# PROJETO FINAL
# SERVIDOR WEB MULTITHREADED

# OLÁ

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## REQUISITOS EXIGIDOS

- Tratar requisições GET
- Versão 1.0 do HTTP.
- Processar múltiplas requisições de serviços em paralelo.
- Identificar os tipos dos arquivos.
- Reportar erro de página não encontrada.

## ESTRUTURA DA IMPLEMENTAÇÃO DO SERVIDOR

- Main;
- Auxiliares:
  - Classe Socket;
  - Utils.
- Classe Webserver;
- Classe HTTP.

# Implementação

Classes auxiliares e principal

1

## MAIN

```
#include <iostream>      // cout
#include "webserver.h"

int main(int argc, char *argv[]) {
    try {
        std::string::size_type sz;
        int port = std::stoi(argv[1], &sz);    // Get port from argument

        Webserver * server = new Webserver(port, "site");    // Instantiate the server

        server->start();    // Start server
    } catch(...) {
        std::cout << "[ERROR] Invalid port entry." << std::endl;
    }

    return 0;
}
```

# UTILS

```
#include <ctime>    // time_t
#include <string>   // strings
#include <iostream> // cout
#include <fstream>  // ifstream

#define CHECK_ERR(cond, msg, ret) {    // Macro user for error handler
                ...
}


typedef char t_byte;      // Type used for data
typedef int  t_socket;    // Type used for sockets ids


std::string getDate(std::string format);    // Get current date and hour from server


int readFile(std::string path, t_byte ** buffer);    // Read a file from disc
```

## SOCKET

```
#include <iostream>    // cout
#include <cstring>     // memset
#include <signal.h>    // SIGPIPE, SIG_IGN
#include <unistd.h>    // socket
#include <arpa/inet.h> // sockaddr
#include "util.h"

       ...

Socket();                    // Constructor
Socket(int port);            // Destructor
int Bind();                  // Bind port
int Listen(int backlog);     // Listem from a port
t_socket Accept();           // Accept a connection
int Connect(std::string ip, int port);    // Connect to a socket
int Close();                 // Close the socket
static int readFrom(t_socket socket, t_byte * buffer, size_t size, int timeout);    // Read message from a
socket
static int sendTo(t_socket socket, t_byte * buffer, size_t size);    // Send a message to a socket
static int Close(t_socket socket);    // Close a socket by id
```

# Implementação 2

Classe Webserver

## WEBSERVER (HEADER)

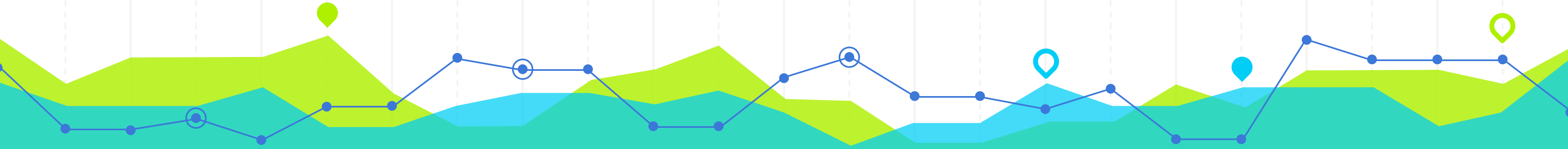
```
#include <string>
#include <thread>
#include "socket.h"
#include "http.h"
#include "util.h"

class Webserver {
    private:
        Socket*      socket;          // TCP Socket for server
        std::string path;             // Path of the Website files
        int          port;            // Port used for the server
        bool         alive;           // Flag to keep the server alive.
    public:
        Webserver(int port, std::string path);     // Constructor
        virtual ~Webserver();                      // Destructor
        void start();                              // Start the server
        void stop();                               // Stop the server
        void startClient(t_socket cl);             // Process the client request and respond to it
        void setPort(int port);                    // Set port
        int getPort();                             // Get port
};
```

## WEBSERVER::START()

```
void Webserver::start() {
    this->socket = new Socket(this->port);    // Create server socket
    if(this->socket->Bind() >= 0) {           // Bind the port
        if(this->socket->Listen(10) >= 0) {   // Listen the port
                    t_socket client;         // Socket to new client connection
                    this->alive = true;

                    std::cout << "[INFO] Server running on port: "  << this->port << std::endl;

                    while(alive) {
                           client = this->socket->Accept();    // Wait for client connection

                           if(client >= 0) {
                                  // Start the client thread
                                  std::thread cl([=](){ Webserver::startClient(client); });
                                  cl.detach();
                           }
                    }
                    std::cout << "[INFO] Session closed!" << std::endl;
             } else std::cout << "[ERROR] Webserver listen error" << std::endl;
    } else std::cout << "[ERROR] Webserver bind error" << std::endl;

    this->socket->CloseServer();    // Close server socket
}
```

# WEBSERVER::STARTCLIENT()

```
void Webserver::startClient(t_socket cl) {
       Http   * http   = new Http();
       t_byte * buffer = new t_byte[1024];
       t_byte * file  = NULL;

       Socket::readFrom(cl, buffer, 1024, 5);    // Read client request message

       http->processRequest(buffer);    // Process request

       int size = readFile(this->path + http->getReqstedFile(), &file);    // Find and read the file

       if(size > 0) {
              http->createResponseHeader(size, Http::Status::OK); // Create the response header
              http->createBinaryPacket(file, size);               // Create the binary packet (header+data of
file)
       } else {
              http->createResponseHeader(0, Http::Status::NOT_FOUND); // Create the response header
              http->createBinaryPacket(NULL, 0);                      // Create the binary packet (header)
       }

       Socket::sendTo(cl, http->getBinaryPacket(), http->getBinarySize());  // Sendo binary packet to client

       // Release memory
       delete[] buffer;
       if(file != NULL) free(file);

       // Close socket
       Socket::Close(cl);
}
```



# Implementação 3

## Classe HTTP

## HTTP (HEADER)

```
#include <string>
#include <cstring>
#include <stdexcept>
#include "util.h"

class Http {
    private:
        int         begin_range;    // Requested content begin range.
        int         end_range;      // Requested content end range.
        size_t      buffer_size;    // Buffer size
        t_byte *    buffer;         // Buffer for binary packet generated.
        std::string reqst_file;     // Requested filename.
        std::string reqst_filetype; // Requested file type.
        std::string server_name;    // Server name
        std::string header;         // Container generated header.

        std::string getfield(std::string src, std::string mark, char end);    // Get value from a field

        . . .
```

# HTTP (HEADER)

```
        . . .

    public:
        enum Status { OK = 200, PARTIAL_CONTENT = 206, NOT_FOUND = 404 };

        Http();
        virtual ~Http();

        void processRequest(t_byte* header);
        std::string createResponseHeader(size_t filelen, int status_code);
        t_byte* createBinaryPacket(t_byte * file_bin, size_t file_size);

        std::string getReqstedFile();
        std::string getHeader();
        size_t getBinarySize();
        t_byte * getBinaryPacket();

        void setServerName(std::string name);
};
```

# HTTP::PROCESSREQUEST

```
void Http::processRequest(t_byte * header) {
    std::string msg(header);                                    // Convert bytes to a string

    if(!(msg.find("GET") != std::string::npos))                 // Check if is a GET Request
        return;

    this->reqst_file    = this->getfield(msg, "GET ", ' ');     // Get the request file name

    if(!this->reqst_file.compare("/")) {                        // Check if client attempts to access the index
        this->reqst_file = "/index.html";
        this->reqst_filetype = "text/html; charset=UTF-8";
    } else {
        std::string filetype = this->reqst_file.substr(         // Get the file extension
            this->reqst_file.rfind(
                ".",
                this->reqst_file.length() - 1
            ) + 1,
            this->reqst_file.length() - 1
        );

    . . .
```

## HTTP::PROCESSREQUEST

```
// Check extension type and set the content-type field
if(!filetype.compare("html") || !filetype.compare("htm"))
    this->reqst_filetype = "text/html; charset=UTF-8";
else if(!filetype.compare("jpg"))
    this->reqst_filetype = "image/jpg";
else if(!filetype.compare("png"))
    this->reqst_filetype = "image/png";
else if(!filetype.compare("gif"))
    this->reqst_filetype = "image/gif";
else if(!filetype.compare("ico"))

     . . .

else if(!filetype.compare("js"))
    this->reqst_filetype = "application/javascript; charset=UTF-8";
else if(!filetype.compare("css"))
    this->reqst_filetype = "text/css";
else
    this->reqst_filetype = "application/octet-stream";

. . .
```

# HTTP::PROCESSREQUEST

```
            . . .

        }

        // Get range begin
        this->begin_range = -1;

        std::string aux = "";
        std::string::size_type sz;

        aux = this->getfield(msg, "Range: bytes=", '-');

        if(aux.length() > 0) {
            try {
                this->begin_range = std::stoi(aux, &sz);
            } catch(...) {
                this->begin_range = -1;
            }
        }
    }
```

# HTTP::CREATERESPONSEHEADER()

```
std::string Http::createResponseHeader(size_t filelen, int status_code) {
    std::string status          = "";
    std::string connection      = "";
    std::string filesize        = std::to_string(filelen);
    std::string content_length  = filesize;
    std::string content_range   = "";
    std::string custom_data     = "";
    std::string http_version    = "HTTP/1.0";
    std::string EOL             = "\r\n";
    std::string options         = "";

     . . .
```

# HTTP::CREATERESPONSEHEADER()

```
. . .

 // Check if is a Partial Content
 if (status_code == Http::Status::OK && this->begin_range >= 0) {

        status_code   = Http::Status::PARTIAL_CONTENT;
        status                  = "206 Partial Content";

        content_length = std::to_string(filelen - this->begin_range);
        content_range= std::to_string(this->begin_range) + "-" + std::to_string(filelen - 1) + "/" + filesize;

        connection    = "keep-alive";

 }

. . .
```

## HTTP::CREATERESPONSEHEADER()

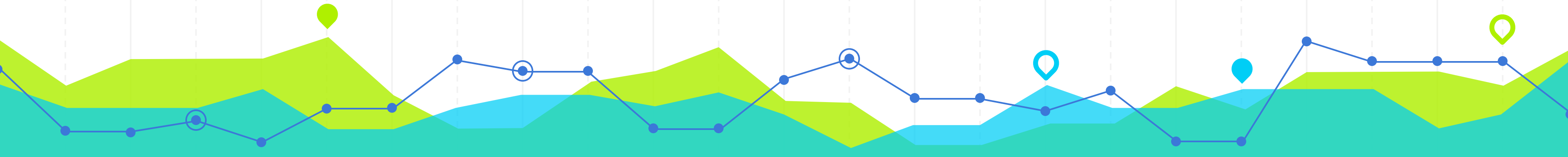
```
. . .

  // Set the range begin to 0 if not has range
  if(this->begin_range < 0)
        this->begin_range = 0;

  // Check if is OK
  if (status_code == Http::Status::OK) {
        status        = "200 OK";
        connection = "keep-alive";
  }

. . .
```

# HTTP::CREATERESPONSEHEADER()

```
    . . .

  // Check if the request file is not found
  else if(status_code == Http::Status::NOT_FOUND) {
          status        = "404 Not Found";
          connection = "close";

          custom_data = "\
                  <html>\
                          <head><title>404 Not Found</title></head>\
                          <body>\

                                  . . .

                          </body>\
                  </html>\
          ";

          content_length = std::to_string(custom_data.length());
          this->reqst_filetype = "text/html; charset=UTF-8";
  }

 . . .
```

# HTTP::CREATERESPONSEHEADER()

```
    . . .

    // Optional fields
    options += "Access-Control-Allow-Origin: *" + EOL;
    options += "Access-Control-Allow-Headers: X-Requested-With, Content-Type, X-Codingpedia, X-HTTP-Method-
Override" + EOL;
    options += "x-content-type-options: nosniff" + EOL;

    . . .
```



# HTTP::CREATERESPONSEHEADER()

```
    . . .

     // Create the HTTP header
     this->header += http_version + " " + status + EOL;

     if(status_code != Http::Status::NOT_FOUND)
            this->header += "Accept-Ranges: bytes" + EOL;

     if(status_code == Http::Status::PARTIAL_CONTENT)
            this->header += "Content-Range: bytes " + content_range + EOL;

     this->header += "Cache-Control: public, max-age=0" + EOL;
     this->header += "Content-Type: " + this->reqst_filetype + EOL;
     this->header += "Content-Length: " + content_length + EOL;
     this->header += "Connection: " + connection + EOL;
     this->header += options;
     this->header += "Date: " + getDate("%a, %d %b %Y %T %Z") + EOL;
     this->header += "X-Powered-By: " + this->server_name + EOL;
     this->header += EOL;
     this->header += custom_data;

     return this->header;
}
```

## HTTP::CREATEBINARYPACKET()

```
t_byte * Http::createBinaryPacket(t_byte * file_bin, size_t file_size) {
       if(this->header.length() < 1) return NULL;

    size_t data_size = 0;

    if(file_bin == NULL) {
        file_size = 0;
    } else data_size = file_size - this->begin_range;

    // Calculates the buffer size
    this->buffer_size = this->header.length() + data_size;

    // Allocates memory to buffer
    this->buffer = new t_byte[this->buffer_size];

    // Copy header to memory buffer
    memcpy(this->buffer, this->header.c_str(), this->header.length());

    // Copy data to memory buffer
    if(data_size  > 0)
        memcpy(this->buffer + this->header.length(), file_bin + this->begin_range, data_size);

    return this->buffer;
}
```

# Resultados 4

Requisição/Resposta

# ARQUIVOS SUPORTADOS PELO SERVIDOR

```
GET /ufpb_logo.png HTTP/1.1
Host: 192.168.77.132:8080
Connection: keep-alive
Cache-Control: max-age=0
Save-Data: on
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML,
like Gecko) Chrome/51.0.2704.79 Safari/537.36
Accept: image/webp,image/*,*/*;q=0.8
DNT: 1
Referer: http://192.168.77.132:8080/
Accept-Encoding: gzip, deflate, sdch
Accept-Language: pt-BR,pt;q=0.8,en-US;q=0.6,en;q=0.4
```

```
HTTP/1.0 200 OK
Accept-Ranges: bytes
Cache-Control: public, max-age=0
Content-Type: image/png
Content-Length: 696941
Connection: keep-alive
Access-Control-Allow-Origin: *
Access-Control-Allow-Headers: X-Requested-With, Content-Type, X-Codingpedia,
X-HTTP-Method-Override
x-content-type-options: nosniff
Date: Wed, 08 Jun 2016 03:56:29 BRT
X-Powered-By: Jorismar
```

## ARQUIVOS NÃO SUPORTADOS PELO SERVIDOR

```
GET /devreport.pdf HTTP/1.1
Host: 192.168.77.132:8080
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Save-Data: on
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML,
like Gecko) Chrome/51.0.2704.79 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;
q=0.8
DNT: 1
Referer: http://192.168.77.132:8080/
Accept-Encoding: gzip, deflate, sdch
Accept-Language: pt-BR,pt;q=0.8,en-US;q=0.6,en;q=0.4
```

```
HTTP/1.0 200 OK
Accept-Ranges: bytes
Cache-Control: public, max-age=0
Content-Type: application/octet-stream
Content-Length: 323627
Connection: keep-alive
Access-Control-Allow-Origin: *
Access-Control-Allow-Headers: X-Requested-With, Content-Type, X-Codingpedia,
X-HTTP-Method-Override
x-content-type-options: nosniff
Date: Wed, 08 Jun 2016 04:04:39 BRT
X-Powered-By: Jorismar
```

# ARQUIVOS COM ENVIO PARCIAL (PARTIAL CONTENT)

```
GET /video.mp4 HTTP/1.1
Host: 192.168.77.132:8080
Connection: keep-alive
Accept-Encoding: identity;q=1, *;q=0
Save-Data: on
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML,
like Gecko) Chrome/51.0.2704.79 Safari/537.36
Accept: */*
DNT: 1
Referer: http://192.168.77.132:8080/
Accept-Language: pt-BR,pt;q=0.8,en-US;q=0.6,en;q=0.4
Range: bytes=0-
```

```
HTTP/1.0 206 Partial Content
Accept-Ranges: bytes
Content-Range: bytes 0-45349551/45349552
Cache-Control: public, max-age=0
Content-Type: video/mp4
Content-Length: 45349552
Connection: keep-alive
Access-Control-Allow-Origin: *
Access-Control-Allow-Headers: X-Requested-With, Content-Type, X-Codingpedia,
X-HTTP-Method-Override
x-content-type-options: nosniff
Date: Wed, 08 Jun 2016 04:03:48 BRT
X-Powered-By: Jorismar
```

# ARQUIVOS COM ENVIO PARCIAL (PARTIAL CONTENT)

```
GET /video.mp4 HTTP/1.1
Host: 192.168.77.132:8080
Connection: keep-alive
Accept-Encoding: identity;q=1, *;q=0
Save-Data: on
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML,
like Gecko) Chrome/51.0.2704.79 Safari/537.36
Accept: */*
DNT: 1
Referer: http://192.168.77.132:8080/
Accept-Language: pt-BR,pt;q=0.8,en-US;q=0.6,en;q=0.4
Range: bytes=25607620-
```

```
HTTP/1.0 206 Partial Content
Accept-Ranges: bytes
Content-Range: bytes 25607620-45349551/45349552
Cache-Control: public, max-age=0
Content-Type: video/mp4
Content-Length: 19741932
Connection: keep-alive
Access-Control-Allow-Origin: *
Access-Control-Allow-Headers: X-Requested-With, Content-Type, X-Codingpedia,
X-HTTP-Method-Override
x-content-type-options: nosniff
Date: Wed, 08 Jun 2016 04:09:18 BRT
X-Powered-By: Jorismar
```

## PÁGINA NÃO ENCONTRADA

```
GET /not_found.html HTTP/1.1
Host: 192.168.77.132:8080
Connection: keep-alive
Upgrade-Insecure-Requests: 1
Save-Data: on
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537.36 (KHTML,
like Gecko) Chrome/51.0.2704.79 Safari/537.36
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;
q=0.8
DNT: 1
Referer: http://192.168.77.132:8080/
Accept-Encoding: gzip, deflate, sdch
Accept-Language: pt-BR,pt;q=0.8,en-US;q=0.6,en;q=0.4
```

```
HTTP/1.0 404 Not Found
Cache-Control: public, max-age=0
Content-Type: text/html; charset=UTF-8
Content-Length: 492
Connection: close
Access-Control-Allow-Origin: *
Access-Control-Allow-Headers: X-Requested-With, Content-Type, X-Codingpedia,
X-HTTP-Method-Override
x-content-type-options: nosniff
Date: Wed, 08 Jun 2016 04:28:05 BRT
X-Powered-By: Jorismar
```

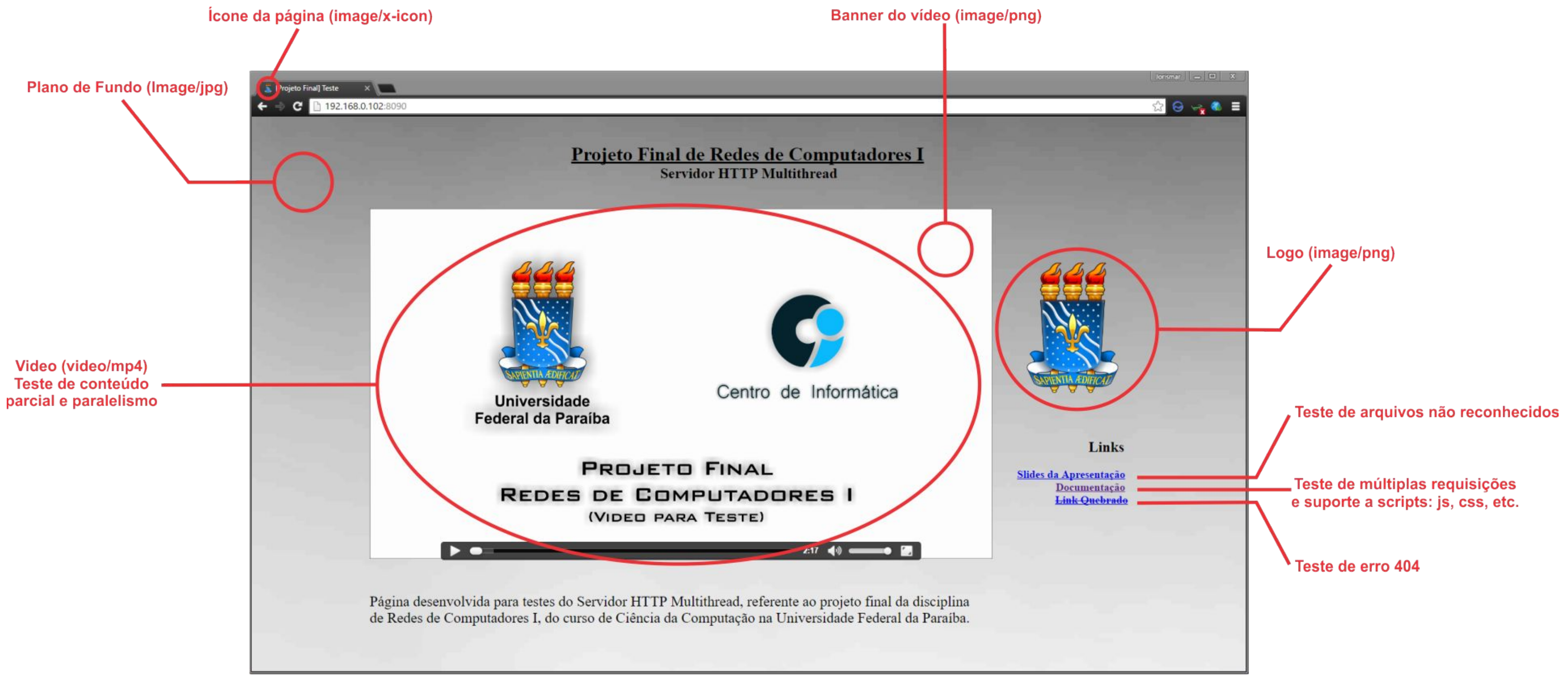
## Demonstração 4

Webserver + Webpage

# LET'S TRY

http://127.0.0.1:8090

# COMPOSIÇÃO DA PÁGINA DE TESTE



Projeto Final de Redes de Computadores I

Servidor HTTP Multithread

Página desenvolvida para testes do Servidor HTTP Multithread, referente ao projeto final da disciplina de Redes de Computadores I, do curso de Ciência da Computação na Universidade Federal da Paraíba.

# OBRIGADO!

## DÚVIDAS?

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**Algoritmo:**

https://github.com/jorismar/CNI-Webserver