Computer Network
Project 3
Simple Proxy Server

CSI4106-01

Fall, 2020

(Difficulty ★★★☆☆)

Prelim.

The project 3 consists of

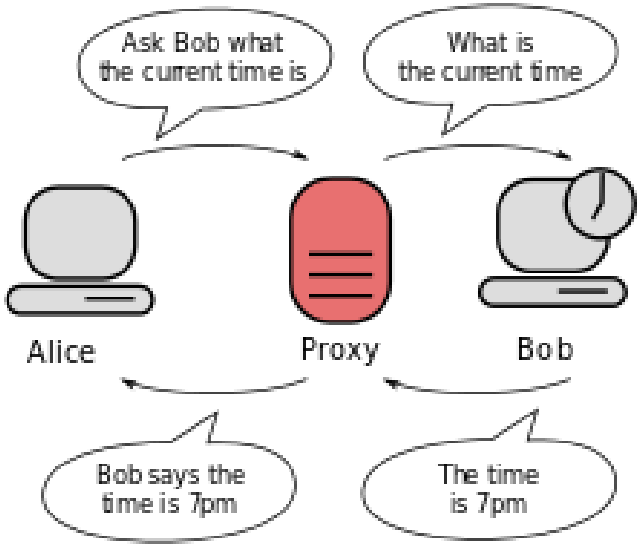
- Mandatory Assignment (100 pts)
- Additional Assignment (+30 pts)
  - Bonus score

Prelim.

Before you do this project, you must be fully aware of "**Project Policy Notice**"

What is a proxy server?

- An intermediary which deals with requests from clients seeking resources of other servers.
- Resides anywhere, between YOU and destination.
- The fundamental function: intercepting and forwarding traffic.

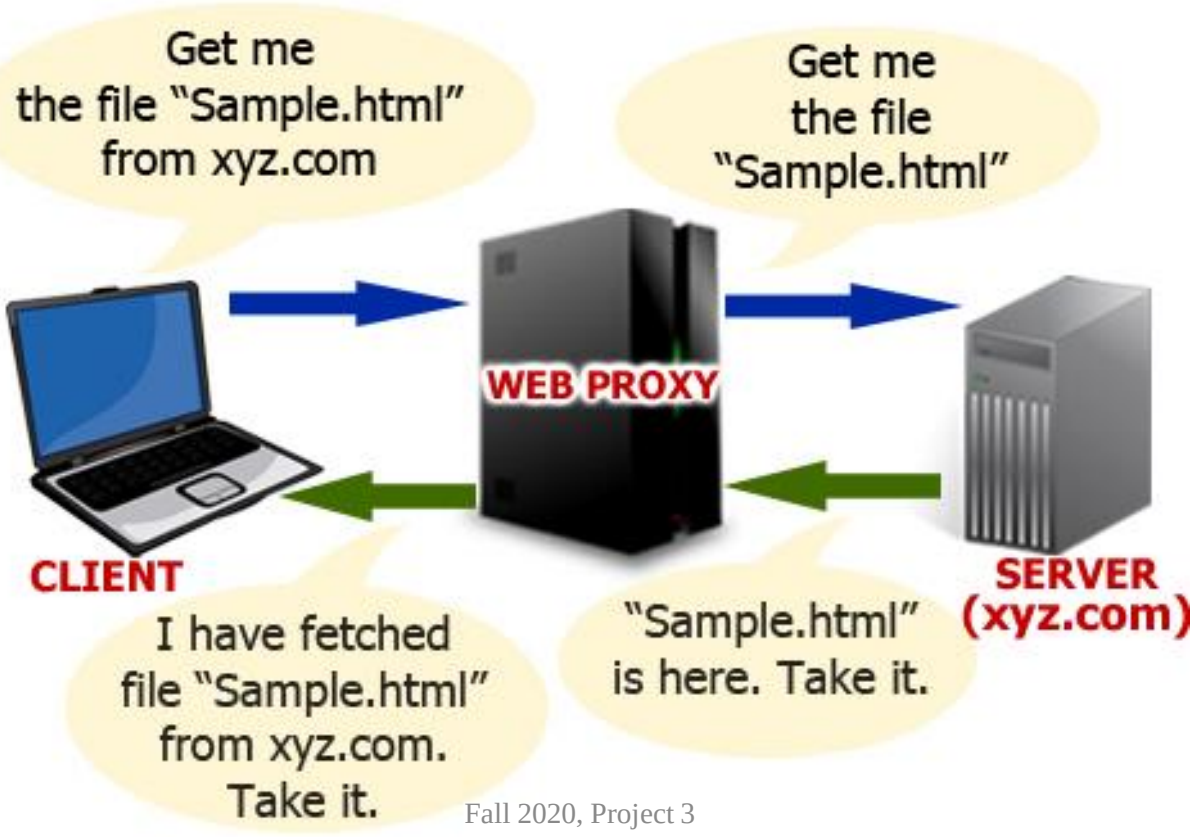


The uses of proxy servers

- Filtering specific data (to block or redirect them)
  - Filtering of encrypted data
  - Bypassing filters / Censorship / Falsification
  - Translation (Localization for different markets)
- Logging or eavesdropping for monitoring traffic
  - Transparent Proxy
- Improving performance (Cache Server)
- ***(e.g.) SSL/DNS/CGI/HTTP proxy***
- ***(further…) Reverse, Anonymous, Tunneling…***

How a http proxy server works?

- **Transparent Proxy on HTTP**



What is the Cache Proxy server?

- https://en.wikipedia.org/wiki/Proxy_server
- A nice example: CDN Service.
- A cache server can be implemented anywhere.
- Cache Position (Conceptually, Client to Server)
  - (Local – Forward) – Gateway – (Reverse – Server)
- **Intermediary Proxy Server**
  - **Forward / Reverse and explicit servers (CDN's cache servers everywhere)**

Mandatory Assignment (100pts)

- Write a code of http **transparent** proxy server
- Implement Required Functions (1)-(3)
  - *Managing sockets with multi-thread*
  - *URL Filtering*
  - *Image Filtering*
- *Your proxy server is running in background*
- ***Your proxy server may be so slow…***
  - ***Make proxy server supporting multi-thread or cache***
- **Follow the usage format below**

```
(Format) ./run.sh port
(Example) ./run.sh 9001
Starting proxy server on port 9001
```

Required Functions
(1) Managing Two Sockets!

- **Question: Why does it need two sockets??**
- One socket for receiving Client Request!
- Another socket for fetching Response of the client request.
- You need to forward Requests/Responses.
- Make your proxy server **multithreading-supported**

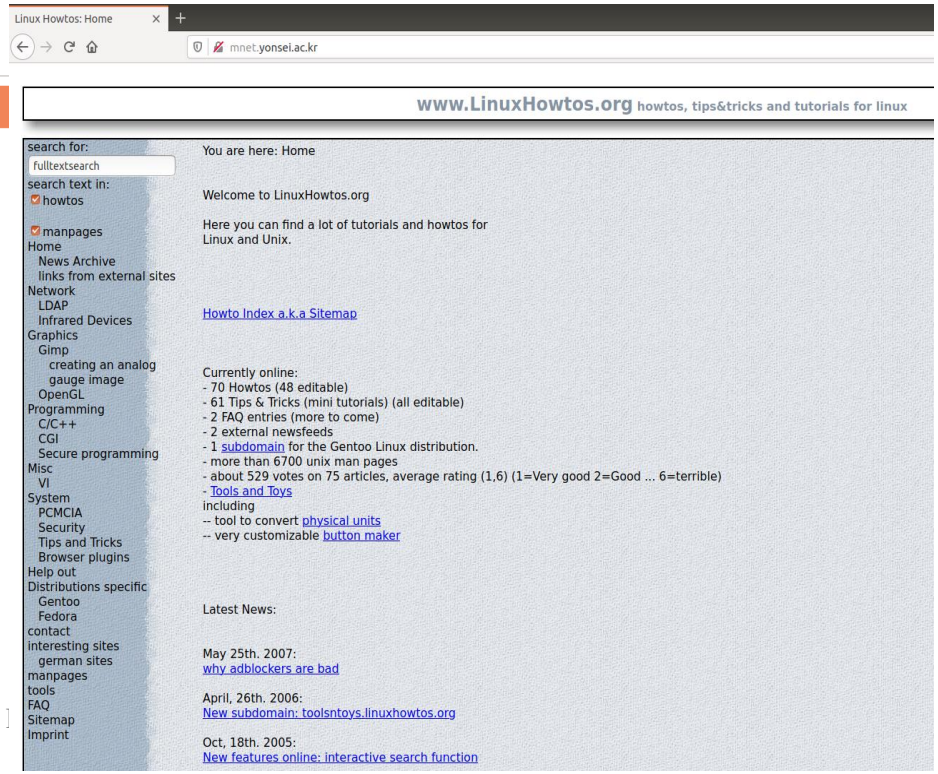
- *Hint:* ***Where should requests/responses go?***

Required Functions
(2) URL Filtering and Redirection

- **Goal: Substitute original URL to designated URL**
  - **Implement it by using flag variable or using a function**

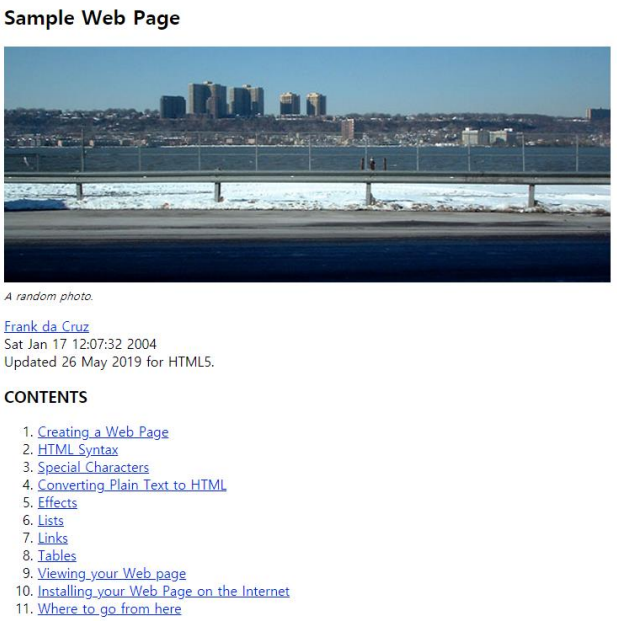
Example) Redirect any URL containing "yonsei" to www.linuxhowtos.org


```
[CLI connected to 127.0.0.1:58118]
[CLI ==> PRX --- SRV]
> GET http://mnet.yonsei.ac.kr/
> Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0)
Gecko/20100101 Firefox/83.0
[SRV connected to mnet.yonsei.ac.kr:80]
[CLI --- PRX ==> SRV]
> GET www.linuxhowtos.org
> Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0)
Gecko/20100101 Firefox/83.0
[CLI --- PRX <== SRV]
> 200 OK
> text/html; charset=utf-8 4238bytes
[CLI <== PRX --- SRV]
> 200 OK
> text/html; charset=utf-8 4238bytes
[CLI disconnected]
[SRV disconnected]
```



Required Functions (3) Image filtering

- **http://[URL]?image_off**
  - With this command, all requests whose domain contains **image** will be dropped.
- To stop it: **http://[URL]?image_on**



Interface
Logging on Command Line

- When a request from a client arrived, your proxy server should print out the precise logs.

```
Starting proxy server on port 9001
-----------------------------------------------
1  [Conn:    1/  20]
[ X ] URL filter | [ X ] Image filter

[CLI connected to 127.0.0.1:40312]
[CLI ==> PRX --- SRV]
  > GET http://www.columbia.edu/~fdc/picture-of-something.jpg
  > Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0) Gecko/20100101
Firefox/83.0
[SRV connected to www.columbia.edu:80]
[CLI --- PRX ==> SRV]
  > GET http://www.columbia.edu/~fdc/picture-of-something.jpg
  > Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0) Gecko/20100101
Firefox/83.0
[CLI --- PRX <== SRV]
  > 200 OK
  > image/jpeg 44926bytes
[CLI <== PRX --- SRV]
  > 200 OK
  > image/jpeg 44926bytes
[CLI disconnected]
[SRV disconnected]
-----------------------------------------------
2 [Conn:    3/  20]
[ X ] URL fitter | [ X ] Image fitter
……
```

*** ? is O or X (indicator)**

```
Starting proxy server on port PORT_NUMBER
-----------------------------------------------
NO [Conn:    thread #/  total_thread]
[ ? ] URL filter | [ ? ] Image filter

[CLI connected to CLI_IP:CLI_PORT]
[CLI ==> PRX --- SRV]
  > Request_1st_Line_from_Client
  > User-Agent_1st_Line_from_Client
[SRV connected to DST_DOMAIN:DST_PORT]
[CLI --- PRX ==> SRV]
  > Request_1st_Line_to_Server
  > User-Agent_1st_Line_from_Client
[CLI --- PRX <== SRV]
  > Response_Status_Code_from_Server
  > Response_MIME_Type Response_Sizebytes
[CLI <== PRX --- SRV]
  > Response_Status_Code_to_Client
  > MIME_Type_to_Client Size_to_Clientbytes
[CLI disconnected]
[SRV disconnected]
```

Background

- TCP (socket programming)
- HTTP Packet (request and response)
- Implementation of Multi-thread in Project 2
- Basic idea of HTML tag
- **Browser' Proxy Setting (How to use proxy)**
  - For this project, you must manually set up your browser's proxy server.(as localhost and custom port)

Directions

- Language: **C or Python3**
- OS: **Ubuntu 18.04** or higher
- You must use only ***internal*** libraries.
  - ***Any 3rd party framework: NOT ALLOWED***

We will test your code as follows

- Work perfectly during evaluation **with no error** (55pts)
  - Managing sockets with multithread (15pts)
  - URL filtering & Redirection (15pts)
  - Image filtering (15pts)
  - Format of interface (10pts)

If you do not implement the following, you will get a deduction on your score

- Run with **custom Port**
- Feature **socket-reuse** (**port reuse**)
- Be **terminated** by only Ctrl+C
- **Close the sockets** (by **netstat**)

Your report must include

- **Introduction/Reference** (3pts)
  - Software environment, programming language you used, version, reference and so on.
- **Flow chart or Diagram** (10pts)
  - Must show the logic of your program
  - Focus on describing how your client and server work.
- **Snapshots for each function** to show your codes are working well. (5pts)

Your report must include (cont'd)

- **Logical explanations block by block in detail**. (20pts)
  - It is different with brief comments in your source code!!!
  - In your report, write what the blocks do and why you implemented those functions.
- **Compare the performance with applying Multi thread and before in chart** (7pts)
  - Performance criterion (Elapsed Time, Memory Use..)

Additional Assignment(+30pts): proxy server with **Cache**

- This is a **supplementary assignment**
  - If you get poor grades on other assignments, this additional assignment can help

- You need to **add the cache feature to the proxy server** of the Mandatory Assignment.

Cache proxy server

- You already know what a **Cache proxy server** is through the homework assignment.

- Cache Replacement Policy
  - We use **LRU (Least Recently Used)** in this project

- **Follow the usage format below**

```
(Format)   ./run.sh port [-size maxSize]
(Example)  ./run.sh 9001 -size 16

maxSize: Maximum Total Cache Size (Unit: MiB)
```

Requirement of cache proxy server (1) update logging about cache

- In addition to the existing log, your proxy server should also print information about the cache
- Example 1:

```
15  [Conn:    5/  20] [Cache: 0.07/10MB] [Items: 3]
[ X ] URL filter | [ X ] Image filter

[CLI connected to 127.0.0.1:40312]
[CLI ==> PRX --- SRV]
  > GET http://www.columbia.edu/~fdc/sample.html
  > Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0)
Gecko/20100101 Firefox/83.0
[SRV connected to www.columbia.edu:80]
################## CACHE HIT ##################
[CLI <== PRX --- SRV]
  > 200 OK
  > text/html 10147bytes
[CLI disconnected]
[SRV disconnected]
```

- Example 2:

```
18  [Conn:    6/  20] [Cache: 0.04/5MB] [Items: 6]
[ X ] URL filter | [ X ] Image filter

[CLI connected from 127.0.0.1:40274]
[CLI ==> PRX --- SRV]
  > GET http://help.websiteos.com/websiteos/htmlpage.jpg
  > Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0) Gecko/20100101
Firefox/83.0
[SRV connected to help.websiteos.com:80]
################## CACHE MISS ##################
[CLI --- PRX ==> SRV]
  > GET http://help.websiteos.com/websiteos/htmlpage.jpg
  > Mozilla/5.0 (X11; Ubuntu; Linux x86_64; rv:83.0) Gecko/20100101
Firefox/83.0
[CLI --- PRX <== SRV]
  > 200 OK
  > image/jpeg 34884bytes
################## CACHE REMOVED ##################
  > http://help.websiteos.com/websiteos/example_of_a_simple_html_page.htm
0.00MB
  > This file has been removed due to LRU!
################## CACHE REMOVED ##################
  > http://help.websiteos.com/websiteos/whtopic.js 0.01MB
  > This file has been removed due to LRU!
################## CACHE ADDED ##################
  > http://help.websiteos.com/websiteos/htmlpage.jpg 0.03MB
  > This file has been added to the cache
  > Current 5 items cached,  0.04/5MB
################################################
[CLI <== PRX --- SRV] @ 01:40:25.891
  < 200 OK
  < image/jpeg 34884bytes
[SRV disconnected]
```

Requirement of cache proxy server (2) Save a log file

- **log.txt file stores cache logs.**
- **This is an example format.**
- **You can modify the format if you want.**
- **But this does not mean you can omit detail information!!**

log.txt example

```
...

# 14 cache hit
http://help.websiteos.com/websiteos/whtopic.js 0.01MB
# start current situation
[Cache: 0.07/0.10MB] [Items: 13]
1:data http://diptera.myspecies.info/sites/all/libraries/mediaelement/build/mediaelement-
and-player.min.js?v=2.1.6
   size 0.01MB
   counter 00:49:50.482
...
13:data http://www.columbia.edu/~fdc/picture-of-something.jpg
   size 0.04MB
   counter 01:40:24.844
# end current situation
```

Additional Assignment (+30pts)

- **Implementation** (20pts)
  - Update logging about cache (10pts)
  - Save a log file (10pts)
- In your **report..**
- **Brief summary of flow charts and block-by-block explanation about cache part**
- **Compare the performance with applying cache and before in chart** (10pts)
  - Performance criterion (Elapsed Time, Memory Use..)

Deliverable

- **Only one zip file of "YourID_p3.zip"**
  - **If your ID is 2020147123, 2020147123_p3.zip should be your deliverable file name.**

- **In the zip file only the two/three files must be included without any folder**
  - **report.pdf**
  - **run.sh**
  - **project.py or project.c**
    - **if you use C language, include compile.sh as well**
    - **Files with different format/name will be a deduction [2pts each]**

- **DUE DATE**

  12/Dec/2020 23:55:00 KST

  No exception for exceeding deadline

- **Delay Policy**

  -33%pts for ~13/Dec 23:55:00

  -66%pts for ~14/Dec 23:55:00

  -100%pts for 15/Dec 23:55:00~

You agree with the following statement by submitting your assignment on YSCEC

Ctrl+C and Ctrl+V is not Code Referencing,

Plagiarizing = 0pts = Fail

No exception for any kinds of cheating and copying

Score Policy : *Max. 100pts*

1	Not submitted / not working / missing files	**0 pts**
2	Overdue ➔ Delay	**-33% pts/day**
3	**The rules or directions whose scores are not specified/ are not followed**	-10 pts/rule
4	**Any 3rd party framework is used**	**0 pts**
5	**Plagiarizing / Over-implementation (Any kinds of Suspicion of Code-copy)**	**0 pts**
6	**Impolite Report / Lack of Comments**	**0 pts / -50% pts**

Bonus Score Policy: *+30pts*

1	Not submitted / not working / missing files	**0 pts**
2	Overdue ➔ Delay	**-33% pts/day**
3	**Any 3rd party framework is used**	**0 pts**
4	**Plagiarizing / Over-implementation (Any kinds of Suspicion of Code-copy)**	**0 pts**
5	**Impolite Report / Lack of Comments**	**0 pts / -50% pts**