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Introduction to Application Layer and Basic Socket Programming
ITCS420 Computer Networks 1/2022
Lab 5: Work Sheet

Instructions: Work on this sheet and save as PDF with the file name "Lab5-SecX-StudentID.pdf" by replacing SecX and Student ID with your Section ID and Student ID, and upload to MyCourses.

Part 1: Basic Linux & networking commands

- **Follow the instructions in Slide #3-6 to set up Ubuntu on Virtual Box**
- **Play with Linux commands in Slide #7-10**

1. Type **ip address** command on the Terminal in Ubuntu. Capture the result and put your screenshot here.

```
muict@muict-VirtualBox:~$ ip address
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group defau
lt qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP g
roup default qlen 1000
    link/ether 08:00:27:f9:71:a4 brd ff:ff:ff:ff:ff:ff
    inet 10.34.14.65/24 brd 10.34.14.255 scope global dynamic noprefixroute enp
0s3
       valid_lft 84700sec preferred_lft 84700sec
    inet6 fe80::4903:4369:1210:428b/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
```

2. What are the HWaddr (ether) and the IP address (inet) of your computer. (Hints: *not* the loopback one)

HW Address: 08:00:27:f9:71:a4

IP Address: 10.34.14.65/24

The IP is private or public? **This is private**

3. Type below commands on the Terminal. Capture the result and put your screenshot here.
   clear
   date
   ifconfig

```
muict@muict-VirtualBox:~$ date
จ. 14 พ.ย. 2565 10:53:12 +07
muict@muict-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.34.14.65  netmask 255.255.255.0  broadcast 10.34.14
        inet6 fe80::4903:4369:1210:428b  prefixlen 64  scopeid 0x20
        ether 08:00:27:f9:71:a4  txqueuelen 1000  (Ethernet)
        RX packets 240388  bytes 344964181 (344.9 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 20461  bytes 1759189 (1.7 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 1763  bytes 217746 (217.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1763  bytes 217746 (217.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

4. What are the results after executed the command **netstat -lu** in Ubuntu?

```
muict@muict-VirtualBox:~$ netstat -lu
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
udp        0      0 localhost:domain        0.0.0.0:*
udp        0      0 0.0.0.0:mdns            0.0.0.0:*
udp        0      0 0.0.0.0:631             0.0.0.0:*
udp        0      0 0.0.0.0:52966           0.0.0.0:*
udp6       0      0 [::]:37919              [::]:*
udp6       0      0 [::]:mdns               [::]:*
```

- How many columns you see?
  Ans: 6 Columns
- What does each column mean? (Hints: use man command to see the explanation).

- Proto -> The protocol (tcp, udp, udpl, raw) used by the socket.
- **Recv-Q** -> The count of bytes not copied by the user program connected to this socket.
- **Send-Q** -> The count of bytes not acknowledged by the remote host.
- **Local Address** -> Address and port number of the local end of the socket.
- **Foreign Address** -> Address and port number of the remote end of the socket.
- **State** -> The state of the socket.

5. Use the command **cat /etc/hosts**. What are written inside this file? Explain.

```
muict@muict-VirtualBox:~$ cat /etc/hosts
127.0.0.1       localhost
127.0.1.1       muict-VirtualBox

# The following lines are desirable for IPv6 capable hosts
::1     ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

Part 2: Setting up and Configuring HTTP Server

Follow the instructions listed in Slide #13-14 to set up HTTP Server in Ubuntu

6. Once the Apache2 installation is done, what are the results after executed the command **netstat -nlt** in Ubuntu? How is it different from using **netstat –lt**?

netstat -nlt

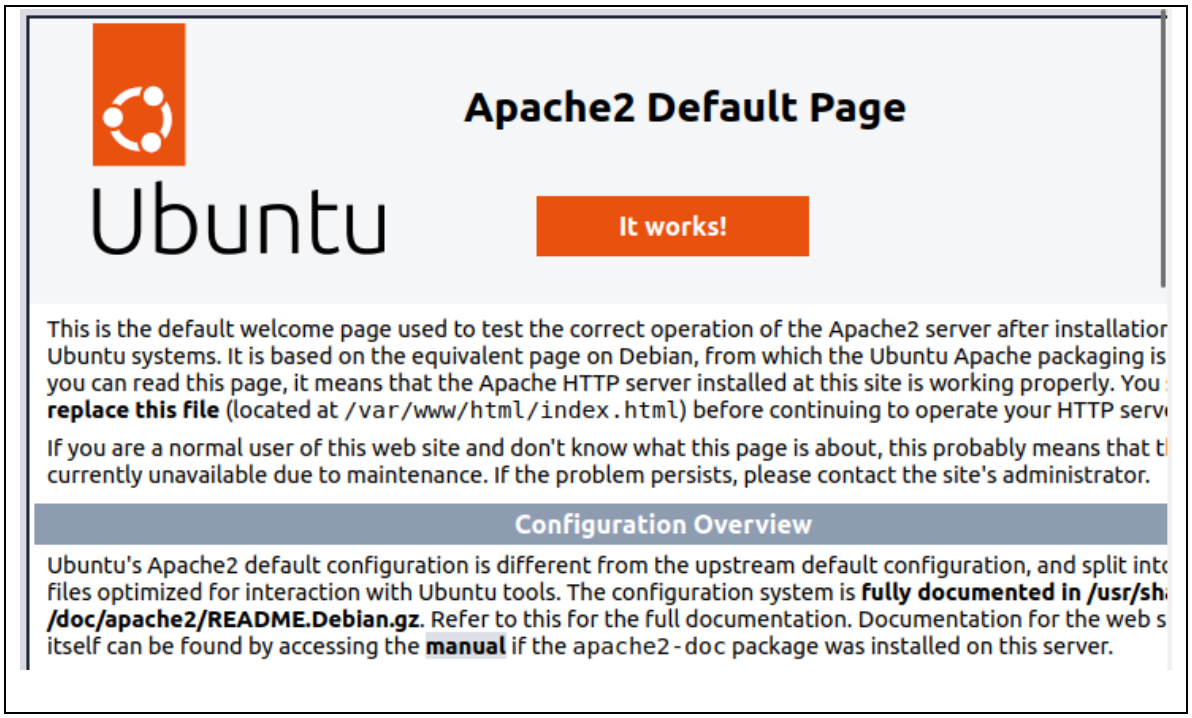
```
muict@muict-VirtualBox:~$ netstat -nlt
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN
tcp6       0      0 :::80                   :::*                    LISTEN
tcp6       0      0 ::1:631                 :::*                    LISTEN
```

netstat –lt

```
muict@muict-VirtualBox:~$ netstat -lt
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 localhost:ipp           0.0.0.0:*               LISTEN
tcp        0      0 localhost:domain        0.0.0.0:*               LISTEN
tcp6       0      0 [::]:http               [::]:*                  LISTEN
tcp6       0      0 ip6-localhost:ipp       [::]:*                  LISTEN
```

Ans: For netstat -nlt, it will change the name of the IP address that shows in netstat -lt to a numerical form such as localhost: ipp -> 127.0.0.1:631

7. Open a Firefox web browser in Ubuntu and type in **http://localhost** in the URL tab. Capture the output screen.

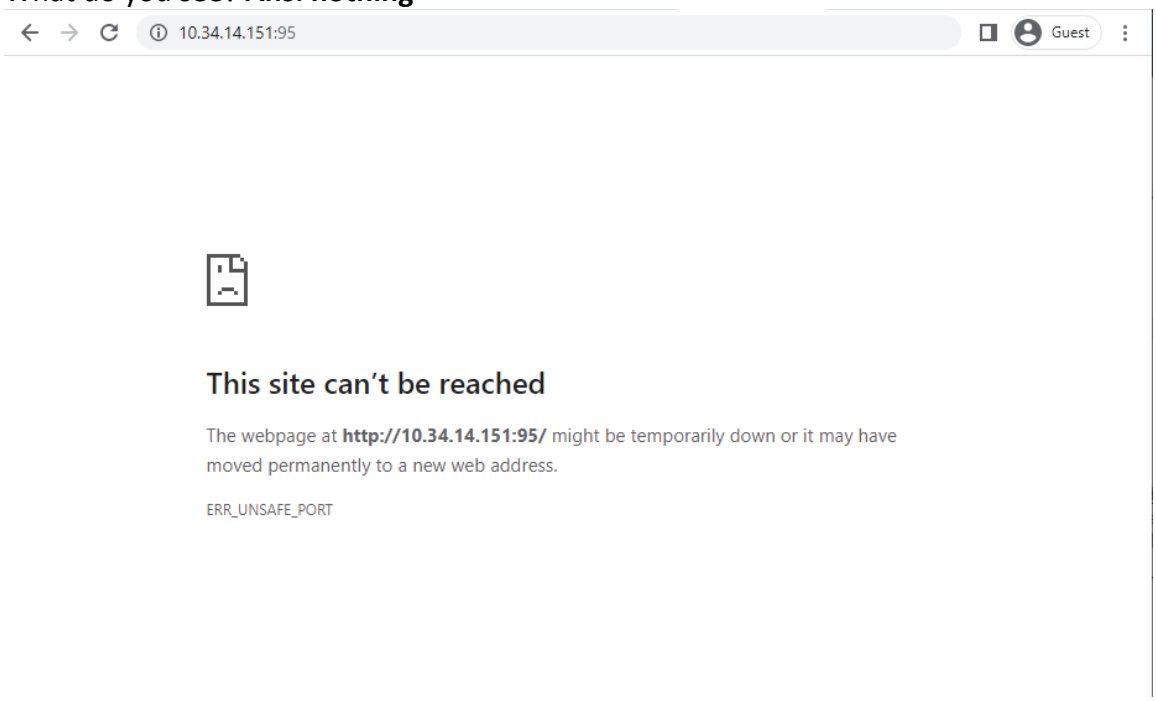


8. Now use the web browser on your host OS (e.g., Windows), type in the Ubuntu's IP address you got from Q2. Capture the output screen? Is it different from the results in Q7?

Ans: They are the same. There is no difference.

9. Use a web browser on Windows, type in **http://[ip address]:95** with the Ubuntu's IP address you have from Q2. Note that the number after colon is used to specify the server's port number. What do you see? Explain why!

What do you see? **Ans: nothing**

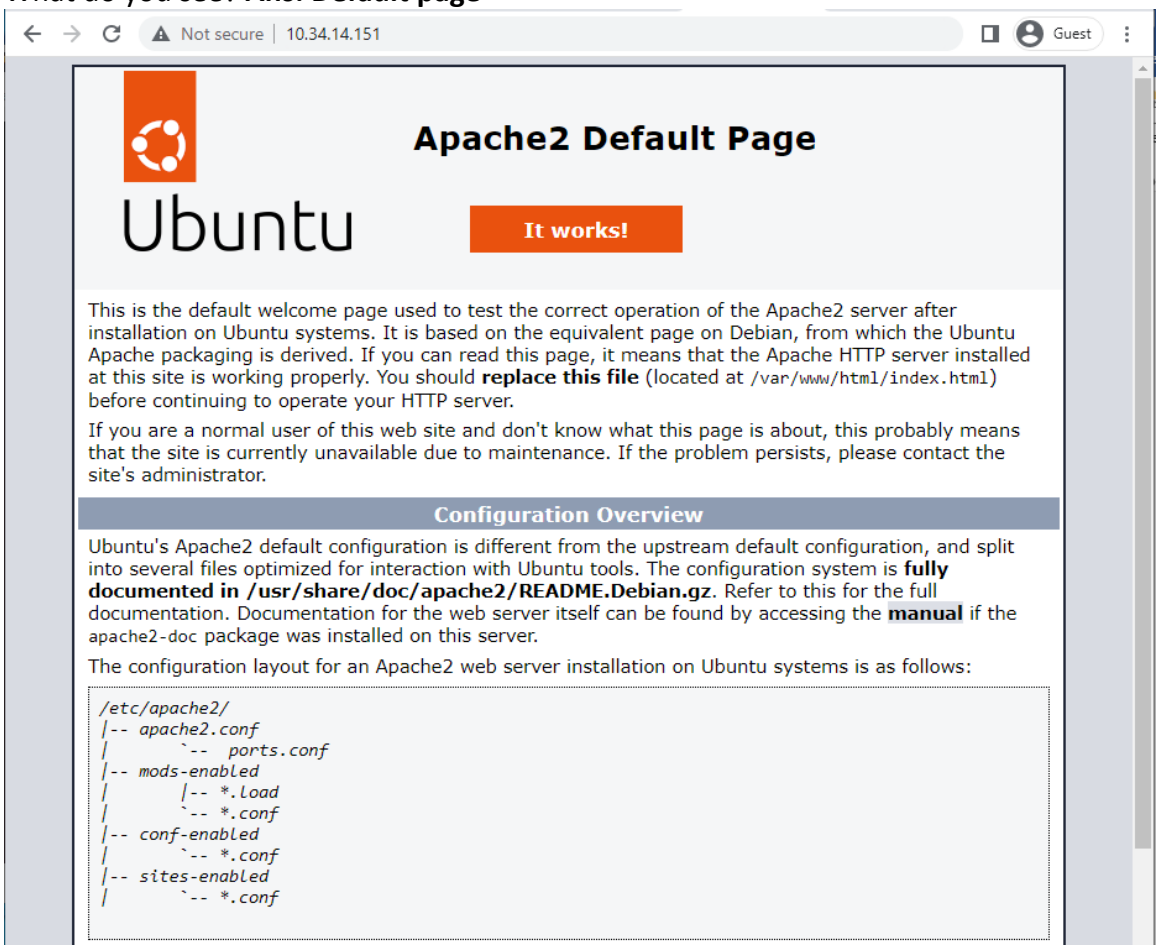


Why?

Ans: There is no result that is in port number 95.

10. Try to change the number 95 on the previous question to 80.

What do you see? **Ans: Default page**



Why?

Ans: Because the result has already been added to port 80.

11. Open the configuration file **/etc/apache2/sites-available/000-default.conf** by using command **less**. Where is the *defaul*t DocumentRoot?

Ans: DocumentRoot /var/www/html

12. Use the command **cd** to go to the directory you answered in Q11. Then, type command **ls -alg**. List the files you see in that folder. And explain what DocumentRoot directory is used for.

```
muict@muict-VirtualBox:/var/www/html$ ls -alg
total 20
drwxr-xr-x 2 root  4096 พ.ย.  15 14:42 .
drwxr-xr-x 3 root  4096 พ.ย.  15 14:42 ..
-rw-r--r-- 1 root 10671 พ.ย.  15 14:42 index.html
```

Ans: DocumentRoot is used to keep paths of the web server.

Follow the instructions listed in Slide #15-17 to configure Apache2 web server.

13. After you changed the DocumentRoot, open a Firefox web browser and type in **http://localhost** in the URL tab. Capture the screen shot of your browser.

Part 3: Understanding HTTP communication

We will use telnet from Ubuntu terminal to communicate with the server (through port 80). See Slide #18-19.

14. Make **GET** request to **http://www.testingmcafeesites.com/index.html**
    Answer following questions**.** Write down the **Telnet** commands you typed in.

telnet www.testingmcafeesites.com

Write down the **HTTP GET request and other parameters** you typed in to get the document. (Hints: Your answer must include two lines.)

GET /index.html HTTP/1.1

Host www.testingmcafeesites.com

Capture the screenshot of the **status line** and **the header lines** of the response you received from the GET request. Explain the status code. What is the server program used?

```
HTTP/1.1 200 OK
Date: Tue, 15 Nov 2022 08:12:02 GMT
Content-Type: text/html
Content-Length: 28634
Connection: keep-alive
Last-Modified: Fri, 08 Apr 2022 16:54:52 GMT
Accept-Ranges: bytes
ETag: "0d6835d694bd81:0"
Server: Microsoft-IIS/10.0
X-Powered-By: ASP.NET
SN: EC2AMAZ-BSL60ON
```

Ans: It shows the status line as 200 and the server program as Microsoft-IIS/10.0.

Next, we will use Curl to get a web page using HTTPS. Follow the instructions in Slide 20

15. Request a web page from https://mahidol.ac.th, capture the screenshot of the response header. What are the status code and the server being used?

```
muict@muict-VirtualBox:~/sec2-6388065$ curl -I https://mahidol.ac.th
HTTP/2 200
server: nginx/1.10.3 (Ubuntu)
date: Tue, 15 Nov 2022 08:20:58 GMT
content-type: text/html; charset=UTF-8
content-length: 81982
last-modified: Tue, 15 Nov 2022 07:35:10 GMT
accept-ranges: bytes
vary: Accept-Encoding
strict-transport-security: max-age=31536000; preload
cache-control: max-age=300
pragma: no-cache
expires: Tue, 15 Nov 2022 08:25:58 GMT
x-cache-status: EXPIRED
```

Status Code: 200
The server: nginx/1.10.3 (Ubuntu)

Part 4: Socket programming by Python

Learn the basic python and socket programing from Slide#27-36.

16. Follow the instructions in Slide 37-38, and write a **tcpserver.py** and **tcpclient.py** programs

- Paste the source codes of both client and server programs here.

Tcpserver.py

```
import socket
server = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
server.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEADDR,1)
server.bind(('127.0.0.1',41111))
print("Waiting for connection...")
server.listen(5)
while True:
        client, addr=  server.accept()
        print("Received a connection from %s" % str(addr))
        data = client.recv(1024)
        split = data.split()
        x = int(split[0])
        y = int(split[1])
        print ("6388014: "+ str(x) + " " + str(y))
        sendclient = x +y
        msg = str(sendclient)
        client.send(msg.encode())
        client.close()
        server.close()
```

Tcpclient.py

```
import socket
import time

client = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
client.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEADDR,1)
client.connect(('127.0.0.1', 41111))

msg = input("Enter two number")
t = time.localtime()

client.send(msg.encode('ascii'))
data = client.recv(1024)
print ("6388014 : %s" %time.asctime(t), data.decode())
client.close()
```

- Paste the screen output of server and client here. (Make sure your output looks like the provided example)

```
PS C:\Users\HP\Desktop\ICT_Year_3\Com net\Lab5> python3 tcpserver.py
Waiting for connection...
Received a connection from ('127.0.0.1', 61748)
6388014: 2 7

PS C:\Users\HP\Desktop\ICT_Year_3\Com net\Lab5> python3 tcpclient.py
Enter two number2 7
6388014 : Mon Nov 21 09:36:42 2022 9
```

17. Change your Python programs from the previous task to support **UDP**, and named the programs as **udpserver.py** and **udpclient.py**. (See Slide 39)

- Paste the source codes of both client and server programs here.

Udpserver.py

```
import socket
server = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
server.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEADDR,1)
server.bind((socket.gethostname(),2233))
print("Waiting for connection...")
client, addr = server.recvfrom(1024)
data = client.decode()
split = data.split()
a = int(split[0])
b = int(split[1])
print("6388014: server received from: ",str(addr)," with data ",str(data))
sendtoclient = str(a + b )
server.sendto(sendtoclient.encode(), addr)
server.close()
```

Udpclient.py

```
import socket
import time

sendtoserver = str(input("Enter two number: "))
client = socket.socket(socket.AF_INET,socket.SOCK_DGRAM)
client.setsockopt(socket.SOL_SOCKET,socket.SO_REUSEADDR,1)

msg = sendtoserver

client.sendto(sendtoserver.encode(), (socket.gethostname(), 2233))
data = client.recvfrom(1024)
t = time.localtime()
print("6388014: %s "% time.asctime(t), data[0].decode())

client.close()
```

- Paste the screen output of server and client here. (Make sure your output looks like the provided example)

```
PS C:\Users\HP\Desktop\ICT_Year_3\Com net\Lab5> python3 upserver.py
Waiting for connection...
6388014: server received from:  ('172.20.10.14', 53849)  with data  2 7
```

```
PS C:\Users\HP\Desktop\ICT_Year_3\Com net\Lab5> python3 upclient.py
Enter two number: 2 7
6388014: Mon Nov 21 09:37:27 2022  9
```