

Systems Programming Final Project Report

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- HOW TO RUN AND TEST THE PROGRAM ?

- You can find the instructions in README.txt in order to run and test the program.

```
-HOW TO RUN THE PROGRAM:
> Run below commands in order:
make

*****

- HOW TO TEST THE PROGRAM:
bash script.sh

*****
```

Implemented Concepts:

- Sockets.
- Signal handling, threads, join-able threads.
- Make files.
- Waiting for the threads to finish.
- Mutex, condition variables, synchronization barrier,monitors.
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Working Cases:

- This program works for cases all the cases.

Note Working Cases:

- NONE

Design Explanation:

- All the System-Calls and their possible return error values are checked with detailed errno checks.
- I have 3 programs(processes) exchanging data via stream sockets, I used struct for sending and receiving data, it acts like JSON in the web world.
- I have my file structure as below 2th picture, lib.c is used as common library for server, servant and client processes.

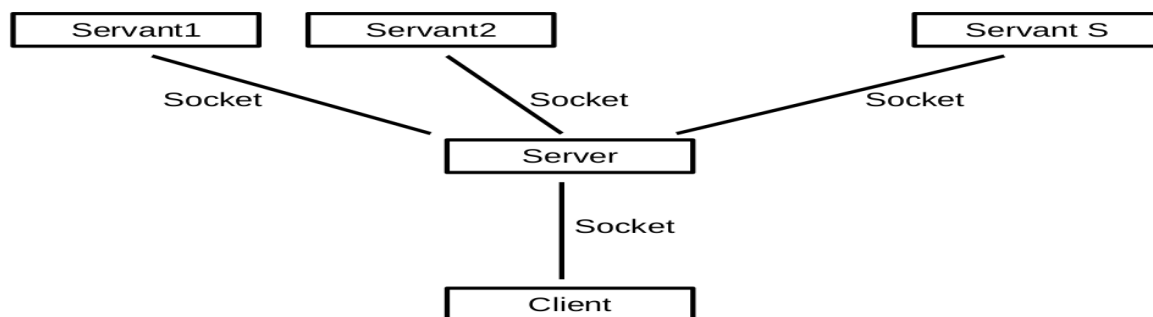
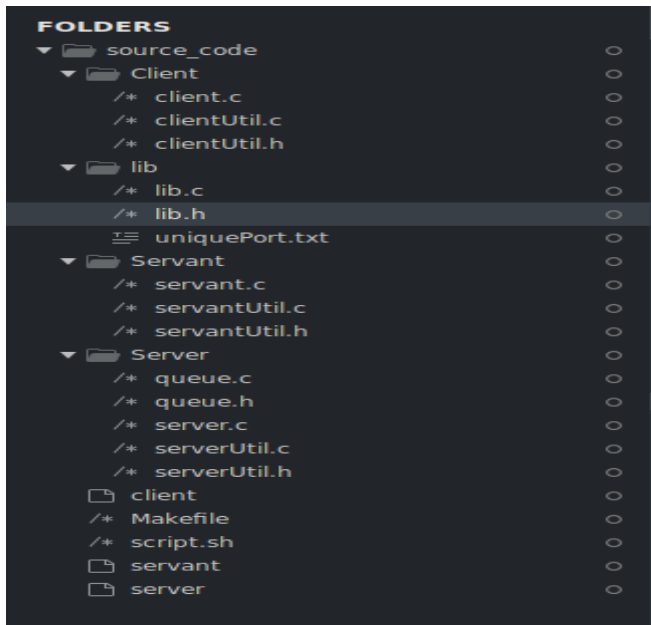


Figure 1 – Overall schema of the programs to be developed.



- here is the file structure for my final project. Each processes has it's own helper functions inside it's corresponding header files.

- in order to run this program, navigate to this main folder and run MAKE command.

- sockets are created properly and used properly. I have main method where every process can reach it and use it as socket creation and connection method as below picture.

```
int openSocket(int socket1, char* IP, int PORT){
    struct sockaddr_in serverAddr;
    int client fd;
    //Create socket file desc
    if ((socket1 = socket(AF_INET, SOCK_STREAM, 0)) < 0){
        perror("couldn't create socket !!");
        exit(EXIT_FAILURE);
    }
    serverAddr.sin_family = AF_INET;
    // serverAddr.sin_addr = inet_addr(IP);
    serverAddr.sin_port = htons(PORT);

    //Convert IPV4 or IPV6 addresses into binary from
    if (inet_pton(AF_INET, IP, &serverAddr.sin_addr) <= 0){
        perror("invalid addresss !!!");
        exit(EXIT_FAILURE);
    }
    client fd = connect(socket1, (struct sockaddr*)&serverAddr, sizeof(serverAddr));
    if (client fd == -1){
        perror("connection failed");
        exit(EXIT_FAILURE);
    }
    return socket1; // return the created socket.
}
```

- here first I create some socket file descriptor and the connect is to given port.

```

void* myThread(void* clientRequestInd){
    struct clientReqServantInfo *threadClientReqStruct = (struct clientReqServantInfo*) clientRequestInd;
    int socketID = 0, size = 0;
    char* message;
    time_t t; time(&t);

    if (sigintcaught == 1){ // if sigint has recieved.
        pthread_exit(NULL);
    }

    message = (char*) malloc(MESSAGE_LEN * sizeof(char));
    sprintf(message, "[%19s] Client-Thread-%d: Thread-%d has been created.\n", ctime(&t), threadClientReqStruct->threadInd, threadClientReqStruct->threadInd);
    printMessage(message);

    // barrier part START
    pthread_mutex_lock(&mtx);
    ++arrived;
    while(arrived < M){ pthread_cond_wait(&cond, &mtx); }
    pthread_cond_broadcast(&cond);
    pthread_mutex_unlock(&mtx);
    // barrier part END

    message = (char*) malloc(MESSAGE_LEN * sizeof(char));
    sprintf(message, "[%19s] Client-Thread-%d: I am requesting %s\n", ctime(&t), threadClientReqStruct->threadInd, threadClientReqStruct->requestStr);
    printMessage(message);

    int data = 1;

    // SENT REQUEST
    socketID = openSocket(socketID, threadClientReqStruct->serverIP, threadClientReqStruct->serverPORT);
    threadClientReqStruct->flag = 1;
    send(socketID, threadClientReqStruct, sizeof(struct clientReqServantInfo), 0);
    //*****
    // RECIEVE RESPONSE
    size = read(socketID, &data, sizeof(int));

    if (size == -1){
        perror("read failed");
        close(socketID);
        exit(EXIT_FAILURE);
    }
    //*****
    if (data == -1){ // no such city
        message = (char*) malloc(MESSAGE_LEN * sizeof(char));
        sprintf(message, "[%19s] Client-Thread-%d: The server's response to %s is %d No Such City Found !!!\n", ctime(&t), threadClientReqStruct->threadInd, threadCli);
        printMessage(message);
    }
    else{
        message = (char*) malloc(MESSAGE_LEN * sizeof(char));
        sprintf(message, "[%19s] Client-Thread-%d: The server's response to %s is %d\n", ctime(&t), threadClientReqStruct->threadInd, threadClientReqStruct->requestSt);
        printMessage(message);
    }
}

```

```

// SERVANT SOCKET SETTINGS START *****

/* Socket create */
socketFd = socket(AF_INET, SOCK_STREAM, 0);
if (socketFd == -1) {
    perror(" socket creation failed.\n");
    exit(EXIT_FAILURE);
}
bzero(&server_address, sizeof(server_address));

/* assigning ip and port */
server_address.sin_family = AF_INET;
server_address.sin_addr.s_addr = htonl(INADDR_ANY);
server_address.sin_port = htons(servantListeningPort);

/* Binds the created socket to given ip and port */
if ((bind(socketFd, (struct sockaddr*)&server_address, sizeof(server_address))) < 0) {
    perror(" socket bind failed.\n");
    exit(EXIT_FAILURE);
}

/* Server listens */
if ((listen(socketFd, 4096)) < 0) {
    perror(" server listen failed.\n");
    exit(EXIT_FAILURE);
}

// SERVANT SOCKET SETTINGS END *****

```

INPUT FILES AS:

```
server.c  x  servant.c  x  requestFile  x
1 transactionCount TARLA 01-01-2073 30-12-2074 ADANA
2 transactionCount MERA 03-02-2018 09-11-2050
3 transactionCount DUKKAN 20-04-2000 23-01-2031 KILIS
4 transactionCount BAG 01-12-2004 27-09-2089 ADIYAMAN
5 transactionCount FIDANLIK 02-09-2016 12-09-2081 BALIKESIR
6 transactionCount BAHCE 02-03-2005 17-01-2084
7
8 transactionCount FABRIKA 22-07-2004 11-05-2072 ANKARA
9
10 transactionCount AMBAR 28-01-2044 13-09-2050 AKSARAY
11 transactionCount VILLA 22-04-2049 20-03-2061
12
13 transactionCount IMALATHANE 04-06-2004 11-11-2011 ISPARTA
```

SCREEN SHOTS FROM THE PROGRAMS:

```
ashraf@ashraf: ~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/Final/source_code
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/Final/source_code$ make clean
rm -rf *.o client server servant vg logfile.out
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/Final/source_code$ make
gcc -o server ./Server/server.c ./Server/serverUtil.c ./Server/queue.c ./lib/lib.c -ansi -Wall -Wshadow -std=gnu99 -ln -lpthread -lrt
gcc -o client ./client/client.c ./client/clientUtil.c ./lib/lib.c -ansi -Wall -Wshadow -std=gnu99 -ln -lpthread -lrt
gcc -o servant ./Servant/servant.c ./Servant/servantUtil.c ./lib/lib.c -ansi -Wall -Wshadow -std=gnu99 -ln -lpthread -lrt
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/Final/source_code$ bash script.sh
[Thu Jun 16 08:06:01] Servant 6067: loaded dataset, cities ARTVIN-BITLIS
[Thu Jun 16 08:06:01] Servant 6066: loaded dataset, cities ADANA-ARDAHAN
[Thu Jun 16 08:06:01] Servant 6068: loaded dataset, cities BOLU-DUZCE
[Thu Jun 16 08:06:01] Servant 6067: listening at port 7963
[Thu Jun 16 08:06:01] Servant 6066: listening at port 7964
[Thu Jun 16 08:06:00] Servant 6067 present at port 7963 handling cities ARTVIN-BITLIS
[Thu Jun 16 08:06:00] Servant 6066 present at port 7964 handling cities ADANA-ARDAHAN
[Thu Jun 16 08:06:00] Servant 6068 present at port 7965 handling cities BOLU-DUZCE
[Thu Jun 16 08:06:01] Servant 6070: loaded dataset, cities HATAY-KARS
[Thu Jun 16 08:06:01] Servant 6072: loaded dataset, cities MALATYA-ORDU
[Thu Jun 16 08:06:00] Servant 6072 present at port 7966 handling cities MALATYA-ORDU
[Thu Jun 16 08:06:00] Servant 6070 present at port 7967 handling cities HATAY-KARS
[Thu Jun 16 08:06:01] Servant 6072: listening at port 7966
[Thu Jun 16 08:06:01] Servant 6071: loaded dataset, cities KASTAMONU-KUTAHYA
[Thu Jun 16 08:06:01] Servant 6069: loaded dataset, cities EDIRNE-HAKKARI
[Thu Jun 16 08:06:01] Servant 6070: listening at port 7967
[Thu Jun 16 08:06:00] Servant 6069 present at port 7969 handling cities EDIRNE-HAKKARI
[Thu Jun 16 08:06:00] Servant 6071 present at port 7968 handling cities KASTAMONU-KUTAHYA
[Thu Jun 16 08:06:01] Servant 6069: listening at port 7969
[Thu Jun 16 08:06:01] Servant 6071: listening at port 7968
[Thu Jun 16 08:06:01] Servant 6073: loaded dataset, cities OSMANIYE-SIVAS
[Thu Jun 16 08:06:00] Servant 6073 present at port 7970 handling cities OSMANIYE-SIVAS
[Thu Jun 16 08:06:01] Servant 6073: listening at port 7970
[Thu Jun 16 08:06:01] Servant 6074: loaded dataset, cities TEKIRDAG-ZONGULDAK
[Thu Jun 16 08:06:00] Servant 6074 present at port 7971 handling cities TEKIRDAG-ZONGULDAK
[Thu Jun 16 08:06:01] Servant 6074: listening at port 7971
[Thu Jun 16 08:06:04] Client: I have loaded 10 requests and I'm creating 10 threads.
[Thu Jun 16 08:06:04] Client-Thread-9: Thread-9 has been created.
[Thu Jun 16 08:06:04] Client-Thread-2: Thread-2 has been created.
[Thu Jun 16 08:06:04] Client-Thread-1: Thread-1 has been created.
[Thu Jun 16 08:06:04] Client-Thread-3: Thread-3 has been created.
[Thu Jun 16 08:06:04] Client-Thread-4: Thread-4 has been created.
[Thu Jun 16 08:06:04] Client-Thread-5: Thread-5 has been created.
[Thu Jun 16 08:06:04] Client-Thread-7: Thread-7 has been created.
[Thu Jun 16 08:06:04] Client-Thread-6: Thread-6 has been created.
[Thu Jun 16 08:06:04] Client-Thread-8: Thread-8 has been created.
[Thu Jun 16 08:06:04] Client-Thread-9: Thread-9 has been created.
[Thu Jun 16 08:06:04] Client-Thread-9: I am requesting transactionCount IMALATHANE 04-06-2004 11-11-2011 ISPARTA
[Thu Jun 16 08:06:04] Client-Thread-7: I am requesting transactionCount AMBAR 28-01-2044 13-09-2050 AKSARAY
[Thu Jun 16 08:06:04] Client-Thread-1: I am requesting transactionCount MERA 03-02-2018 09-11-2050
[Thu Jun 16 08:06:04] Client-Thread-3: I am requesting transactionCount BAG 01-12-2004 27-09-2089 ADIYAMAN
[Thu Jun 16 08:06:04] Client-Thread-5: I am requesting transactionCount BAHCE 02-03-2005 17-01-2084
[Thu Jun 16 08:06:04] Client-Thread-8: I am requesting transactionCount VILLA 22-04-2049 20-03-2061
```

```

ashraf@ashraf: ~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/Final/source_code
[Thu Jun 16 08:06:04] Client-Thread-5: Thread-5 has been created.
[Thu Jun 16 08:06:04] Client-Thread-7: Thread-7 has been created.
[Thu Jun 16 08:06:04] Client-Thread-6: Thread-6 has been created.
[Thu Jun 16 08:06:04] Client-Thread-8: Thread-8 has been created.
[Thu Jun 16 08:06:04] Client-Thread-9: Thread-9 has been created.
[Thu Jun 16 08:06:04] Client-Thread-9: I am requesting transactionCount IMALATHANE 04-06-2004 11-11-2011 ISPARTA
[Thu Jun 16 08:06:04] Client-Thread-7: I am requesting transactionCount AMBAR 28-01-2044 13-09-2050 AKSARAY
[Thu Jun 16 08:06:04] Client-Thread-1: I am requesting transactionCount MERA 03-02-2018 09-11-2050
[Thu Jun 16 08:06:04] Client-Thread-3: I am requesting transactionCount BAG 01-12-2004 27-09-2089 ADIYAMAN
[Thu Jun 16 08:06:04] Client-Thread-5: I am requesting transactionCount BAHCE 02-03-2005 17-01-2084
[Thu Jun 16 08:06:04] Client-Thread-8: I am requesting transactionCount VILLA 22-04-2049 20-03-2061
[Thu Jun 16 08:06:04] Client-Thread-0: I am requesting transactionCount TARLA 01-01-2073 30-12-2074 ADANA
[Thu Jun 16 08:06:04] Client-Thread-6: I am requesting transactionCount FABRIKA 22-07-2004 11-05-2072 ANKARA
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7967
[Thu Jun 16 08:06:04] Client-Thread-4: I am requesting transactionCount FIDANLIK 02-09-2016 12-09-2081 BALIKESIR
[Thu Jun 16 08:06:00] Response Arrived: 4, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-9: The server's response to transactionCount IMALATHANE 04-06-2004 11-11-2011 ISPARTA is 4
[Thu Jun 16 08:06:00] Client-Thread-9: Terminating...
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7964
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7964
[Thu Jun 16 08:06:00] Response Arrived: 4, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-7: The server's response to transactionCount AMBAR 28-01-2044 13-09-2050 AKSARAY
is 4
[Thu Jun 16 08:06:04] Client-Thread-7: Terminating...
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7968
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7963
[Thu Jun 16 08:06:04] Client-Thread-0: The server's response to transactionCount TARLA 01-01-2073 30-12-2074 ADANA
is 3
[Thu Jun 16 08:06:04] Client-Thread-0: Terminating...
[Thu Jun 16 08:06:00] Response Arrived: 52, Forwarded to Client
[Thu Jun 16 08:06:00] Response Arrived: 3, Forwarded to Client
[Thu Jun 16 08:06:00] Response Arrived: 37, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-3: The server's response to transactionCount BAG 01-12-2004 27-09-2089 ADIYAMAN
is 52
[Thu Jun 16 08:06:04] Client-Thread-3: Terminating...
[Thu Jun 16 08:06:04] Client-Thread-4: The server's response to transactionCount FIDANLIK 02-09-2016 12-09-2081 BALIKESIR
is 39

```

```

[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7964
[Thu Jun 16 08:06:00] Contacting Servent 7964
[Thu Jun 16 08:06:00] Contacting Servent 7964
[Thu Jun 16 08:06:00] Response Arrived: 4, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-7: The server's response to transactionCount AMBAR 28-01-2044 13-09-2050 AKSARAY
is 4
[Thu Jun 16 08:06:04] Client-Thread-7: Terminating...
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7968
[Thu Jun 16 08:06:00] Request Arrived
[Thu Jun 16 08:06:00] Contacting Servent 7963
[Thu Jun 16 08:06:04] Client-Thread-0: The server's response to transactionCount TARLA 01-01-2073 30-12-2074 ADANA
is 3
[Thu Jun 16 08:06:04] Client-Thread-0: Terminating...
[Thu Jun 16 08:06:00] Response Arrived: 52, Forwarded to Client
[Thu Jun 16 08:06:00] Response Arrived: 3, Forwarded to Client
[Thu Jun 16 08:06:00] Response Arrived: 37, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-3: The server's response to transactionCount BAG 01-12-2004 27-09-2089 ADIYAMAN
is 52
[Thu Jun 16 08:06:04] Client-Thread-3: Terminating...
[Thu Jun 16 08:06:04] Client-Thread-4: The server's response to transactionCount FIDANLIK 02-09-2016 12-09-2081 BALIKESIR
is 39
[Thu Jun 16 08:06:04] Client-Thread-4: Terminating...
[Thu Jun 16 08:06:00] Response Arrived: 39, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-6: The server's response to transactionCount FABRIKA 22-07-2004 11-05-2072 ANKARA
is 37
[Thu Jun 16 08:06:04] Client-Thread-6: Terminating...
[Thu Jun 16 08:06:04] Client-Thread-8: The server's response to transactionCount VILLA 22-04-2049 20-03-2061
is 29
[Thu Jun 16 08:06:04] Client-Thread-1: The server's response to transactionCount MERA 03-02-2018 09-11-2050
is 158
[Thu Jun 16 08:06:04] Client-Thread-8: Terminating...
[Thu Jun 16 08:06:04] Client-Thread-1: Terminating...
[Thu Jun 16 08:06:00] Response Arrived: 16, Forwarded to Client
[Thu Jun 16 08:06:04] Client-Thread-2: The server's response to transactionCount DUKKAN 20-04-2000 23-01-2031 KILIS
is 16
[Thu Jun 16 08:06:04] Client-Thread-5: The server's response to transactionCount BAHCE 02-03-2005 17-01-2084
is 343
[Thu Jun 16 08:06:04] Client-Thread-5: Terminating...
[Thu Jun 16 08:06:04] Client-Thread-2: Terminating...
[Thu Jun 16 08:06:04] Client: All threads have terminated, goodbye.
ashraf@ashraf:~/Desktop/SEMESTER 10/2 SYSTEMS PROGRAMMING/HomeWorks/Final/source_code$ bash script.sh

```