

数据通信作业

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一、 实验名称及内容

名称：利用 Winsock 进行服务端与客户端的应答实验

内容：1、利用 Winsock 搭建客户端、服务端，使服务端能接收处理单一客户端的信息并进行应答交互。服务端接收并打印从客户端收到的信息，并将信息返回给客户端，直到客户端关闭连接。客户端发送信息给服务端，并接收服务端返回的信息，输入“quit”时客户端关闭连接。

2、利用 Winsock 搭建客户端、服务端，使服务端能同时接收处理多客户端的信息并进行应答交互。服务端接收并打印从客户端收到的信息，并将信息返回给客户端，直到客户端关闭连接。客户端发送信息给服务端，并接收服务端返回的信息，输入“quit”时客户端关闭连接。

二、实验过程和结果

物理主机系统： macOS Catalina 10.15.4

虚拟机系统： Windows 10 专业版 x64； 计算机名： 691B

虚拟机软件： Parallels Desktop 15 for Mac Pro Edition, version 15.1.4 (47270)

编程环境 (IDE)： Visual Studio 2019

经过前几次实验，我的 winsock 编程环境已经比较完善，按照所给材料进行代码编写后，整个编译、运行过程没有出现问题。

- **一对一应答：**
 - **客户端：**
 1. 调用 WSASStartup 函数，初始化 winsock。
 2. 调用 socket()函数创建一个 Socket
 3. 调用 connect()函数和服务器进行连接
 4. 调用 send()和 recv()函数向服务器收发消息。
 5. 调用 shutdown(), closesocket(), WSACleanup()函数断开与服务器的连接，关闭 socket。
 - **服务端：**
 1. 调用 WSASStartup 函数，初始化 winsock。
 2. 调用 socket()函数创建一个 Socket
 3. 调用 bind()函数和 socket 绑定
 4. 调用 listen()函数监听一个 socket
 5. 调用 accept()函数接受由一个客户端发起的连接
 6. 调用 send()和 recv()函数向客户端收发消息。

7. 客户端断开连接后，调用 shutdown(), closesocket()函数断开与服务器的连接，关闭 socket。

- 多对一应答：

- 客户端（与一对一应答一样）：

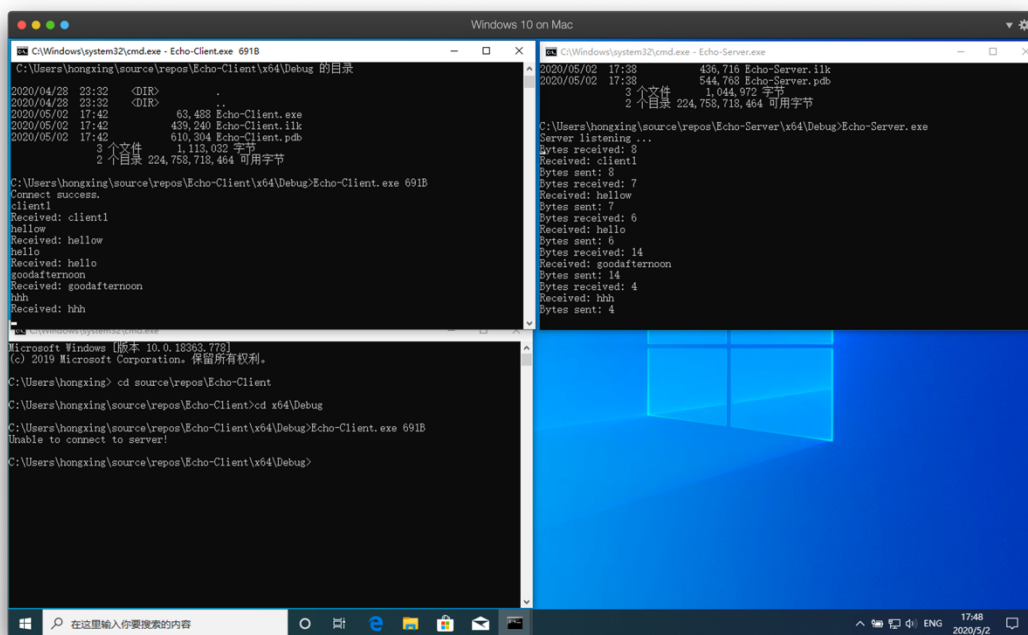
8. 调用 WSASStartup 函数，初始化 winsock。
9. 调用 socket()函数创建一个 Socket
10. 调用 connect()函数和服务器进行连接
11. 调用 send()和 recv()函数向服务器收发消息。
12. 调用 shutdown(), closesocket(), WSACleanup()函数断开与服务器的连接，关闭 socket。

- 服务端：

1. 调用 WSASStartup 函数，初始化 winsock。
2. 调用 socket()函数创建一个 Socket
3. 调用 bind()函数和 socket 绑定
4. 调用 listen()函数监听一个 socket
5. 调用 accept()函数接受由一个客户端发起的连接
6. 为该连接创建一个线程来处理与对应客户端有关的服务
7. 调用 send()和 recv()函数向客户端收发消息。
8. 客户端断开连接后，调用 _endthread()函数关闭线程
9. 调用 shutdown(), closesocket()函数断开与服务器的连接，关闭 socket

- 运行成功：

- 一对一应答：左边两个窗口将分别运行客户端程序，右边的一个窗口将运行一对一的服务端程序。



```
C:\Windows\system32\cmd.exe - Echo-Client.exe 691B
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug 的目录
2020/04/28 23:32 <DIR> .
2020/04/28 23:32 <DIR> ..
2020/05/02 17:42 63,488 Echo-Client.exe
2020/05/02 17:42 439,240 Echo-Client.ilc
2020/05/02 17:42 610,304 Echo-Client.pdb
3 个文件 1,113,032 字节
2 个目录 224,758,718,464 可用字节

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Connect success.
client1
Received: client1
hello
Received: hello
hello
Received: hello
goodafternoon
Received: goodafternoon
hhh
Received: hhh

Microsoft Windows [版本 10.0.18363.778]
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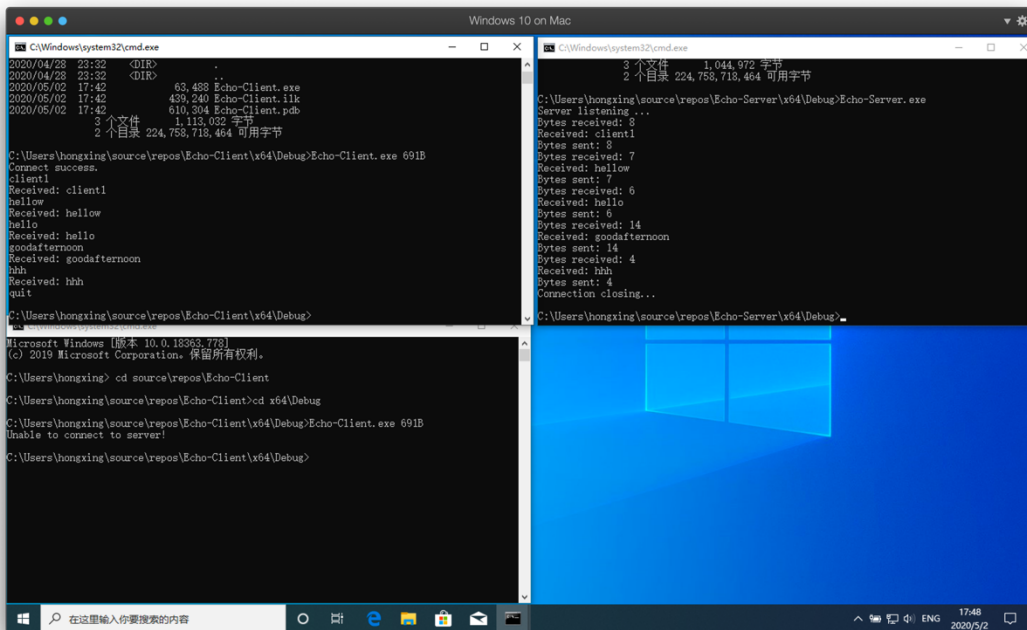
C:\Users\hongxing> cd source\repos\Echo-Client
C:\Users\hongxing\source\repos\Echo-Client> cd x64\Debug
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Unable to connect to server!

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>
```

```
C:\Windows\system32\cmd.exe - Echo-Server.exe
2020/05/02 17:38 436,716 Echo-Server.ilc
2020/05/02 17:38 544,768 Echo-Server.pdb
3 个文件 1,044,972 字节
2 个目录 224,758,718,464 可用字节

C:\Users\hongxing\source\repos\Echo-Server\x64\Debug>Echo-Server.exe
Server listening ...
Bytes received: 8
Received: client1
Bytes sent: 8
Bytes received: 7
Received: hello
Bytes sent: 7
Bytes received: 6
Received: hello
Bytes sent: 6
Bytes received: 14
Received: goodafternoon
Bytes sent: 14
Bytes received: 4
Received: hhh
Bytes sent: 4
```

先运行服务端程序，再运行一个客户端程序，客户端打印连接成功。之后用客户端向服务端发送信息进行应答测试，发现程序正确运行。保持原来的客户端不关闭，同时打开另一个客户端，发现另一个客户端连接失败，说明服务端只能同时处理一个客户端连接。



```
C:\Windows\system32\cmd.exe
2020/04/28 23:32 <DIR> .
2020/04/28 23:32 <DIR> ..
2020/05/02 17:42 63,488 Echo-Client.exe
2020/05/02 17:42 439,240 Echo-Client.lib
2020/05/02 17:42 610,304 Echo-Client.pdb
3 个文件 1,113,032 字节
2 个目录 224,758,718,464 可用字节

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Connect success.
client1
Received: client1
hello
Received: hello
hello
Received: hello
goodafternoon
Received: goodafternoon
hhh
Received: hhh
quit

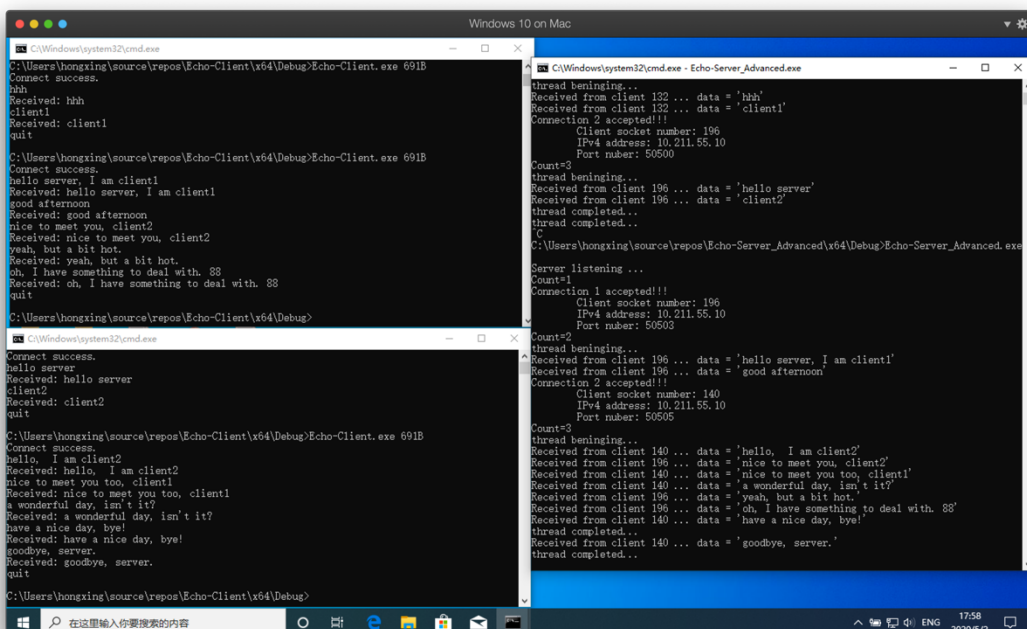
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>
Microsoft Windows [版本 10.0.18363.778]
(c) 2019 Microsoft Corporation. 保留所有权利。
C:\Users\hongxing> cd source\repos\Echo-Client
C:\Users\hongxing\source\repos\Echo-Client> cd x64\Debug
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Unable to connect to server!
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>
```

```
C:\Windows\system32\cmd.exe
3 个文件 1,044,972 字节
2 个目录 224,758,718,464 可用字节

C:\Users\hongxing\source\repos\Echo-Server\x64\Debug>Echo-Server.exe
Server listening...
Bytes received: 8
Received: client1
Bytes sent: 8
Bytes received: 7
Received: hello
Bytes sent: 7
Bytes received: 6
Received: hello
Bytes sent: 6
Bytes received: 14
Received: goodafternoon
Bytes sent: 14
Bytes received: 4
Received: hhh
Bytes sent: 4
Connection closing...
```

客户端输入“quit”后连接关闭。

- 多对一应答：左边两个窗口将分别运行客户端程序，右边的一个窗口将运行多对一的服务端程序。



```
C:\Windows\system32\cmd.exe
Connect success.
hhh
Received: hhh
client1
Received: client1
quit

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Connect success.
hello server, I am client1
Received: hello server, I am client1
goodafternoon
Received: goodafternoon
nice to meet you, client2
Received: nice to meet you, client2
yeah, but a bit hot.
Received: yeah, but a bit hot.
oh, I have something to deal with. 88
Received: oh, I have something to deal with. 88
quit

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>
Microsoft Windows [版本 10.0.18363.778]
(c) 2019 Microsoft Corporation. 保留所有权利。
C:\Users\hongxing> cd source\repos\Echo-Client
C:\Users\hongxing\source\repos\Echo-Client> cd x64\Debug
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Connect success.
hello server
Received: hello server
client2
Received: client2
quit

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>
Microsoft Windows [版本 10.0.18363.778]
(c) 2019 Microsoft Corporation. 保留所有权利。
C:\Users\hongxing> cd source\repos\Echo-Client
C:\Users\hongxing\source\repos\Echo-Client> cd x64\Debug
C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>Echo-Client.exe 691B
Connect success.
hello, I am client2
Received: hello, I am client2
nice to meet you too, client1
Received: nice to meet you too, client1
a wonderful day, isn't it?
Received: a wonderful day, isn't it?
have a nice day, bye!
Received: have a nice day, bye!
goodbye, server.
Received: goodbye, server.
quit

C:\Users\hongxing\source\repos\Echo-Client\x64\Debug>
```

```
C:\Windows\system32\cmd.exe - Echo-Server_Advanced.exe
Thread beninging...
Received from client 132 ... data = 'hhh'
Received from client 132 ... data = 'client1'
Connection 2 accepted!!!
Client socket number: 196
IPv4 address: 10.211.55.10
Port nuber: 50500
Count=3
Thread beninging...
Received from client 196 ... data = 'hello server'
Received from client 196 ... data = 'client2'
Thread completed...
Thread completed...
C
C:\Users\hongxing\source\repos\Echo-Server_Advanced\x64\Debug>Echo-Server_Advanced.exe
Server listening ...
Connection 1 accepted!!!
Client socket number: 196
IPv4 address: 10.211.55.10
Port nuber: 50503
Count=2
Thread beninging...
Received from client 196 ... data = 'hello server, I am client1'
Received from client 196 ... data = 'goodafternoon'
Connection 2 accepted!!!
Client socket number: 140
IPv4 address: 10.211.55.10
Port nuber: 50505
Count=3
Thread beninging...
Received from client 140 ... data = 'hello, I am client2'
Received from client 196 ... data = 'nice to meet you, client2'
Received from client 140 ... data = 'nice to meet you, client1'
Received from client 140 ... data = 'a wonderful day, isn't it?'
Received from client 196 ... data = 'yeah, but a bit hot.'
Received from client 196 ... data = 'oh, I have something to deal with. 88'
Received from client 140 ... data = 'have a nice day, bye!'
Thread completed...
Received from client 140 ... data = 'goodbye, server.'
Thread completed...
```

先运行服务端程序，再同时打开两个客户端，发现两个客户端均显示连接成功。同时发送消息发现服务端能同时处理并应答两个客户端的消息。说明服务端能同时处理多个客户端的连接。

三、问题与思考

本次实验利用 winsock 编程我们实现了简单的客户端与服务器应答。其中一对一应答让我深刻理解了客户端与服务端从创建 socket 到断开连接关闭 socket 的一整个流程，并能够应用于实际。其实在上学期的计算机通信网络课程的大作业里，我也是运用了 socket 编程实现了一个功能较全的聊天软件的客户端与服务端，由于是初次使用，在网上查找了不少关于 socket 编程的资料，对其过程有比较深的印象，因此在本课上系统地学习并实践 socket 编程很有亲切感，也加深了对它的理解。只不过在上学期我是用 python 实现的，其 socket 库对 socket 编程的函数封装得很好，而本科上使用 C++ 进行 socket 编程，展现了函数的更多细节，对 socket 编程的理解也更有利。