

## Network Applications Programming - Homework 2

### (FTP program with Huffman coding)

#### Motivation:

FTP is a common network service. Since you have learned how to write UNIX socket programs in class, this homework asks you to practice the socket programming skill.

#### Homework Content:

You need to provide the FTP service in the homework. By using TCP sockets, you can create a FTP server and a FTP client. Your FTP client has to support some commands:

- **connect** IP\_addr port\_num:  
Connect to a server. Your program should allow users to specify the IP address and port number of a server. Notice that the server side needs to print out the client's connection information (e.g., IP address, port #, socket type, etc.)
- **exit**:  
Terminate the connection. The server side has to also show the leave of the client.
- **upload** filename:  
Upload a file called "filename" to the server. Your FTP service should support non-textual files like MP3 or WORD files. In addition, you need to provide file compression to reduce the transmission time. In particular, you can use fixed-length Huffman coding to compress the file. When you use the "upload" command, your client in fact should send two separated files to the server:
  - 1) The coded version of "filename".
  - 2) Necessary information related to Huffman coding (e.g., the appearing frequency of each alphabet in the file).

Here are some examples of the above commands:

Client side (140.113.1.1)
[student @ CSE ~]\$ connect 140.113.1.2 1234 The server with IP "140.113.1.2" has accepted your connection. [student @ CSE ~]\$ upload 1.txt Original file length: 140,234 bytes, compressed file length: 23,768 bytes (ratio: 16.95%) Using fixed-length codeword (3 bits) [student @ CSE ~]\$ exit Goodbye.
Server side (140.113.1.2 port 1234)
[TA @ CSE ~] server # <i>TA runs the server program</i> A client "140.113.1.1" has connected via port num 1732 using SOCK_STREAM (TCP) The client sends a file "1.txt" with size of 140,234 bytes. The Huffman coding data are

stored in "1-code.txt".

# TA will open "1.txt" here to test its correctness. Also, TA will check the "1-code.txt" file  
# to make sure that you indeed compress the file via Huffman coding.

The client "140.113.1.1" with port 4323 has terminated the connection.

Below gives some format of the Huffman coding-related information:

Fixed-length Huffman coding (3-bit codeword):

Alphabet (ASCII code)	Frequency (%)	Codeword
A (65)	140,231 (21.45%)	000
B (66)	50,123 (7.67%)	001
C (67)	63,154 (9.66%)	010
...		
Z (90)	234,453 (35.86%)	011

### Requirements:

- You need to use UNIX socket programming in this homework.
- You have to provide a makefile. TAs reserve the right to deduct your grades if there is no makefile, or the makefile is erroneous.
- You must submit a README file along with your program. The README file should briefly describe how you write your codes (for example, the idea of your program).
- You have to demonstrate your program. TAs will announce the demonstration time.

### Grading Policy:

You need to submit your codes and demonstrate your program to TAs. The due day of this homework is **4/13**. You will get **no point** if you do NOT demonstrate your program (even though you submit codes). Discussion among your classmates is encouraged. However, plagiarists will get **ZERO point**. Below are the points you can get in this homework:

Items	Points
Socket connection (i.e., connect and exit commands on the client side and the connection information on the server side)	10%
File transmission	20%
Huffman coding	50%
User interface (for example, welcome message or help command)	10%
Code's comments and README file	10%
<b>Bonus:</b> You ALSO provide variable-length Huffman coding	20%

### Reference:

(Huffman coding) [http://en.wikipedia.org/wiki/Huffman\\_coding](http://en.wikipedia.org/wiki/Huffman_coding)