MAWLANA BHASHANI SCIENCE AND TECHNOLOGY UNIVERSITY,

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Lab Report No	**:**	06
Lab Report Name	**:**	Python for Networking
Course Name	**:**	Computer Networks Lab

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Objective :

The objective of the lab is to :

- Install python and use third-party libraries
- Interact with network interfaces using python
- Getting information from internet using Python

Theory :

Connection: In networking, a connection refers to pieces of related information that are transferred through a network. This generally infers that a connection is built before the data transfer (by following the procedures laid out in a protocol) and then is deconstructed at the end of the data transfer.

Packet: A packet is, generally speaking, the most basic unit that is transfered over a network. When communicating over a network, packets are the envelopes that carry our data (in pieces) from one end point to the other. Packets have a header portion that contains information about the packet including the source and destination, timestamps, network hops, etc. The main portion of a packet contains the actual data being transfered. It is sometimes called the body or the payload.

Network Interface: A network interface can refer to any kind of software interface to networking hardware. For instance, if you have two network cards in your computer, you can control and configure each network interface associated with them individually.A network interface may be associated with a physical device, or it may be a representation of a virtual interface. The "loopback" device, which is a virtual interface to the local machine, is an example of this.

LAN: LAN stands for "local area network". It refers to a network or a portion of a network that is not publicly accessible to the greater internet. A home or office network is an example of a LAN.

WAN: WAN stands for "wide area network". It means a network that is much more extensive than a LAN. While WAN is the relevant term to use to describe large, dispersed networks in general, it is usually meant to mean the internet, as a whole. If an interface is said to be connected to the WAN, it is generally assumed that it is reachable through the internet.

Protocol: A protocol is a set of rules and standards that basically define a language that devices can use to communicate.

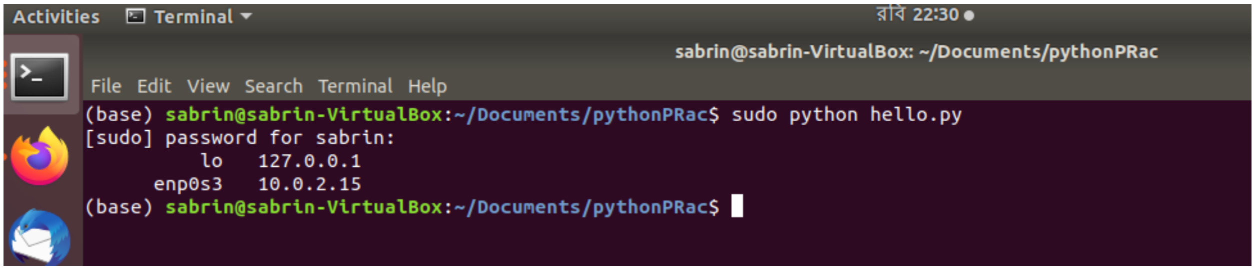
Firewall: A firewall is a program that decides whether traffic coming into a server or going out should be allowed. A firewall usually works by creating rules for which type of traffic is acceptable on which ports.

Exercise 4.1: Enumerating interfaces on your machine

Code :

```
import socket
import fcntl
import struct
import array

def all_interfaces():
    max_possible = 128  # arbitrary. raise if needed.
    bytes = max_possible * 32
    s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    names = array.array('B', '\0' * bytes)
    outbytes = struct.unpack('iL', fcntl.ioctl(
        s.fileno(),
        0x8912,  # SIOCGIFCONF
        struct.pack('iL', bytes, names.buffer_info()[0])
    ))[0]
    namestr = names.tostring()
    lst = []
    for i in range(0, outbytes, 40):
        name = namestr[i:i+16].split('\0', 1)[0]
        ip   = namestr[i+20:i+24]
        lst.append((name, ip))
    return lst

def format_ip(addr):
    return str(ord(addr[0])) + '.' + \
           str(ord(addr[1])) + '.' + \
           str(ord(addr[2])) + '.' + \
           str(ord(addr[3]))


ifs = all_interfaces()
for i in ifs:
    print "%12s   %s" % (i[0], format_ip(i[1]))
```

Output :



Exercise 4.2: Finding the IP address for a specific interface on your machine

Code :

```
import netifaces
def get_interfaces():

  interfaces = netifaces.interfaces()
  interfaces.remove('lo')

  out_interfaces = dict()

  for interface in interfaces:
    addrs = netifaces.ifaddresses(interface)
    out_addrs = dict()
    if netifaces.AF_INET in addrs.keys():
      out_addrs["ipv4"] = addrs[netifaces.AF_INET]
    if netifaces.AF_INET6 in addrs.keys():
      out_addrs["ipv6"] = addrs[netifaces.AF_INET6]
    out_interfaces[interface] = out_addrs

  return out_interfaces
print(get_interfaces())
```

Output :

```
{'enp0s3': {'ipv4': [{'addr': '10.0.2.15', 'netmask': '255.255.255.0', 'broadcast': '10.0.2.255'}], 'ipv6': [{'add
r': 'fe80::e9c6:14bf:8a03:312b%enp0s3', 'netmask': 'ffff:ffff:ffff:ffff::/64'}]}}
```

Exercise 4.3: Finding whether an interface is up on your machine

Code :

```
interfaces = netifaces.interfaces()
out_interfaces = dict()

for interface in interfaces:
    addrs = netifaces.ifaddresses(interface)
    out_addrs = dict()
    if netifaces.AF_INET in addrs.keys():
        out_addrs["ipv4"] = addrs[netifaces.AF_INET]
    if netifaces.AF_INET6 in addrs.keys():
        out_addrs["ipv6"] = addrs[netifaces.AF_INET6]
    out_interfaces[interface] = out_addrs
print(out_interfaces)
```

Output :

```
{'lo': {'ipv4': [{'addr': '127.0.0.1', 'netmask': '255.0.0.0', 'peer': '127.0.0.1'}], 'ipv6': [{'addr': '::1', 'ne
tmask': 'ffff:ffff:ffff:ffff:ffff:ffff:ffff:ffff/128'}]}, 'enp0s3': {'ipv4': [{'addr': '10.0.2.15', 'netmask': '25
5.255.255.0', 'broadcast': '10.0.2.255'}], 'ipv6': [{'addr': 'fe80::e9c6:14bf:8a03:312b%enp0s3', 'netmask': 'ffff:
ffff:ffff:ffff::/64'}]}}
```

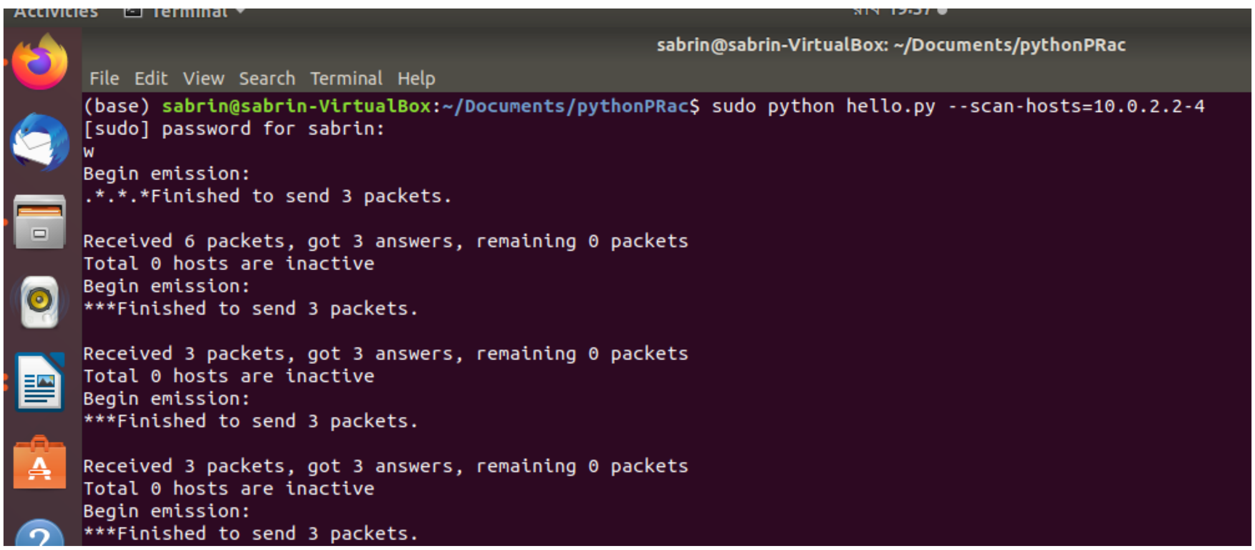
Exercise 4.4: Detecting inactive machines on your network

Code :

```
import argparse
import time
import sched
from scapy.layers.inet import *
RUN_FREQUENCY = 10
scheduler = sched.scheduler(time.time, time.sleep)
def detect_inactive_hosts(scan_hosts):

    global scheduler
    scheduler.enter(RUN_FREQUENCY, 1, detect_inactive_hosts, (scan_hosts, ))
    inactive_hosts = []
    try:
        ans, unans = sr(IP(dst=scan_hosts)/ICMP(), retry=0, timeout=1)
        #ans.summary(lambda(s,r) : r.sprintf("%IP.src% is alive"))
        for inactive in unans:
```

```
        print ("%s is inactive" %inactive.dst)
        inactive_hosts.append(inactive.dst)
      print ("Total %d hosts are inactive" %(len(inactive_hosts)))
    except KeyboardInterrupt:
      exit(0)
if __name__ == "__main__":
  parser = argparse.ArgumentParser(description='Python networking utils')
  parser.add_argument('--scan-hosts', action="store", dest="scan_hosts",
  required=False)
  given_args = parser.parse_args()
  scan_hosts = given_args.scan_hosts
  scheduler.enter(1, 1, detect_inactive_hosts, (scan_hosts, ))
  scheduler.run()
```

Output :



Exercise 4.5: Pinging hosts on the network with ICMP

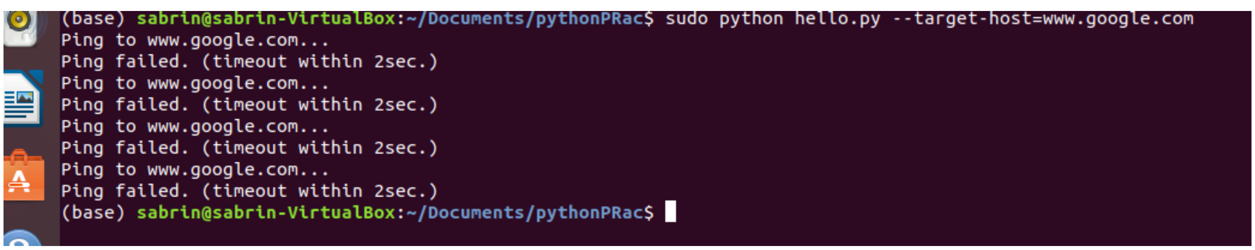
Code :

```
import os
import argparse
import socket
import struct
import select
import time
ICMP_ECHO_REQUEST = 8 # Platform specific
DEFAULT_TIMEOUT = 2
DEFAULT_COUNT = 4
class Pinger(object):

  def __init__(self, target_host, count=DEFAULT_COUNT,timeout=DEFAULT_TIMEOUT):
    self.target_host = target_host
    self.count = count
    self.timeout = timeout
  def do_checksum(self, source_string):
    sum = 0
    max_count = (len(source_string)/2)*2
    count = 0
    while count < max_count:
      val = ord(source_string[count + 1])*256
      ord(source_string[count])
      sum = sum + val
      sum = sum & 0xffffffff
      count = count + 2
    if max_count<len(source_string):
      sum = sum + ord(source_string[len(source_string) - 1])
      sum = sum & 0xffffffff
    sum = (sum >> 16) + (sum & 0xffff)
    sum = sum + (sum >> 16)
    answer = ~sum
    answer = answer & 0xffff
    answer = answer >> 8 | (answer << 8 & 0xff00)
    return answer
  def receive_pong(self, sock, ID, timeout):

    time_remaining = timeout
    while True:
      start_time = time.time()
      readable = select.select([sock], [], [], time_remaining)
```

```
        time_spent = (time.time() - start_time)
        if readable[0] == []: # Timeout
            return
        time_received = time.time()
        recv_packet, addr = sock.recvfrom(1024)
        icmp_header = recv_packet[20:28]
        type, code, checksum, packet_ID, sequence = struct.unpack(
        "bbHHh", icmp_header)
    if packet_ID == ID:
        bytes_In_double = struct.calcsize("d")
        time_sent = struct.unpack("d", recv_packet[28:28 +bytes_In_double])[0]
        return time_received - time_sent
    time_remaining = time_remaining - time_spent
    if time_remaining <= 0:
        return
def send_ping(self, sock, ID):

    target_addr = socket.gethostbyname(self.target_host)
    my_checksum = 0
    header = struct.pack("bbHHh", ICMP_ECHO_REQUEST, 0, my_checksum,ID, 1)
    bytes_In_double = struct.calcsize("d")
    data = (192 - bytes_In_double) * "Q"
    data = struct.pack("d", time.time()) + data

    my_checksum = self.do_checksum(header + data)
    header = struct.pack("bbHHh", ICMP_ECHO_REQUEST, 0, socket.htons(my_checksum), ID,
1)
    packet = header + data
    sock.sendto(packet, (target_addr, 1))
def ping_once(self):

    icmp = socket.getprotobyname("icmp")
    try:
        sock = socket.socket(socket.AF_INET, socket.SOCK_RAW, icmp)
    except socket.error(errno, msg):
        if errno == 1:

            msg += "ICMP messages can only be sent from root user processes"
            raise socket.error(msg)
    except Exception,e:
        print ("Exception: %s" %(e))
    my_ID = os.getpid() & 0xFFFF
    self.send_ping(sock, my_ID)
    delay = self.receive_pong(sock, my_ID, self.timeout)
```

```
      sock.close()
      return delay
    def ping(self):

      for i in xrange(self.count):
        print("Ping to %s..." % self.target_host)
        try:
          delay = self.ping_once()
        except socket.gaierror, e:
          print("Ping failed. (socket error: '%s')" % e[1])
          break
        if delay == None:
          print("Ping failed. (timeout within %ssec.)" % self.timeout)
        else:
          delay = delay * 1000
          print ("Get pong in %0.4fms" % delay)
if __name__ == '__main__':
  parser = argparse.ArgumentParser(description='Python ping')
  parser.add_argument('--target-host', action="store",dest="target_host", required=False)
  given_args = parser.parse_args()
  target_host = given_args.target_host
  pinger = Pinger(target_host=target_host)
  pinger.ping()
```

Output :



Exercise 4.6: Pinging hosts on the network with ICMP using pc resources

Code :

```
import subprocess
import shlex
command_line = "ping -c 1 10.0.2.15"
if __name__ == '__main__':
```

```
    args = shlex.split(command_line)
try:
    subprocess.check_call(args,stdout=subprocess.PIPE,stderr=subprocess.PIPE)
    print ("Sabrin your pc is up!")
except subprocess.CalledProcessError:
    print ("Sabrin your pc Failed to get ping.")
```

Output :

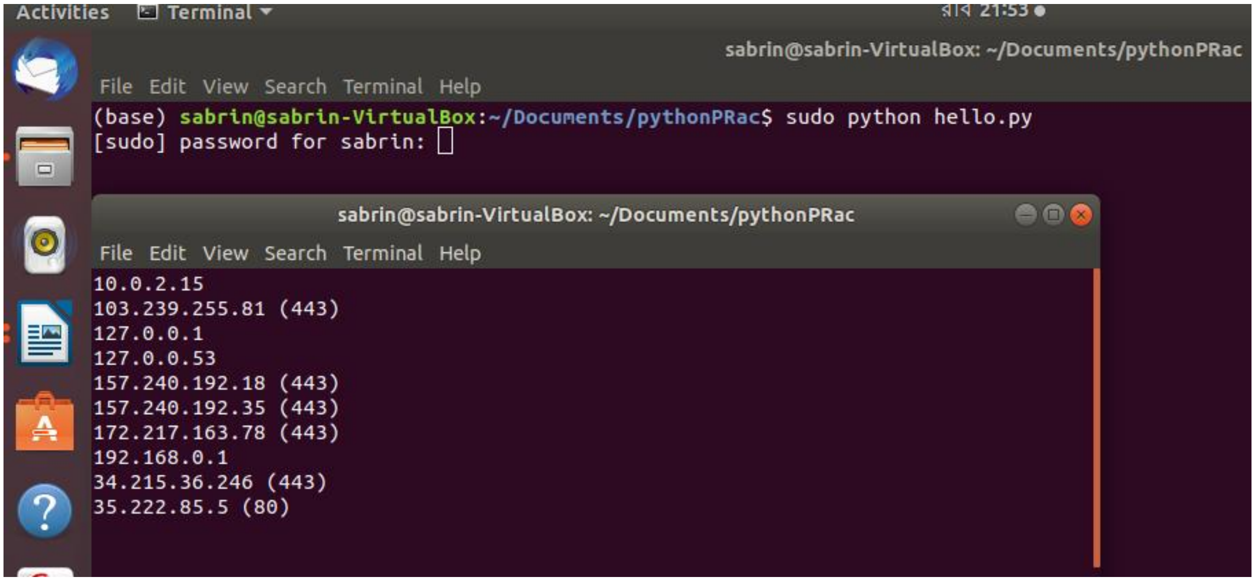
```
    print ("Sabrin your pc Failed to get ping.")

Sabrin your pc is up!
```

Exercise 4.7: Scanning the broadcast of packets

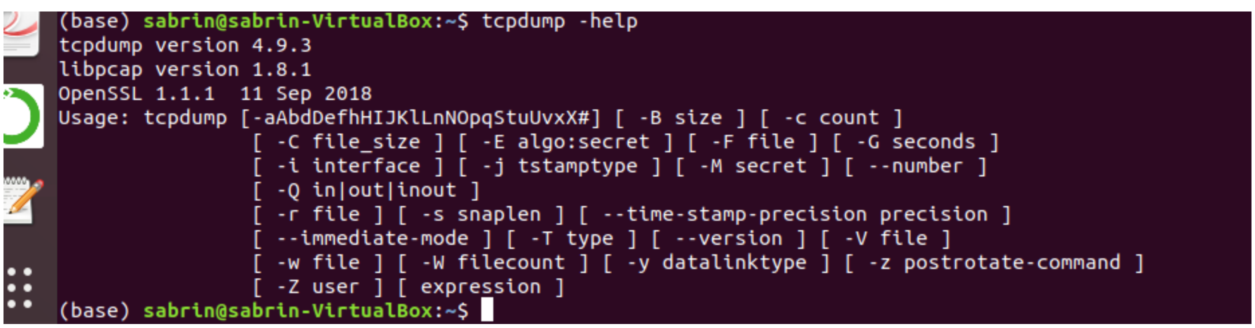
Code :

```
from scapy.all import *
from scapy.layers.inet import *
captured_data = dict()
END_PORT = 1000

def monitor_packet(pkt):
    if IP in pkt:
        if not captured_data.has_key(pkt[IP].src):
            captured_data[pkt[IP].src] = []
    if TCP in pkt:
        if pkt[TCP].sport <= END_PORT:
            if not str(pkt[TCP].sport) in captured_data[pkt[IP].src]:
                captured_data[pkt[IP].src].append(str(pkt[TCP].sport))
    os.system('clear')
    ip_list = sorted(captured_data.keys())
    for key in ip_list:
        ports=', '.join(captured_data[key])
        if len (captured_data[key]) == 0:
            print ('%s' % key)
        else:
            print ('%s (%s)' % (key, ports))
if __name__ == '__main__':
    sniff(prn=monitor_packet, store=0)
```

Output :



Exercise 4.8: Sniffing packets on your network



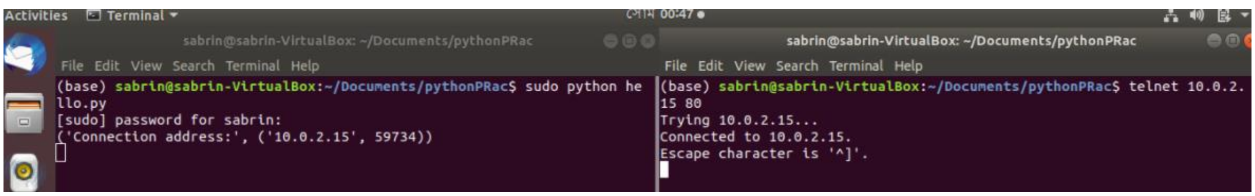
Exercise 4.9 : Performing a basic Telnet

Code :

```
import socket
TCP_IP = '10.0.2.15'
TCP_PORT = 80
```

```
BUFFER_SIZE = 20 # Normally 1024, but we want fast response
s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
s.bind((TCP_IP, TCP_PORT))
s.listen(1)
conn, addr = s.accept()
print ('Connection address:', addr)

while 1:
   data = conn.recv(BUFFER_SIZE)
   if not data: break
   print ("received data:", data)
   conn.send(data) # echo
conn.close()
```

Output:



Conclusion : Python provides two levels of access to network services. At a low level, you can access the basic socket support in the underlying operating system, which allows you to implement clients and servers for both connection-oriented and connectionless protocols. Python also has libraries that provide higher-level access to specific application-level network protocols, such as FTP, HTTP, and so on.

Sockets are the endpoints of a bidirectional communications channel. Sockets may communicate within a process, between processes on the same machine, or between processes on different continents.

To write Internet servers, we use the socket function available in socket module to create a socket object. A socket object is then used to call other functions to setup a socket server.

Now call bind(hostname, port) function to specify a port for our service on the given host.

Next, call the accept method of the returned object. This method waits until a client connects to the port we specified, and then returns a *connection* object that represents the connection to that client.