MAWLANA BHASHANI SCIENCE AND TECHNOLOGY UNIVERSITY

Lab Report: 03

Report Name: Python for Networking

Course code: ICT-3208

Course title: Computer Networks Lab

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SUBMITTED BY

Name: Shakhera khanom &
Masuk Mia

ID: IT-18033 & IT-18049

3rd year 2nd semester

Session: 2017-18

Department of ICT,

MBSTU.

SUBMITTED TO

Nazrul Islam

Assistant Professor

Department of ICT,

MBSTU.

Experiment No: 03

Experiment Name: Python for Networking.

Objectives:

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

Theory:

Third-party libraries: Although the Python's standard library provides a great set of awesome functionalities, there will be times that you will eventually run into the need of making use of third party libraries.

Networking Glossary: Before we begin discussing networking with any depth, we must define some common terms that you will see throughout this guide, and in other guides and documentation regarding networking.

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 your 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.

Protocol: A protocol is a set of rules and standards that basically define a language that devices can use to communicate. There are a great number of protocols in use extensively in networking, and they are often implemented in different layers. Some low level protocols are TCP, UDP, IP, and ICMP.

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. Generally, firewalls block ports that are not used by a specific application on a server.

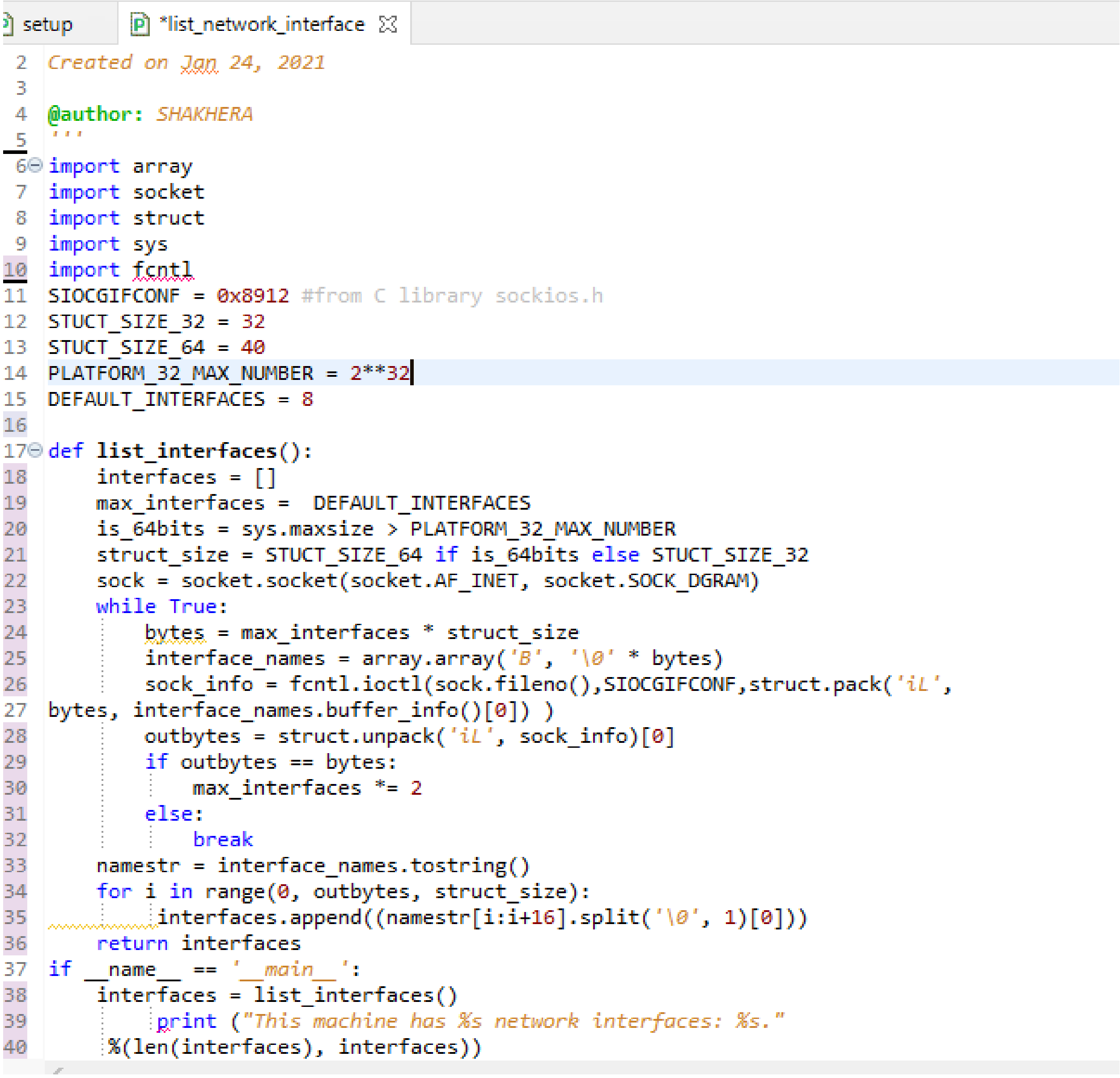
NAT: NAT stands for network address translation. It is a way to translate requests that are incoming into a routing server to the relevant devices or servers that it knows about in the LAN.

VPN: VPN stands for virtual private network. It is a means of connecting separate LANs through the internet, while maintaining privacy. This is used as a means of connecting remote systems as if they were on a local network, often for security reasons.

Interfaces: Interfaces are networking communication points for your computer. Each interface is associated with a physical or virtual networking device. Typically, your server will have one configurable network interface for each Ethernet or wireless internet card you have.

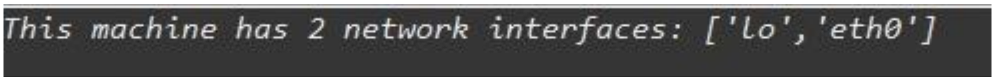
Exercise 4.1: Enumerating interfaces on your machine.

Code:



```
Created on Jan 24, 2021

@author: SHAKHERA
'''
import array
import socket
import struct
import sys
import fcntl
SIOCGIFCONF = 0x8912 #from C library sockios.h
STUCT_SIZE_32 = 32
STUCT_SIZE_64 = 40
PLATFORM_32_MAX_NUMBER = 2**32
DEFAULT_INTERFACES = 8

def list_interfaces():
    interfaces = []
    max_interfaces =  DEFAULT_INTERFACES
    is_64bits = sys.maxsize > PLATFORM_32_MAX_NUMBER
    struct_size = STUCT_SIZE_64 if is_64bits else STUCT_SIZE_32
    sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    while True:
        bytes = max_interfaces * struct_size
        interface_names = array.array('B', '\0' * bytes)
        sock_info = fcntl.ioctl(sock.fileno(),SIOCGIFCONF,struct.pack('iL',
bytes, interface_names.buffer_info()[0]) )
        outbytes = struct.unpack('iL', sock_info)[0]
        if outbytes == bytes:
            max_interfaces *= 2
        else:
            break
    namestr = interface_names.tostring()
    for i in range(0, outbytes, struct_size):
         interfaces.append((namestr[i:i+16].split('\0', 1)[0]))
    return interfaces
if __name__ == '__main__':
    interfaces = list_interfaces()
         print ("This machine has %s network interfaces: %s."
     %(len(interfaces), interfaces))
```

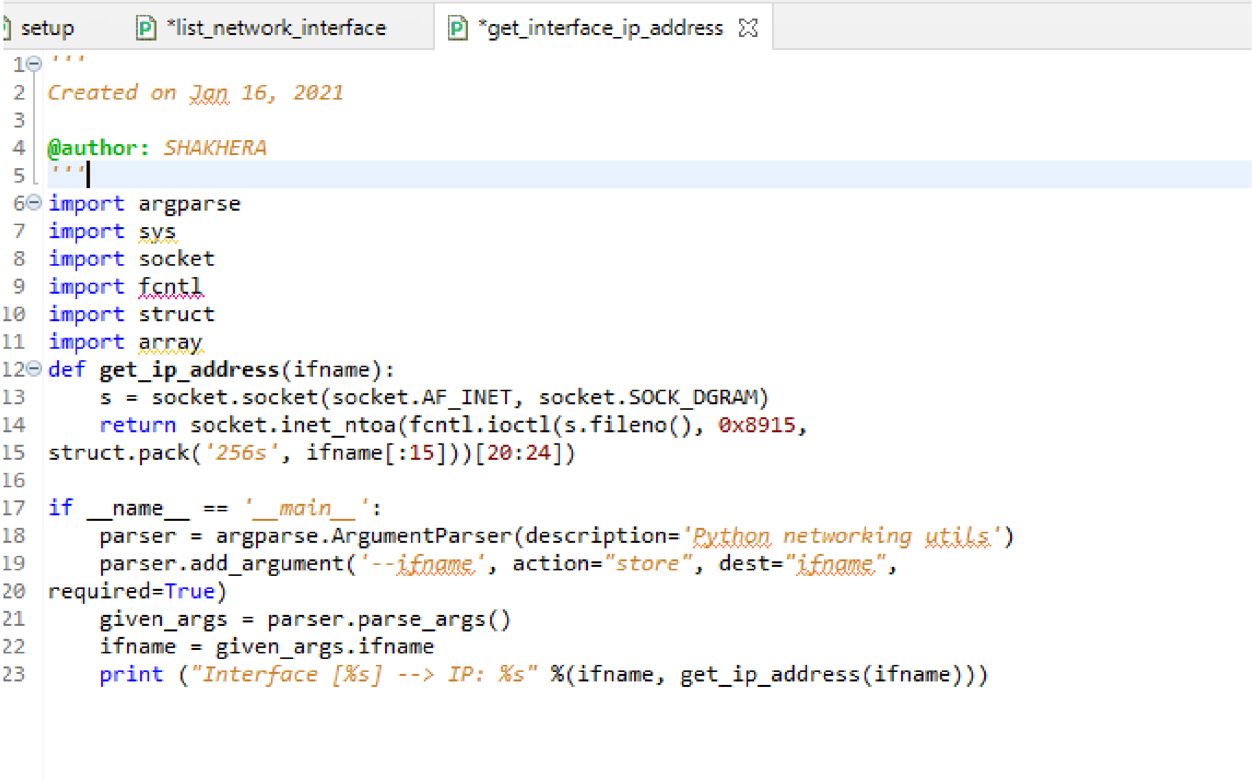
Output:



```
This machine has 2 network interfaces: ['lo','eth0']
```

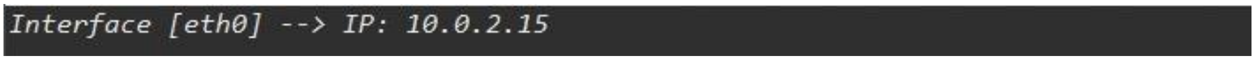
Exercise 4.2: Finding the IP address for a specific interface on your machine.

Code:



```
'''
Created on Jan 16, 2021

@author: SHAKHERA
'''
import argparse
import sys
import socket
import fcntl
import struct
import array
def get_ip_address(ifname):
    s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    return socket.inet_ntoa(fcntl.ioctl(s.fileno(), 0x8915,
struct.pack('256s', ifname[:15]))[20:24])

if __name__ == '__main__':
    parser = argparse.ArgumentParser(description='Python networking utils')
    parser.add_argument('--ifname', action="store", dest="ifname",
required=True)
    given_args = parser.parse_args()
    ifname = given_args.ifname
    print ("Interface [%s] --> IP: %s" %(ifname, get_ip_address(ifname)))
```

<u>Output:</u>

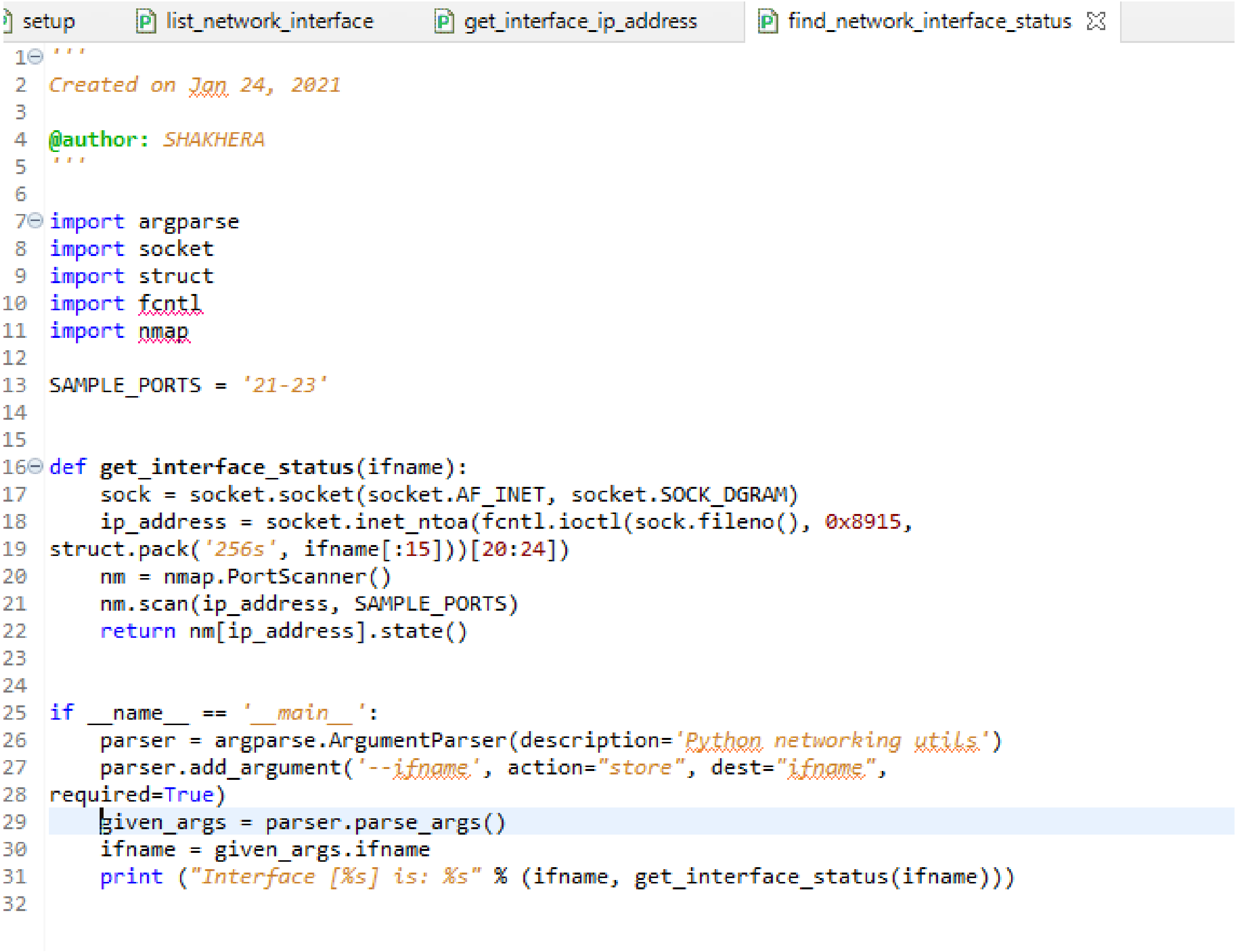


```
Interface [eth0] --> IP: 10.0.2.15
```

What is the purpose of parse module?
Answer:

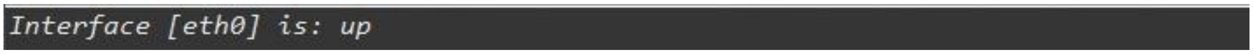
The parse module provides an interface to Python’s internal parser and byte-code compiler. The primary purpose for this interface is to allow Python code to edit the parse tree of a Python expression and create executable code from this.

Exercise 4.3: Finding whether an interface is up on your machine.
<u>Code:</u>



```python
'''
Created on Jan 24, 2021

@author: SHAKHERA
'''

import argparse
import socket
import struct
import fcntl
import nmap

SAMPLE_PORTS = '21-23'


def get_interface_status(ifname):
    sock = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
    ip_address = socket.inet_ntoa(fcntl.ioctl(sock.fileno(), 0x8915,
struct.pack('256s', ifname[:15]))[20:24])
    nm = nmap.PortScanner()
    nm.scan(ip_address, SAMPLE_PORTS)
    return nm[ip_address].state()


if __name__ == '__main__':
    parser = argparse.ArgumentParser(description='Python networking utils')
    parser.add_argument('--ifname', action="store", dest="ifname",
required=True)
    given_args = parser.parse_args()
    ifname = given_args.ifname
    print ("Interface [%s] is: %s" % (ifname, get_interface_status(ifname)))
```

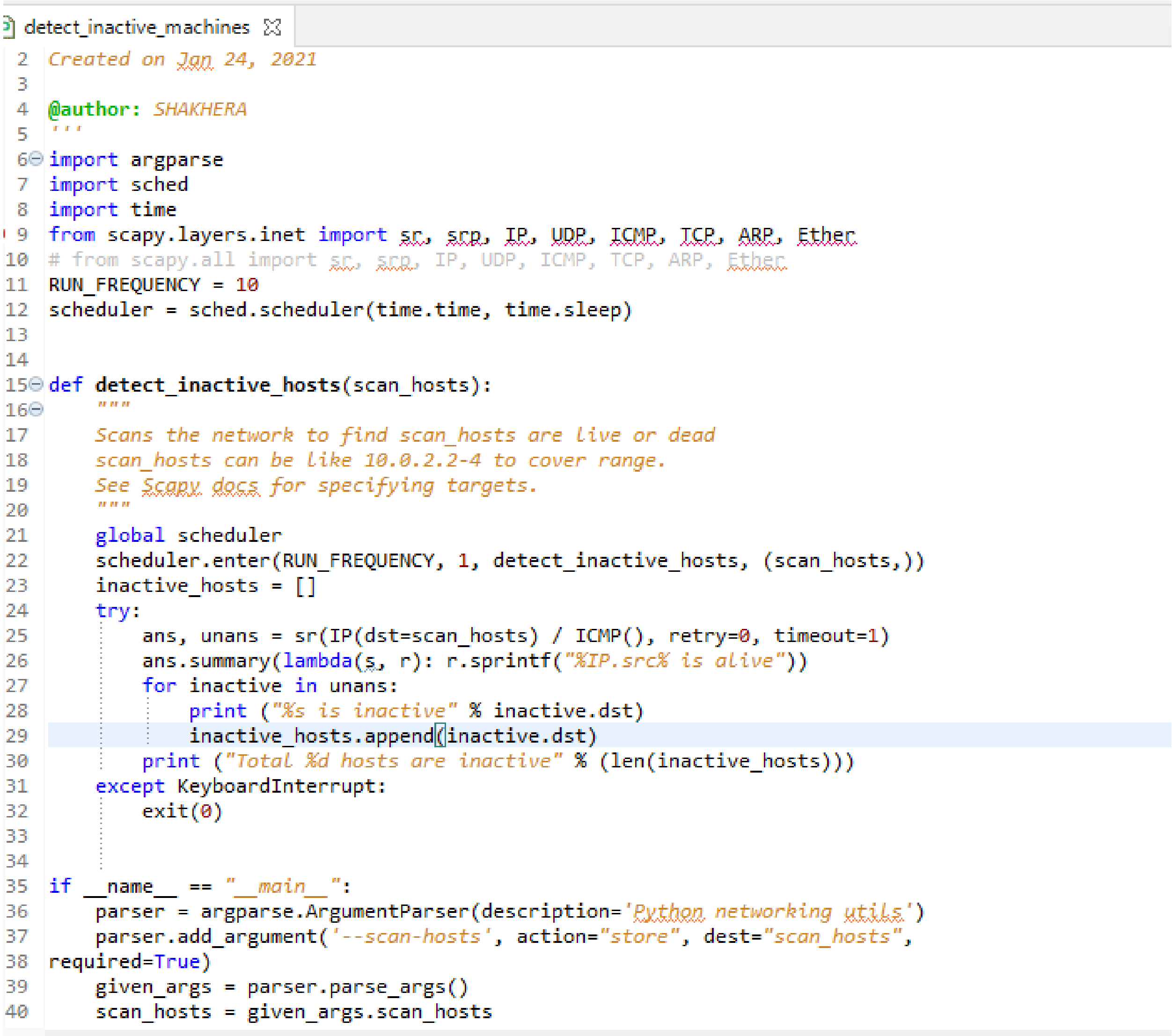
Output:



```
Interface [eth0] is: up
```

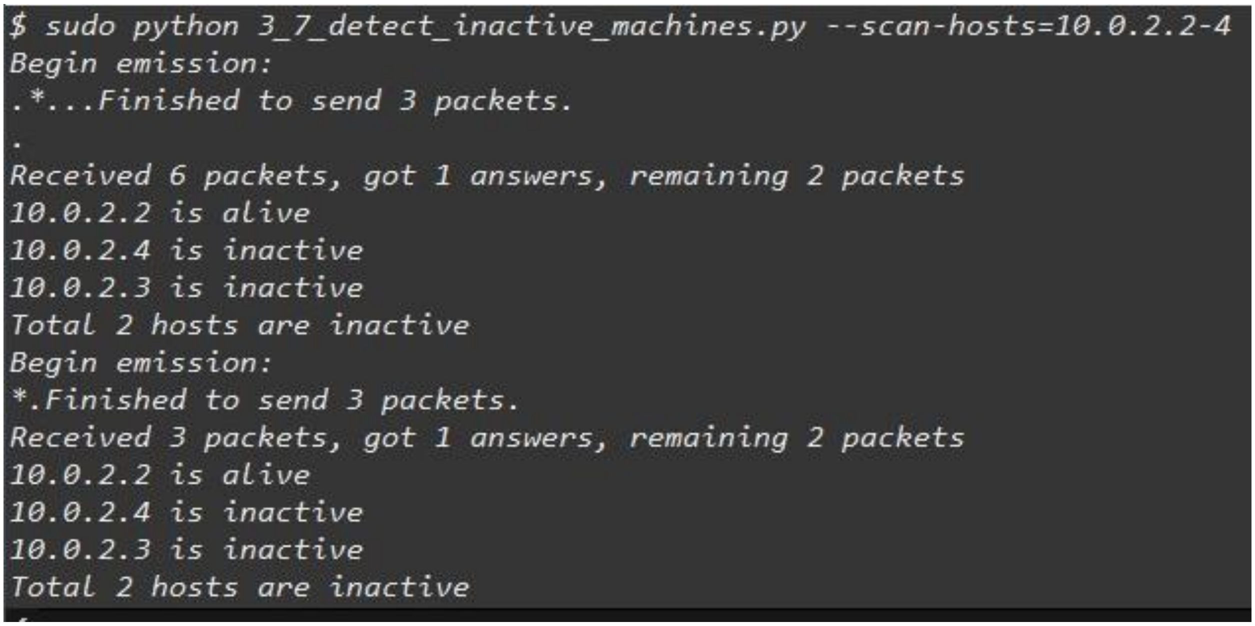
- **Exercise 4.4: Detecting inactive machines on your network.**

Code:



```
Created on Jan 24, 2021

@author: SHAKHERA
'''
import argparse
import sched
import time
from scapy.layers.inet import sr, srp, IP, UDP, ICMP, TCP, ARP, Ether
# from scapy.all import sr, srp, IP, UDP, ICMP, TCP, ARP, Ether
RUN_FREQUENCY = 10
scheduler = sched.scheduler(time.time, time.sleep)


def detect_inactive_hosts(scan_hosts):
    """
    Scans the network to find scan_hosts are live or dead
    scan_hosts can be like 10.0.2.2-4 to cover range.
    See Scapy docs for specifying targets.
    """
    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=True)
    given_args = parser.parse_args()
    scan_hosts = given_args.scan_hosts
```

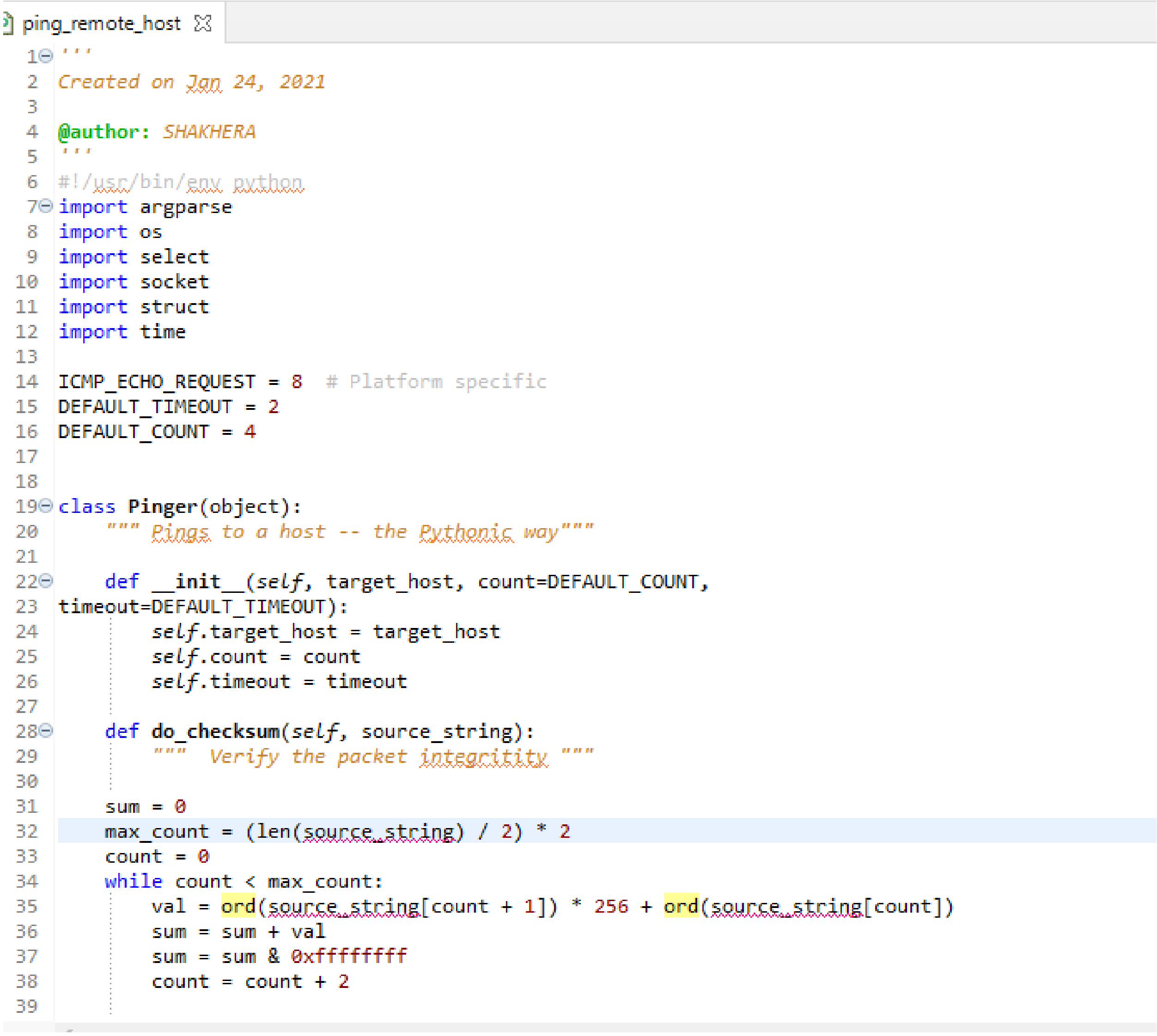
Output:



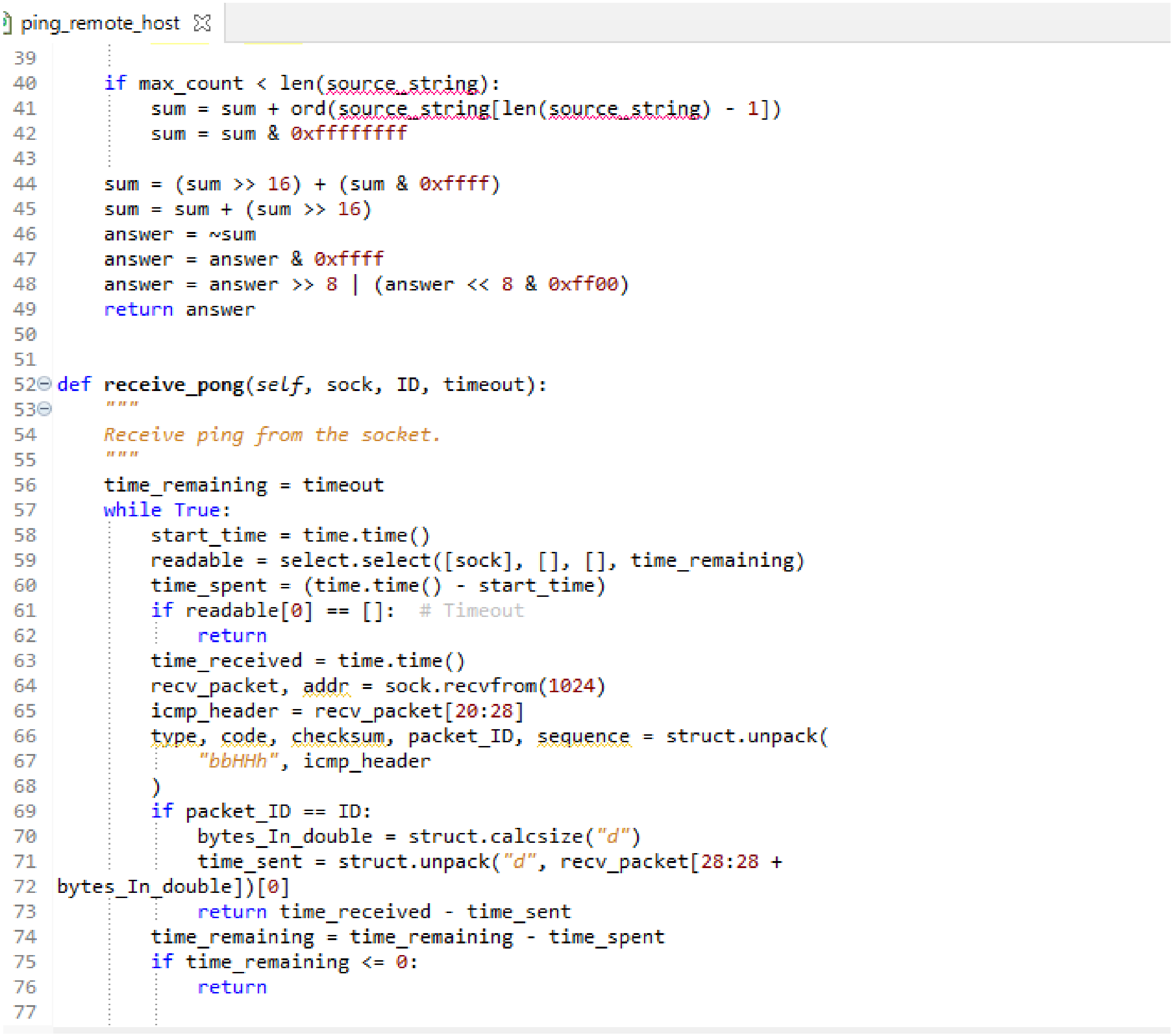
```
$ sudo python 3_7_detect_inactive_machines.py --scan-hosts=10.0.2.2-4
Begin emission:
.*...Finished to send 3 packets.
.
Received 6 packets, got 1 answers, remaining 2 packets
10.0.2.2 is alive
10.0.2.4 is inactive
10.0.2.3 is inactive
Total 2 hosts are inactive
Begin emission:
*.Finished to send 3 packets.
Received 3 packets, got 1 answers, remaining 2 packets
10.0.2.2 is alive
10.0.2.4 is inactive
10.0.2.3 is inactive
Total 2 hosts are inactive
```

Exercise 4.5: Pinging hosts on the network with ICMP.

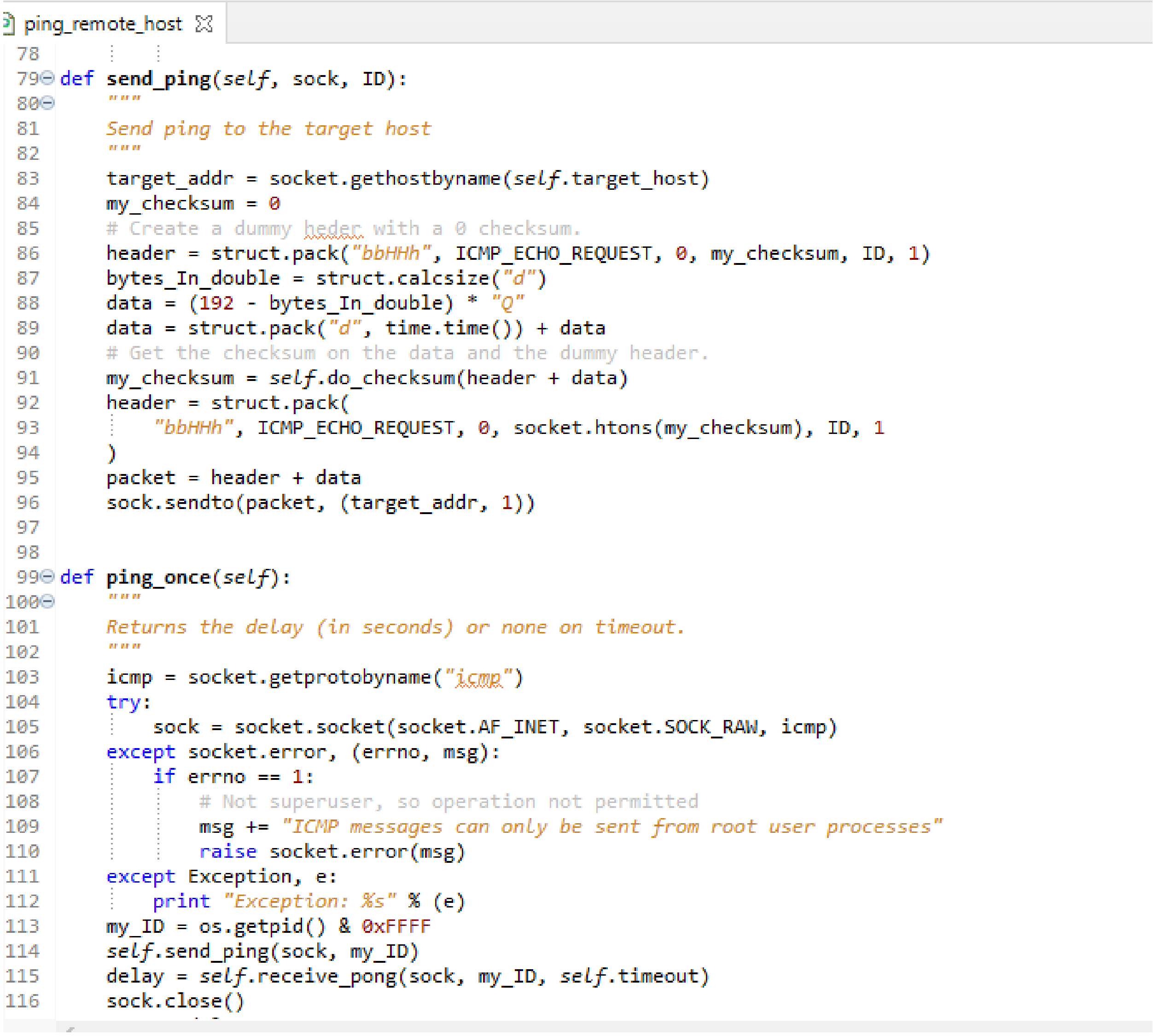
Code:



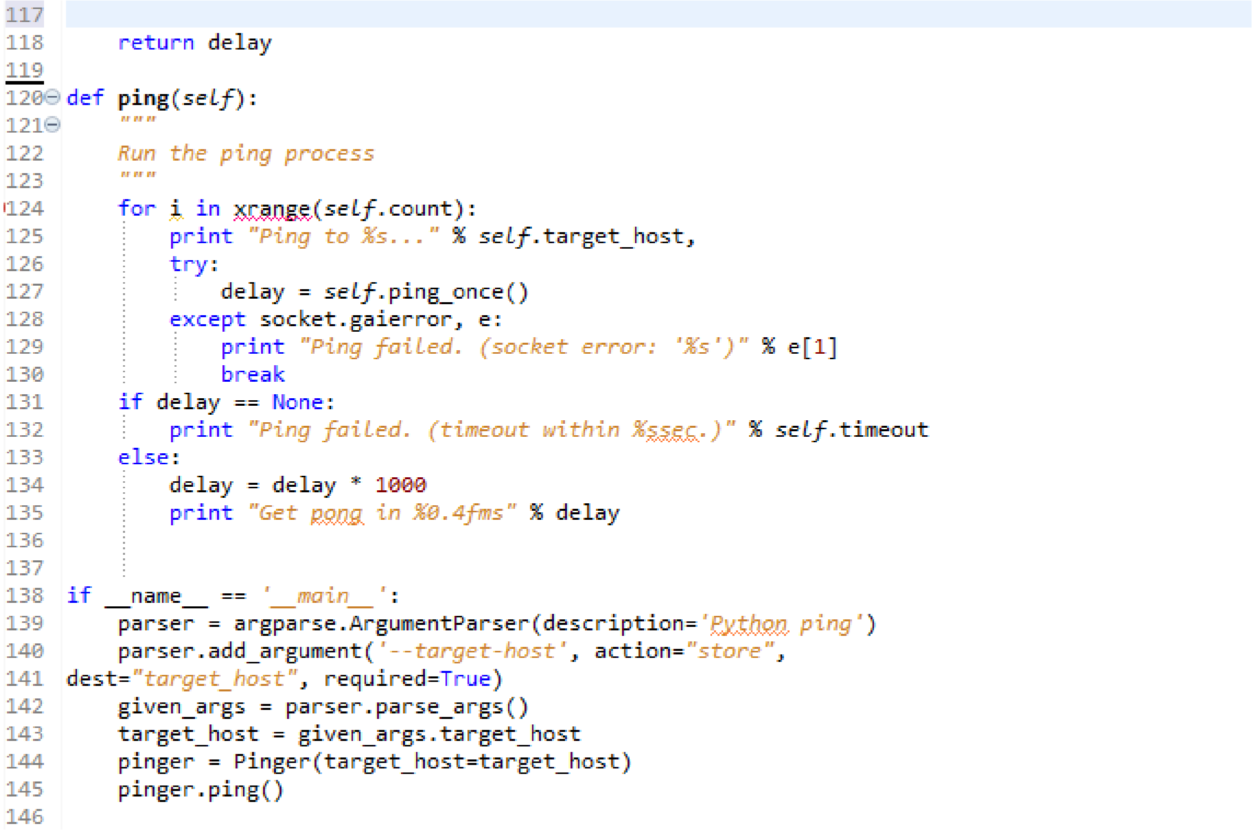
```python
'''
Created on Jan 24, 2021

@author: SHAKHERA
'''
#!/usr/bin/env python
import argparse
import os
import select
import socket
import struct
import time

ICMP_ECHO_REQUEST = 8  # Platform specific
DEFAULT_TIMEOUT = 2
DEFAULT_COUNT = 4


class Pinger(object):
    """ Pings to a host -- the Pythonic way"""

    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):
        """  Verify the packet integritity """

    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):
    """
    Receive ping from the socket.
    """
    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

```

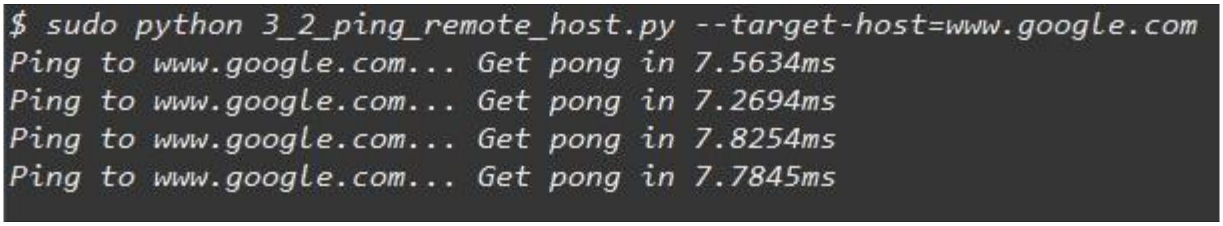


```python

def send_ping(self, sock, ID):
    """
    Send ping to the target host
    """
    target_addr = socket.gethostbyname(self.target_host)
    my_checksum = 0
    # Create a dummy heder with a 0 checksum.
    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
    # Get the checksum on the data and the dummy header.
    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):
    """
    Returns the delay (in seconds) or none on timeout.
    """
    icmp = socket.getprotobyname("icmp")
    try:
        sock = socket.socket(socket.AF_INET, socket.SOCK_RAW, icmp)
    except socket.error, (errno, msg):
        if errno == 1:
            # Not superuser, so operation not permitted
            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):
    """
    Run the ping process
    """
    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=True)
    given_args = parser.parse_args()
    target_host = given_args.target_host
    pinger = Pinger(target_host=target_host)
    pinger.ping()
```

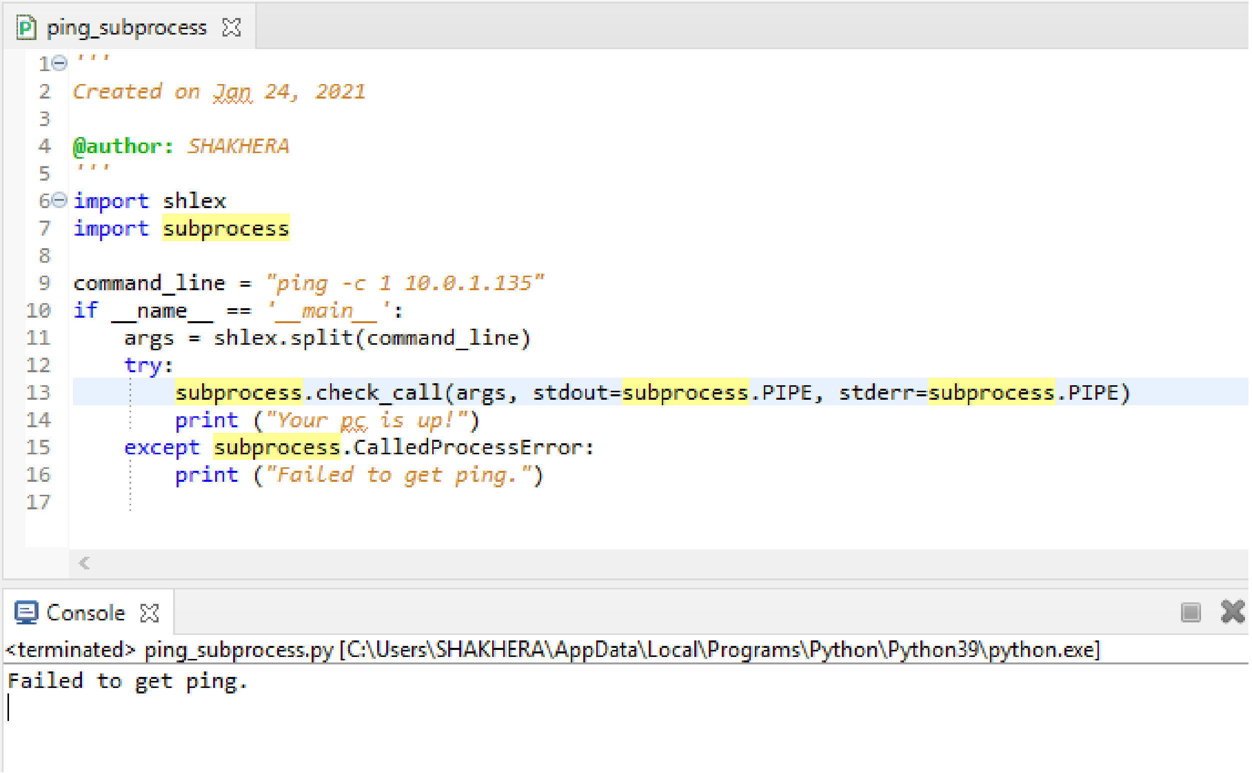
Output:



```
$ sudo python 3_2_ping_remote_host.py --target-host=www.google.com
Ping to www.google.com... Get pong in 7.5634ms
Ping to www.google.com... Get pong in 7.2694ms
Ping to www.google.com... Get pong in 7.8254ms
Ping to www.google.com... Get pong in 7.7845ms
```

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

Code:



```
'''
Created on Jan 24, 2021

@author: SHAKHERA
'''
import shlex
import subprocess

command_line = "ping -c 1 10.0.1.135"
if __name__ == '__main__':
    args = shlex.split(command_line)
    try:
        subprocess.check_call(args, stdout=subprocess.PIPE, stderr=subprocess.PIPE)
        print ("Your pc is up!")
    except subprocess.CalledProcessError:
        print ("Failed to get ping.")
```

```
<terminated> ping_subprocess.py [C:\Users\SHAKHERA\AppData\Local\Programs\Python\Python39\python.exe]
Failed to get ping.
```

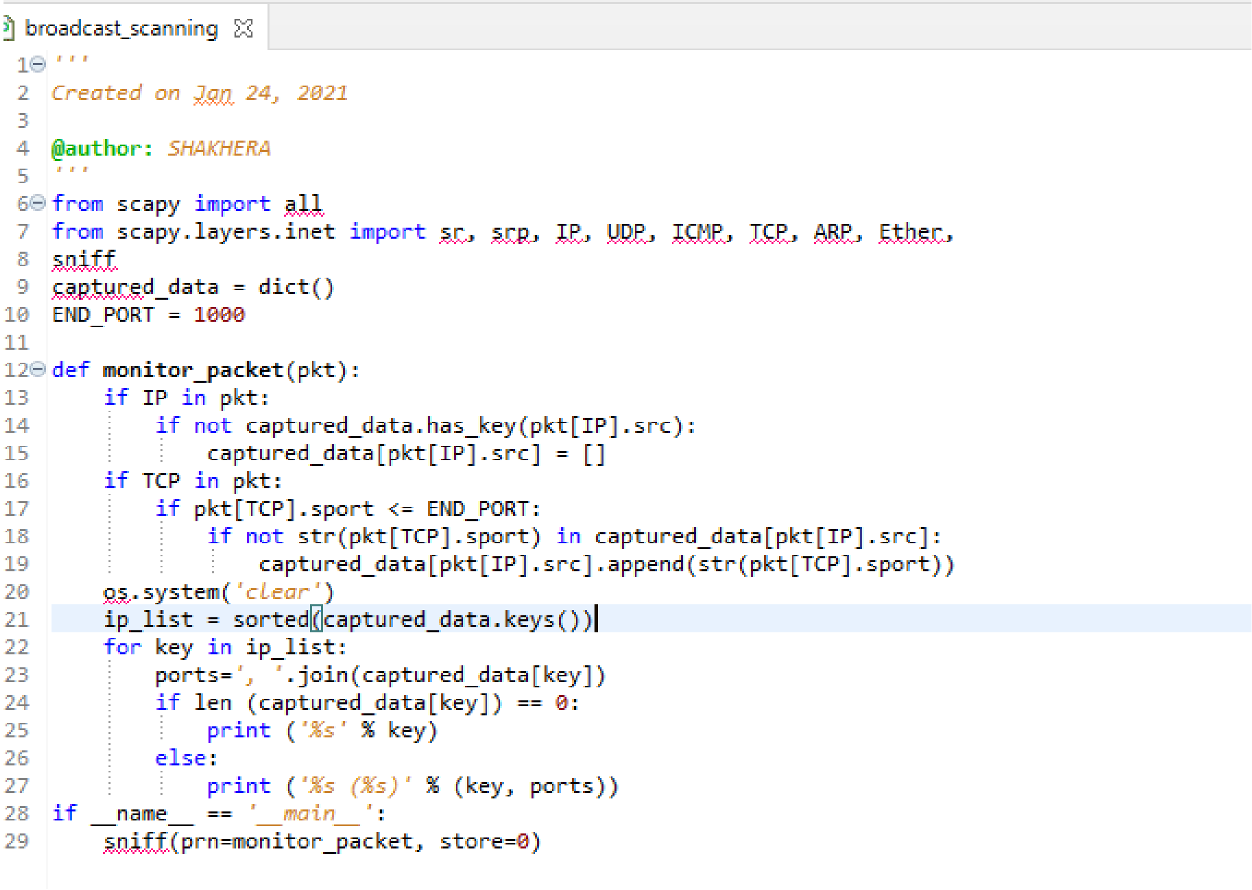
What is the role of subprocess?

Answer:

The subprocess module provides a consistent interface to creating and working with additional processes. It offers a higher-level interface than some of the other available modules, and is intended to replace functions such as so.

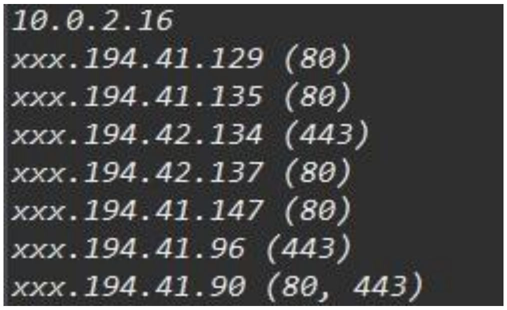
Exercise 4.7: Scanning the broadcast of packets

<u>Code:</u>



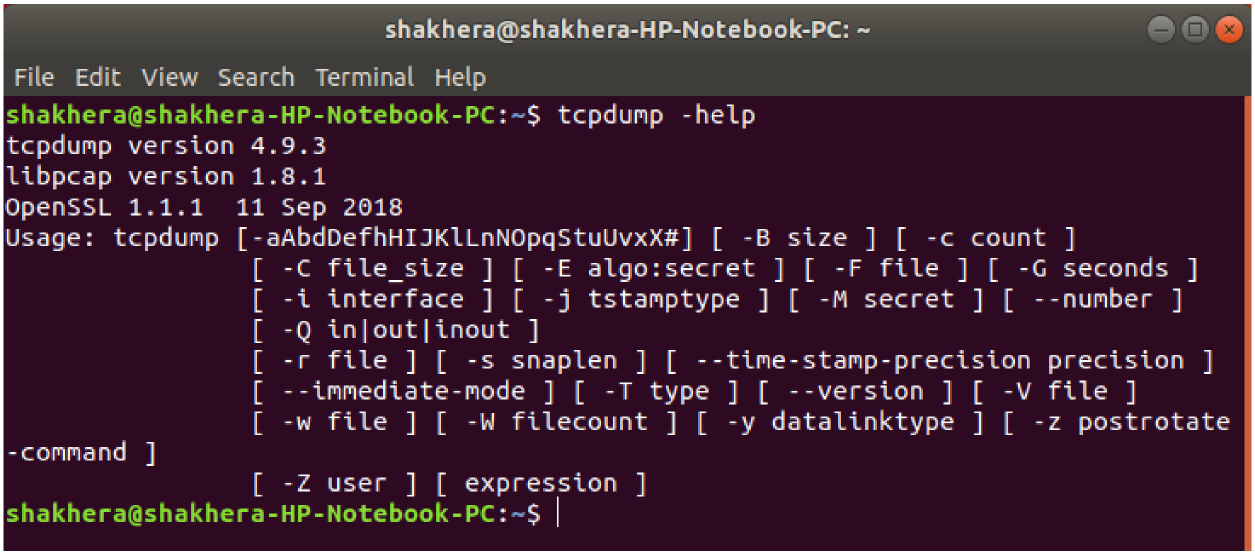
```python
'''
Created on Jan 24, 2021

@author: SHAKHERA
'''
from scapy import all
from scapy.layers.inet import sr, srp, IP, UDP, ICMP, TCP, ARP, Ether,
sniff
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:



```
10.0.2.16
xxx.194.41.129 (80)
xxx.194.41.135 (80)
xxx.194.42.134 (443)
xxx.194.42.137 (80)
xxx.194.41.147 (80)
xxx.194.41.96 (443)
xxx.194.41.90 (80, 443)
```

Exercise 4.8: Sniffing packets on your network


shakhera@shakhera-HP-Notebook-PC: ~
File Edit View Search Terminal Help

```
shakhera@shakhera-HP-Notebook-PC:~$ tcpdump -help
tcpdump version 4.9.3
libpcap version 1.8.1
OpenSSL 1.1.1  11 Sep 2018
Usage: tcpdump [-aAbdDefhHIJKlLnNOpqStuUvxX#] [ -B size ] [ -c count ]
                [ -C file_size ] [ -E algo:secret ] [ -F file ] [ -G seconds ]
                [ -i interface ] [ -j tstamptype ] [ -M secret ] [ --number ]
                [ -Q in|out|inout ]
                [ -r file ] [ -s snaplen ] [ --time-stamp-precision precision ]
                [ --immediate-mode ] [ -T type ] [ --version ] [ -V file ]
                [ -w file ] [ -W filecount ] [ -y datalinktype ] [ -z postrotate
-command ]
                [ -Z user ] [ expression ]
shakhera@shakhera-HP-Notebook-PC:~$ 
```

Question 5.1: Explain in your own words what is a network interface?
Answer:

In computing, a network interface is a software or hardware interface between two pieces of equipment or protocol layers in a computer network. A network interface will usually have some form of network address.

Question 5.2: How many network interface usually you find in your pc?
Answer:

Multiple network interfaces enable you to create configurations in which an instance connects directly to several VPC networks. Each of the interface must have in internal IP address, and each interface can also have an external IP address. Each instance can have up to 8 interface, depending on the instance's type

Question 5.3: Explain why you sniffing the network interface? Give examples?
Answer:

A network sniffer, also known as a package analyzer, is either software or hardware that can intercept data packets as they travel across a network. Admins use network sniffers to monitor network traffic at the packet level, helping ensure network health and security.

Packet sniffing defined as the process to capture the packets of data flowing across a computer network. For example, system administrators use packet sniffing to determine the slowest part of a network.

Question 5.4: Explain why it is relevant to communicate using sockets?
Answer:

Sockets need not have a source address, for example, for only sending data, but if a program binds a socket to a source address, the socket can be used to received data sent to that address.

Discussion: Python plays an essential role in network programming. The standard library of Python has full support for network protocols, encoding, and decoding of data and other networking concepts, and it is simpler to write network programs in Python than that of C++.
From this lab, I have known that how to Install python and use third-party libraries. I have understood that how to python's standard library provides a great set of awesome functionalities, there will be times that I will eventually run into the need of making use of third party libraries. I learnt that Interact with network interfaces using python and getting information from internet using Python. I also learnt that networking with any depth, discuss some common terms.