CS447 : Networks and Data Communications
Programming Assignment #1
Total Points: 150

Assigned Date : Monday, March 13, 2023
Due Date : Monday, March 27, 2023 @ 01:29:59 p.m.

Overview

Your second programming assignment this semester is to **implement an Internet Relay Chat (IRC) application** using the socket interface. The IRC protocol description is fairly lengthy and spread over multiple RFCs. Given our 2 week window, you are not expected to implement a fully-fledged IRC application, but rather a simplified basic IRC. In essence, what you are working on is a very light-weight version of **`Discord`**. Moreover, your `P2` will be a direct extension of this project. Specific learning objectives of this assignment are:

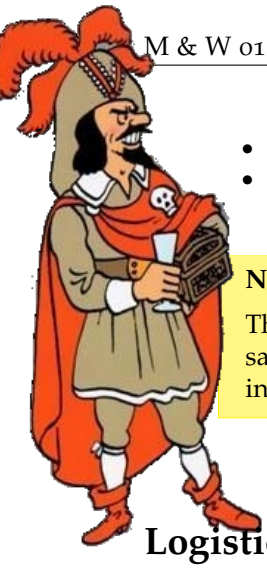
a. to learn how to read RFCs and implement protocols to their specifications
b. to further reinforce the concept of "*protocol*" using hands-on programming; and
c. to gain experience in developing TCP-based multi-threaded applications.

Back Story

Captain Haddock started an international shipping business using the Red Rackham's treasure. Although business is booming, his lack of a realiable group communication method with his captains is causing all sorts of headaches. "*Thundering typoons!!*". Screamed Haddock. "*That's the 4^{th} missed delivery this week!!. Whose orders are these guys following?*" Professor Calculus, after overhearing Haddock cursing and kicking around the furniture in frustration, approached him with a potential solution. "*Let me build you a relay chat network Haddock. You can chat with any and all of your captains when you want, and they can also chat with any other captains as they wish*". Calculus said proudly. "*Everyone will know about everyone's whereabouts all the time*".

Technical Requirements

1. You are to write a `client-server` application to support Calculus's IRC system.
2. Implement a single central server IRC network. `server-to-server` communication is outside the scope of P1.
3. The `client` $\leftrightarrow$ `server` interaction should happen over TCP.
4. Follow the protocol grammar listed under **RFC #2812 Internet Relay Chat: Client Protocol** https://www.rfc-editor.org/rfc/rfc2812 Sec. 2.3.1. It's highly recommended to use <`regex`> for efficient parsing and overall code readability.
5. Support the following Connection Registration messages (RFC #2812 Sec. 3.1): `NICK`, `USER`, and `QUIT`.
6. Support the following Channel Operation messages (RFC #2812 Sec. 3.2): `JOIN`, `PART`, `TOPIC`, and `NAMES`.
7. `PRIVMSG` command (RFC #2812 Sec. 3.3.1).
8. `TIME` command (RFC #2812 Sec. 3.4.6).
9. Closely related to each message above are the numeric replies listed under them. These correspond to message responses (`RPL_` prefix) and error replies (`ERR_` prefix). Carefully read **RFC #2812** Sec. 5.1 and 5.2.



- Clearly document all reply codes you've implemented in your report.
- Grader will randomly test numeric replies by triggering the corresponding error condition(s). Thus, it is advised to implement as many numeric replies as possible corresponding to each message.

Note:

The RFC lists several examples under each message (Sec. 3.1 and 3.2) that demonstrates each `client` message as well as the corresponding `server` response. You are expected to follow the same format/syntax in your implementations.

Logistics

1. Use configuration files to provide runtime arguments as follows:
   - The client executable receives two runtime arguments through `client.conf`.

     client.conf

     ```
     SERVER_IP=y.y.y.y
     SERVER_PORT=xxxx
     ```

   - The configuration file for the server executable should have the following format:

     server.conf

     ```
     NICK=<server_nickname>
     PASS=
     PORT=
     SERVERS=
     SOCK_ADDR=
     ```

     The only necessary server runtime argument at this point are `NICK` and `PORT`. Rest are in anticipation of P2. For now, simply read and store the unused runtime arguments in variables (for future use).
2. Concurrent multiple clients should be supported; more than one `client` should be capable of communicating the with `server` at the same time without any interference.
3. `clients` should be able to change their nickname(s) (`NICK`), register their usernames (`USER`), and gracefully exit thru `QUIT`.
4. `clients` should be able to join/create channels (`JOIN`), leave channels (`PART`), set/view/list/clear topics (`TOPIC`), and list all other nicknames on the server (`NAMES`).
5. `clients` should be able to communicate with other users either directly or through channels (`PRIVMSG`).
6. `clients` should be able to query the server for the localtime (`TIME`).
7. The `server` process is permitted to be forcefully killed if needed.
8. Print all reply codes on all interactions to the standard output.
9. At the end of your implementation, you should be able to:
   - Compile and run your code on a typical Linux machine(s). Include a `README` file with clear compilation instructions ~~and any additional software the grader might have to install~~ for the grader in case your `MAKEFILE` doesn't work.
   - Run your `server` program first.
   - Run one or more `clients` and register with the `server`.
   - Create channels. Engage with other users through IRC.
   - Exit the `client`(s) gracefully.
10. Here's a very basic sample interaction. The `client`'s hostname and IP are `10.24.186.1/tgamage-1`. For the `server` they are `10.24.186.0/tgamage-0` Assume the server's nickname is `babbage`.

```
                Client_1 (tgamage-1)        Server (tgamage-0)
                       NICK haddock   →
USER haddock 0 * :Archibald Haddock   →
                                      ←   :babbage 001 :Welcome to
                                          Calculus IRC haddock!haddock@babbage
                             NICK     →
                                      ←   :babbage 431 :No nickname given
                         NICK cpt.H   →
                                      ←   :babbage :haddock!haddock@babbage
                                          NICK cpt.H
                             TIME     →
                                      ←   :babbage 391 babbage :Sat
                                          Mar 4 22:16:56 UTC 2023
                             QUIT     →
```

- Have a look at http://chi.cs.uchicago.edu/chirc/irc_examples.html for few more sample interactions but do not use any code you find there in your implementations.

Instructions

- **Start early!!**. This is a fairly loaded assignment for 2 weeks.
- **Take backups of your code often!!**. Practice good version control habits.
- Follow a good coding standard. Use one of Google's coding standard found here https://google.github.io/styleguide/, if you don't already follow one.
- In addition to sections explicitly listed above, it is recommended to read other relevant sections of the RFC #2812 to get a better understanding of the protocol.
- Use of unauthorized/third party packages, except basic I/O, regex, socket, and/or string parsing packages, without the instructor's explicit permission, will nullify your submission.
- The due date of this assignment is **Monday, March 27, 2023 @ 01:29:59 p.m.**. A dropbox will be opened for submission on Moodle.

Deliverables

A complete solution comprises of:

- A short report of the design and implementation of your system. The report should be **PDF** format. At a minimum, your report should include the following sections:
  - Introduction: Your objective and what you hope to gain from the assignment.
  - Overall design, specific design choices, and reply codes used.
  - The output of a sample run (including screenshots where applicable).
  - Summary and Issues encountered. What you were able to achieve from your own objectives (from the introduction) as well as project specifications. Make sure to explicitly list functionality you failed to implement (or buggy).
- A compressed tarball that contains:
  - a directory containing (only) your source code. **Do not** include executables, folders created by your programs, or any other files not specifically listed here as required. There will be penalties for those who do this.
  - A short `readme` file with compilation instructions.
  - A `makefile` to automate compilation.

To create a compressed tarball of the directory source, use the following command:
`tar -zcvf siue-id-p1.tgz source/`.
e.g. `tar -zcvf tgamage-p1.tgz P1/`

Collaborating on ideas or answering each other's questions is always encouraged. Most times, I find that you learn a lot from your peers. However, do not share/copy/duplicate code from others, including online sources. The exercise is meant for you to learn network programming, not to test your googling abilities. Issues related to academic integrity and plagiarism have **ZERO** tolerance.

Useful Resources

- Linux Man pages – found in all linux distributions
- Beej's Guide to Network Programming – A pretty thorough free online tutorial on basic network programming https://beej.us/guide/bgnet/html/
- Internet Relay Chat: Client Protocol RFC #2812 https://www.rfc-editor.org/rfc/rfc2812
- Internet Relay Chat: Architecture RFC #2810 https://www.rfc-editor.org/rfc/rfc2810
- Internet Relay Chat: Channel Management RFC #2811 https://www.rfc-editor.org/rfc/rfc2811
- Internet Relay Chat: Server Protocol RFC #2813 https://www.rfc-editor.org/rfc/rfc2813
- The University of Chicago χ-Project http://chi.cs.uchicago.edu/chirc/irc.html