Jorael Jamison

CSIA 440 – Cyber Testing & Penetration

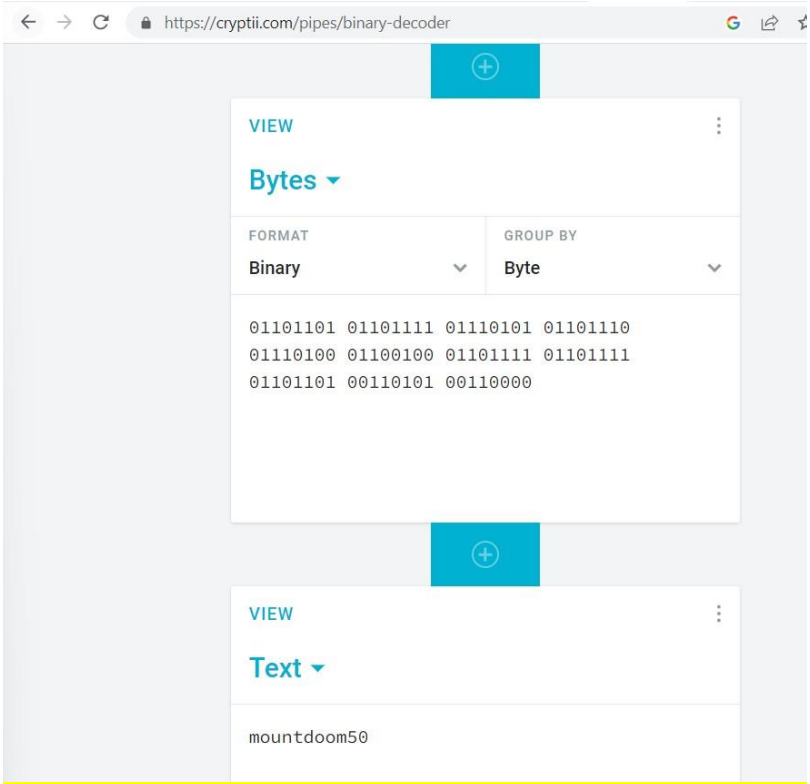
Professor Robinson

06/01/2023

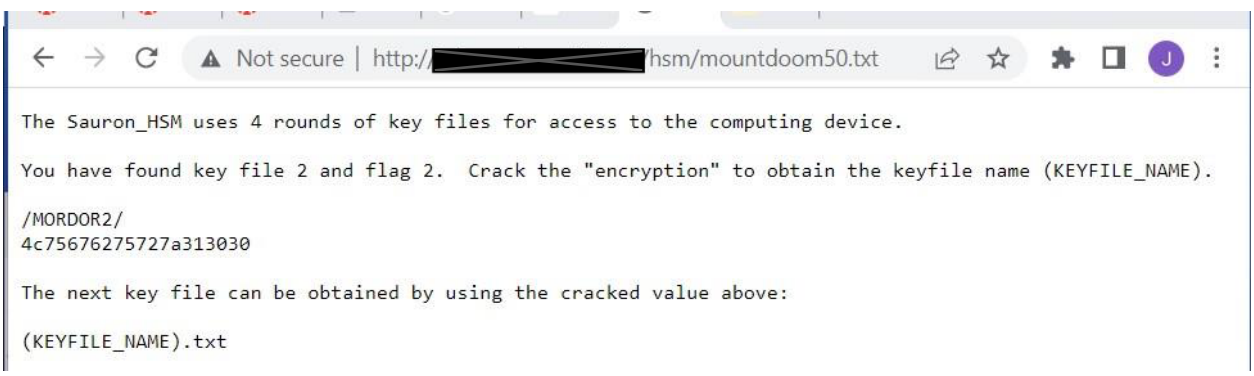
Exam Sauron_HSM Appliance

**Flag 1 (/MORDOR1/):**

The final exam study guide said this pen-test would be performed on the [redacted] Security company. I decided to explore the website [redacted] to see if anything changed from the last time that we used the site for a capture the flag exam. I found MORDOR1 by clicking on the 'products' tab and saw 'SAURON_HSM'. I clicked on this, and it loaded a page displaying a file titled: key1.txt. This displayed the first key file's encrypted name: *01101101 01101111 01110101 01101110 01110100 01100100 01101111 01101111 01101101 00110101 00110000.* It mentioned the cracked value would be the name needed to obtain the next key file. I cracked the encryption by entering the string into a 'binary to text' converter I found online. The result was: *mountdoom50*. Finally, I appended this to the end of the URL with the file extension '.txt'.




**Flag 2 (/MORDOR2/):**



https://www.boxentriq.com/code-breaking/cipher-identi...

BOXENTRIQ

TOOLS PUZZLE ABOUT

# Cipher Identifier and Analyzer

Find Tools...

Stuck with a cipher or cryptogram? This tool will help you identify the type of cipher, as well as give you information about possibly useful tools to solve it.

This tool uses AI/Machine Learning technology to recognize over 25 common cipher types and encodings including: Caesar Cipher, Vigenère Cipher (including the autokey variant), Beaufort Cipher (including the autokey variant), Playfair Cipher, Two-Square/Double Playfair Cipher, Columnar Transposition Cipher, Bifid Cipher, Four-Square Cipher, Atbash Cipher, and many more!

## Enter Ciphertext here

4c75676275727a313030

Analyze Text | Copy | Paste | Text Options...

Note: To get accurate results, your ciphertext should be at least 25 characters long.

## Analysis Results

4c75676275727a313030

Your ciphertext is likely of this type:

**Hexadecimal Code (click to read more)**

Note: Your ciphertext is less than 25 characters long. Results are less reliable.

https://string-functions.com/hex-string.aspx

**www.string-functions.com**

ONLINE STRING MANIPULATION TOOLS

## Hex To Text Converter Online Tool

**Enter the hexadecimal text to decode, and then click "Convert!":**

4c75676275727a313030

Convert!

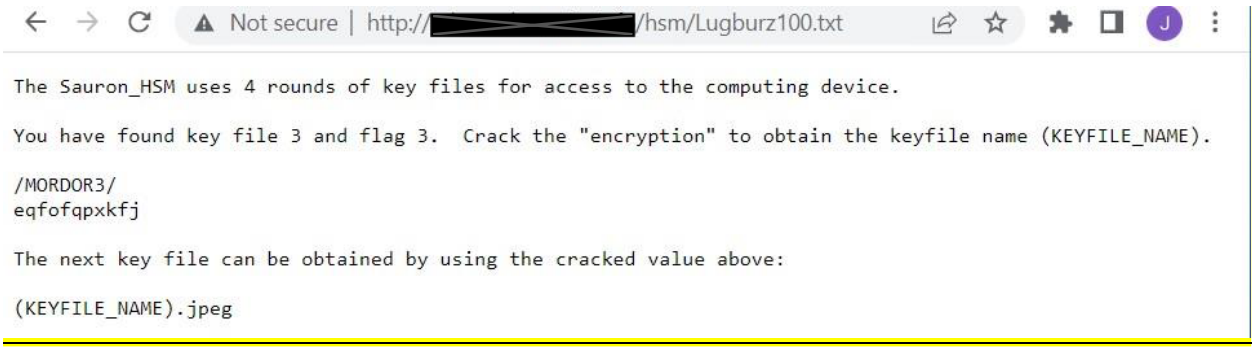
**The decoded string:**

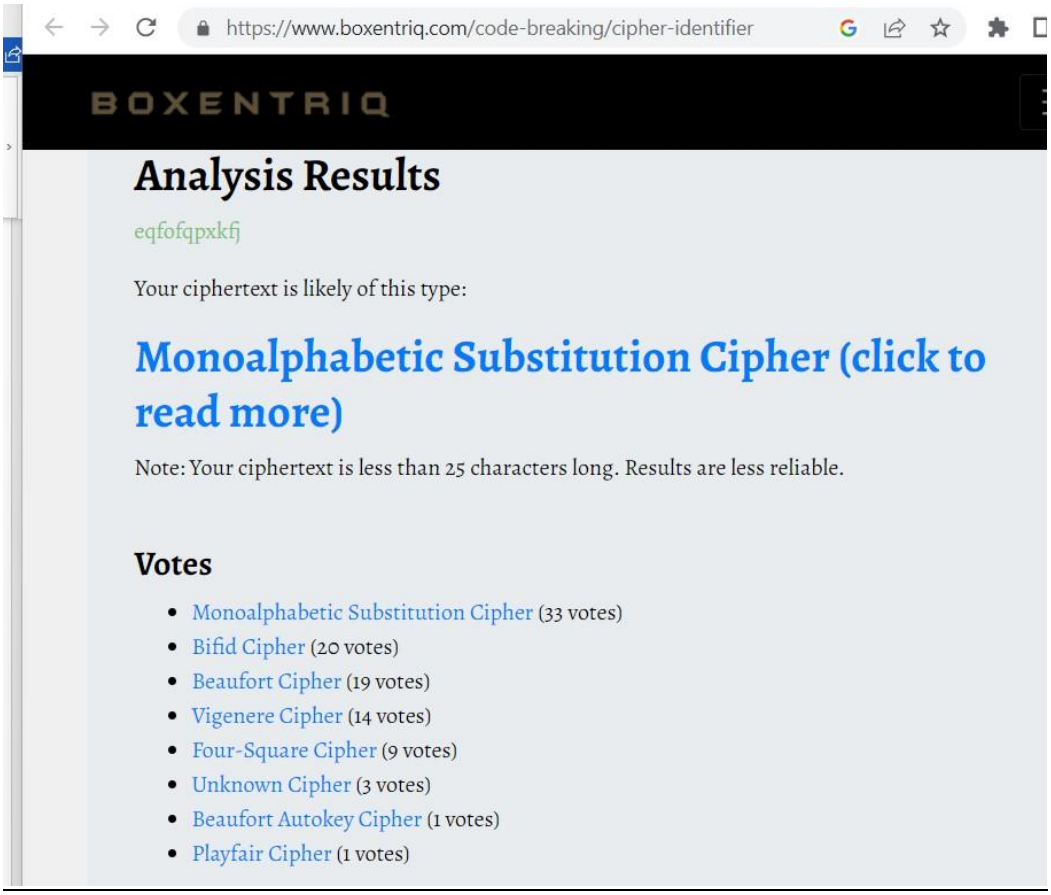
Lugburz100

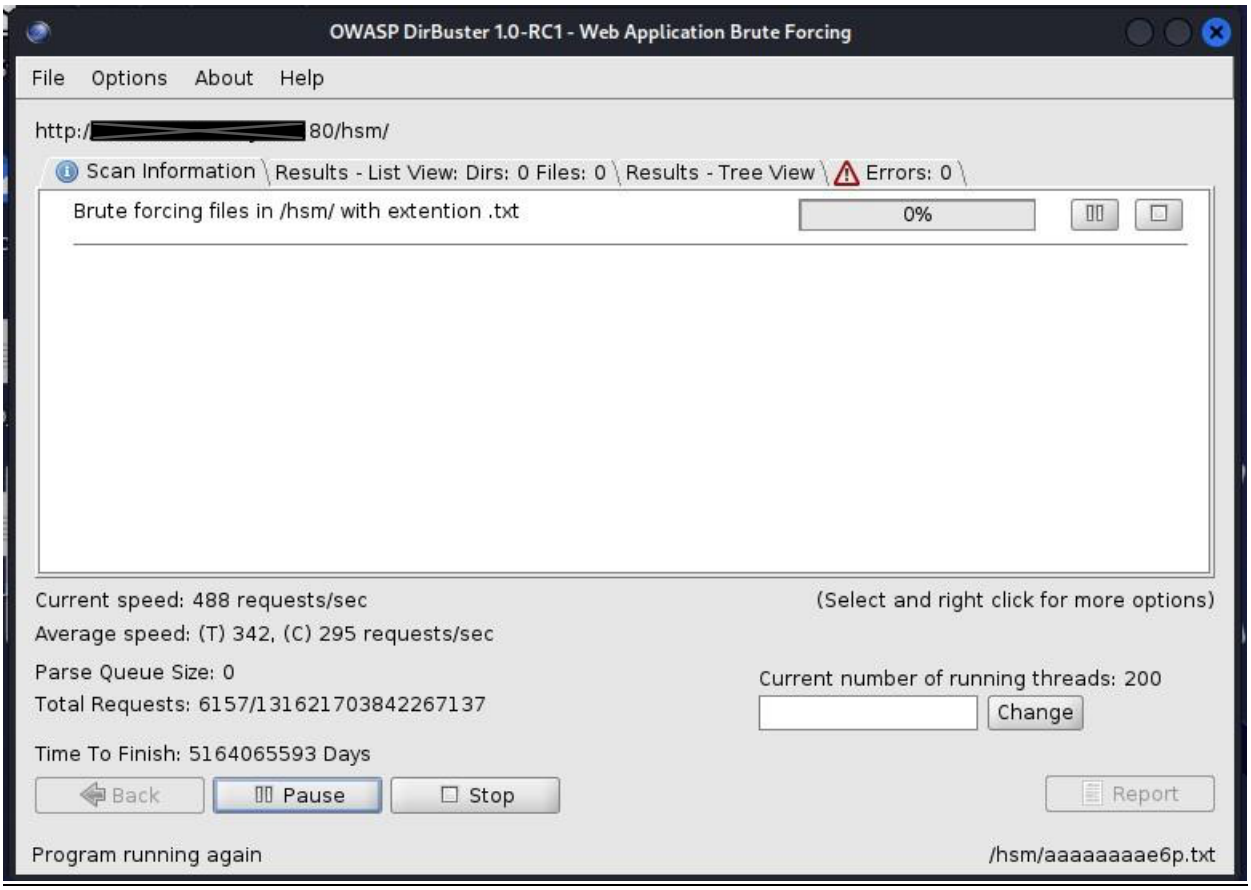
Please note: any spaces or colons (:) in the hexadecimal string will be removed.

I found MORDOR2 after I cracked the value from MORDOR1. I appended ‘mountdoom.txt’ to the end of the [redacted] URL and it loaded a page displaying the file. This displayed the second key file’s encrypted name: *4c75676275727a313030*. It mentioned the cracked value would be the name needed to obtain the next key file. I cracked the encryption by first analyzing the string online and entering it into a Hex to Text Converter tool I found online. The result was: *Lugburz100*. Finally, I appended this to the end of the URL with the file extension ‘.txt’.

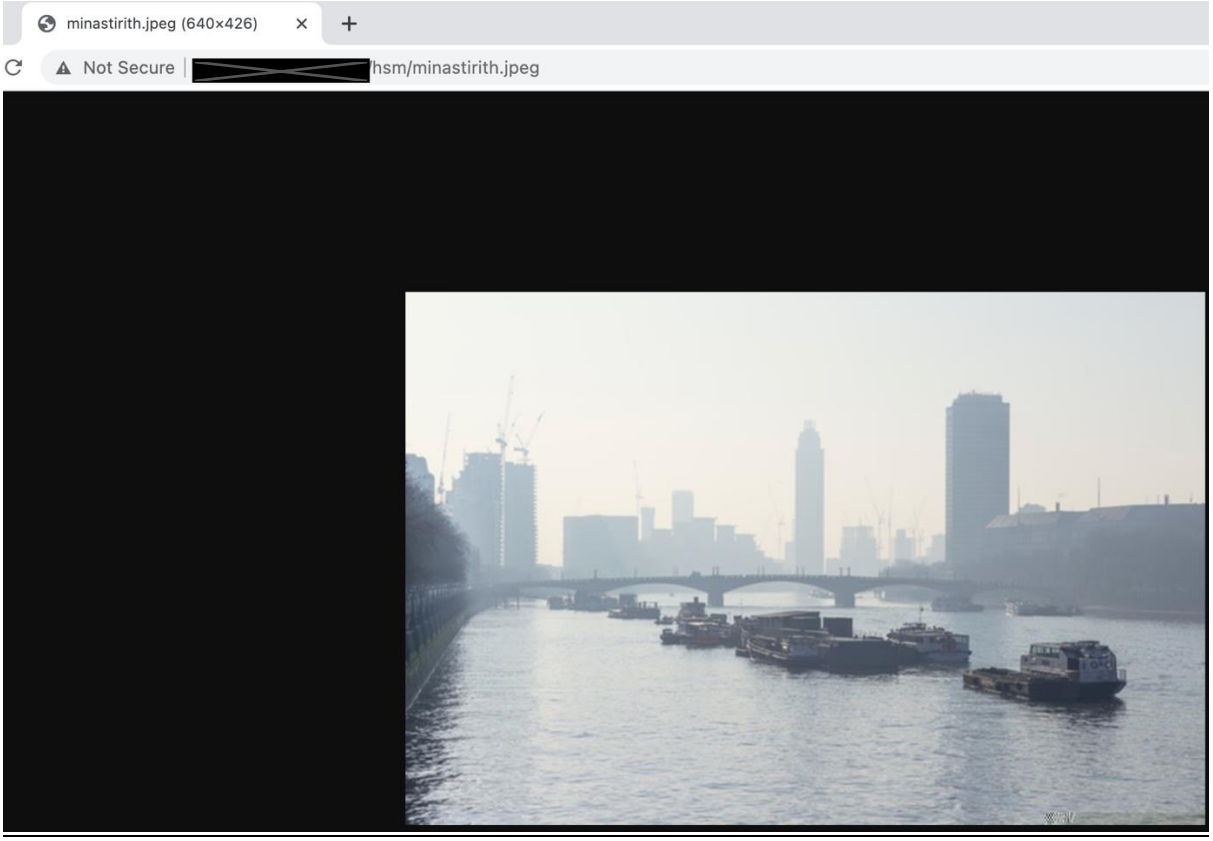
**Flag 3 (/MORDOR3/):**




OWASP DirBuster 1.0-RC1 - Web Application Brute Forcing
File Options About Help
http:/[redacted]80/hsm/
Scan Information
Results - List View: Dirs: 0 Files: 0
Results - Tree View
Errors: 0
Brute forcing files in /hsm/ with extention .txt
0%
Current speed: 488 requests/sec
(Select and right click for more options)
Average speed: (T) 342, (C) 295 requests/sec
Parse Queue Size: 0
Current number of running threads: 200
Total Requests: 6157/131621703842267137
Change
Time To Finish: 5164065593 Days
Back
Pause
Stop
Report
Program running again
/hsm/aaaaaaaae6p.txt

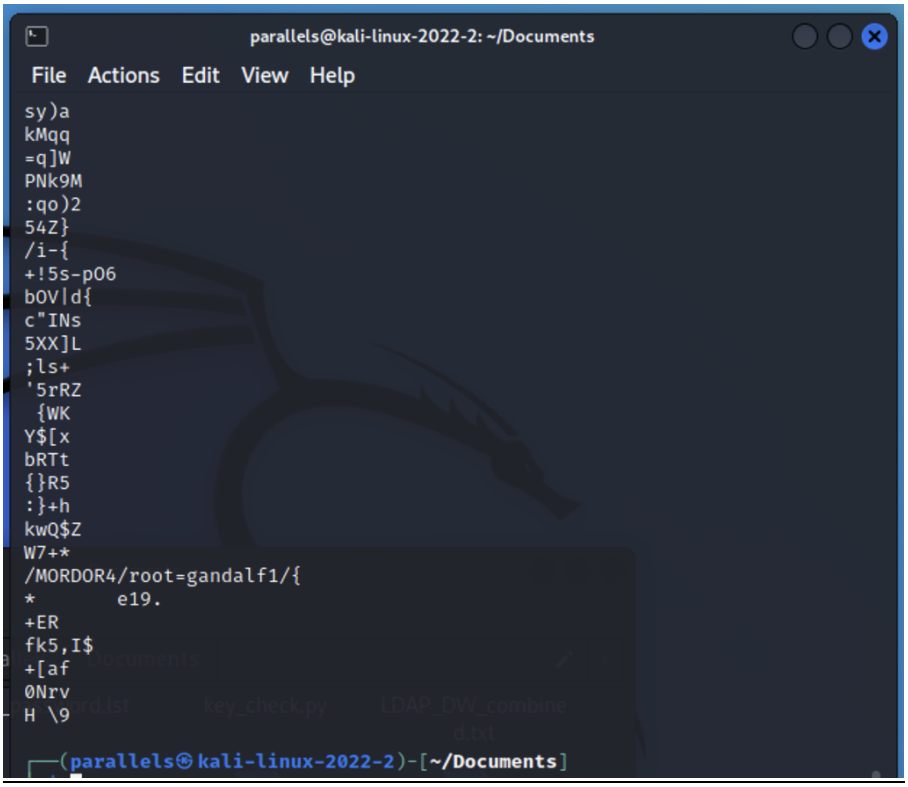

Search for a tool
Search a tool on dCode by keywords:
e.g. type 'caesar'
Browse the full dCode tools' list
Results
A=1,B=23 minastirith
A=11,B=18 lnervoncnou
A=11,B=4 rtkxbutitua
A=21,B=23 ionamrohorj
A=11,B=5 yareibapabh
A=17,B=10 dpanlipopis
Affine Cipher
Cryptography › Substitution Cipher › Affine Cipher
Affine Decoder
Affine ciphertext
jfkxpqfofqe
Expected plaintext language English
Alphabet ABCDEFGHIJKLMNOPQRSTUVWXYZ
Automatic brute force decryption
Manual Parameters and Options
A coefficient 1
B coefficient 1



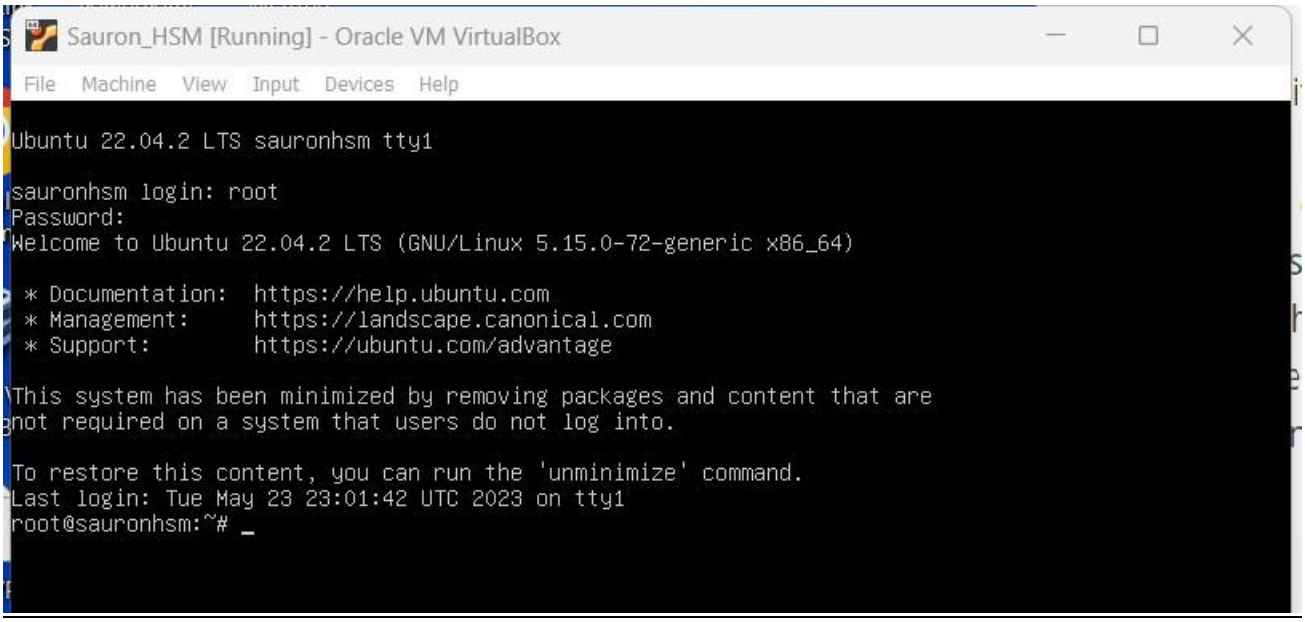

I found MORDOR3 after I cracked the value from MORDOR2. I appended 'lugburz100.txt' to the end of the [redacted] URL and it loaded a page displaying the file. This displayed the third key file's encrypted name: *eqfofqpxkfj*. It mentioned the cracked value would be the name needed to obtain the next key file. Unfortunately, I failed to crack this code. I first ran it through a cipher analyzer online which displayed that it was most likely a 'mono-alphabetic substitution cipher.' I went from there and exhausted all efforts to crack it by using all variations of encryption ciphers on different code-breaking websites, but I was unable to find anything that resembled the correct answer. I also spent time using CrypTool to analyze various ciphers to crack it, in addition to a last resort of brute-forcing and dictionary attacks by using the tool Dirbuster in Kali. This would most likely work, but I do not have that many years to go through all the possible combinations of .txt files. I also could not find anything else on the [redacted] website or the SAURON_HSM server that could help or maybe offer a clue or key to cracking the code. I ran 'find' commands to search for any other relevant files.

Upon reviewing today's class zoom meeting I retried this cipher by reversing the string as hinted: jfkxpqfofqe. I ran this on the dcode website and both Affine and Cesar substitution Cipher's listed the phrase "minastirith" as the number 1 result. I read online this was associated with Lord of the Rings, which was another hint. I tried pulling this file from the [redacted] website using "minastirith.txt" and kept receiving a 404 error. I was certain I had the correct word now, so I went back and double checked the lugburz100 file. I apparently had been trying to pull this with a txt extension and that was my issue, it needed to be .jpeg. I was focused on txt as that was the previously flags format.

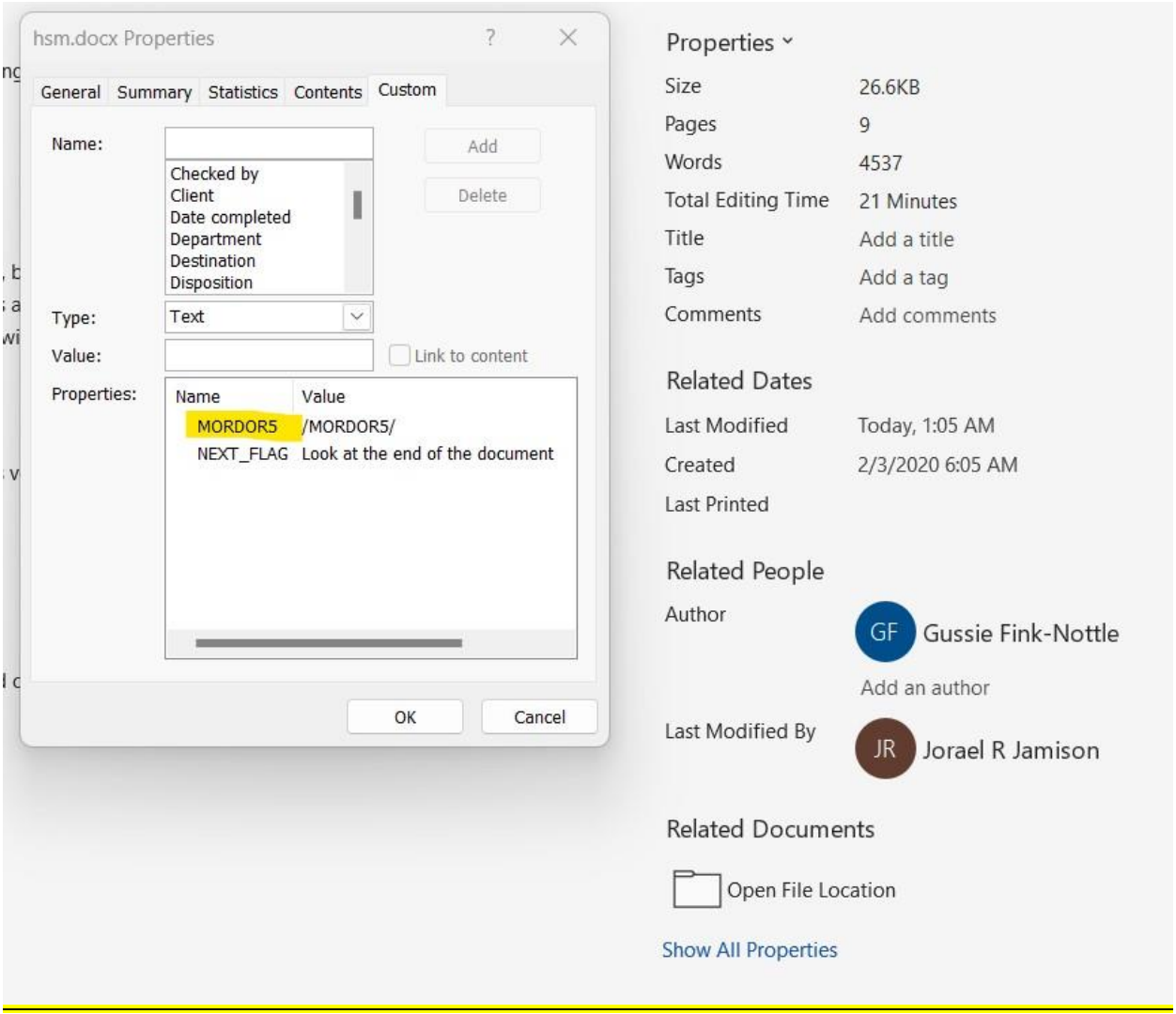
**Flag 4 (/MORDOR4/):**




Now that I have the found the image for MORDOR 3, I began to analyze for any steganography. On Kali, I used wget to download the image from the [redacted] URL and used the 'strings' command which displayed MORDOR 4, along with the root password to the server = gandalf1. As I had previously accessed the server through means of pre-boot vulnerability, I opened a fresh copy of the Sauron server to try this password. It was successful to login (shown below).




**Flag 5 (/MORDOR5/):**




He drew out slowly from an upper waistcoat pocket a scarlet card-case, and as slowly produced a very large card. Even in the instant of its production, they fancied it was of a queer shape, unlike the cards of ordinary gentlemen. But it was there only for an instant; for as it passed from his fingers to Arthur's, one or another slipped his hold. The strident, tearing gale in that garden carried away the stranger's card to join the wild waste paper of the universe; and that great western wind shook the whole house and passed.

You can find /MORDOR6/ in keys.xxx

---

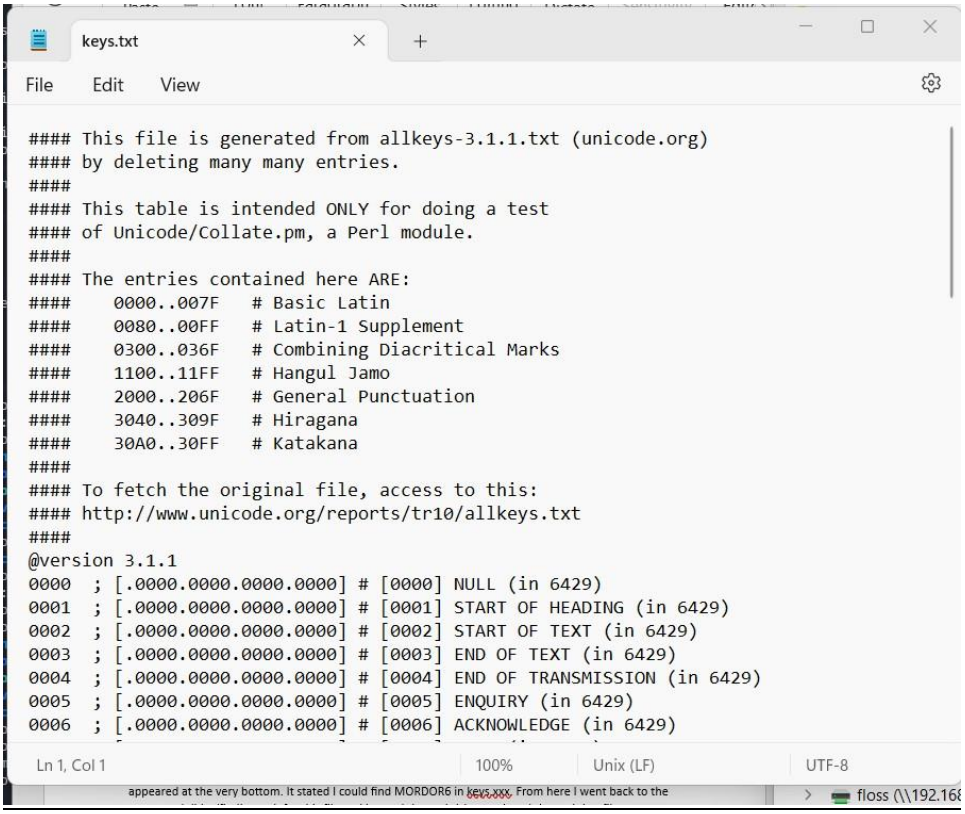
I found MORDOR5 after I cracked root access to the SAURON_HSM server. I located and saved the file named: hsm.txt to my computer for analysis. More detailed steps of how I obtained this file are in MORDOR6 below. Upon further examining the document's meta-data I found in the properties that this was MORDOR5. It also referenced that I could locate the next flag at the end of the document. The end of the document showed MORDOR6 could be found in the file: keys.xxx.

**Flag 6 (/MORDOR6/):**

```
root@sauronhsm:~# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
_apt:x:100:65534::/nonexistent:/usr/sbin/nologin
systemd-network:x:101:102:systemd Network Management,,,:/run/systemd:/usr/sbin/nologin
systemd-resolve:x:102:103:systemd Resolver,,,:/run/systemd:/usr/sbin/nologin
messagebus:x:103:104::/nonexistent:/usr/sbin/nologin
systemd-timesync:x:104:105:systemd Time Synchronization,,,:/run/systemd:/usr/sbin/nologin
pollinate:x:105:1::/var/cache/pollinate:/bin/false
sshd:x:106:65534::/run/sshd:/usr/sbin/nologin
usbmux:x:107:46:usbmux daemon,,,:/var/lib/usbmux:/usr/sbin/nologin
saruman1:x:1000:1000:saruman1:/home/saruman1:/bin/bash
root@sauronhsm:~#
```

```
saruman1@sauronhsm:/$ sudo cp /root/hsm.docx /home
saruman1@sauronhsm:/$ ls /home
hsm.docx  saruman1
saruman1@sauronhsm:/$
```

```
root@sauronhsm:/# find . -name keys.*
./usr/share/perl/5.34.0/Unicode/Collate/keys.txt
root@sauronhsm:/#
```



keys.txt

File Edit View

```
#### This file is generated from allkeys-3.1.1.txt (unicode.org)
#### by deleting many many entries.
####
#### This table is intended ONLY for doing a test
#### of Unicode/Collate.pm, a Perl module.
####
#### The entries contained here ARE:
####    0000..007F   # Basic Latin
####    0080..00FF   # Latin-1 Supplement
####    0300..036F   # Combining Diacritical Marks
####    1100..11FF   # Hangul Jamo
####    2000..206F   # General Punctuation
####    3040..309F   # Hiragana
####    30A0..30FF   # Katakana
####
#### To fetch the original file, access to this:
#### http://www.unicode.org/reports/tr10/allkeys.txt
####
@version 3.1.1
0000  ; [.0000.0000.0000.0000] # [0000] NULL (in 6429)
0001  ; [.0000.0000.0000.0000] # [0001] START OF HEADING (in 6429)
0002  ; [.0000.0000.0000.0000] # [0002] START OF TEXT (in 6429)
0003  ; [.0000.0000.0000.0000] # [0003] END OF TEXT (in 6429)
0004  ; [.0000.0000.0000.0000] # [0004] END OF TRANSMISSION (in 6429)
0005  ; [.0000.0000.0000.0000] # [0005] ENQUIRY (in 6429)
0006  ; [.0000.0000.0000.0000] # [0006] ACKNOWLEDGE (in 6429)
```

Ln 1, Col 1 100% Unix (LF) UTF-8

appeared at the very bottom. It stated I could find MORDOR6 in keys.xxx. From here I went back to the

I cracked root access to the SAURON_HSM server using a pre-boot vulnerability.. Once logged in, I did a ls command to see what was in the home directory. It showed a file titled: hsm.docx. I attempted to cat this file but it displayed text that was not readable. I attempted to login to WinSCP to transfer the file to my computer for further analysis, but it would not allow me access and said, “not authorized”. I found a way around this by going back to the server and searching for any other users that have sudo privileges. I ran a cat command on the passwd file and saw a user by the name: saruman1. I changed the password and logged in as this user. Once logged in I transferred the hsm.docx file to this account by using the command: sudo cp (root path to file) (local path to copy). I went back to WinSCP and was able to successfully log in as saruman1 and find the file that I copied over. I used this technique, in addition to ‘wget’, for many other files I wanted to examine further from the root account and [redacted] website. I could not find anything further of relevance. The HSM document was examined, and it was a long publication. I did a quick search for keywords and found ‘MORDOR’ appeared at the very bottom. It stated I could find MORDOR6 in keys.xxx. From here I went back to the server and did a ‘find’ search for this file and located the path (shown above) to a keys.txt file in the Unicode path. I saved that file to my computer (screenshot above).

After analyzing this file for a while I realized it was the wrong keys file as I could not find anything by skimming though the document or by checking its metadata. I went back to the server and did another ‘find’ search, but this time for hidden files and found the correct “keys.xxx” in root. I copied the file over to Saruman1 and used WinSCP to transfer to my computer for further analysis. It appeared to be encrypted as it was unreadable. I also did a strings search on the file and saw “files.xxxUT”. I did a find search and found a files.py that may have some significance, so I copied it over with the same process. I moved on from this and tried another strategy as I wasn’t getting anywhere.

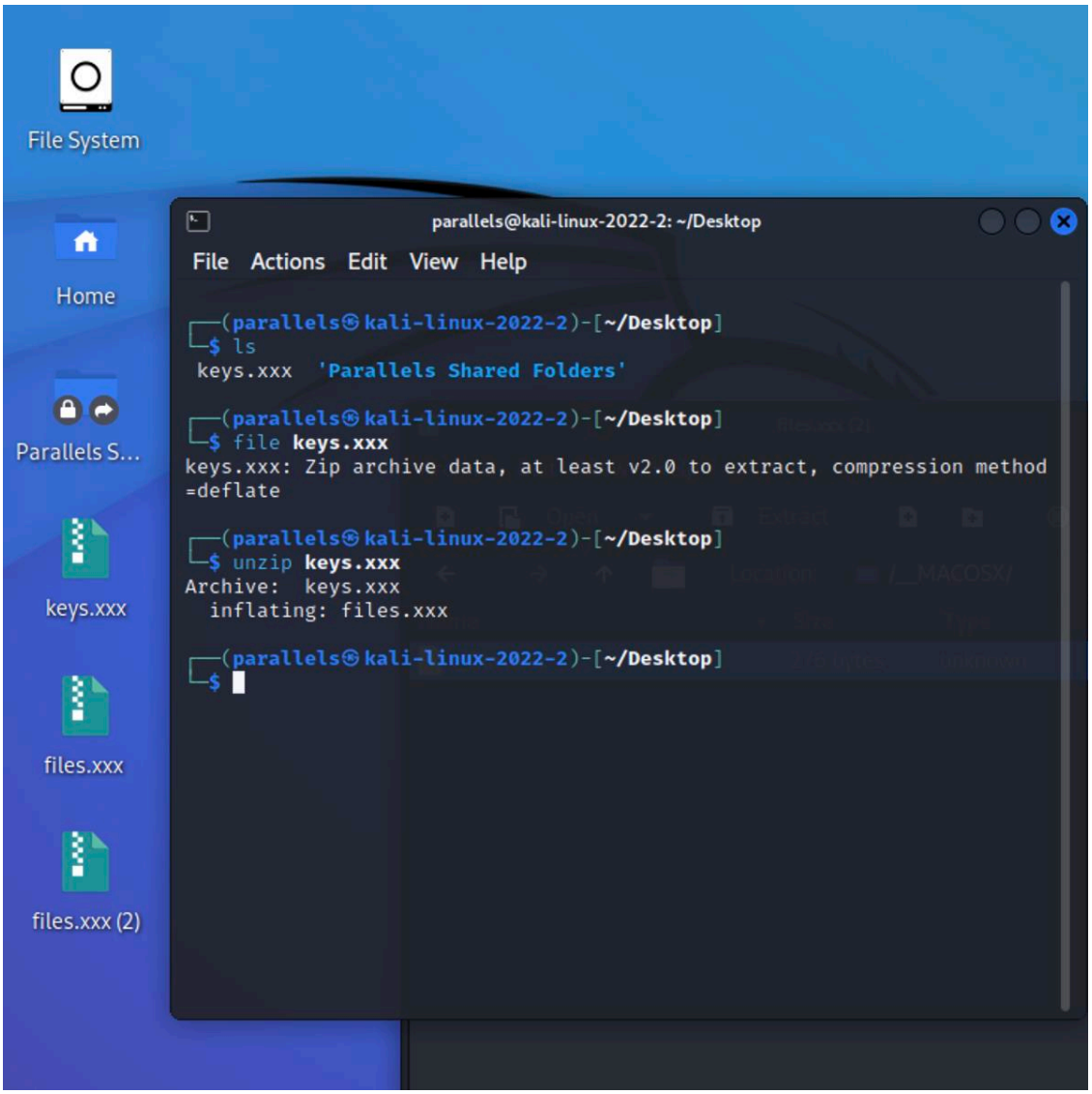
Todays zoom meeting helped as you mentioned to be persistent, and you spoke about zipping to nest files. I used the keys.xxx file previously saved and in Kali ran the command “file keys.xxx” to identify the file type, it showed it was a “Zip archive data file” and to use the “deflate” method. I researched online and entered “unzip keys.xxx” and it inflated the file creating a folder named files.xxx. I also unzipped this folder and Inside was bunch of bin files,  a run_md5.py script, and a test.txt file that contained a long list of duplicate md5 hashes (shown below).

Now that I knew what I was looking for, I went back to the server to attempted to  unzip it directly from there. I had to first download the unzip command using “sudo apt install install.” I was able to unzip the hidden /root/.keys.xxx file and files.xxx was extracted.  I unzipped the files.xxx folder and a “files” directory appeared. I ran the ‘run_md5.sh’ script and it executed but read “md5: command not found.” I attempted to cat one of the bin files and it appeared encrypted.

After I had originally submitted this exam, I went back and rechecked the bin files as it was bothering me why I couldn’t find the flag. I opened the test.txt file that appeared to have all the same MD5 Hashes, however, to be sure I looked through each one and found binFIle-695 that stood out as having a different hash value. I did the cat command to view bin-file 695, at first, I tried to decode the text and hash online and using hashcat but unsuccessful. Next, I decided to run the strings command on the binFile and that is when the MORDOR6 flag appeared. All screen shots throughout this process are documented below. The final flag is the last screen shot: MORDOR6/// found in binFile-695.

```
root@sauronhsm:~# find . / -name ".keys.*"
./.keys.xxx
/root/.keys.xxx
root@sauronhsm:~#
```

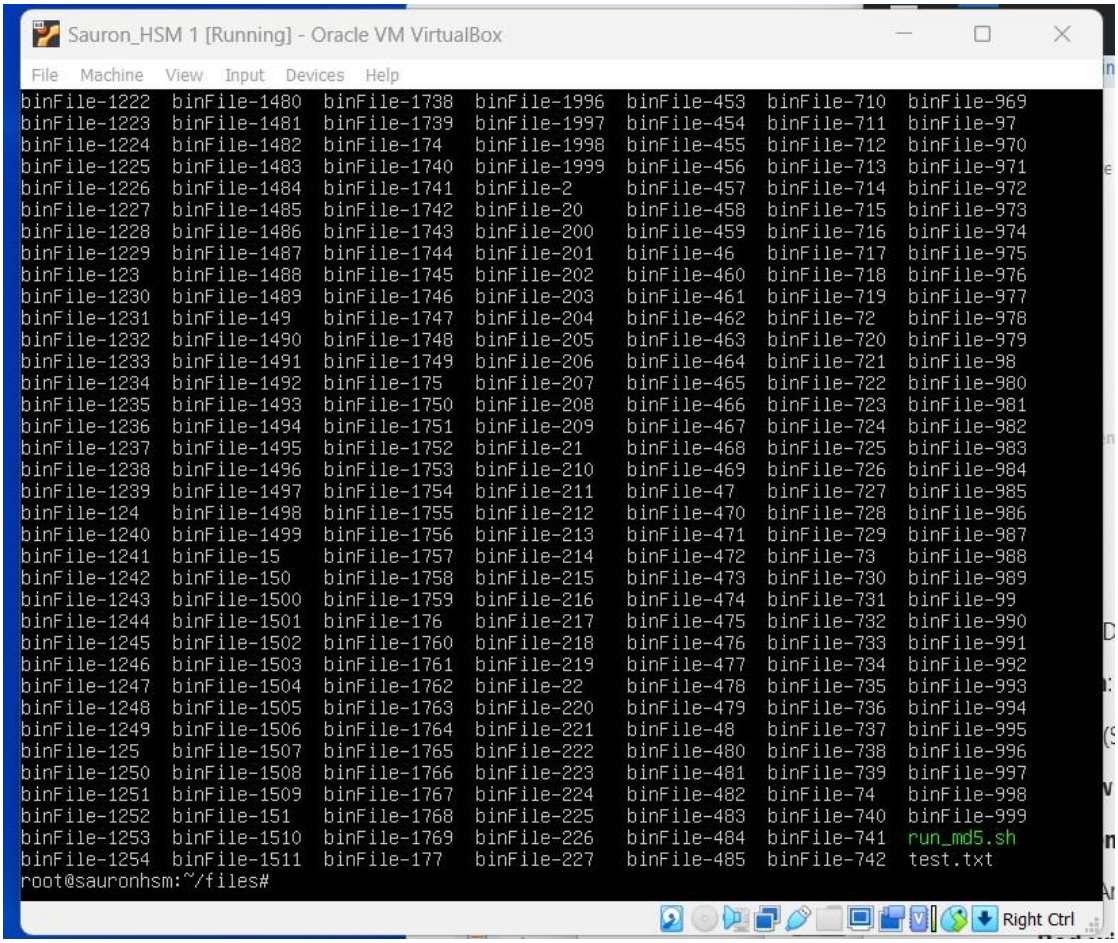
```
root@sauronhsm:/# find . / -name "files.*"
./usr/share/python3/debpython/__pycache__/files.cpython-310.pyc
./usr/share/python3/debpython/files.py
/usr/share/python3/debpython/__pycache__/files.cpython-310.pyc
/usr/share/python3/debpython/files.py
```


File System
Home
Parallels S...
keys.xxx
files.xxx
files.xxx (2)
parallels@kali-linux-2022-2: ~/Desktop
File Actions Edit View Help
┌──(parallels㉿kali-linux-2022-2)-[~/Desktop]
└─$ ls
keys.xxx 'Parallels Shared Folders'
┌──(parallels㉿kali-linux-2022-2)-[~/Desktop]
└─$ file keys.xxx
keys.xxx: Zip archive data, at least v2.0 to extract, compression method =deflate
┌──(parallels㉿kali-linux-2022-2)-[~/Desktop]
└─$ unzip keys.xxx
Archive: keys.xxx
inflating: files.xxx
┌──(parallels㉿kali-linux-2022-2)-[~/Desktop]
└─$

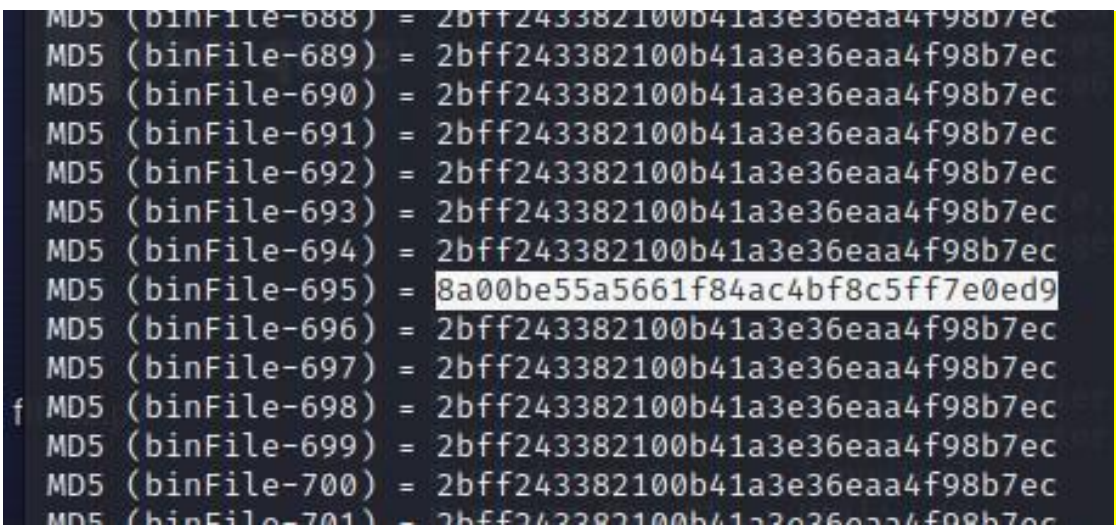
```
Open                                                    *test.txt
                                                        ~/.cache/.fr-iHNFAH/fi
MD5 (binFile-0) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-1) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-2) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-3) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-4) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-5) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-6) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-7) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-8) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-9) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-10) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-11) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-12) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-13) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-14) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-15) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-16) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-17) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-18) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-19) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-20) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-21) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-22) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-23) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-24) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-25) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-26) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-27) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-28) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-29) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-30) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-31) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-32) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-33) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-34) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-35) = 2bff243382100b41a3e36eaa4f98b7ec
MD5 (binFile-36) = 2bff243382100b41a3e36eaa4f98b7ec
```

From Server Terminal after extracted files:

```
root@sauronhsm:~# ls -al
total 2332
drwx------  6 root root    4096 Jun  2 05:37 .
drwxr-xr-x 19 root root    4096 May 23 22:02 ..
-rw-------  1 root root     551 Jun  2 05:24 .bash_history
-rw-r--r--  1 root root    3106 Oct 15  2021 .bashrc
drwx------  3 root root    4096 May 23 22:08 .cache
-rw-r--r--  1 root root   62417 May 23 22:58 .keys.xxx
-rw-r--r--  1 root root     161 Jul  9  2019 .profile
drwx------  2 root root    4096 May 23 22:02 .ssh
drwxr-xr-x  3 root root    4096 Jun  2 05:37 __MACOSX
drwx------  2 root root   65536 May 23 16:55 files
-rw-r--r--  1 root root 2123721 May 23 16:58 files.xxx
-rw-r--r--  1 root root   65246 Jun  2 05:27 files_cp.xxx
-rw-r--r--  1 root root   27127 May 23 22:58 hsm.docx
root@sauronhsm:~#
```




MORDOR6 FOUND



```
root@sauronhsm:~/files# cat binFile-695
g◆P◆◆◆◆/ ◆◆◆◆&Na9◆0◆x◆◆◆X◆a◆◆▒◆◆:◆◆▒◆>*0{nZ◆◆\|◆_4u:◆◆导◆WK◆+◆ 1◆◆◆◆h◆~◆p!◆!◆◆4
                                                                                FW?N◆◆{t◆◆o◆◆,#◆◆
◆◆◆◆◆4◆_▒W◆◆◆◆◆V
                ◆C◆
                   0◆◆◆~
                        #P◆◆◆
◆":◆(◆◆ZH◆gT◆g*◆#◆ЯQyEv◆◆◆D◆-◆▒◆c◆◆◆◆r◆6%◆◆◆v◆Y◆◆◆◆Bq◆◆◆◆[vY◆◆X◆+p◆_-◆◆◆◆š5U◆h◆\◆◆
◆~$◆◆◆x◆j\?◆◆◆<◆\◆c◆m@Fć◆◆◆C5C◆^x0|◆k;r◆db◆◆◆s◆m*◆gKJ$◆u◆R◆◆◆◆◆◆◆|◆◆^
                                                                                ◆\◆*◆:◆◆◆_◆◆<
◆ia◆◆◆-`◆Q◆v◆◆}◆◆F◆◆ R◆root@sauronhsm:~/files# strings binFile-695
MORDOR6///_
YJ|'j
Q|~r3
gKJ$
root@sauronhsm:~/files#
```