Socket应用编程实验

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实验内容

使用C语言分别实现最简单的HTTP服务器和HTTP客户端

1. 服务器监听80端口，收到HTTP请求，解析请求内容，回复HTTP应答

- 对于本地存在的文件，返回HTTP 200 OK和相应文件
- 对于本地不存在的文件，返回HTTP 404 File Not Found

2. 服务器、客户端只需要支持HTTP Get方法，不需要支持Post等方法
3. 服务器使用多线程支持多路并发

实验流程

1. 查看example文件中的示例程序，学习socket API的具体使用
2. 查看http协议，学习封装方法
3. 编写代码，主要包括socket API交互和http协议封装
4. 测试，包括server、client分别和”python -m SimpleHTTPServer 80”和wget，server、client之间相互测试，以及多个终端同时请求

实验结果及分析

1. 代码展示

server部分

```
//主要函数如下:
void reqparse(int);                //解析接收到的请求并处理
void headers(int, const char *); //返回响应的头部（200
void not_found(int);               //返回404
int socket_init(u_short *);        //建立socket，开始监听

//main函数:
int main(void)
{
    int server_sock = -1;
    u_short port = 80;
    int client_sock = -1;
    struct sockaddr_in client_name;
    int client_name_len = sizeof(client_name);
    pthread_t newthread;
    //调用socket_init
    server_sock = socket_init(&port);
```

```
    printf("httpd running on port %d\n", port);
    while (1)
    {
        //接收客户端连接请求
        client_sock = accept(server_sock,(struct sockaddr *)&client_name,
(socklen_t *)&client_name_len);
        if (client_sock == -1){
            perror("accept");
            exit(1);
        }
        //派生新线程用 reqparse 函数处理新请求
        if (pthread_create(&newthread , NULL, reqparse, client_sock) != 0)
            perror("pthread_create");
    }
    close(server_sock);
    return(0);
}

//socket_init函数:
int socket_init(u_short *port)
{
    int httpd = 0;
    struct sockaddr_in name;

    //建立 socket
    httpd = socket(PF_INET, SOCK_STREAM, 0);
    if (httpd == -1)
    {
        perror("socket");
        return -1;
    }
    memset(&name, 0, sizeof(name));
    name.sin_family = AF_INET;
    name.sin_port = htons(*port);
    name.sin_addr.s_addr = htonl(INADDR_ANY);
    //指定端口
    if (bind(httpd, (struct sockaddr *)&name, sizeof(name)) < 0)
    {
        perror("bind");
        return -1;
    }
    //开始监听
    if (listen(httpd, 5) < 0)
    {
        perror("listen");
        return -1;
    }
    return(httpd);
}
```

```c
//reqparse函数:
void reqparse(int client)
{
    ...//（部分代码已省略
    //接收请求信息并解析
    query_len = get_line(client, buf, sizeof(buf));
    i = 0; j = 0;
    //打印请求信息
    printf("REQUESTING: %s",buf);
    while (!isspace((int)buf[j]))
    {
        method[i] = buf[j];
        i++; j++;
    }
    method[i] = '\0';

    //如果请求方法不是 GET
    if (strcasecmp(method, "GET")){
        unimplemented(client);
        return;
    }
    ...
    //请求未指明文件时，返回hello文件
    if ((url[0] == '\0')){
        strcat(url, "hello");
        //printf("empty\n");
    }
    //文件查找
    if (stat(url, &st)==-1){
        not_found(client);
    }
    //文件传输
    else
    {
      FILE *resource = NULL;
      resource=fopen(url, "r");
      if (resource == NULL)
          not_found(client);
      else
            {
                headers(client, url);
                char bufa[1024];
                fgets(bufa, sizeof(bufa), resource);
                while (!feof(resource)){
                    send(client, bufa, strlen(bufa), 0);
                    fgets(bufa, sizeof(bufa), resource);
                }
            }
```

```
        fclose(resource);
    }
    close(client);
}

//响应信息:
void headers(int client, const char *filename){
    char buf[1024];
    (void)filename;
    strcpy(buf, "HTTP/1.0 200 OK\r\n");
    send(client, buf, strlen(buf), 0);
    strcpy(buf, "Server: 10.0.0.1\r\n");
    send(client, buf, strlen(buf), 0);
    sprintf(buf, "Content-Type: text/html\r\n");
    send(client, buf, strlen(buf), 0);
    strcpy(buf, "\r\n");
    send(client, buf, strlen(buf), 0);
}
```

client部分：

在老师提供的echo-client示例上修改而成

```
int main(int argc, char *argv[])
{
    int sock;
    struct sockaddr_in server;
    char message[1000];
    //请求信息
    sprintf(message, "GET /hello HTTP/1.1\r\n");
    strcat(message, "Host: 10.0.0.1\r\n");
    strcat(message,"Connection: Keep-Alive\r\n");

    // create socket
    sock = socket(AF_INET, SOCK_STREAM, 0);
    //printf("socket: %d\n",sock);
    if (sock == -1)
    {
        printf("create socket failed");
        return -1;
    }
    printf("socket created\n");

    server.sin_addr.s_addr = inet_addr("10.0.0.1");
    server.sin_family = AF_INET;
    server.sin_port = htons(80);
    // connect to server
    if (connect(sock, (struct sockaddr *)&server, sizeof(server)) < 0) {
        perror("connect failed");
```

```
        return 1;
    }
    printf("connected\n");
    int i=0;
    int buf_size=65536;

        printf("requesting...\n");
        // send http request
        if (send(sock, message, strlen(message), 0) < 0) {
            printf("send failed");
            return 1;
        }
        shutdown(sock, SHUT_WR);
        // receive
        int fd = open("hello-copy", O_CREAT | O_WRONLY, S_IRWXG | S_IRWXO |
S_IRWXU);
        if (fd < 0){
            printf("Create file failed\n");
            return 0;
        }
        char *buf = (char *) malloc(buf_size * sizeof(char));
        //从套接字中读取文件流
        int len;
        int j=0;
        while((len = recv(sock, buf, buf_size,0))>0){
          if(j==1)
          printf("CONNECTED. RECEIVING......\n");
          j++;
          write(fd, buf, len);
        }
    }
    close(sock);
    return 0;
}
```

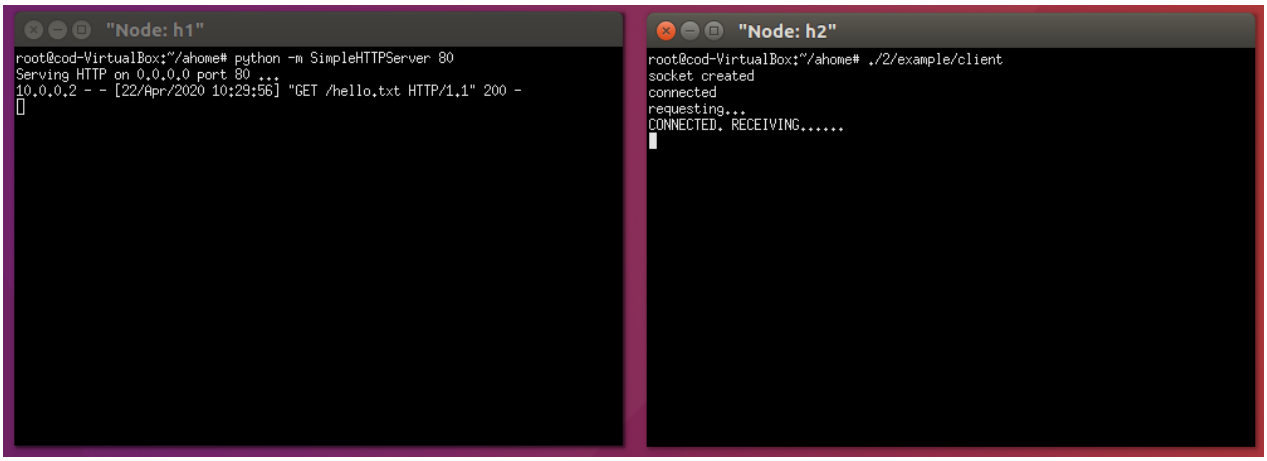
2. 测试结果

以下描述中的server和client均指自己完成的http server和client

（pdf中图片可能显示不清晰，以下图片已随代码一起打包上传

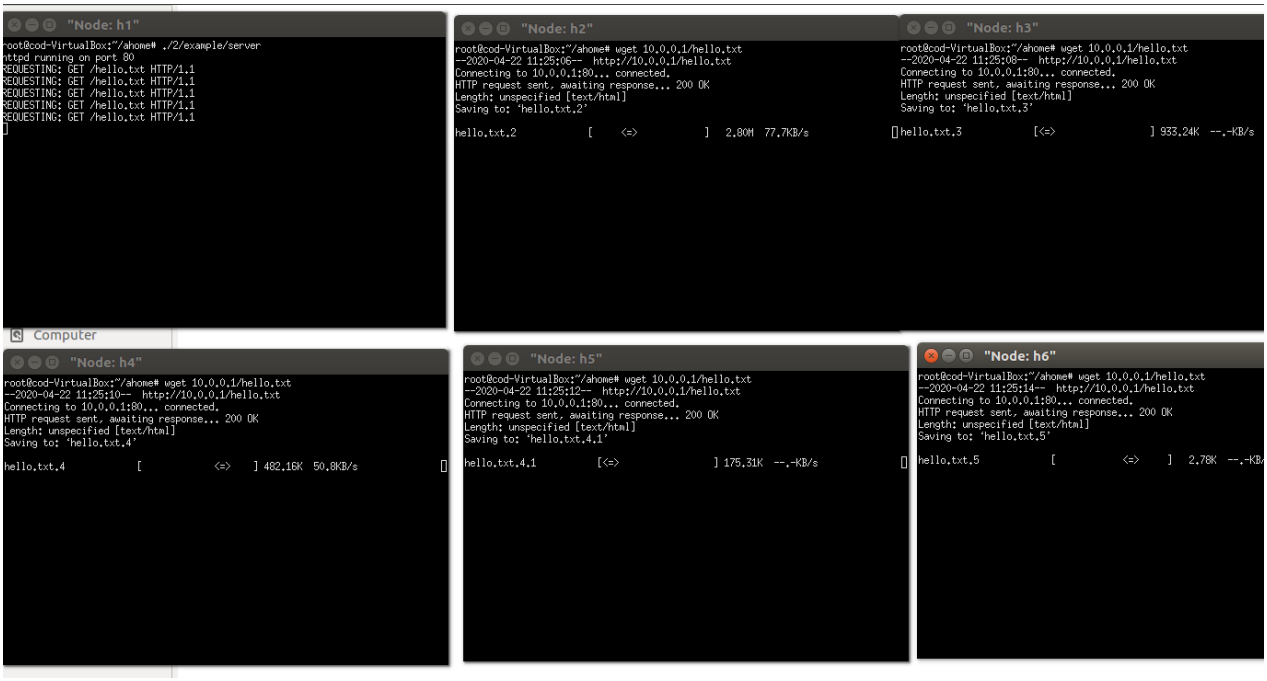
1. client单测：h1运行python -m SimpleHTTPServer 80+h2运行client

可以看到对端接收到请求，连接成功



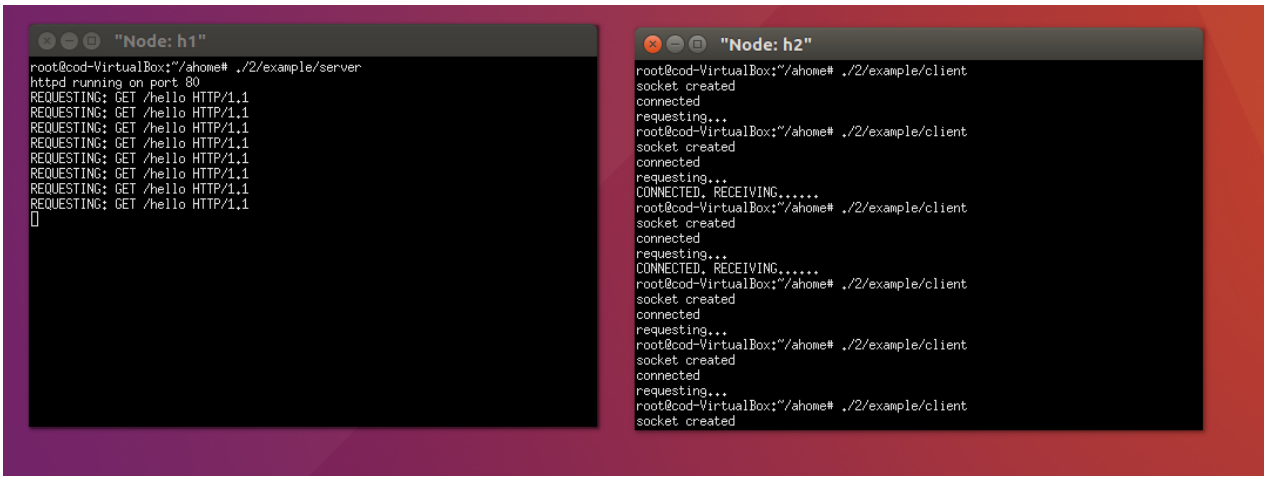
2. server单测：h1运行server，h2-h6运行wget

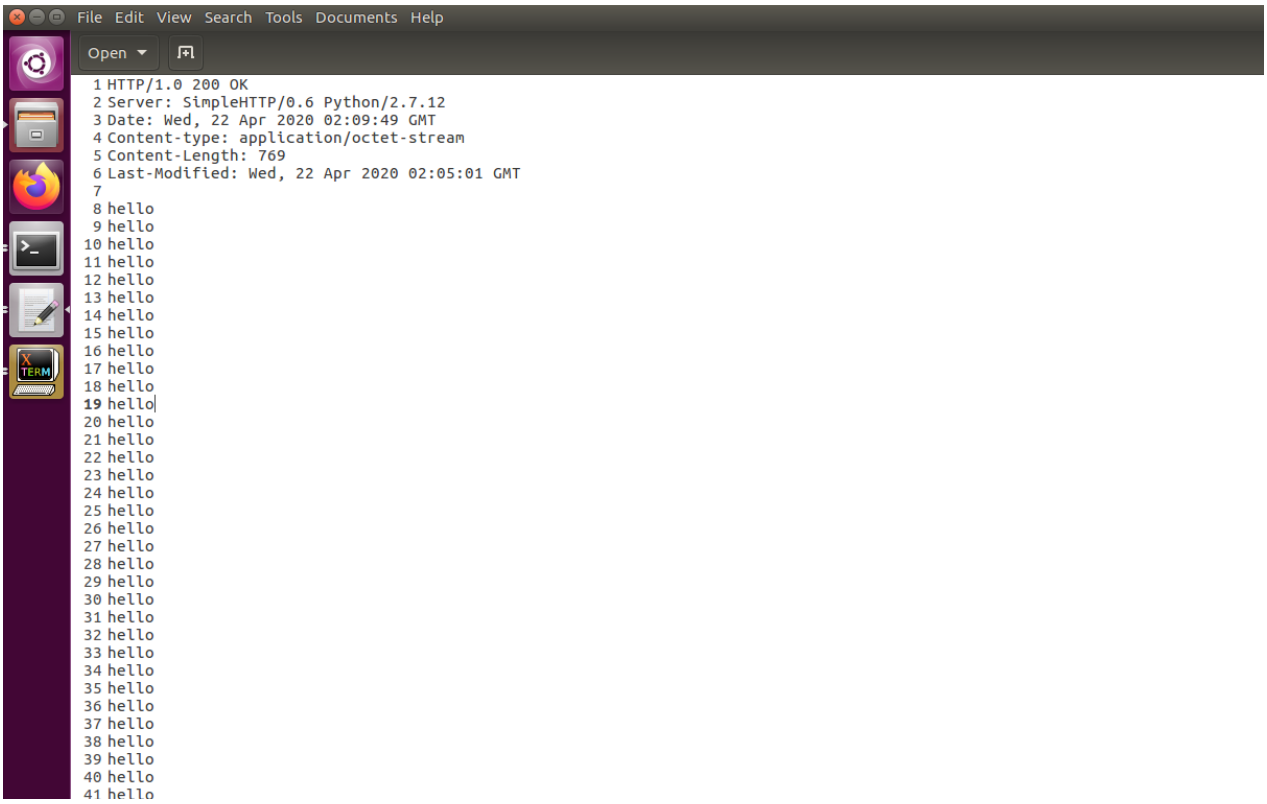
可以看到server接收到5个请求并处理，5个终端在同时接收文件



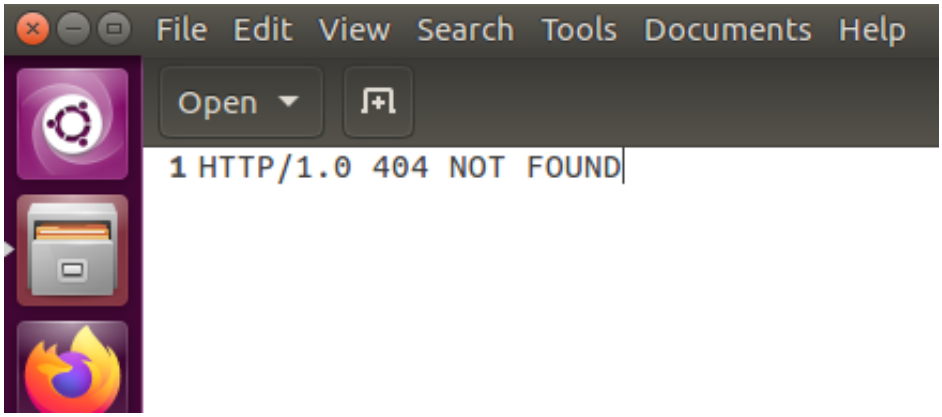
3. server和client交互测试：h1运行server，其余运行client

- 多次发起请求：可以看到server可以接收，client也接收到文件

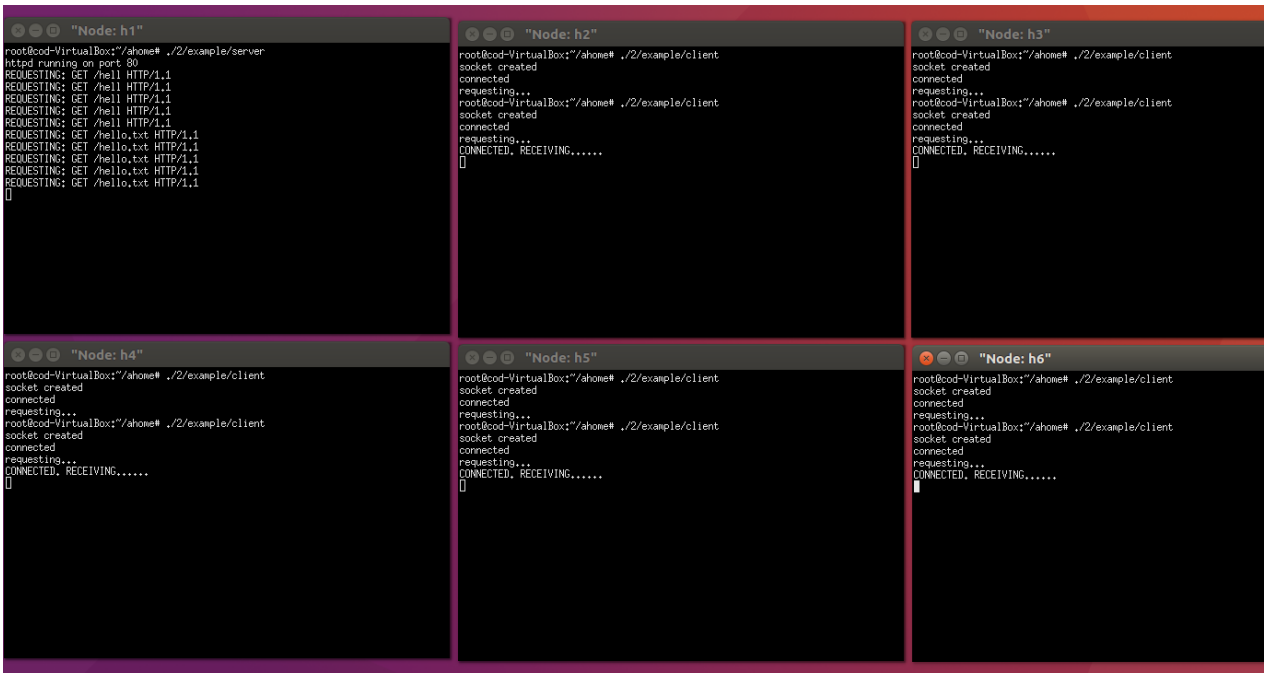




- 请求不存在的文件：返回404



- 多个终端同时请求：连接成功，多个同事处理


"Node: h1"
root@cod-VirtualBox:~/ahome# ./2/example/server
httpd running on port 80
REQUESTING: GET /hell HTTP/1.1
REQUESTING: GET /hell HTTP/1.1
REQUESTING: GET /hell HTTP/1.1
REQUESTING: GET /hell HTTP/1.1
REQUESTING: GET /hell HTTP/1.1
REQUESTING: GET /hello.txt HTTP/1.1
REQUESTING: GET /hello.txt HTTP/1.1
REQUESTING: GET /hello.txt HTTP/1.1
REQUESTING: GET /hello.txt HTTP/1.1
REQUESTING: GET /hello.txt HTTP/1.1
"Node: h2"
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
CONNECTED. RECEIVING.....
"Node: h3"
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
CONNECTED. RECEIVING.....
"Node: h4"
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
CONNECTED. RECEIVING.....
"Node: h5"
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
CONNECTED. RECEIVING.....
"Node: h6"
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
root@cod-VirtualBox:~/ahome# ./2/example/client
socket created
connected
requesting...
CONNECTED. RECEIVING.....