Ahmet DENİZLİ 161044020

CSE344 System Programming Midterm Project Report

When starting, serverY checks is there any instance of running if there is one then exits. Then checks arguments and make process daemon. Then forks serverZ and serverZ forks for its workers and waits forwarded request from serverY via pipe. ServerY forks for its workers and waits requests from serverFifo.

1. Design

Client sends its pid to the serverY over server fifo, then sends matrix size and matrix over client fifo. ServerY opens client fifo and reads matrix informations and handle it.

I designed a shared memory for serverY to counting for invertible matrix, not invertible matrix, forwarded requests and running workers. This shared memory has POSIX semaphore for synchronization. Once a request arrives through the serverFifo, it will send it (using a pipe) to any available worker process. I will designed a main pipe when any serverY worker process is available then its writes to main pipe its pidarray index and decrements the running process count in serverY workers. serverY checks running worker count if its less than pool size then serverY reads next available worker from mainpipe and sends request body over pipe to the worker, then worker checks if matrix is invertible or not then response to the client directly over client fifo. If runnning worker count is equal to pool size then serverY forwards request to the serverZ over serverZpipe.

In shared memory for serverZ there is POSIX semaphores, invertible matrix count, not invertible matrix count, forwarded requests count, running workers count, queue, rear and front. If any request forwarded to serverZ over serverZpipe, serverZ enque the request and incerements semaphore. ServerZ workers waits for semaphore, if semaphore triggered than dequeue request from queue and checks if matrix is invertible or not, then response result to the client directly over client fifo.

2. Signal Handling

Defined sigint handler function with sigaction for the server program to exit. When takes SIGINT signal, prints an caught information, then changes the global sigint flag from. All processes breaks, free their resources and exits.

3. Functions

3.1. serverY.c

int isInvertible(int n, int mat[n][n]): This function calls determinantOfMatrix function and return 1 if it is invertible, return 0 if it is not invertible.

int determinantOfMatrix(int n, int mat[n][n]): Recursive function for finding determinant of matrix n is dimension of matrix.

void getCofactor(int n, int mat[n][n], int temp[n-1][n-1], int p, int q): This function gets cofactor of mat[p][q] in temp[][], n is the dimension of mat matrix.

void serverZfun(): This function performs Server Z and its childs operations. Written separately from main for code readability.

void errExit(char *s): This function prints given error via perror then exits.

void errExitFd(int fd, char *s): This function writes given string to the fd file descriptor then exits.

void sigint_handler(int signum): Handler for SIGINT and SIGTERM for serverY.

void sigint_handler_ServerZ(int signum): Handler for SIGINT and SIGTERM for serverY.

int main(int argc, char *argv[]): The log file and server fifo are opened, the daemon processes created, double instantiation blocked and after all processes created ServerY listens serverFifo for clients.

3.2. client.c

int main(int argc, char *argv[]): The data file, client fifo and server fifo are opened, the matrix readed from file and send to the server, waits response from the server and prints the result.

void sigint_handler(int signum): Handler for SIGINT and SIGTERM for client. Closes opened file descriptors and unlink client fifo.

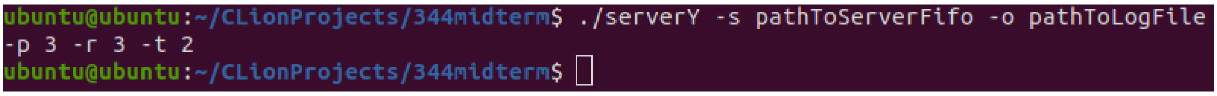
3.3. output.c

unsigned long get_time_seconds(): Returns current timestamp in seconds.

unsigned long get_time_microseconds (): Returns current timestamp in micro seconds.

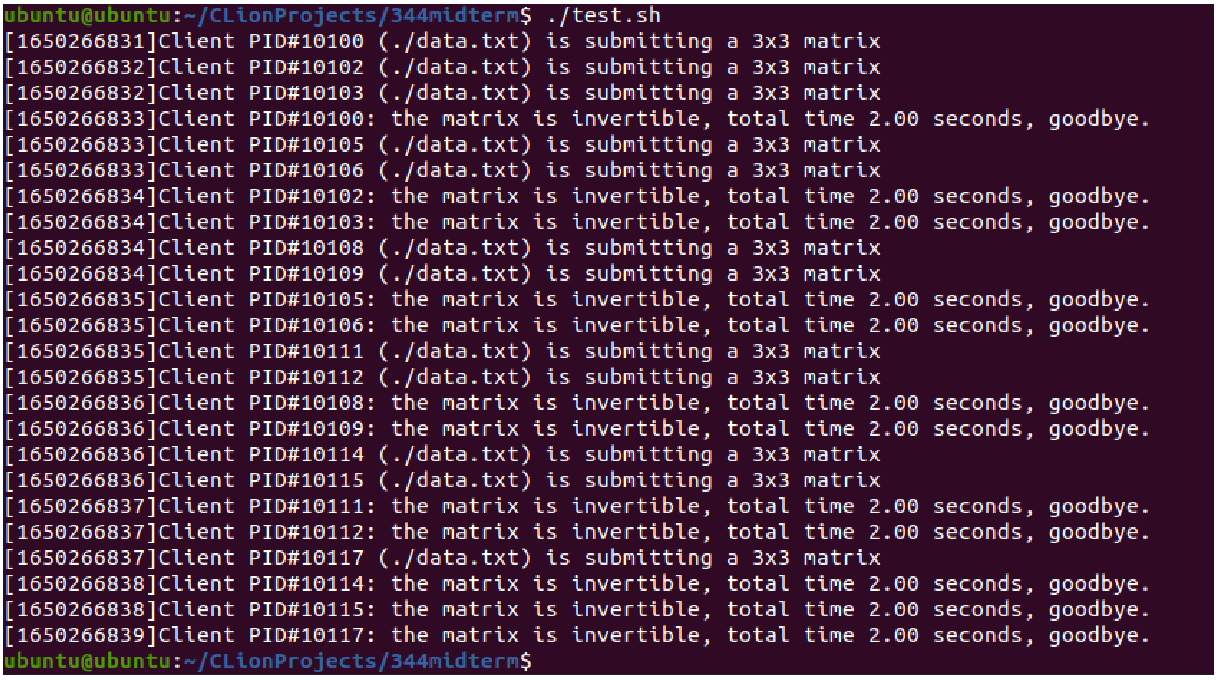
4. Sample Screenshots

Running Server daemon process



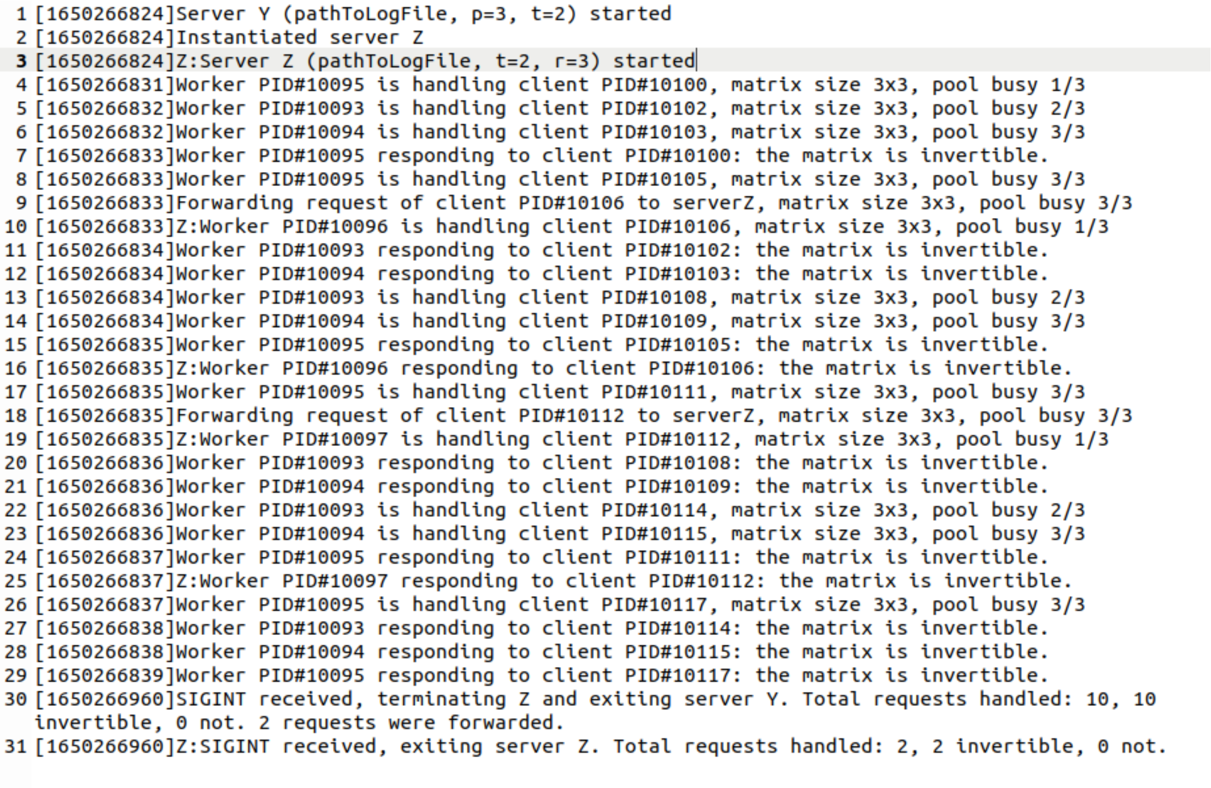
```
ubuntu@ubuntu:~/CLionProjects/344midterm$ ./serverY -s pathToServerFifo -o pathToLogFile
-p 3 -r 3 -t 2
ubuntu@ubuntu:~/CLionProjects/344midterm$ 
```

Running 12



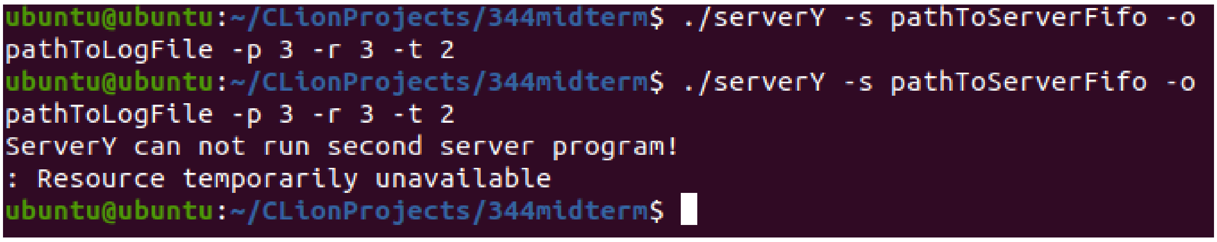
```
ubuntu@ubuntu:~/CLionProjects/344midterm$ ./test.sh
[1650266831]Client PID#10100 (./data.txt) is submitting a 3x3 matrix
[1650266832]Client PID#10102 (./data.txt) is submitting a 3x3 matrix
[1650266832]Client PID#10103 (./data.txt) is submitting a 3x3 matrix
[1650266833]Client PID#10100: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266833]Client PID#10105 (./data.txt) is submitting a 3x3 matrix
[1650266833]Client PID#10106 (./data.txt) is submitting a 3x3 matrix
[1650266834]Client PID#10102: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266834]Client PID#10103: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266834]Client PID#10108 (./data.txt) is submitting a 3x3 matrix
[1650266834]Client PID#10109 (./data.txt) is submitting a 3x3 matrix
[1650266835]Client PID#10105: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266835]Client PID#10106: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266835]Client PID#10111 (./data.txt) is submitting a 3x3 matrix
[1650266835]Client PID#10112 (./data.txt) is submitting a 3x3 matrix
[1650266836]Client PID#10108: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266836]Client PID#10109: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266836]Client PID#10114 (./data.txt) is submitting a 3x3 matrix
[1650266836]Client PID#10115 (./data.txt) is submitting a 3x3 matrix
[1650266837]Client PID#10111: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266837]Client PID#10112: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266837]Client PID#10117 (./data.txt) is submitting a 3x3 matrix
[1650266838]Client PID#10114: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266838]Client PID#10115: the matrix is invertible, total time 2.00 seconds, goodbye.
[1650266839]Client PID#10117: the matrix is invertible, total time 2.00 seconds, goodbye.
ubuntu@ubuntu:~/CLionProjects/344midterm$
```

LogFile



```
[1650266824]Server Y (pathToLogFile, p=3, t=2) started
[1650266824]Instantiated server Z
[1650266824]Z:Server Z (pathToLogFile, t=2, r=3) started
[1650266831]Worker PID#10095 is handling client PID#10100, matrix size 3x3, pool busy 1/3
[1650266832]Worker PID#10093 is handling client PID#10102, matrix size 3x3, pool busy 2/3
[1650266832]Worker PID#10094 is handling client PID#10103, matrix size 3x3, pool busy 3/3
[1650266833]Worker PID#10095 responding to client PID#10100: the matrix is invertible.
[1650266833]Worker PID#10095 is handling client PID#10105, matrix size 3x3, pool busy 3/3
[1650266833]Forwarding request of client PID#10106 to serverZ, matrix size 3x3, pool busy 3/3
[1650266833]Z:Worker PID#10096 is handling client PID#10106, matrix size 3x3, pool busy 1/3
[1650266834]Worker PID#10093 responding to client PID#10102: the matrix is invertible.
[1650266834]Worker PID#10094 responding to client PID#10103: the matrix is invertible.
[1650266834]Worker PID#10093 is handling client PID#10108, matrix size 3x3, pool busy 2/3
[1650266834]Worker PID#10094 is handling client PID#10109, matrix size 3x3, pool busy 3/3
[1650266835]Worker PID#10095 responding to client PID#10105: the matrix is invertible.
[1650266835]Z:Worker PID#10096 responding to client PID#10106: the matrix is invertible.
[1650266835]Worker PID#10095 is handling client PID#10111, matrix size 3x3, pool busy 3/3
[1650266835]Forwarding request of client PID#10112 to serverZ, matrix size 3x3, pool busy 3/3
[1650266835]Z:Worker PID#10097 is handling client PID#10112, matrix size 3x3, pool busy 1/3
[1650266836]Worker PID#10093 responding to client PID#10108: the matrix is invertible.
[1650266836]Worker PID#10094 responding to client PID#10109: the matrix is invertible.
[1650266836]Worker PID#10093 is handling client PID#10114, matrix size 3x3, pool busy 2/3
[1650266836]Worker PID#10094 is handling client PID#10115, matrix size 3x3, pool busy 3/3
[1650266837]Worker PID#10095 responding to client PID#10111: the matrix is invertible.
[1650266837]Z:Worker PID#10097 responding to client PID#10112: the matrix is invertible.
[1650266837]Worker PID#10095 is handling client PID#10117, matrix size 3x3, pool busy 3/3
[1650266838]Worker PID#10093 responding to client PID#10114: the matrix is invertible.
[1650266838]Worker PID#10094 responding to client PID#10115: the matrix is invertible.
[1650266839]Worker PID#10095 responding to client PID#10117: the matrix is invertible.
[1650266960]SIGINT received, terminating Z and exiting server Y. Total requests handled: 10, 10 invertible, 0 not. 2 requests were forwarded.
[1650266960]Z:SIGINT received, exiting server Z. Total requests handled: 2, 2 invertible, 0 not.
```

Blocking double instantiation



```
ubuntu@ubuntu:~/CLionProjects/344midterm$ ./serverY -s pathToServerFifo -o
pathToLogFile -p 3 -r 3 -t 2
ubuntu@ubuntu:~/CLionProjects/344midterm$ ./serverY -s pathToServerFifo -o
pathToLogFile -p 3 -r 3 -t 2
ServerY can not run second server program!
: Resource temporarily unavailable
ubuntu@ubuntu:~/CLionProjects/344midterm$
```