

시스템 프로그래밍 실습

[FTP 3-3]

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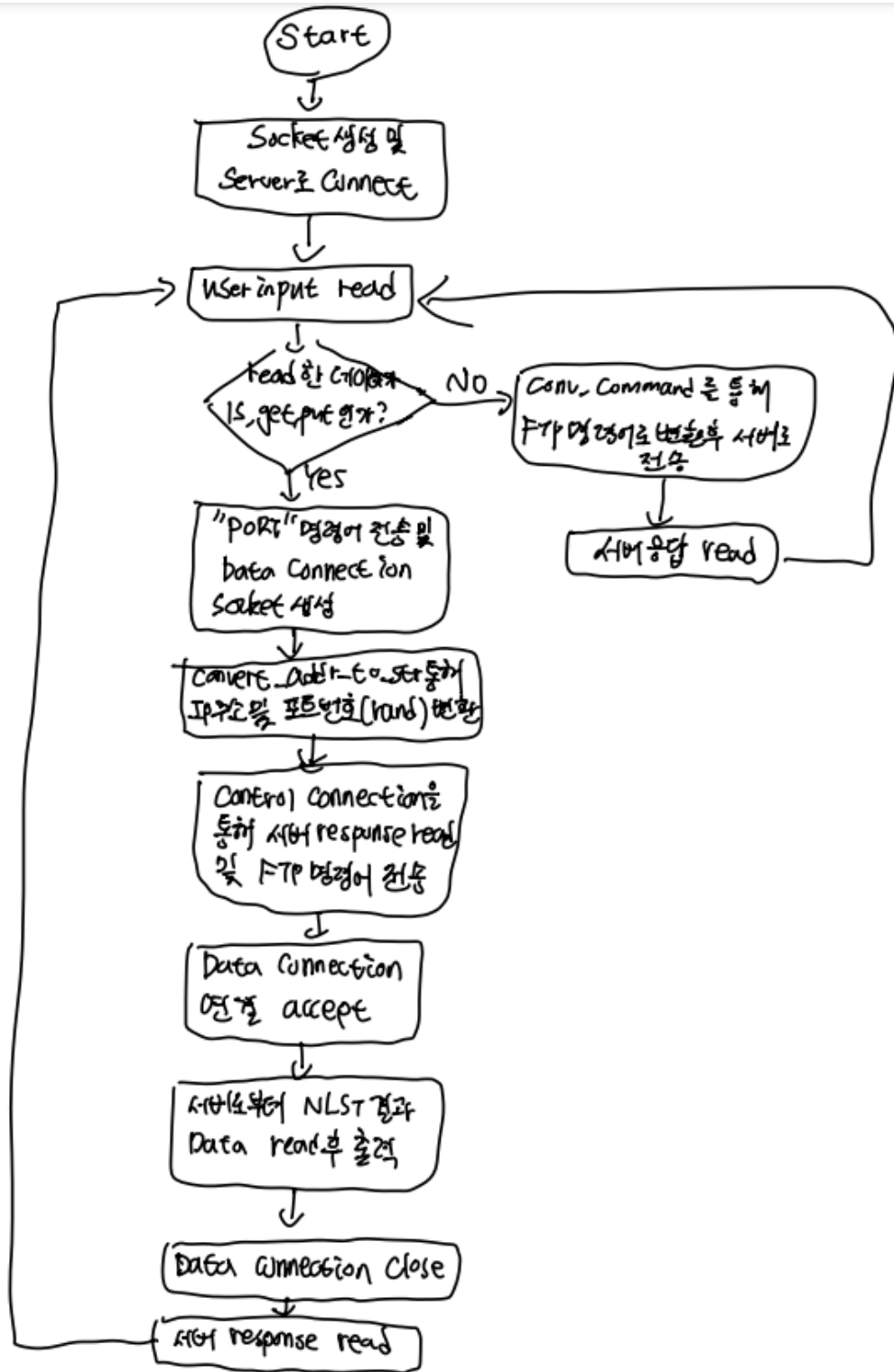
Introduction

이번 [FTP 3-3](#) 과제는 최종적으로 FTP 서버-클라이언트 구조를 구현하는 프로젝트의 마지막 과정으로, 지금까지 구현한 각 명령어의 동작, 로그인, 시그널, dual connection 등을 통합하여 최종적으로 FTP 서버 클라이언트를 구현하는 것을 목적으로 한다. 클라이언트와 서버를 연결하면 먼저 USER 와 PASSWD 를 입력하여 로그인을 하고, 로그인에 성공할 경우 사용자 입력을 통해 사용자 명령어를 입력하면 해당 명령어가 FTP 명령어로 변환되어 서버로 전송되고, 서버에서 이를 처리한 후 FTP 코드를 클라이언트로 전송하여 출력한다. 이 때 사용자 명령어가 ls, get, put 인 경우 dual connection 을 이용하는데, data connection 을 새로 생성하여 이를 통해 결과를 전송한다. 이러한 동작들을 구현하고, 결과를 테스트하는 것을 이번 과제의 목적으로 한다.

Flow chart

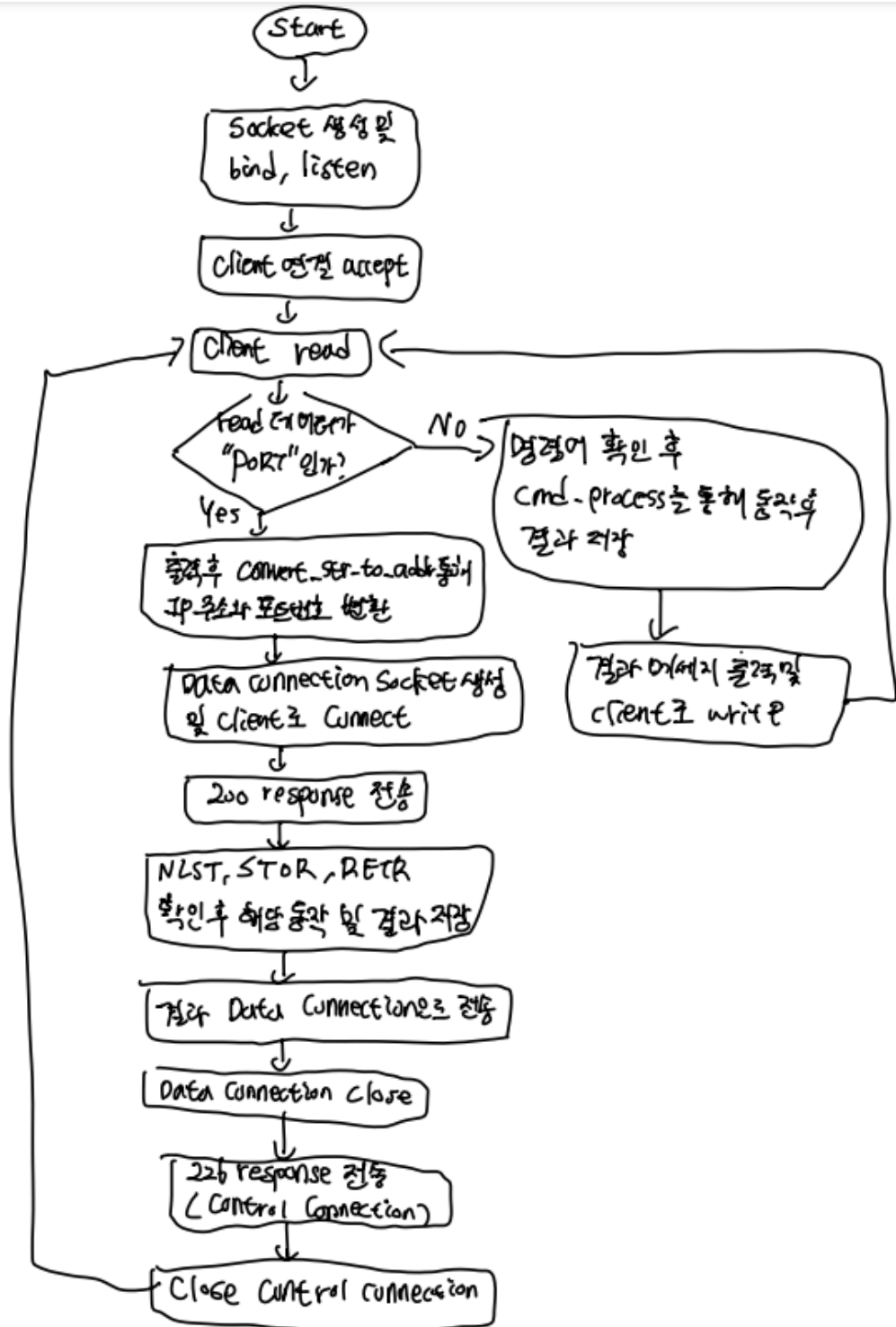
<cli.c>

<cli.c>



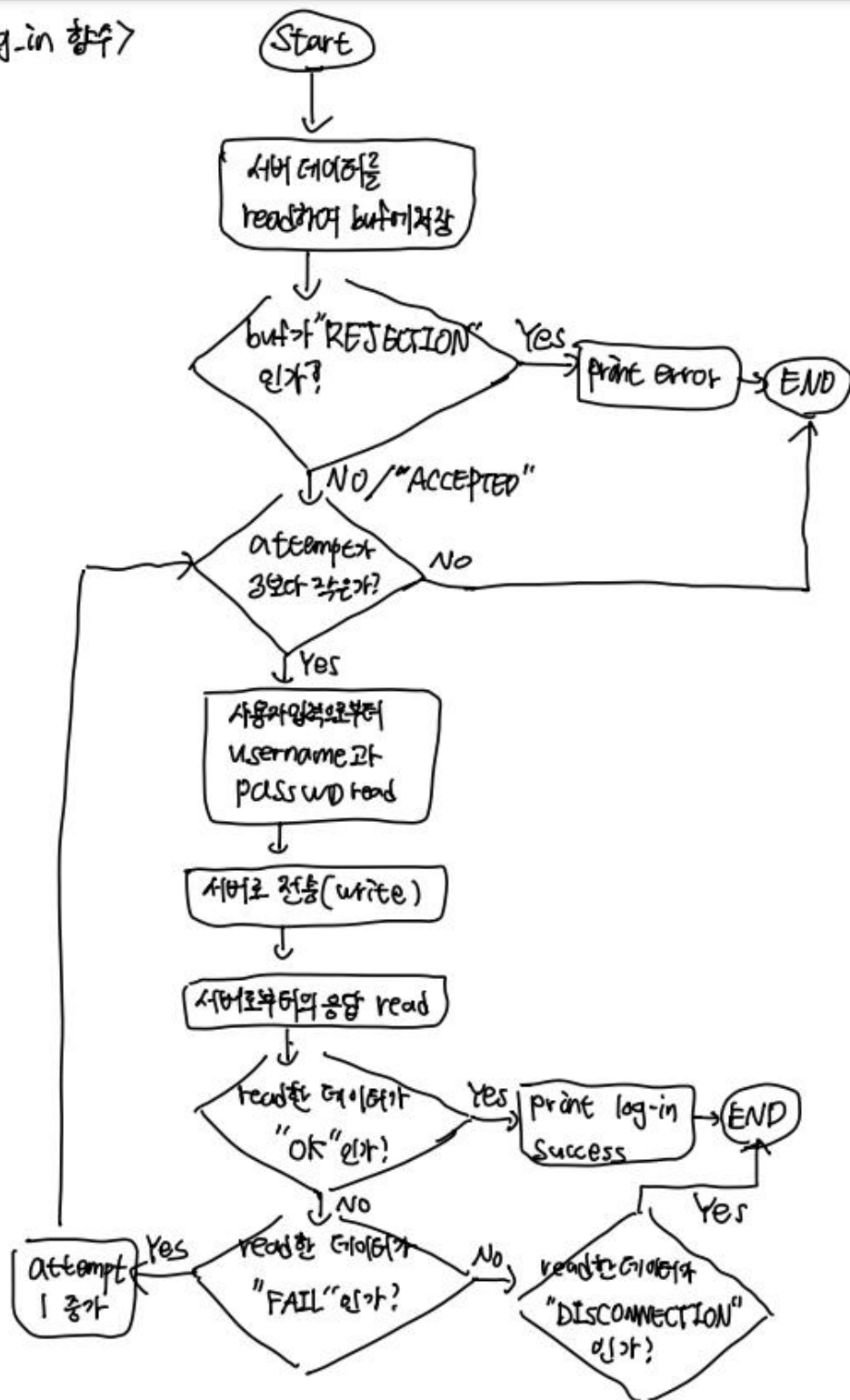
<srv.c>

<srv.c>

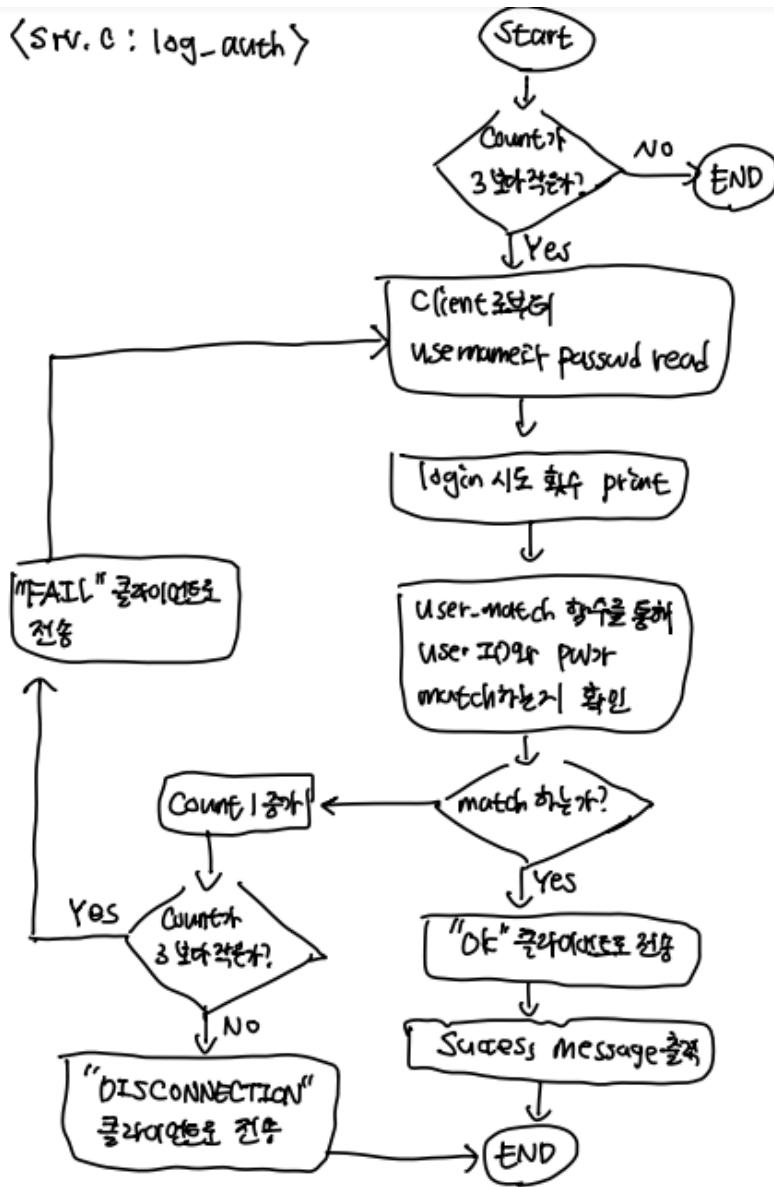


<login 관련 함수>

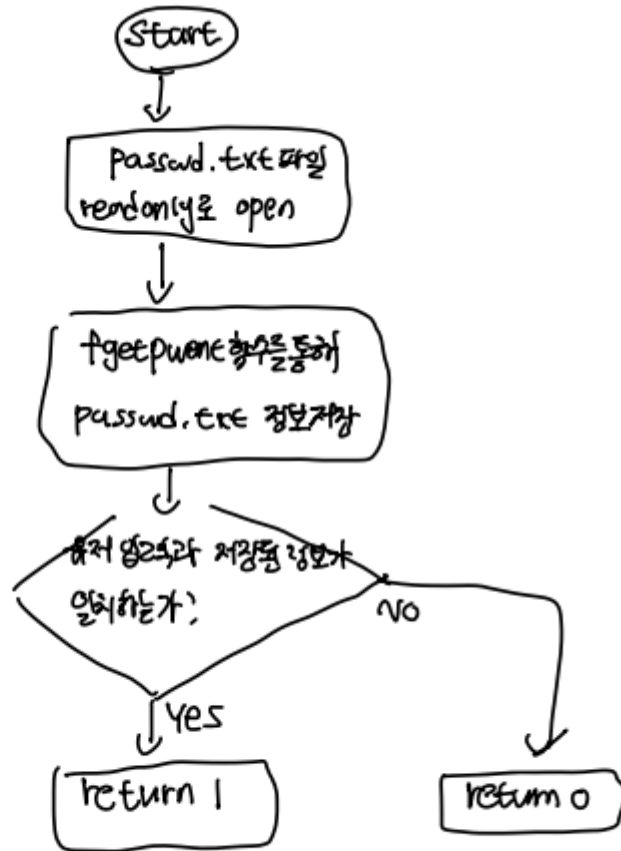
< C++, log-in 함수 >



<srv.c: log_auth>

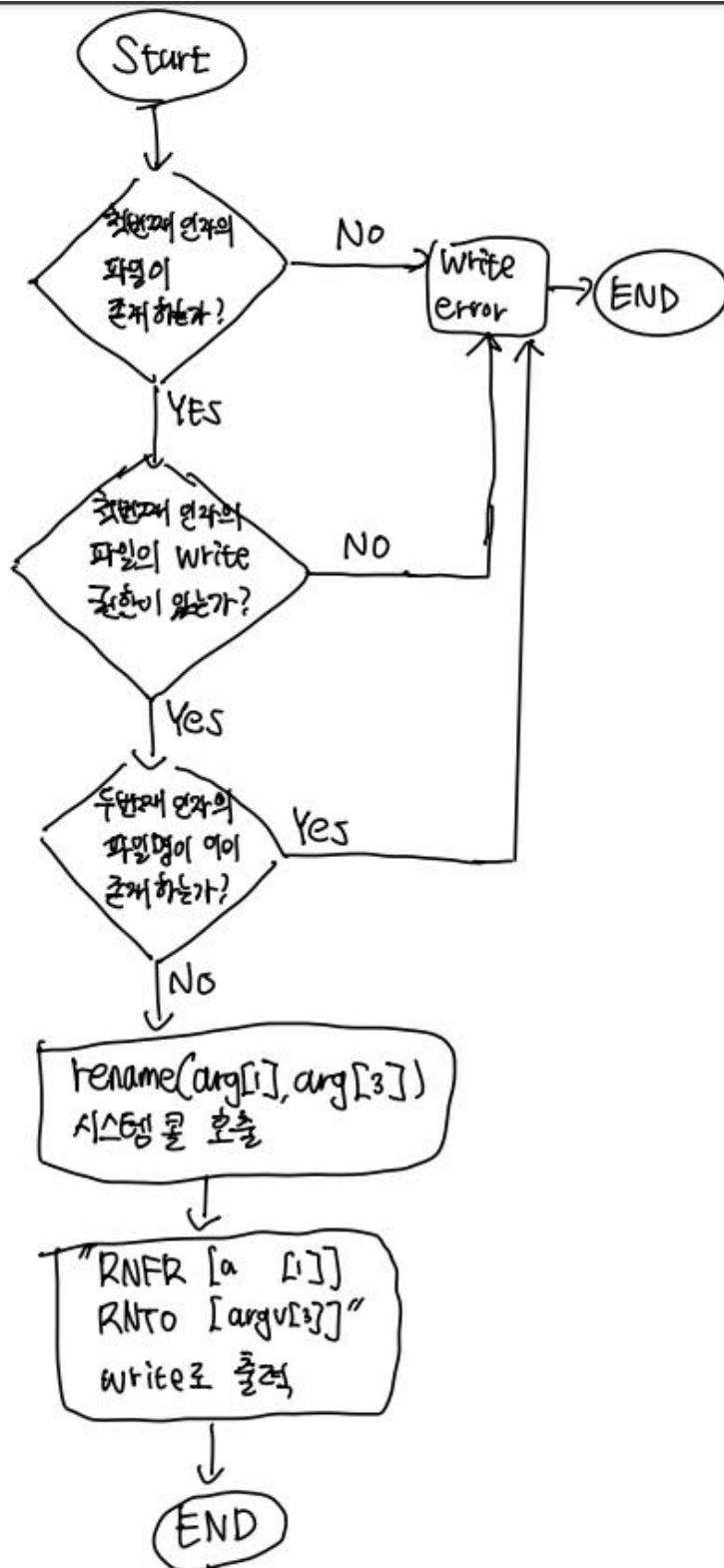


<srv.c: user_match 함수>

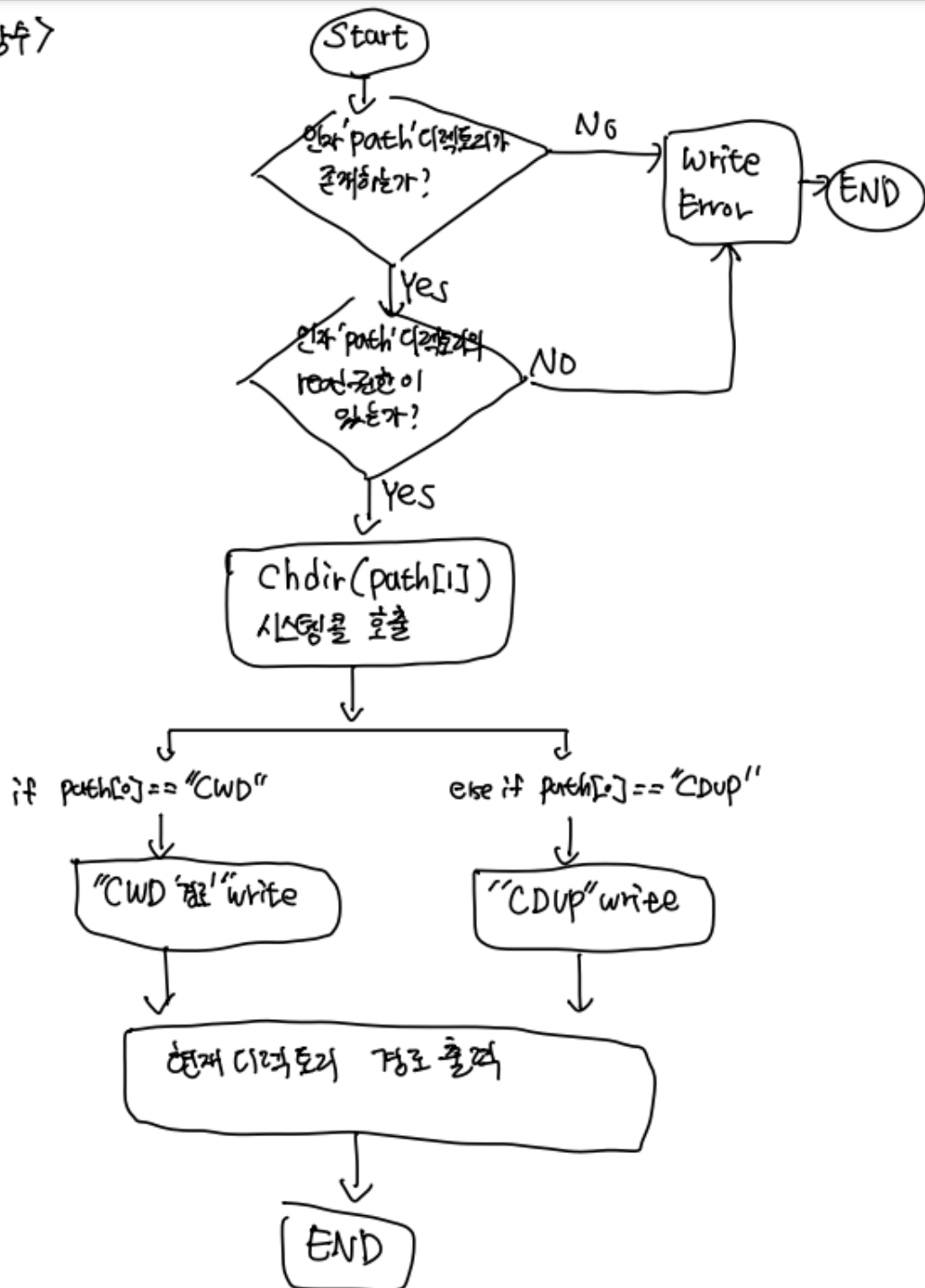


<명령어 처리 함수>

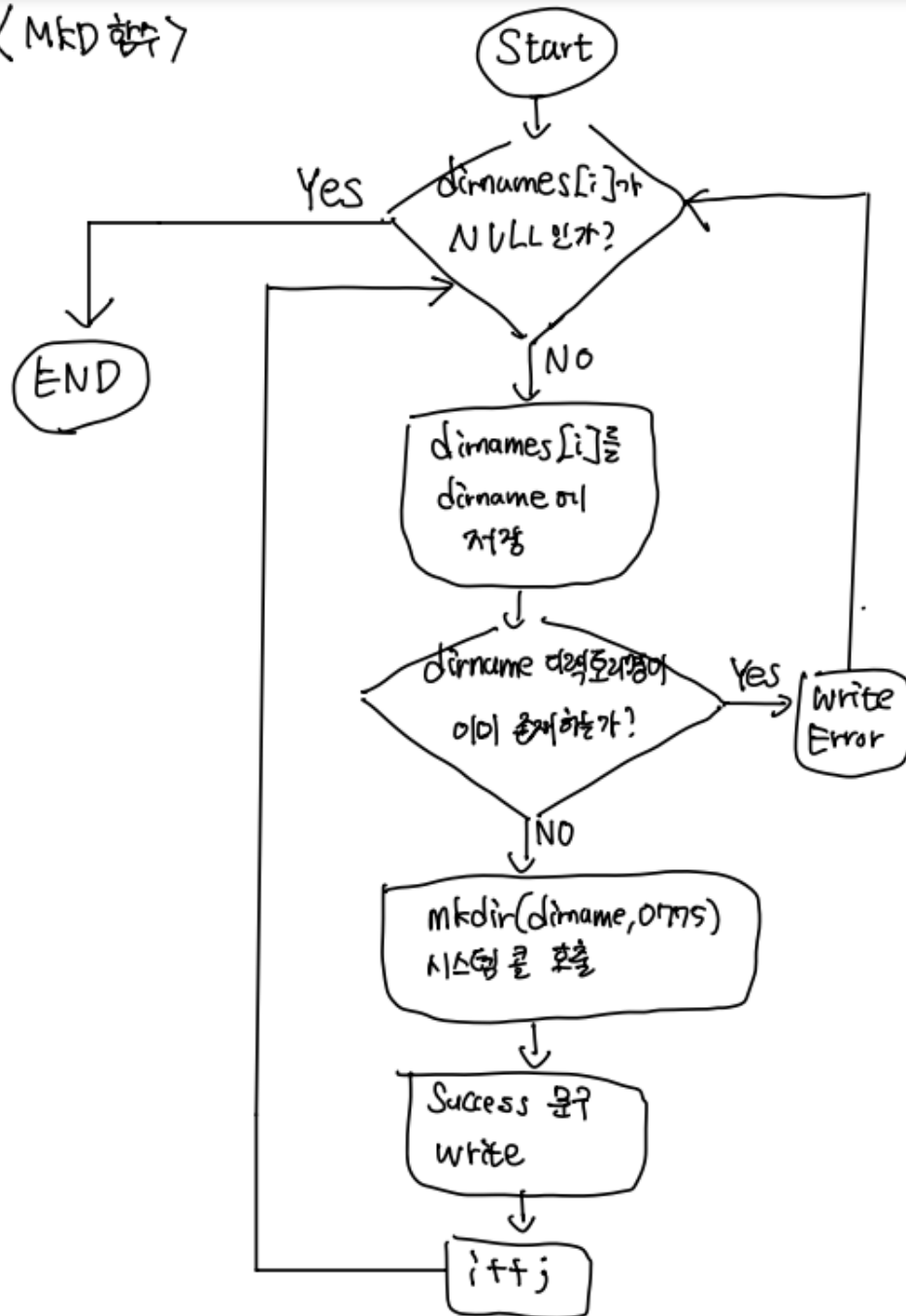
<RENAME 함수>



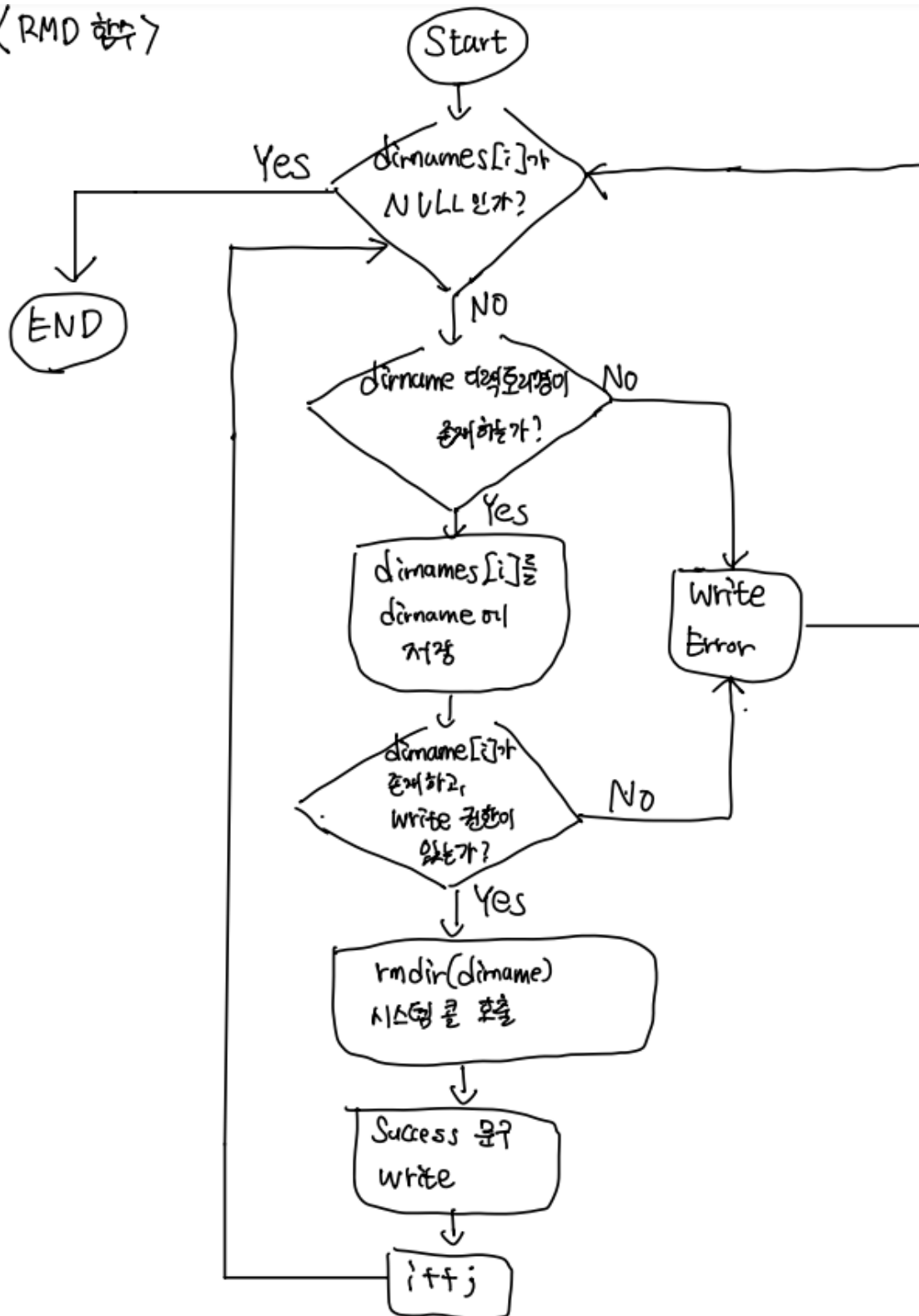
<CD 함수>



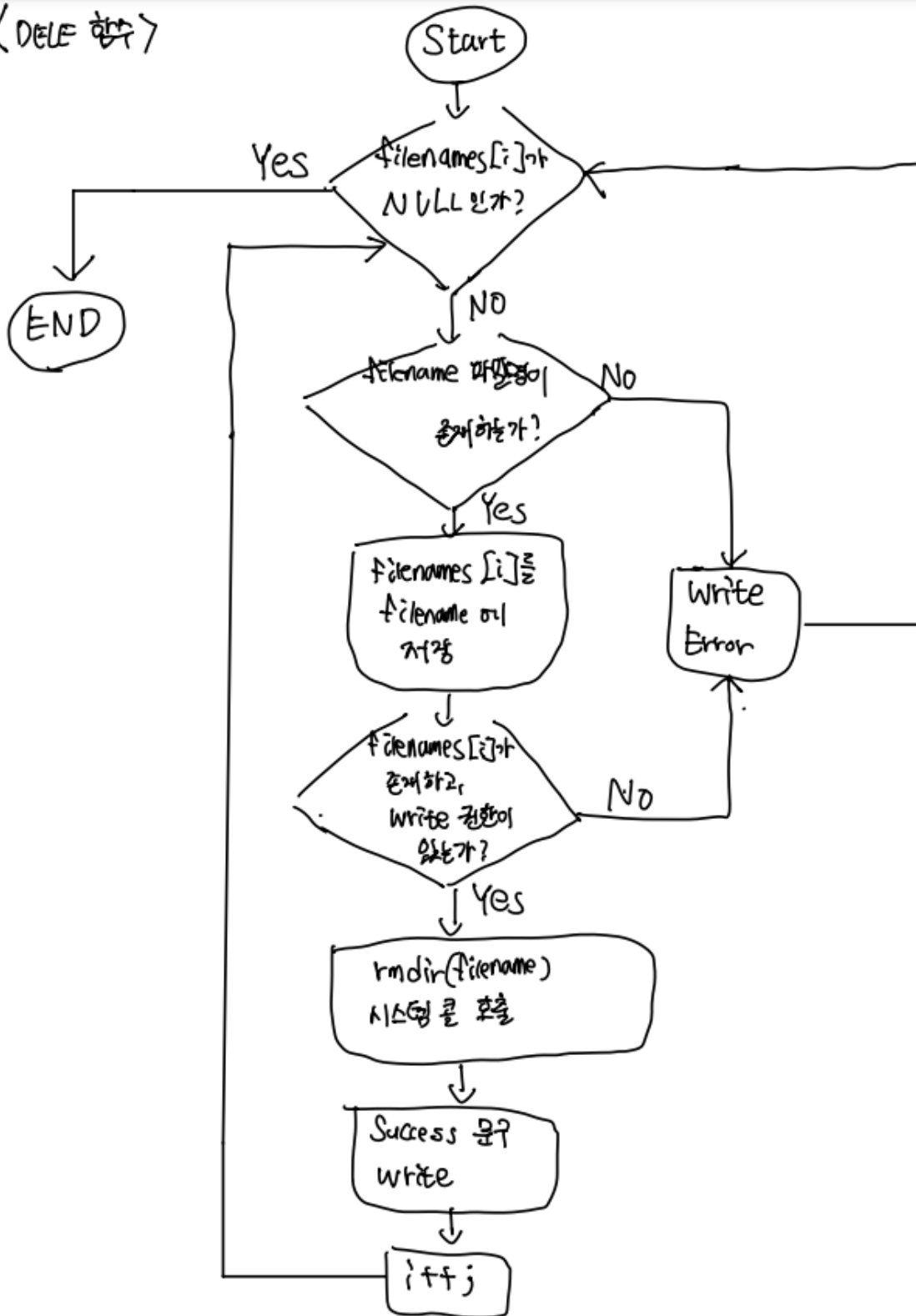
< Mkd 함수 >



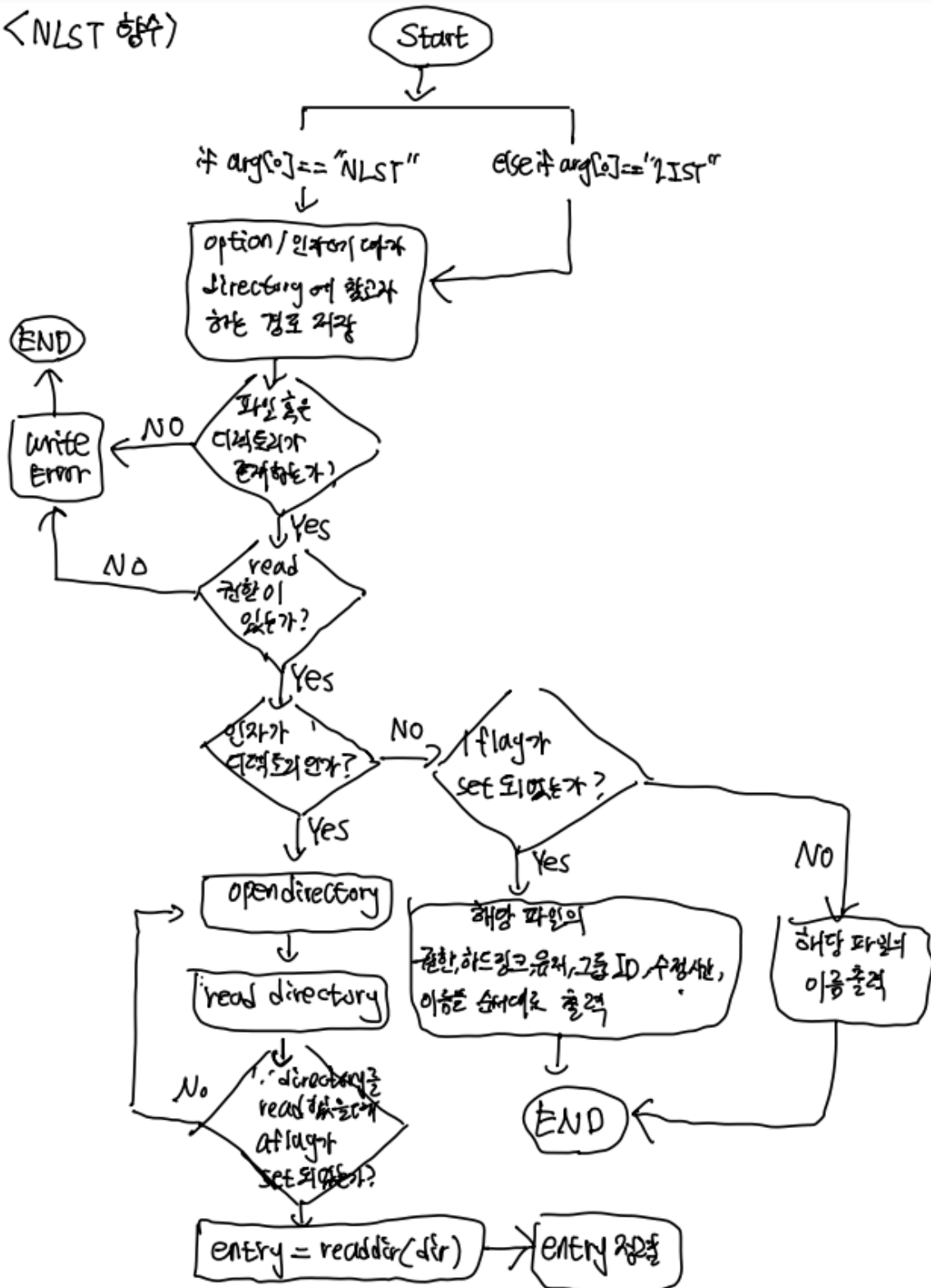
<RMD 함수>

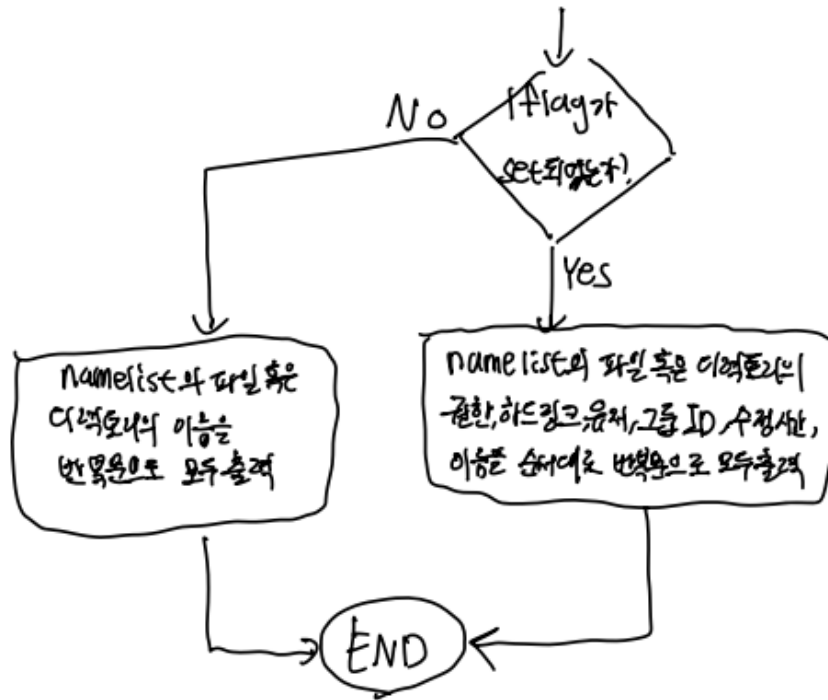


< DELETE 함수 >



<NLST 함수>





Pseudo code

<cli.c>

void main(int argc, char **argv)

 declare variables for communication with server

 Check if IP address and port number are provided

 Create socket

 set server address structure

 connect to the server

 read from user input

 if user input is equal to "ls"

 create data connection socket

 write "PORT" to the server

 read from server

 print message

 write "NLST" to the server

 read from server

 print message

 read data from server as data connection

 print data

 close data connection

 read from server

 print message

 else if user input is equal to "quit"

```
        convert quit to QUIT
        write "QUIT" to server
        read data from server
        if message is start with 221
            print message
            break;
    else
        write command to server
        close control connection
        exit(0);
close control connection
```

```
void handle_command(int sockfd, char* send_buff, char *server_ip)
```

```
    if command is NLST or STOR, or RETR
        send port command to server
        send ftp command to server
        read message from the server
        print message
```

```
char* conver_addr_to_str(struct sockaddr_in *addr, const char *ip)
```

```
    conver IP address into four integers
    convert port number to binary
    return addr_str;
```



```
int create_data_socket(struct sockaddr_in *addr)
```

```
    create data connection socket
```

```
    set data connection address structure
```

```
    bind();
```

```
    listen();
```

```
    return sock;
```

```
void log_in(int sockfd)
```

```
    declare buf to store username and passwd
```

```
    read from server
```

```
    if message from server is "ACCEPTED"
```

```
        for three time attempt
```

```
        prompt the user for their username
```

```
        store username into buf
```

```
        prompt the user for their password
```

```
        store passwd into buf
```

```
    read server's response to the login attempt
```

```
    if read data is "OK"
```

```
        print success message
```

```
        return;
```

```
    else if read data is "FAIL"
```

```
        print fail message
```

```
    else if read data is "DISCONNECTION"
```

```
        print connection closed;
```

```
        exit(1);
```

<srv.c>

void main(int argc, char** argv)

declare variables for connection with client

Check if the port number is provided

create control connection socket

Initialize control connection address

bind()

listen()

accept incoming connection from client

While(1)

Print client information

fopen the access.txt file

fgets each line in access.txt file

declare access_granted = 0;

if line is "*. *.*.*

access_granted = 1;

break;

else if line == client_ip

access_granted = 1;

else if last letter of line is "*" and line == client_ip

access_granted = 1;

close access.txt

```
if access_granted == 0
    write "REJECTION" to server
else if access_granted == 1
    write "ACCEPTED" to server

if(log_auth(connfd) == 0)
    print fail to login
    close
    continue;
close connfd;

read from client
if read data is "PORT"
    convert string to address
    print port command
    create socket for data connection
    write 200 response to client
    read from client
    cmd_process(buff, result_buff);

if read data is "NLST / STOR / RETR"
    write 150 response to client
    print message
```

```
        write result of the corresponding FTP command to the client

        write 226 response to client

        print message

    else

        write buffer to the client

else if command is "QUIT"

    if there are arguments

        print error message

        write error message

        continue;

    print 221 ack

    write message to client

else

    cmd_process;

    print message

    close control connection

    exit(1);

close control connection

exit(1);
```

```
void handle_port_command(int client_sock, char* buff)
```

```
    initialize structure

    create data socket
```

```
write 200 code message to client  
write 150 code message to client  
process FTP command (NLST, STOR, RETR)  
write result to the client with data connection  
cmd_process;  
close data connection  
write 226 code message to the client
```

```
void cmd_process(char *buff, char* result_buff)  
    if command is "NLST"  
        if argc > 1  
            write 501 response into result_buff  
        else NLST(argv, 0, 0, result_buff);  
    else  
        write 500 response into result_buff;
```

```
void NLST(char *argv[128], int aflag, int lflag, char *result_buff)  
    char *directory = current directory  
    if there is no such directory  
        write 550 response into result_buff  
        if the directory cannot be accessed  
            write 550 response into result_buff  
        while readdir(directory) != NULL
```

```
    nalelist[i++] = entry;
```

```
bubblesort(namelist);
```

```
for (j=0; j<l ;j++)
```

```
    write namelist[j]->d_name into the result_buff;
```

```
char *convert_str_to_addr (char* str, int *port)
```

```
    convert four integer to IP address
```

```
    convert two 8-bit binary to port number (decimal)
```

```
    return addr_str;
```

```
int login(int connfd)
```

```
    int count = 0;
```

```
    while (count < 3)
```

```
        read username from client
```

```
        read passwd from client
```

```
        print the number of attempt to log-in
```

```
    if user_match(user, passwd) == 1)
```

```
        write "OK" to client
```

```
        print success message
```

```
        return 1;
```

```
    else
```

```
        count++;
```

```
        print fail message
```

```
        if (count < 3)
            write "FAIL" to client
        else
            write "DISCONNECTION" to client
            return 0;
    return 0;
```

```
int user_match(char *user, char *passwd)
```

```
    FILE *fp;
```

```
    fopen "passwd.txt" for readonly
```

```
    while (pw = fgetpwent(fp) != NULL)
```

```
        store inputtedusername into stored_user
```

```
        store inputted passwd into stored_passwd
```

```
    if they match "passwd.txt" information
```

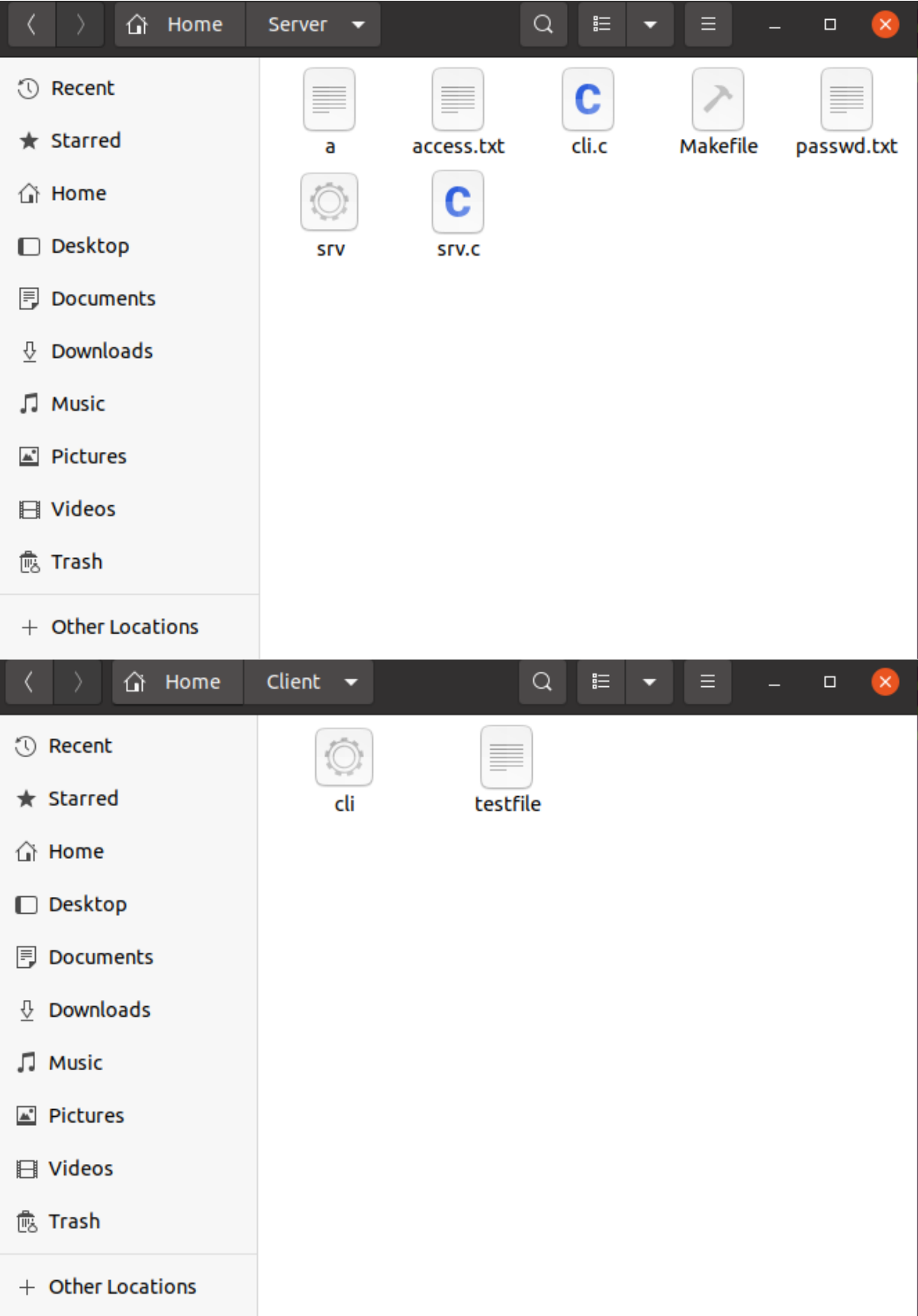
```
        fclose fp
```

```
        return -1;
```

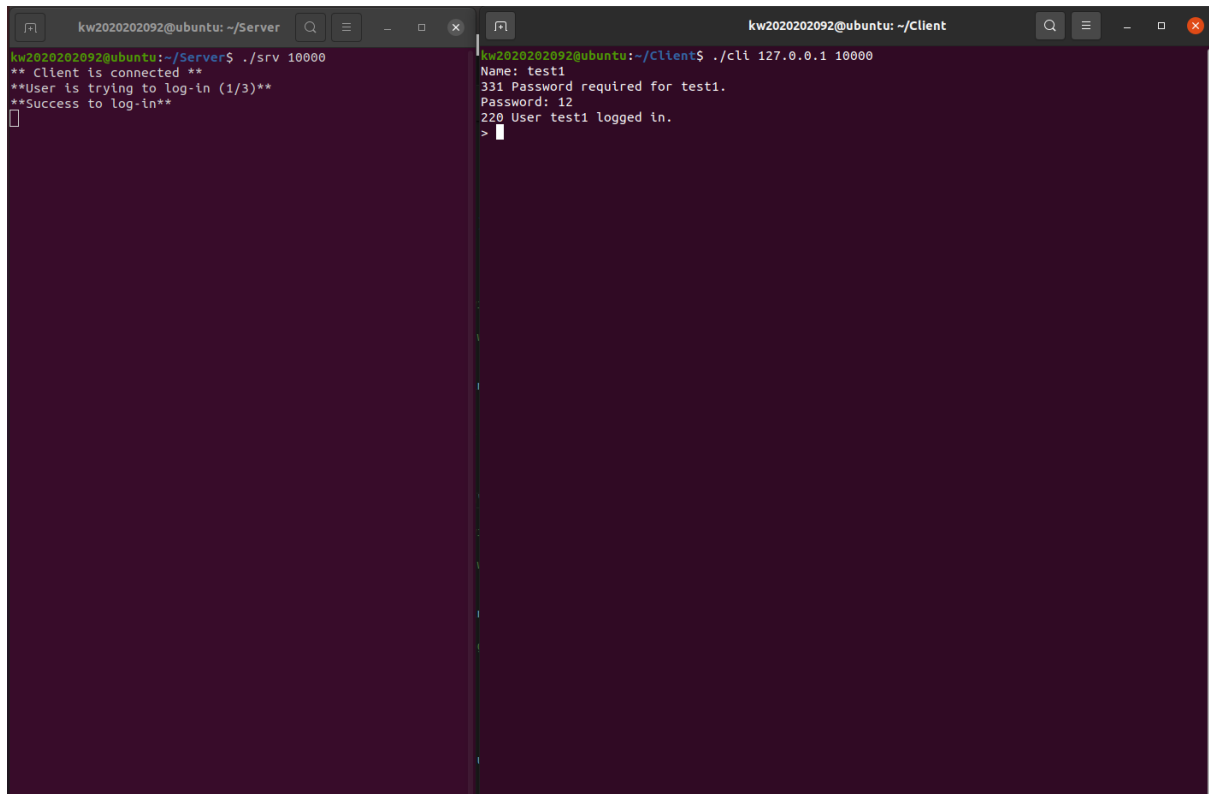
```
    fclose fp
```

```
    return 0;
```

결과화면



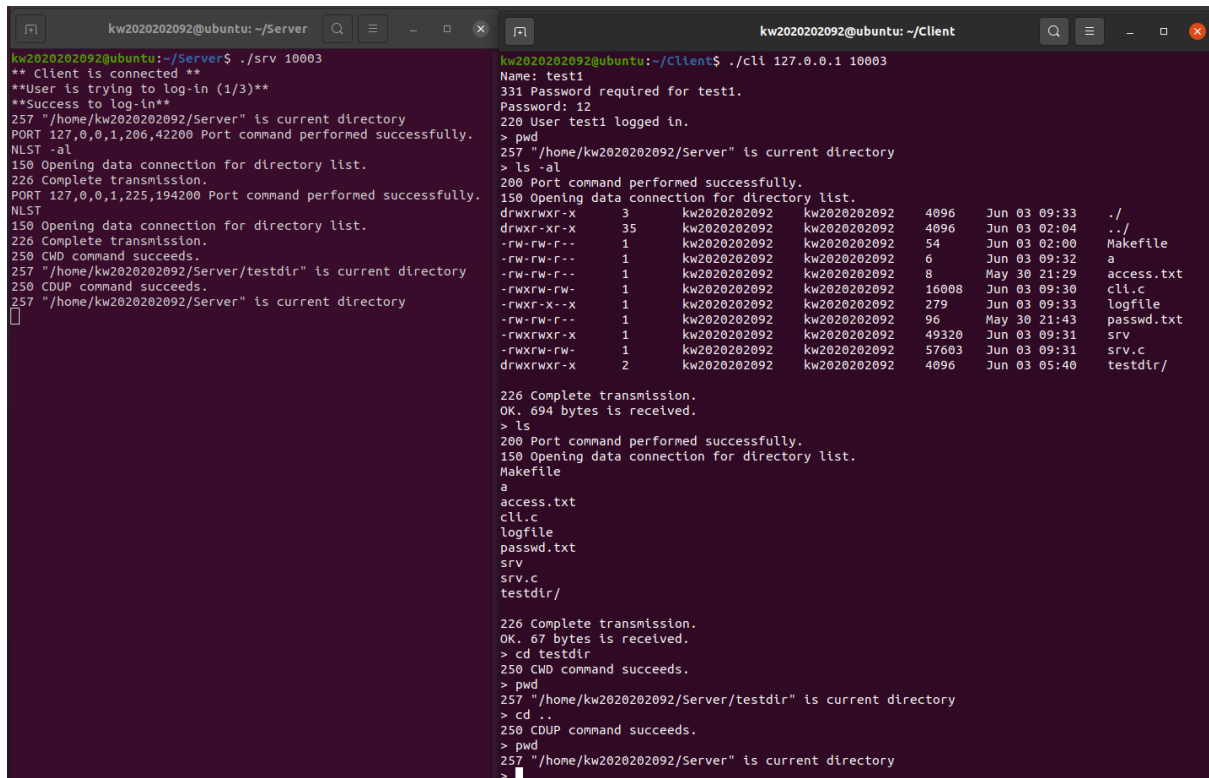
위와 같이 서버와 클라이언트를 다른 경로에 두고 테스트를 진행하였다.



```
kw2020202092@ubuntu: ~/Server
kw2020202092@ubuntu:~/Server$ ./srv 10000
** Client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
[]

kw2020202092@ubuntu:~/Client$ ./cli 127.0.0.1 10000
Name: test1
331 Password required for test1.
Password: 12
220 User test1 logged in.
> []
```

먼저 서버와 클라이언트를 연결한 후, username 과 passwd 를 입력하여 접속을 진행한다.



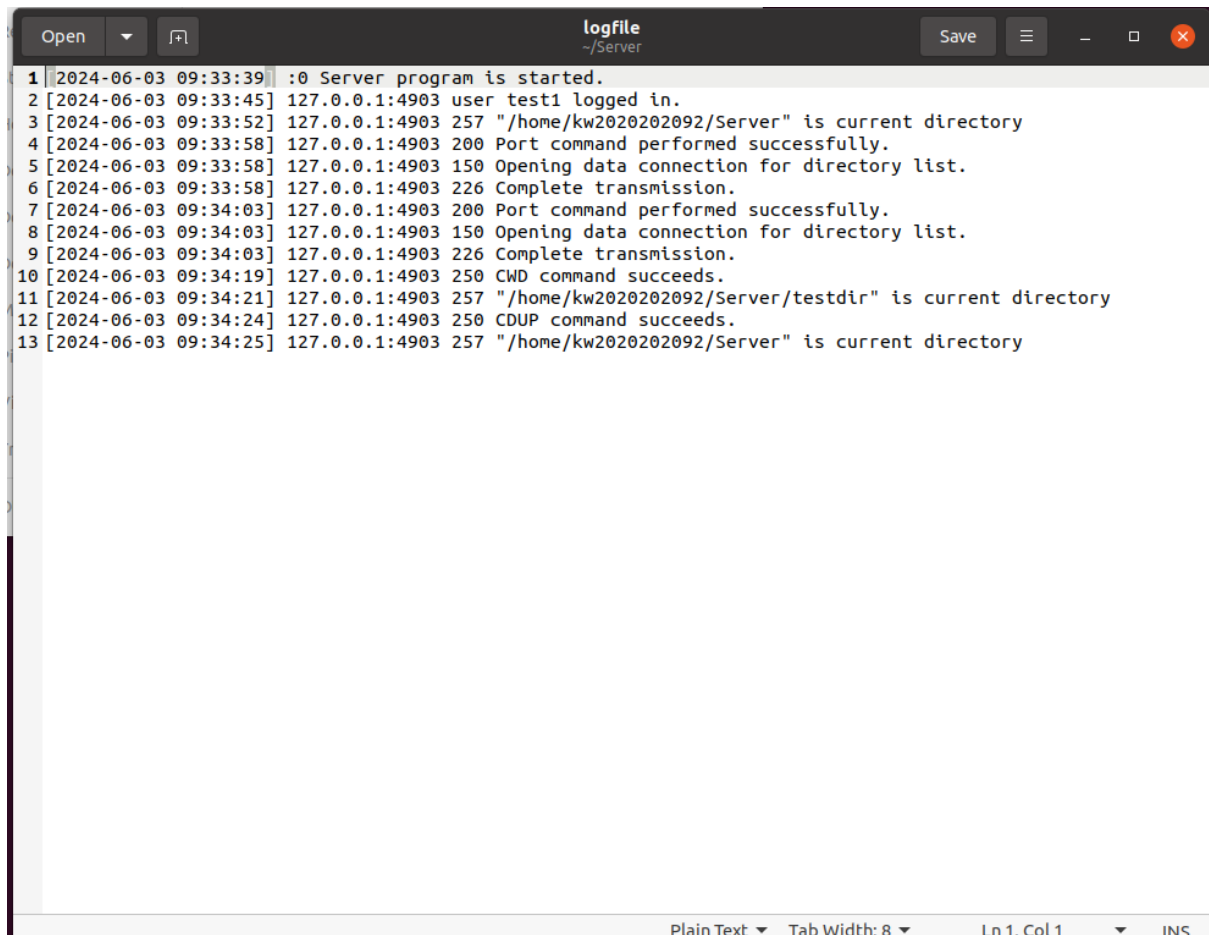
```
kw2020202092@ubuntu:~/Server
kw2020202092@ubuntu:~/Server$ ./srv 10003
** Client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
257 "/home/kw2020202092/Server" is current directory
PORT 127,0,0,1,206,42200 Port command performed successfully.
NLST -al
150 Opening data connection for directory list.
226 Complete transmission.
PORT 127,0,0,1,225,194200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
250 CWD command succeeds.
257 "/home/kw2020202092/Server/testdir" is current directory
250 CDUP command succeeds.
257 "/home/kw2020202092/Server" is current directory
[]

kw2020202092@ubuntu:~/Client$ ./cli 127.0.0.1 10003
Name: test1
331 Password required for test1.
Password: 12
220 User test1 logged in.
> pwd
257 "/home/kw2020202092/Server" is current directory
> ls -al
200 Port command performed successfully.
150 Opening data connection for directory list.
drwxrwxr-x 3 kw2020202092 kw2020202092 4096 Jun 03 09:33 ./
drwxr-xr-x 35 kw2020202092 kw2020202092 4096 Jun 03 02:04 ../
-rw-rw-r-- 1 kw2020202092 kw2020202092 54 Jun 03 02:00 Makefile
-rw-rw-r-- 1 kw2020202092 kw2020202092 6 Jun 03 09:32 a
-rw-rw-r-- 1 kw2020202092 kw2020202092 8 May 30 21:29 access.txt
-rwxrwx-rw- 1 kw2020202092 kw2020202092 16008 Jun 03 09:30 cli.c
-rwxr-x-x 1 kw2020202092 kw2020202092 279 Jun 03 09:33 logfile
-rw-rw-r-- 1 kw2020202092 kw2020202092 96 May 30 21:43 passwd.txt
-rwxrwxr-x 1 kw2020202092 kw2020202092 49320 Jun 03 09:31 srv
-rwxrwx-rw- 1 kw2020202092 kw2020202092 57603 Jun 03 09:31 srv.c
drwxrwxr-x 2 kw2020202092 kw2020202092 4096 Jun 03 05:40 testdir/

226 Complete transmission.
OK. 694 bytes is received.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
a
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/

226 Complete transmission.
OK. 67 bytes is received.
> cd testdir
250 CWD command succeeds.
> pwd
257 "/home/kw2020202092/Server/testdir" is current directory
> cd ..
250 CDUP command succeeds.
> pwd
257 "/home/kw2020202092/Server" is current directory
> []
```

로그인 성공 후, pwd 와 ls -al, ls, 그리고 cd testdir 및 cd ..를 입력하고 pwd 로 확인해본 결과 정상적으로 동작하는 것을 확인할 수 있고, 로그파일을 살펴보면 다음과 같이 의도대로 출력되는 것을 확인할 수 있다.



The screenshot shows a window titled "logfile" with a subtitle "~/.Server". The window contains a list of 13 log entries. The entries are as follows:

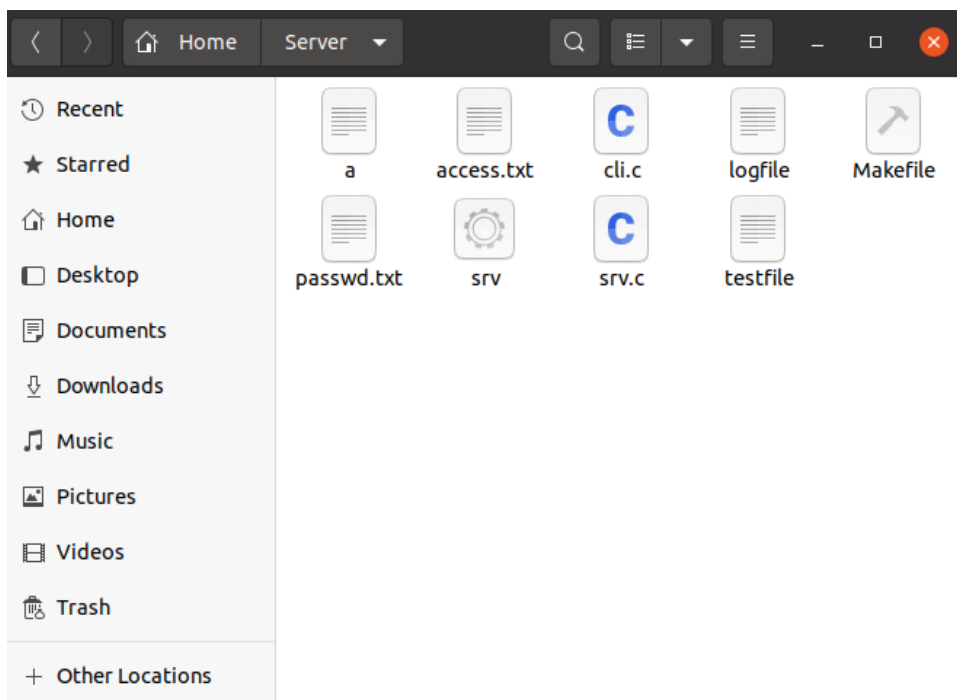
Line	Timestamp	IP	Port	Message
1	2024-06-03 09:33:39			Server program is started.
2	2024-06-03 09:33:45	127.0.0.1	4903	user test1 logged in.
3	2024-06-03 09:33:52	127.0.0.1	4903	257 "/home/kw2020202092/Server" is current directory
4	2024-06-03 09:33:58	127.0.0.1	4903	200 Port command performed successfully.
5	2024-06-03 09:33:58	127.0.0.1	4903	150 Opening data connection for directory list.
6	2024-06-03 09:33:58	127.0.0.1	4903	226 Complete transmission.
7	2024-06-03 09:34:03	127.0.0.1	4903	200 Port command performed successfully.
8	2024-06-03 09:34:03	127.0.0.1	4903	150 Opening data connection for directory list.
9	2024-06-03 09:34:03	127.0.0.1	4903	226 Complete transmission.
10	2024-06-03 09:34:19	127.0.0.1	4903	250 CWD command succeeds.
11	2024-06-03 09:34:21	127.0.0.1	4903	257 "/home/kw2020202092/Server/testdir" is current directory
12	2024-06-03 09:34:24	127.0.0.1	4903	250 CDUP command succeeds.
13	2024-06-03 09:34:25	127.0.0.1	4903	257 "/home/kw2020202092/Server" is current directory

The window also has a toolbar with "Open", "Save", and window control buttons. At the bottom, it shows "Plain Text", "Tab Width: 8", "Ln 1. Col 1", and "INS".

```
kw2020202092@ubuntu: ~/Server
kw2020202092@ubuntu:~/Server$ ./srv 10003
** Client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
201 Type set to I.
201 Type set to A.
PORT 127,0,0,1,183,68200 Port command performed successfully.
STOR testfile
500 Unknown command

kw2020202092@ubuntu:~/Client$ ./cli 127.0.0.1 10003
Name: test1
331 Password required for test1.
Password: 12
220 User test1 logged in.
> bin
201 Type set to I.
> ascii
201 Type set to A.
> put testfile
200 Port command performed successfully.
150 Opening ASCII mode data connection for testfile.
226 Transfer complete.
OK. 9336 bytes is received.
OK. 9336 bytes is received.
>
```

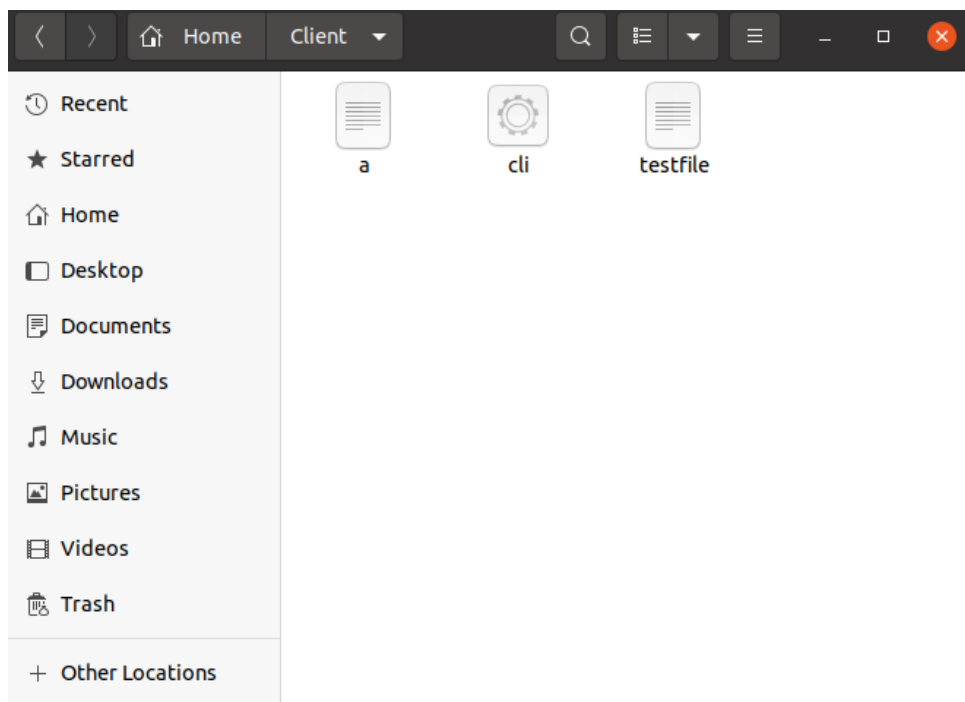
그 후 위와 같이 type 명령어에 대한 테스트를 하였고, type 을 ascii 로 바꾼 후 put testfile 을 입력한 결과 아래와 같이 testfile 이 서버가 있는 경로에 저장되는 것을 확인할 수 있고, 위의 캡처화면과 같이 put 명령어에 해당하는 ftp 메시지와 전송된 파일의 바이트 수가 출력되는 것을 확인할 수 있으며, 150 메시지의 경우 ascii mode 로 전송되었다는 메시지가 출력되는 것을 확인할 수 있다.



```
kw2020202092@ubuntu: ~/Server
** Client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
201 Type set to I.
201 Type set to A.
PORT 127,0,0,1,183,68200 Port command performed successfully.
STOR testfile
500 Unknown command
PORT 127,0,0,1,188,208200 Port command performed successfully.
RETR a
500 Unknown command

kw2020202092@ubuntu: ~/Client
Name: test1
331 Password required for test1.
Password: 12
220 User test1 logged in.
> bin
201 Type set to I.
> ascii
201 Type set to A.
> put testfile
200 Port command performed successfully.
150 Opening ASCII mode data connection for testfile.
226 Transfer complete.
OK. 9336 bytes is received.
OK. 9336 bytes is received.
> get a
200 Port command performed successfully.
150 Opening ASCII mode data connection for a.
226 Transfer complete.
OK. 0 bytes is sent.
OK. 0 bytes is received.
>
```

그 후 서버 경로에 있는 빈 파일인 a 를 get 명령어와 함께 입력한 결과 아래와 같이 a 파일이 클라이언트 경로에 저장되는 것을 확인할 수 있고, put 과 마찬가지로 현재 mode 에 따른 메시지들이 출력되는 것을 확인할 수 있다.



다음은 위의 type, put, get 명령어 테스트에 대한 logfile 이다.

Open

logfile
~/Server

Save

```
1 [2024-06-03 09:33:39] :0 Server program is started.
2 [2024-06-03 09:33:45] 127.0.0.1:4903 user test1 logged in.
3 [2024-06-03 09:33:52] 127.0.0.1:4903 257 "/home/kw2020202092/Server" is current directory
4 [2024-06-03 09:33:58] 127.0.0.1:4903 200 Port command performed successfully.
5 [2024-06-03 09:33:58] 127.0.0.1:4903 150 Opening data connection for directory list.
6 [2024-06-03 09:33:58] 127.0.0.1:4903 226 Complete transmission.
7 [2024-06-03 09:34:03] 127.0.0.1:4903 200 Port command performed successfully.
8 [2024-06-03 09:34:03] 127.0.0.1:4903 150 Opening data connection for directory list.
9 [2024-06-03 09:34:03] 127.0.0.1:4903 226 Complete transmission.
10 [2024-06-03 09:34:19] 127.0.0.1:4903 250 CWD command succeeds.
11 [2024-06-03 09:34:21] 127.0.0.1:4903 257 "/home/kw2020202092/Server/testdir" is current directory
12 [2024-06-03 09:34:24] 127.0.0.1:4903 250 CDUP command succeeds.
13 [2024-06-03 09:34:25] 127.0.0.1:4903 257 "/home/kw2020202092/Server" is current directory
14 [2024-06-03 09:36:13] 127.0.0.1:4903 221 Goodbye
15 [2024-06-03 09:36:20] 127.0.0.1:4903 The server has shut down.
16 [2024-06-03 09:36:27] :0 Server program is started.
17 [2024-06-03 09:36:33] 127.0.0.1:4903 user test1 logged in.
18 [2024-06-03 09:36:39] 127.0.0.1:4903 201 Type set to I.
19 [2024-06-03 09:36:46] 127.0.0.1:4903 201 Type set to A.
20 [2024-06-03 09:37:05] 127.0.0.1:4903 200 Port command performed successfully.
21 [2024-06-03 09:37:05] 127.0.0.1:4903 500 Unknown command
22 [2024-06-03 09:37:05] 127.0.0.1:4903 150 Opening ASCII mode data connection for testfile.
23 [2024-06-03 09:37:05] 127.0.0.1:4903 226 Transfer complete.
24 [2024-06-03 09:37:05] 127.0.0.1:4903 OK. 9336 bytes is received.
25 [2024-06-03 09:37:46] 127.0.0.1:4903 200 Port command performed successfully.
26 [2024-06-03 09:37:46] 127.0.0.1:4903 500 Unknown command
27 [2024-06-03 09:37:46] 127.0.0.1:4903 150 Opening ASCII mode data connection for a.
28 [2024-06-03 09:37:46] 127.0.0.1:4903 226 Transfer complete.
29 [2024-06-03 09:37:46] 127.0.0.1:4903 OK. 0 bytes is sent.
```

Plain Text ▾ Tab Width: 8 ▾ Ln 29, Col 58 ▾ INS

```
kw2020202092@ubuntu: ~/Server
kw2020202092@ubuntu:~/Server$ ./srv 10000
** Client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
PORT 127,0,0,1,206,42200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
250 RMD command performed successfully.
250 RMD command performed successfully.
250 RMD command performed successfully.
550 testdir3: can't remove directory.
250 RMD command performed successfully.
PORT 127,0,0,1,177,75200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.

```

```
kw2020202092@ubuntu: ~/Client
kw2020202092@ubuntu:~/Client$ ./cli 127.0.0.1 10000
Name: test1
331 Password required for test1.
Password: 12
220 User test1 logged in.
> mkdir testdir1 testdir2 testdir3
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
a
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/
testdir1/
testdir2/
testfile
testdir3/

226 Complete transmission.
OK. 105 bytes is received.
> rmdir testdir1 testdir2 testdir3
250 RMD command performed successfully.
250 RMD command performed successfully.
550 testdir3: can't remove directory.
> rmdir testdir3
250 RMD command performed successfully.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
a
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/
testfile

226 Complete transmission.
OK. 76 bytes is received.

```

```
kw2020202092@ubuntu: ~/Server
kw2020202092@ubuntu:~/Server$ ./srv 10000
** Client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
PORT 127,0,0,1,206,42200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
250 RMD command performed successfully.
250 RMD command performed successfully.
250 RMD command performed successfully.
550 testdir3: can't remove directory.
250 RMD command performed successfully.
PORT 127,0,0,1,177,75200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
250 DELE command performed successfully.
PORT 127,0,0,1,200,222200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.

```

```
kw2020202092@ubuntu: ~/Client
550 testdir3: can't remove directory.
> rmdir testdir3
250 RMD command performed successfully.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
a
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/
testfile

226 Complete transmission.
OK. 76 bytes is received.
> delete a
250 DELE command performed successfully.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/
testfile

226 Complete transmission.
OK. 74 bytes is received.
> dir
drwxrwxr-x 3 kw2020202092 kw2020202092 4096 Jun 03 09:40 ./
drwxr-xr-x 35 kw2020202092 kw2020202092 4096 Jun 03 02:04 ../
-rw-rw-r-- 1 kw2020202092 kw2020202092 54 Jun 03 02:00 Makefile
-rw-rw-r-- 1 kw2020202092 kw2020202092 8 May 30 21:29 access.txt
-rwxrwxrwx 1 kw2020202092 kw2020202092 16008 Jun 03 09:30 cli.c
-rwxr-x--x 1 kw2020202092 kw2020202092 3750 Jun 03 09:40 logfile
-rw-rw-r-- 1 kw2020202092 kw2020202092 96 May 30 21:43 passwd.txt
-rwxrwxr-x 1 kw2020202092 kw2020202092 49320 Jun 03 09:31 srv
-rwxrwxrwx 1 kw2020202092 kw2020202092 57603 Jun 03 09:31 srv.c
drwxrwxr-x 2 kw2020202092 kw2020202092 4096 Jun 03 05:40 testdir/
-rw-r--r-- 1 kw2020202092 kw2020202092 9336 Jun 03 09:37 testfile

```

```
kw2020202092@ubuntu: ~/Server
kw2020202092@ubuntu:~/Server$ ./srv 10000
** client is connected **
**User is trying to log-in (1/3)**
**Success to log-in**
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
250 MKD command performed successfully.
PORT 127,0,0,1,206,42200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
250 RMD command performed successfully.
250 RMD command performed successfully.
250 RMD command performed successfully.
550 testdir3: can't remove directory.
250 RMD command performed successfully.
PORT 127,0,0,1,177,75200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
250 DELE command performed successfully.
PORT 127,0,0,1,200,222200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.
350 File exists, ready to rename
250 RNTD command succeeds.
PORT 127,0,0,1,117,108200 Port command performed successfully.
NLST
150 Opening data connection for directory list.
226 Complete transmission.

```

```
kw2020202092@ubuntu: ~/Client
250 DELE command performed successfully.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/
testfile
226 Complete transmission.
OK. 74 bytes is received.
> dir
drwxrwxr-x 3 kw2020202092 kw2020202092 4096 Jun 03 09:40 ./
drwxr-xr-x 35 kw2020202092 kw2020202092 4096 Jun 03 02:04 ../
-rw-rw-r-- 1 kw2020202092 kw2020202092 54 Jun 03 02:00 Makefile
-rw-rw-r-- 1 kw2020202092 kw2020202092 8 May 30 21:29 access.txt
-rwxrw-rw- 1 kw2020202092 kw2020202092 16008 Jun 03 09:30 cli.c
-rwxr-x--x 1 kw2020202092 kw2020202092 3750 Jun 03 09:40 logfile
-rw-rw-r-- 1 kw2020202092 kw2020202092 96 May 30 21:43 passwd.txt
-rwxrwxr-x 1 kw2020202092 kw2020202092 49320 Jun 03 09:31 srv
-rwxrw-rw- 1 kw2020202092 kw2020202092 57603 Jun 03 09:31 srv.c
drwxrwxr-x 2 kw2020202092 kw2020202092 4096 Jun 03 05:40 testdir/
-rw-r--r-- 1 kw2020202092 kw2020202092 9336 Jun 03 09:37 testfile
> rename testfile testfile2
350 File exists, ready to rename
250 RNTD command succeeds.
> ls
200 Port command performed successfully.
150 Opening data connection for directory list.
Makefile
access.txt
cli.c
logfile
passwd.txt
srv
srv.c
testdir/
testfile2
226 Complete transmission.
OK. 75 bytes is received.
> quit
221 Goodbye
kw2020202092@ubuntu:~/Client$
```

위와 같이 mkdir, rmdir, delete, dir, rename 명령어 또한 정상적으로 동작하는 것을 확인할 수 있다. 그리고 마지막으로 quit 을 입력하여 해당 process 가 종료되는 것을 확인할 수 있다. 위 명령어들에 대한 logfile 은 다음과 같다.

Open

logfile
~/Server

Save

```
13 [2024-06-03 09:34:25] 127.0.0.1:4903 257 /home/kw2020202092/Server its current directory
14 [2024-06-03 09:36:13] 127.0.0.1:4903 221 Goodbye
15 [2024-06-03 09:36:20] 127.0.0.1:4903 The server has shut down.
16 [2024-06-03 09:36:27] :0 Server program is started.
17 [2024-06-03 09:36:33] 127.0.0.1:4903 user test1 logged in.
18 [2024-06-03 09:36:39] 127.0.0.1:4903 201 Type set to I.
19 [2024-06-03 09:36:46] 127.0.0.1:4903 201 Type set to A.
20 [2024-06-03 09:37:05] 127.0.0.1:4903 200 Port command performed successfully.
21 [2024-06-03 09:37:05] 127.0.0.1:4903 500 Unknown command
22 [2024-06-03 09:37:05] 127.0.0.1:4903 150 Opening ASCII mode data connection for testfile.
23 [2024-06-03 09:37:05] 127.0.0.1:4903 226 Transfer complete.
24 [2024-06-03 09:37:05] 127.0.0.1:4903 OK. 9336 bytes is received.
25 [2024-06-03 09:37:46] 127.0.0.1:4903 200 Port command performed successfully.
26 [2024-06-03 09:37:46] 127.0.0.1:4903 500 Unknown command
27 [2024-06-03 09:37:46] 127.0.0.1:4903 150 Opening ASCII mode data connection for a.
28 [2024-06-03 09:37:46] 127.0.0.1:4903 226 Transfer complete.
29 [2024-06-03 09:37:46] 127.0.0.1:4903 OK. 0 bytes is sent.
30 [2024-06-03 09:38:52] 127.0.0.1:4903 221 Goodbye
31 [2024-06-03 09:38:53] 127.0.0.1:4903 The server has shut down.
32 [2024-06-03 09:38:58] :0 Server program is started.
33 [2024-06-03 09:39:06] 127.0.0.1:4135 user test1 logged in.
34 [2024-06-03 09:39:16] 127.0.0.1:4135 250 MKD command performed successfully.
35 [2024-06-03 09:39:16] 127.0.0.1:4135 250 MKD command performed successfully.
36 250 MKD command performed successfully.
37 [2024-06-03 09:39:16] 127.0.0.1:4135 250 MKD command performed successfully.
38 250 MKD command performed successfully.
39 250 MKD command performed successfully.
40 [2024-06-03 09:39:19] 127.0.0.1:4135 200 Port command performed successfully.
41 [2024-06-03 09:39:19] 127.0.0.1:4135 150 Opening data connection for directory list.
42 [2024-06-03 09:39:19] 127.0.0.1:4135 226 Complete transmission.
43 [2024-06-03 09:39:29] 127.0.0.1:4135 250 RMD command performed successfully.
44 [2024-06-03 09:39:29] 127.0.0.1:4135 250 RMD command performed successfully.
45 250 RMD command performed successfully.
46 [2024-06-03 09:39:29] 127.0.0.1:4135 250 RMD command performed successfully.
47 250 RMD command performed successfully.
48 550 testdir3: can't remove directory.
49 [2024-06-03 09:39:39] 127.0.0.1:4135 250 RMD command performed successfully.
50 [2024-06-03 09:39:44] 127.0.0.1:4135 200 Port command performed successfully.
51 [2024-06-03 09:39:44] 127.0.0.1:4135 150 Opening data connection for directory list.
52 [2024-06-03 09:39:44] 127.0.0.1:4135 226 Complete transmission.
53 [2024-06-03 09:40:44] 127.0.0.1:4135 250 DELE command performed successfully.
54 [2024-06-03 09:40:51] 127.0.0.1:4135 200 Port command performed successfully.
55 [2024-06-03 09:40:51] 127.0.0.1:4135 150 Opening data connection for directory list.
56 [2024-06-03 09:40:51] 127.0.0.1:4135 226 Complete transmission.
57 [2024-06-03 09:42:32] 127.0.0.1:4135 350 File exists, ready to rename
58 250 RNT0 command succeeds.
59 [2024-06-03 09:42:35] 127.0.0.1:4135 200 Port command performed successfully.
60 [2024-06-03 09:42:35] 127.0.0.1:4135 150 Opening data connection for directory list.
61 [2024-06-03 09:42:35] 127.0.0.1:4135 226 Complete transmission.
```

Plain Text ▾ Tab Width: 8 ▾ Ln 61, Col 64 ▾ INS

고찰

이번 [FTP 3-3](#) 과제를 통해서 최종적으로 FTP 서버-클라이언트 구조의 구현을 완료하였는데, 이번 과제를 진행하면서 지금까지 구현했던 내용인 FTP 명령어의 동작, 서버와 클라이언트의 연결, data connection 을 이용한 데이터 전송, 로그인 등의 여러 동작을 한 개로 통합하는 과정에서 이에 대한 구현 내용을 다시 한번 학습할 수 있는 기회가 되었다. 하지만 갑자기 많은 양의 내용을 통합하고, type, get, put 명령어들의 추가 및 logfile 기능 추가 등의 추가 구현 내용으로 인해 구현하는데 조금 어려움이 있었지만, 미리 내용들을 합치기 위한 방법을 생각해놓고 시작해서 조금 더 할만했던 것 같다. 이번 시스템 프로그래밍 프로젝트를 통해 어렵게만 느껴졌던 서버-클라이언트 구조의 데이터 통신에 대해 제대로 학습할 기회가 되었던 것 같아 좋았다.

Reference