



Final Project- Simple FTP Client

BUPT/QMUL
2019-5-9



北京邮电大学

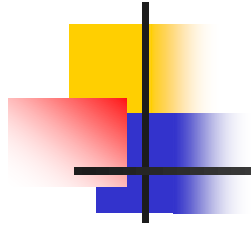
BEIJING UNIVERSITY OF POSTS AND TELECOMMUNICATIONS

Electronic Engineering 



Content

- Introduction
- Using *nc* command to connect FTP server
 - To learn about passive and active mode, control connection and data connection of FTP
- Using **Wireshark** to get familiar with FTP
 - To learn about the communication procedure, commands and replies of FTP



Introduction



About the Project

- A simple FTP client
 - Implement all the content of **Project Requirements**
 - Use C language in Linux operation system
 - Use gcc compiler and gdb debug tool
 - Use CLI (Command Line Interface) as input & output
- Important date
 - Program check: before the end of lab time in week 16
 - Source code and the report are required to be submitted
 - FTP: 10.3.255.85
 - User name/password: gjxy-project/student
 - Deadline: before 22:00, 2019-06-16 (UTC+8)



Documents to read

- *ftp client project-requirements-20190509*
 - Basic requirements – should be implemented
 - Extension requirements – if possible
- 实验指导书-20190509
 - Some helpful information for reference
- ftp client project report-20190509
 - Sample report for reference
- main.c
 - Program infrastructure for reference
 - Note: This is just a reference. You can definitely follow your own design rule.



Using nc to connect FTP server (I)

■ To learn about **passive mode**,
control connection and data connection
of FTP



nc command

- nc (netcat)
- Function: open TCP connections, send UDP packets, listen on arbitrary TCP and UDP ports, do port scanning, and deal with both IPv4 and IPv6
- Parameters
 - -4: for IPv4
 - -l: listen for an incoming connection
 - -v: give more verbose output



Objective

- Use nc to login FTP server
- Learn how to open control connection and data connection (**Passive mode**)
- Understand the functionality of control connection and data connection
- Learn the communication procedure, commands and replies of FTP

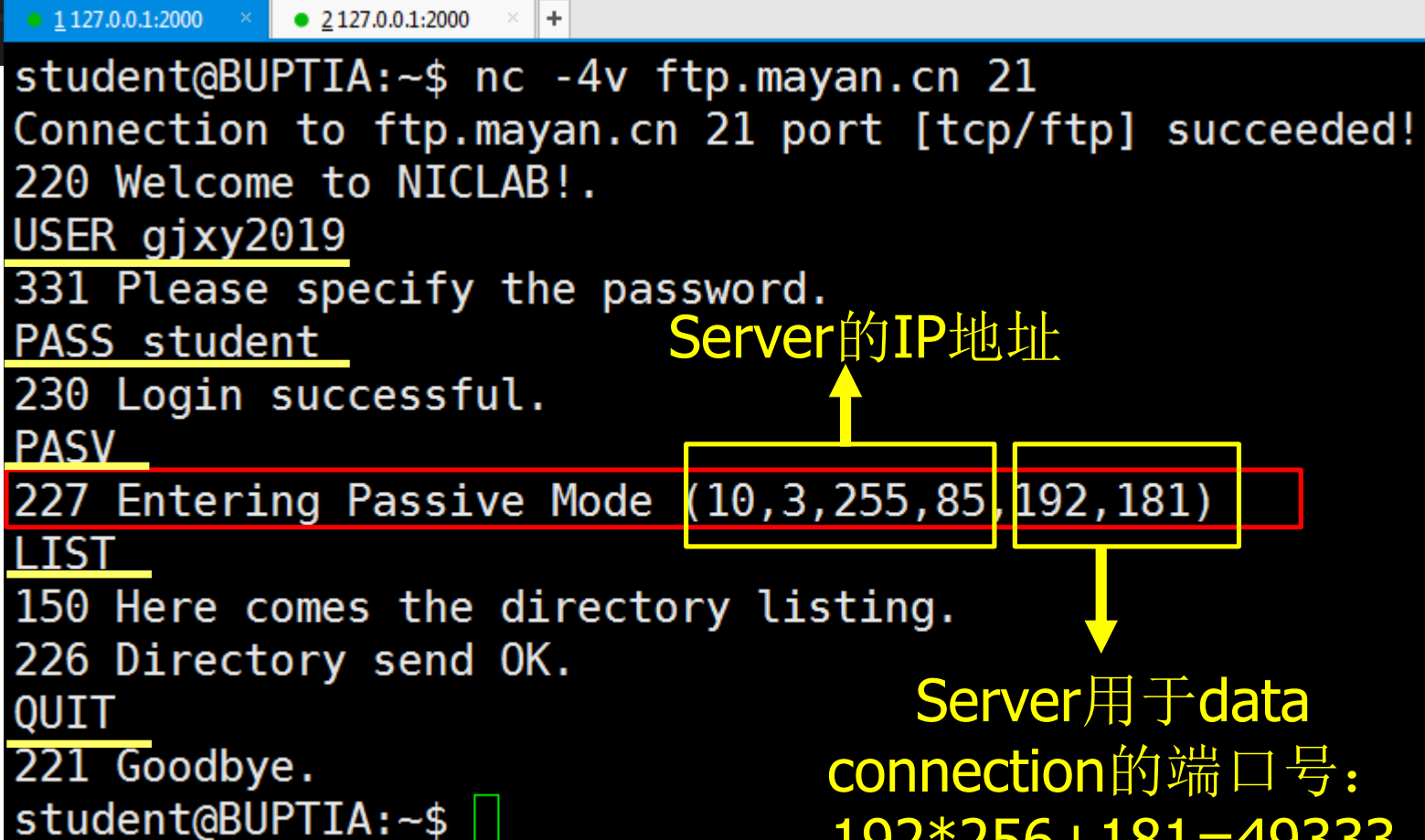


Steps

Note: After connecting to FTP server using *nc*, you should use control commands in the following steps.

- 1. Using nc to connect to given FTP server
 - \$ nc -4v ftp.mayan.cn 21
- 2. login using username "gjxy2019" and password "student"
- 3. Input command "PASV", calculate port number for data connections: *port* = $p1 \times 256 + p2$, p1 and p2 are taken from the server's reply
- 4. Using another terminal to set up data connection
 - \$ nc -4v ftp.mayan.cn *port*
- 5. Input command "LIST"

Example of FTP control connection



```
student@BUPTIA:~$ nc -4v ftp.mayan.cn 21
Connection to ftp.mayan.cn 21 port [tcp/ftp] succeeded!
220 Welcome to NICLAB!.
USER gjxy2019
331 Please specify the password.
PASS student
230 Login successful.
PASV
227 Entering Passive Mode (10,3,255,85,192,181)
LIST
150 Here comes the directory listing.
226 Directory send OK.
QUIT
221 Goodbye.
student@BUPTIA:~$
```

Server的IP地址

Server用于data connection的端口号:
 $192 \times 256 + 181 = 49333$

Example of FTP data connection

- After inputting command "LIST" in terminal of command connection, it displays in terminal of data connection:

```
student@BUPTIA:~$ nc -4v ftp.mayan.cn 49333
Connection to ftp.mayan.cn 49333 port [tcp/*] succeeded!
-rwxr-xr-x 1 0 0 603493 Feb 24 14:34 0-Outline-20190225.pdf
-rwxr-xr-x 1 0 0 2002003 Feb 24 14:43 1-Introduction.pdf
-rwxr-xr-x 1 0 0 1582878 Mar 03 20:13 2-Network Definition & Layered Architecture-20190304.pdf
-rwxr-xr-x 1 0 0 983258 Mar 10 17:05 3-Network Programming-20190311.pdf
-rwxr-xr-x 1 0 0 500577 Mar 17 10:26 4-NetworkProgramming-2-20190318.pdf
-rwxr-xr-x 1 0 0 991421 Mar 24 18:25 5-NetworkProgramming-3-20190325.pdf
-rwxr-xr-x 1 0 0 2002510 Mar 31 18:04 6-DHCP-20190401.pdf
-rwxr-xr-x 1 0 0 33105 Mar 31 18:04 6-How DHCP Relay works-20190401.pdf
-rwxr-xr-x 1 0 0 1197536 Apr 07 22:15 7-DNS-20190408.pdf
-rwxr-xr-x 1 0 0 2340797 Apr 15 07:52 8-TELNET-20190415.pdf
-rwxr-xr-x 1 0 0 1524716 Apr 21 22:01 9-FTP-20190422.pdf
-rwxr-xr-x 1 0 0 2185131 Mar 03 20:14 Lab01-Setup-20190228.pdf
-rwxr-xr-x 1 0 0 249634 Mar 06 16:54 Lab02-Assignment.pdf
-rwxr-xr-x 1 0 0 985652 Mar 06 16:54 Lab02-IntroductionLinux(Part_I).pdf
-rwxr-xr-x 1 0 0 510838 Mar 10 17:05 Lab03-Assignment.pdf
-rwxr-xr-x 1 0 0 1437223 Mar 10 17:05 Lab03-IntroductionLinux(Part_II).pdf
-rwxr-xr-x 1 0 0 128570 Mar 17 10:26 Lab04-Assignment.pdf
-rwxr-xr-x 1 0 0 697961 Mar 24 18:25 Lab05~06-UDP.pdf
-rwxr-xr-x 1 0 0 723047 Apr 02 17:53 Lab06~07-Hostentry.pdf
-rwxr-xr-x 1 0 0 653 Mar 31 18:45 Lab06~07-hostentry.c
-rwxr-xr-x 1 0 0 252866 Apr 07 22:18 Lab07~08-TCP.pdf
```



Using nc to connect FTP server (II)

■ To learn about **active mode**, control connection and data connection of FTP

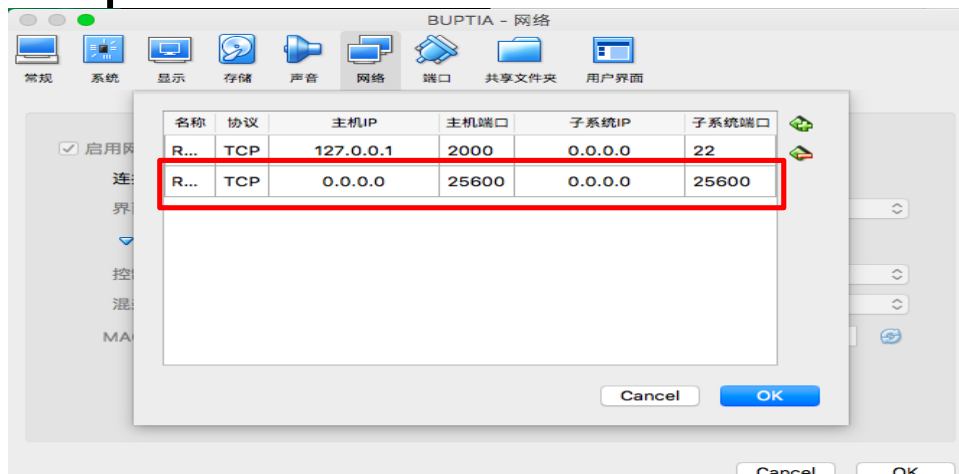


Objective

- Use nc to login FTP server
- Learn how to open control connection and data connection (**Active mode**)
- Fully understand the functionality of control connection and data connection
- Learn the communication procedure, commands and replies of FTP

Steps

- 1. Figure out ip address *ip1.ip2.ip3.ip4* of your physical machine
 - E.g. 10.3.255.115, *ip1=10 ip2=3 ip3=255 ip4=115*
- 2. Choose the last five digits of your student ID as a port number
 - E.g. 2016225600, *port=25600*
- 3. Set port forward rule in virtualbox

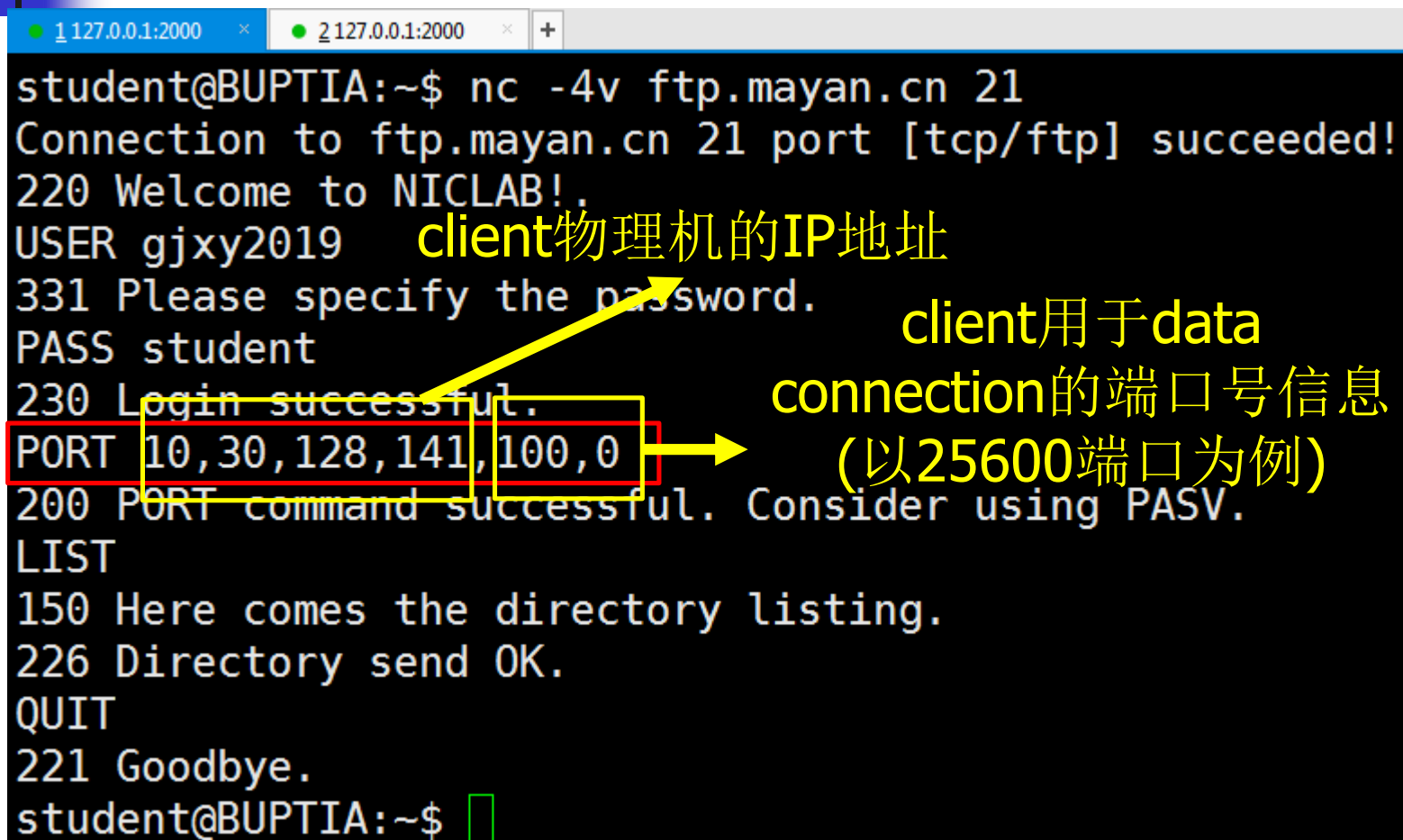




Steps

- 4. Using nc to connect to given FTP server
 - `$ nc -4v ftp.mayan.cn 21`
- 5. login using username "gjxy2019" and password "student"
- 6. Using another terminal to listen to data connection
 - Using IP address of eth0 in virtual machine
 - `$ nc -4lv ip-eth0 port`
- 7. Return to first terminal, calculate port number for data connections: $p1 = [port/256]$, $p2 = port - p1 * 256$, input command "PORT *ip1,ip2,ip3,ip4,p1,p2*"
- 8. Input command "LIST"
- Note: Firewall in physical machine may need to be closed **15**

Example of FTP control connection



The image shows a terminal window with two tabs, both displaying the IP address 127.0.0.1 and port 2000. The terminal output shows an FTP session initiated from a machine named student@BUPTIA. The user 'gjxy2019' logs in successfully. The 'PORT' command is used to specify the data connection port, with the value '10,30,128,141,100,0' highlighted by a red box. A yellow arrow points from this box to the text 'client物理机的IP地址'. Another yellow arrow points from the text 'client用于data connection的端口号信息 (以25600端口为例)' to the same red box. The session continues with a directory listing and ends with a goodbye message.

```
student@BUPTIA:~$ nc -4v ftp.mayan.cn 21
Connection to ftp.mayan.cn 21 port [tcp/ftp] succeeded!
220 Welcome to NICLAB!.
USER gjxy2019
331 Please specify the password.
PASS student
230 Login successful.
PORT 10,30,128,141,100,0
200 PORT command successful. Consider using PASV.
LIST
150 Here comes the directory listing.
226 Directory send OK.
QUIT
221 Goodbye.
student@BUPTIA:~$
```

client物理机的IP地址

client用于data connection的端口号信息
(以25600端口为例)

Example of FTP data connection

- After inputting command "LIST" in terminal of command connection, it displays in terminal of data connection:

```
student@BUPTIA:~$ nc -4lv 10.0.2.15 25600
Listening on [10.0.2.15] (family 2, port 25600)
Connection from [10.0.2.2] port 25600 [tcp/*] accepted (family 2, sport 20)
-rwxr-xr-x 1 0 0 603493 Feb 24 14:34 0-Outline-20190225.pdf
-rwxr-xr-x 1 0 0 2002003 Feb 24 14:43 1-Introduction.pdf
-rwxr-xr-x 1 0 0 1582878 Mar 03 20:13 2-Network Definition & Layered Architecture-20190304.pdf
-rwxr-xr-x 1 0 0 983258 Mar 10 17:05 3-Network Programming-20190311.pdf
-rwxr-xr-x 1 0 0 500577 Mar 17 10:26 4-NetworkProgramming-2-20190318.pdf
-rwxr-xr-x 1 0 0 991421 Mar 24 18:25 5-NetworkProgramming-3-20190325.pdf
-rwxr-xr-x 1 0 0 2002510 Mar 31 18:04 6-DHCP-20190401.pdf
-rwxr-xr-x 1 0 0 33105 Mar 31 18:04 6-How DHCP Relay works-20190401.pdf
-rwxr-xr-x 1 0 0 1197536 Apr 07 22:15 7-DNS-20190408.pdf
-rwxr-xr-x 1 0 0 2340797 Apr 15 07:52 8-TELNET-20190415.pdf
-rwxr-xr-x 1 0 0 1524716 Apr 21 22:01 9-FTP-20190422.pdf
-rwxr-xr-x 1 0 0 2185131 Mar 03 20:14 Lab01-Setup-20190228.pdf
-rwxr-xr-x 1 0 0 249634 Mar 06 16:54 Lab02-Assignment.pdf
-rwxr-xr-x 1 0 0 985652 Mar 06 16:54 Lab02-IntroductionLinux(Part_I).pdf
-rwxr-xr-x 1 0 0 510838 Mar 10 17:05 Lab03-Assignment.pdf
-rwxr-xr-x 1 0 0 1437223 Mar 10 17:05 Lab03-IntroductionLinux(Part_II).pdf
-rwxr-xr-x 1 0 0 128570 Mar 17 10:26 Lab04-Assignment.pdf
-rwxr-xr-x 1 0 0 697961 Mar 24 18:25 Lab05-06-UDP.pdf
-rwxr-xr-x 1 0 0 723047 Apr 02 17:53 Lab06-07-Hostentry.pdf
-rwxr-xr-x 1 0 0 653 Mar 31 18:45 Lab06-07-hostentry.c
```

Client虚拟机的IP地址



Servers to connect

- Our lab's ftp server with full privileges
 - <ftp.mayan.cn>
 - Username/Password: gjxylab/student
- Some public ftp servers that can be used for testing:
 - ftp.sjtu.edu.cn
 - You can use *anonymous* as user name and *guest* or an email address as password. E.g.:
 - anonymous, guest
 - anonymous, abc@123
 - ftp, ftp@



FTP control commands to try

- USER
- PASS
- PWD
- CDUP
- LIST
- STOR
- TYPE
- QUIT
- ...



Using Wireshark to get familiar with FTP

- To learn about the communication procedure, commands and replies of FTP



Objective

- Observe the replies from FTP server
- Learn about the function and usage of major FTP commands and reply codes
- Using Wireshark to capture FTP messages and learn about the message flow

Note: You should use user commands in the following steps.

How to connect to the FTP server

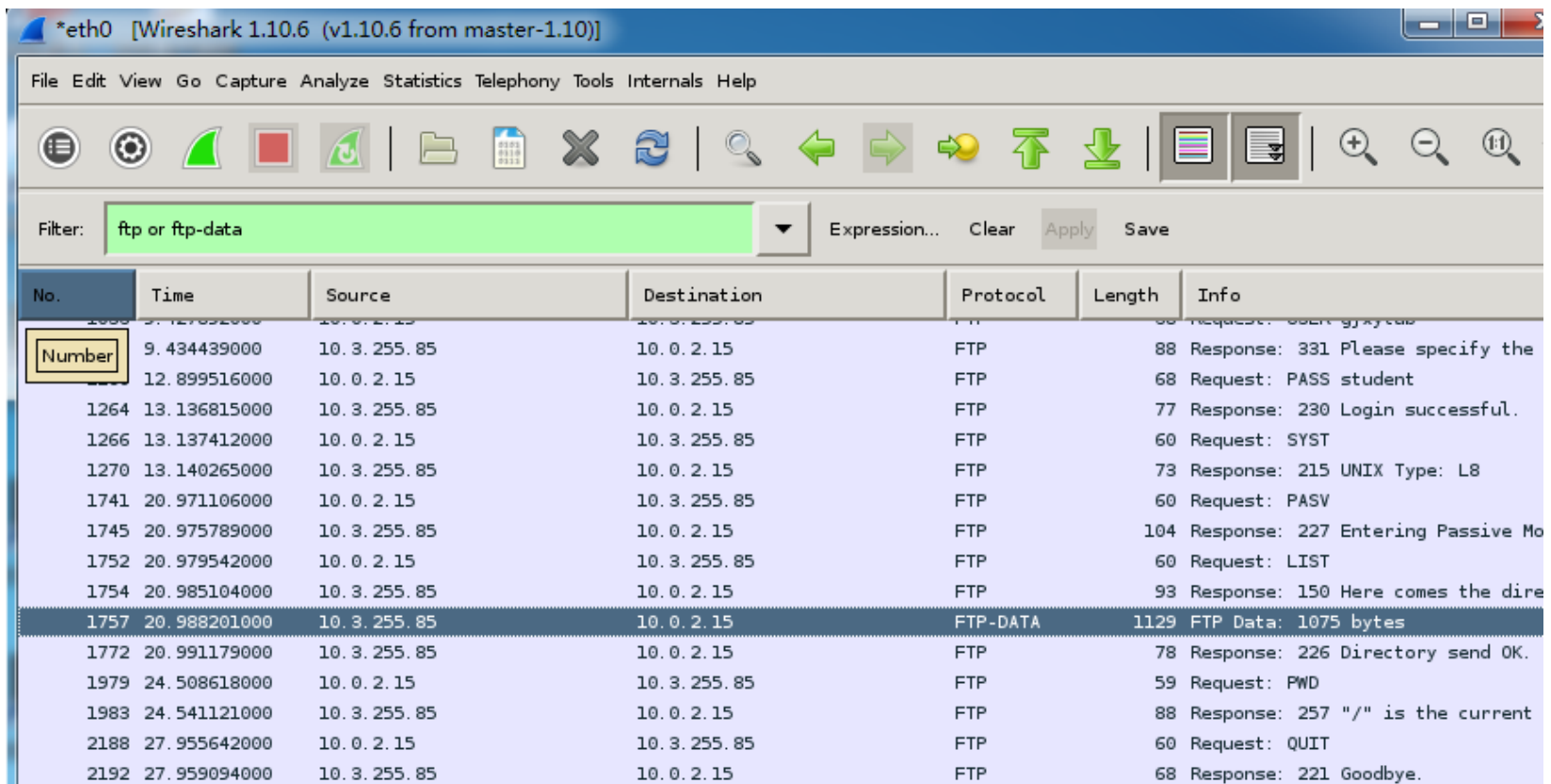
- In xShell or Terminal: Login virtual machine and start **wireshark** ;
- In another xShell or Terminal: Type user command as follows:

```
#ftp 10.3.255.85  
(This is the IP address of ftp.mayan.cn.)  
Name: gjxylab  
Password: student  
ftp> passive  
ftp> ls  
ftp> pwd  
ftp> get ** (** is the name of the file)  
ftp> put **  
ftp> binary  
ftp> ascii
```
- Try user commands: *ls, pwd, cd, put, get, type, ascii, binary, quit*
- Understand user command and FTP command using wireshark

Note: Only passive mode could be used because of the network configuration in VM. Please use *passive* command in ftp to switch to passive mode.

How to analyze FTP packets

- Set filter as: **ftp or ftp-data**

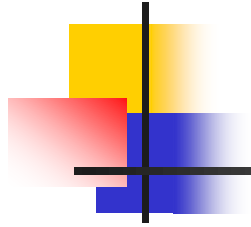


Wireshark 1.10.6 (v1.10.6 from master-1.10)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter: **ftp or ftp-data** Expression... Clear Apply Save

No.	Time	Source	Destination	Protocol	Length	Info
1264	13.136815000	10.3.255.85	10.0.2.15	FTP	77	Response: 230 Login successful.
1266	13.137412000	10.0.2.15	10.3.255.85	FTP	60	Request: SYST
1270	13.140265000	10.3.255.85	10.0.2.15	FTP	73	Response: 215 UNIX Type: L8
1741	20.971106000	10.0.2.15	10.3.255.85	FTP	60	Request: PASV
1745	20.975789000	10.3.255.85	10.0.2.15	FTP	104	Response: 227 Entering Passive Mode
1752	20.979542000	10.0.2.15	10.3.255.85	FTP	60	Request: LIST
1754	20.985104000	10.3.255.85	10.0.2.15	FTP	93	Response: 150 Here comes the directory listing
1757	20.988201000	10.3.255.85	10.0.2.15	FTP-DATA	1129	FTP Data: 1075 bytes
1772	20.991179000	10.3.255.85	10.0.2.15	FTP	78	Response: 226 Directory send OK.
1979	24.508618000	10.0.2.15	10.3.255.85	FTP	59	Request: PWD
1983	24.541121000	10.3.255.85	10.0.2.15	FTP	88	Response: 257 "/" is the current directory
2188	27.955642000	10.0.2.15	10.3.255.85	FTP	60	Request: QUIT
2192	27.959094000	10.3.255.85	10.0.2.15	FTP	68	Response: 221 Goodbye.



End