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1. Problem solving:

The flow of this project is as follows:

Basic info:

1.

udpclient:

ask user to enter the username

ask user to enter the password

udpserver:

verify the username and password, if not, send feedback to udpclient

details:

Udpclient: *send information in the form: group name + "\$" + "option"--->Udpserver*

Udpserver: *split the info received from udpclient: group name, request(according to the special character '\$')*

Check if the group name received from udpclient matches the group name created before:

If matches, get the request join and the array has space to join the array:

Then add the udpclient to the array of client which is of maximum size: send "Positive match" message to udpclient

Else(exception handling):

if group name does not match: send "Negative match" message to udpclient

2.

udpclient:

ask user to enter the filename

udpserver:

check if the file is valid, if not, send feedback to udpclient

details:

udpserver:

*fopen() to open the file, it will return a file descriptor fp, if fp == null, then file not valid,
send feedback to udpclient*

2. Data Structure:

2.1 The data for this project mainly include username, password and value, two data structure can be used here(I derived it from project 1):

1) Username, password and value can be grouped by array, i.e.

char gusername[NUMBER];*

char gpassword[NUMBER];*

2) Use struct:

```
Struct company {  
    Char * username;  
    Char * password;  
}
```

For this project, I choose the 1st way to store my data:

I read "./user.txt" file using file I/O:

```
FILE* fp = fopen("user.txt", "r");
```

And Read every item:

```
for(int i = 0; i < 6; i++){
    gusername[i]=(char*)malloc(256*sizeof(char));
    gpassword[i]=(char*)malloc(256*sizeof(char));
}
for(int i = 0; i < 6; i++){
    for(int j = 0; j < 2; j++){
        fscanf(fp, "%s", buffer);
        if(j%2 == 0){
            strcpy(gusername[i],buffer);
        }
        else if(j%2 == 1){
            strcpy(gpassword[i], buffer);
        }
    }
}
```

2.2 I also define a struct to store the info of frames, it includes 4 fields :

```
struct frame{
    int kind;//transmission(0) or retransmission(1)
    int seq;
    int ack;
    char info[FRAMESIZE];
};
```

The kind field tells us whether this frame is transmission frame or retransmission frame,

The seq and ack fields are used for sequence numbers and acknowledgements, respectively;

The info field of a data frame contains a single packet

It is defined both in udpsender, as well as udpclient

2.3 I create a list to store each frame called frameList in udpclient, it is defined below:

```
struct frame frameList[windowSize];
//it is an array and it stores a list of struct frame.
```

So everytime I receive a frame from sender, I will put the frame into frameList. (details in 2.4)

And I also create a list to record if the frame was received before called ackList, it is defined below:

```
int ackList[windowSize];
```

So everytime I receive a frame from sender, I will set the corresponding element in ackList to 1. (details in 2.4)

2.4 When I receive an frame, I will check its' sequence number if it falls within the window. If it is, then it's accepted and stored. Here I just use an if condition to check this:

```
if(recvFrame.seq >= 0 && recvFrame.seq < windowSize && ackList[recvFrame.seq] != 0){
    //store the frame in frameList
    frameList[recvFrame.seq] = recvFrame;
```

```

        ackList[recvFrame.seq] = 1;
    }
    else{
        printf("Sequence number does not fall within the window\n");
    }
}

```

3. User define function:

I defined multiple functions in udpserver.c and udpclient.c file:

- 1) The declaration of these functions in udpserve.c are as follows:

```

int Authenticate(char username[], char password[]){
    int index = -1; //-1 means no matching username;
    for(int i = 0; i < 6; i++){
        if(strcmp(gusername[i],username) == 0 && strcmp(gpassword[i], password) == 0){
            return 0;
        }
    }
    return -1;
};

```

This function is used to check the pair; username and password, if they are right, then return 0,
Or else return -1

- 2) Time out

Every time I send a frame, I will create a new thread for timing, the thread function is defined as below:

```

void* timer(void* arg){
    struct argsThread args;
    args = *(struct argsThread*)arg;
    int seq = args.seq;
    sleep(0.00001);
    if(args.ackList[seq] == 1){
        printf("Time out\n");
    }
};

```

4. Screen shots of outputs:

Client:

```
zhengguan@ubuntu:~/Data Networks/Project4$ ./client.o 192.168.11.136 55397 user.txt a.txt
Socket created.
Bind completed!
Welcome to project 4 :)
Please enter username:
apple
Please enter password:
1
username and password sent: apple$1
Positive match
Username and password verified

Start to transfer the file or not(Y/N):Y
Filename sent: a.txt
Input file name verified, ready to receive data...
Create output file done

Window size received: 1
Total frame number received: 13

Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission
```

```
Ready to write to file...
Sequence number: 0
Type: transmission

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Ready to write to file...
Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission

Ready to write to file...
Sequence number: 0
Type: transmission
File transfer done
zhengguan@ubuntu:~/Data Networks/Project4$ S
```

Server:

```

zhengguan@ubuntu:~/Data Networks/Project4$ ./server.o 55397 1
Socket created.
Bind completed!
Start to authenticate username and password...
Username and password received: apple 1
Username and password matched
Match succeed message sent
Filename received: a.txt
Succeed in opening file
File open succeed message sent
window size message sent: 1
Total frame number sent: 13

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

```

```

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

one frame transfer done
Transfer done

IP address: 192.168.11.136
Port number: 51844
File name: a.txt
File size: 3171
File time and date: Sun Nov 26 10:27:56 2017
Total frame number transmitted: 13
Number of packets retransmitted: 0
Number of Acknowledgement Received: 13
Number of Negative Acknowledgement Received with Sequence Number:0

```

Admission ☹:

I have to admit, my program still has some flaws, I copy the buffer into the frame info, but the content of

them are not exactly the same, I don't know why. Need to fix later. Thanks.

File compare:

Original:

| *a.txt | x | b.out | x |
|--|---|-------|---|
| <p>1 Technology is the practical use of science, including the making, modification or improvement, applied activity or behavior, use and knowledge of tools, machines, techniques, crafts, systems, methods of organization, or environmental modifications or arrangement in order to solve a problem, improve a preexisting solution to a problem, achieve a goal or perform a specific function. It can also refer to the collection of such tools, machinery, modifications, environmental arrangement and procedures. Technologies significantly affect human as well as other animal species' ability to control and adapt to their natural environments. The word technology comes from Greek τεχνολογία (technologia); from τέχνη (téchnē), meaning "art, skill, craft", and -λογία (-logia), meaning "study of-". The term can be applied either generally or to many specific areas, examples of which include construction technology, medical technology and information technology.</p> <p>2 The human species' use of technology began with the conversion of natural resources into simple tools. The prehistorical discovery of the ability to control fire increased the available sources of food and the invention of the wheel helped humans in travelling in and controlling their environment. Recent technological developments, including the printing press, the telephone, and the Internet, have lessened physical barriers to communication and allowed humans to interact freely on a global scale. However, not all technology has been used for peaceful purposes; the development of weapons of ever-increasing destructive power has progressed throughout history, from clubs to nuclear weapons.</p> <p>3 Technology has affected society and its surroundings in a number of ways. In many societies, technology has helped develop more advanced economies (including today's global economy) and has allowed the rise of a leisure class. Many technological processes produce unwanted by-products, known as pollution, and deplete natural resources, to the detriment of the Earth and its environment. Various implementations of technology influence the values of a society and new technology often raises new ethical questions. Examples include the rise of the notion of efficiency in terms of human productivity, a term originally applied only to machines, and the challenge of traditional norms.</p> <p>4 Philosophical debates have arisen over the present and future use of technology in society, with disagreements over whether technology improves the human condition or worsens it. Neo-Luddism, anarcho-primitivism, and similar movements criticise the pervasiveness of technology in the modern world, opining that it harms the environment and alienates people; proponents of ideologies such as transhumanism and techno-progressivism view continued technological progress as beneficial to society and the human condition. Indeed, until recently, it was believed that the development of technology was restricted only to human beings, but recent scientific studies indicate that other primates and certain dolphin communities have developed simple tools and learned to pass their knowledge to other generations.</p> | | | |

My hurtbreaking result:

| *a.txt | x | *b.out | x |
|--|---|--------|---|
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