.

```
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ ./client -r requestFile -q 8080 -s 127.0.0.1
Thu Jun 16 04:03:52 2022 ---- Client: I have loaded 10 requests and I'm creating 10 threads.
Thu Jun 16 04:03:52 2022 ---- Client-Thread-2: Thread-2 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-1: Thread-1 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-5: Thread-5 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-0: Thread-0 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-4: Thread-4 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-3: Thread-3 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-6: Thread-6 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-7: Thread-7 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-8: Thread-8 has been created
Thu Jun 16 04:03:52 2022 ---- Client-Thread-9: Thread-9 has been created
Error connecting to server
Error connecting to server
Error connecting to server
```

● Valgrind Results

1. Server result

```
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ valgrind ./server -p 8080 -t 5
==41196== Memcheck, a memory error detector
==41196== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==41196== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==41196== Command: ./server -p 8080 -t 5
==41196==
^CSIGINT received
Thu Jun 16 04:08:35 2022 ---- Contacting ALL to deliver SIGINT to servants
SIGINT has been received. I handled a total of 0 requests. Goodbye.
==41196==
==41196== HEAP SUMMARY:
==41196==   in use at exit: 1,360 bytes in 5 blocks
==41196==   total heap usage: 23 allocs, 18 frees, 3,081,526 bytes allocated
==41196==
==41196== LEAK SUMMARY:
==41196==   definitely lost: 0 bytes in 0 blocks
==41196==   indirectly lost: 0 bytes in 0 blocks
==41196==   possibly lost: 1,360 bytes in 5 blocks
==41196==   still reachable: 0 bytes in 0 blocks
==41196==   suppressed: 0 bytes in 0 blocks
==41196== Rerun with --leak-check=full to see details of leaked memory
==41196==
==41196== For lists of detected and suppressed errors, rerun with: -s
==41196== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$
```

2. Servant result

```
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ valgrind ./servant -d dataset -c 12-81 -r 127.0.0.1 -p 8080
==41272== Memcheck, a memory error detector
==41272== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==41272== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==41272== Command: ./servant -d dataset -c 12-81 -r 127.0.0.1 -p 8080
==41272==
==41272== Conditional jump or move depends on uninitialised value(s)
==41272==   at 0x10B1E4: findProcessNumber (servant.c:614)
==41272==   by 0x1098E3: main (servant.c:103)
==41272==
==41272== Conditional jump or move depends on uninitialised value(s)
==41272==   at 0x10B218: findProcessNumber (servant.c:614)
==41272==   by 0x1098E3: main (servant.c:103)
==41272==
Thu Jun 16 04:10:53 2022 ---- Servant -1: loaded dataset cities BALIKESIR - ZONGULDAK
Thu Jun 16 04:10:53 2022 ---- Servant -1: listening at port 2012
Connection failed!
==41272==
==41272== HEAP SUMMARY:
==41272==   in use at exit: 0 bytes in 0 blocks
==41272==   total heap usage: 7,394 allocs, 7,394 frees, 4,099,113 bytes allocated
==41272==
==41272== All heap blocks were freed -- no leaks are possible
==41272==
==41272== Use --track-origins=yes to see where uninitialised values come from
==41272== For lists of detected and suppressed errors, rerun with: -s
==41272== ERROR SUMMARY: 123 errors from 2 contexts (suppressed: 0 from 0)
sano@sano-HP-Pavillon-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$
```

3. Client result

```
==41376== ERROR SUMMARY: 1 errors from 1 contexts (suppressed: 0 from 0)
sano@sano-HP-Pavilion-Gaming-Laptop-15-cx0xxx:~/Desktop/son/son/FinalProject$ valgrind
==41376== Memcheck, a memory error detector
==41376== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==41376== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==41376== Command: ./client -r requestFile -q 8080 -s 127.0.0.1
==41376==
==41376== Invalid write of size 1
==41376==    at 0x109D2D: readFile (client.c:201)
==41376==    by 0x1096EE: main (client.c:69)
==41376== Address 0x4a7415f is 1 bytes before a block of size 60 alloc'd
==41376==    at 0x483DFAF: realloc (in /usr/lib/x86_64-linux-gnu/valgrind/vgpreload_memcheck-and64-linux.so)
==41376==    by 0x109B98: readFile (client.c:172)
==41376==    by 0x1096EE: main (client.c:69)
==41376==
Thu Jun 16 04:12:12 2022 ---- Client: I have loaded 10 requests and I'm creating 10 threads.
Thu Jun 16 04:12:12 2022 ---- Client-Thread-9: Thread-9 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-5: Thread-5 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-6: Thread-6 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-7: Thread-7 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-8: Thread-8 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-2: Thread-2 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-1: Thread-1 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-0: Thread-0 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-3: Thread-3 has been created
Thu Jun 16 04:12:12 2022 ---- Client-Thread-4: Thread-4 has been created
Error connecting to server
==41376==
==41376== HEAP SUMMARY:
==41376==    in use at exit: 2,720 bytes in 10 blocks
==41376==    total heap usage: 45 allocs, 35 frees, 16,362 bytes allocated
==41376==
==41376== LEAK SUMMARY:
==41376==    definitely lost: 0 bytes in 0 blocks
==41376==    indirectly lost: 0 bytes in 0 blocks
==41376==    possibly lost: 2,720 bytes in 10 blocks
==41376==    still reachable: 0 bytes in 0 blocks
==41376==    suppressed: 0 bytes in 0 blocks
==41376== Rerun with --leak-check=full to see details of leaked memory
==41376==
==41376== For lists of detected and suppressed errors, rerun with: -s
==41376== ERROR SUMMARY: 1 errors from 1 contexts (suppressed: 0 from 0)
```