INDIVIDUAL ASSIGNMENT

ASSIGNMENT TITLE	**:**	**Digital Forensics and Cyber Security Tools** **Final Submission Portfolio**
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Table of Contents

I. Introduction

This portfolio delves into key tools and techniques essential for digital forensics and cybersecurity. It explores practical applications of Hex Editor, Wireshark, Exif Tool, and imaging tools like FTK Imager and Guymager in Kali Linux. We will also look at a case study and use Windows-based and Linux-based investigation tools to analyze an image file in order to find evidence.

Each section provides step-by-step guides accompanied by screenshots, demonstrating how these tools are used for file analysis, network traffic inspection, metadata extraction, and forensic investigations. These tools play a crucial role in safeguarding digital assets and ensuring the integrity of digital evidence, making them indispensable in today's cybersecurity landscape.

II. Portfolio 1: Hex Editor, Wireshark, and Exif Tool

Tool 1: Hex Editor

Task 1

The findings for the different file types and signatures are given in Table 1.

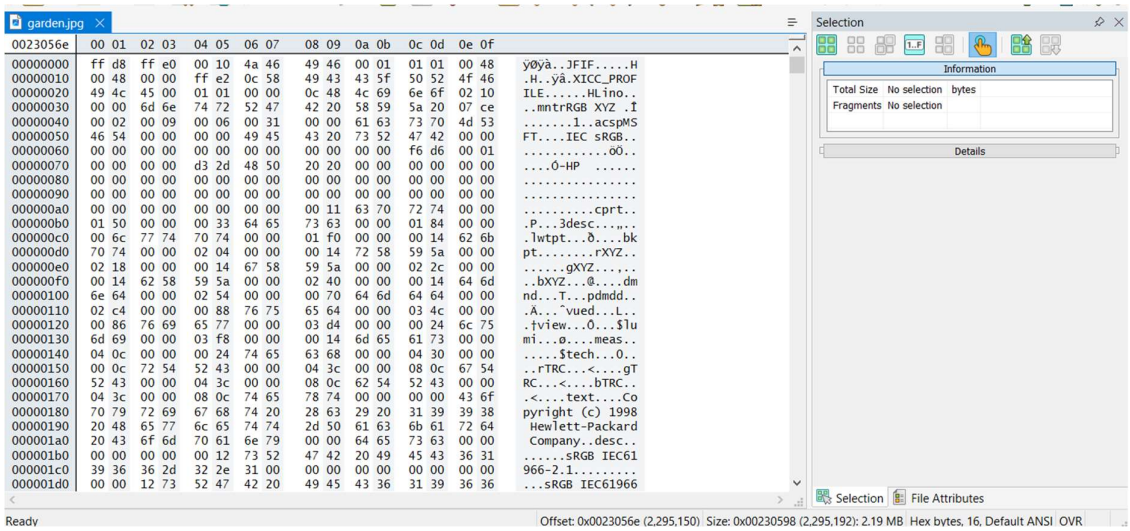
Table 1: File types and signatures

File Type	Hex Signature
.jpg	FF D8
.doc	D0 CF 11 E0 A1 B1 1A E1
.docx	50 4B 03 04 14 00 06 00
.pdf	25 50 44 46
.xls	D0 CF 11 E0 A1 B1 1A E1
.xlsx	50 4B 03 04 14 00 06 00
.ppt	D0 CF 11 E0 A1 B1 1A E1
.pptx	50 4b 03 04 14 00 06 00
mp3	49 44 33

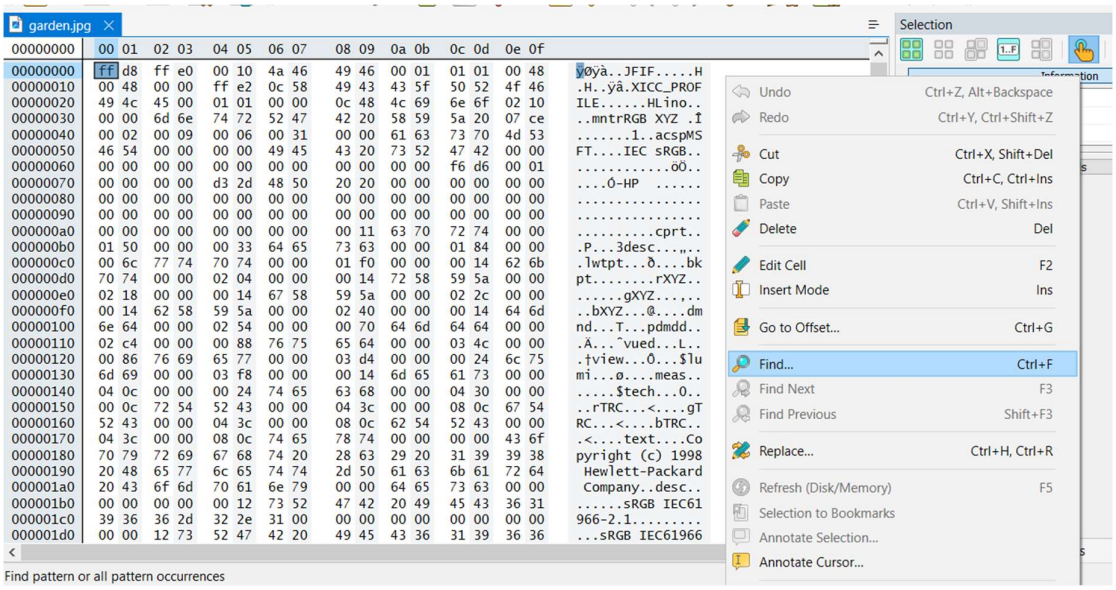
Task 2

Finding flag in garden.jpg:

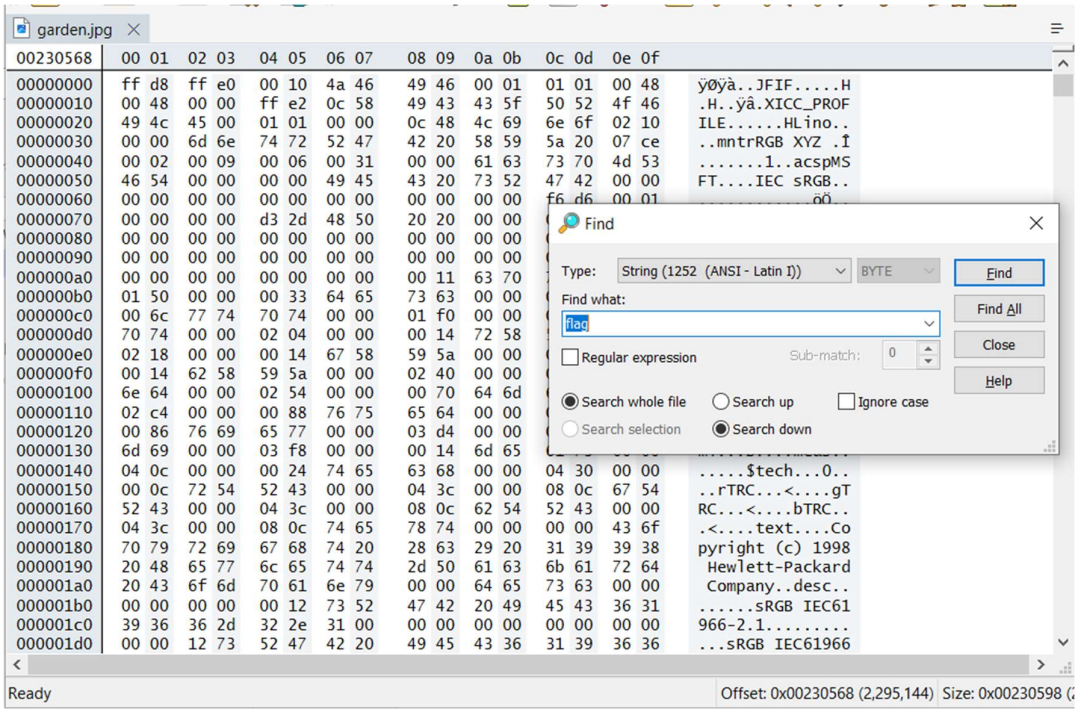
a. To find the flag in the garden.jpg file, first open the image file using the hex editor.



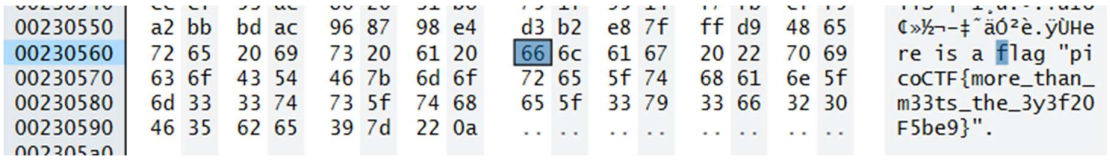
b. Next, we can search for the flag using the Find feature, this can be done by right clicking the interface and selecting Find, or pressing Ctrl + F.



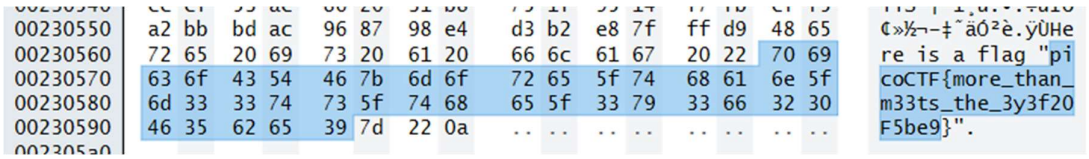
c. We will search for a string that contains the word “flag” in the file.



d. Once found, we can examine the ASCII view on the right side to determine the ASCII text of the flag.



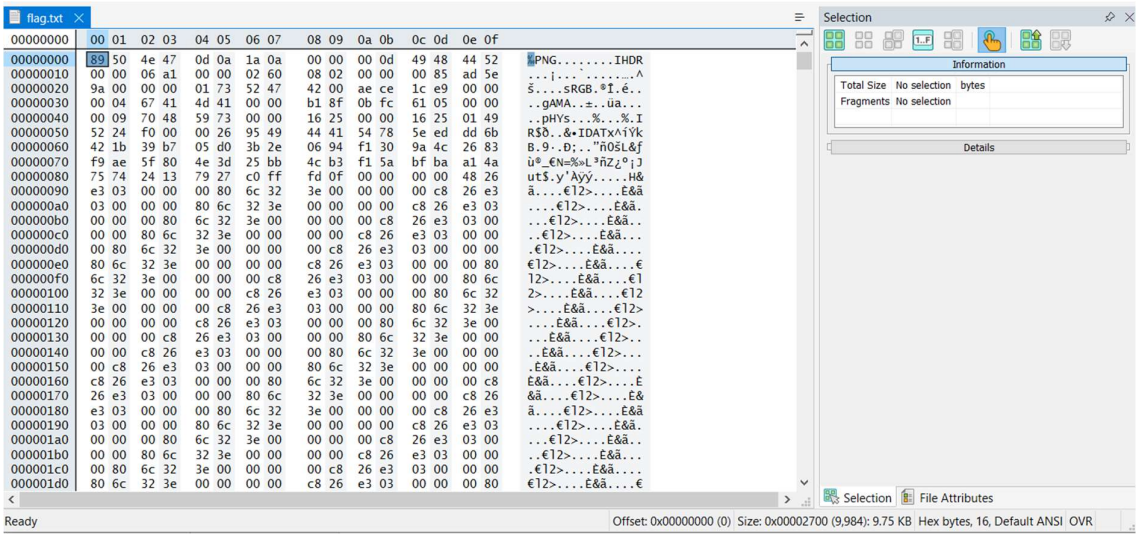
e. We can see that the flag is the text enclosed within the double quotation marks.



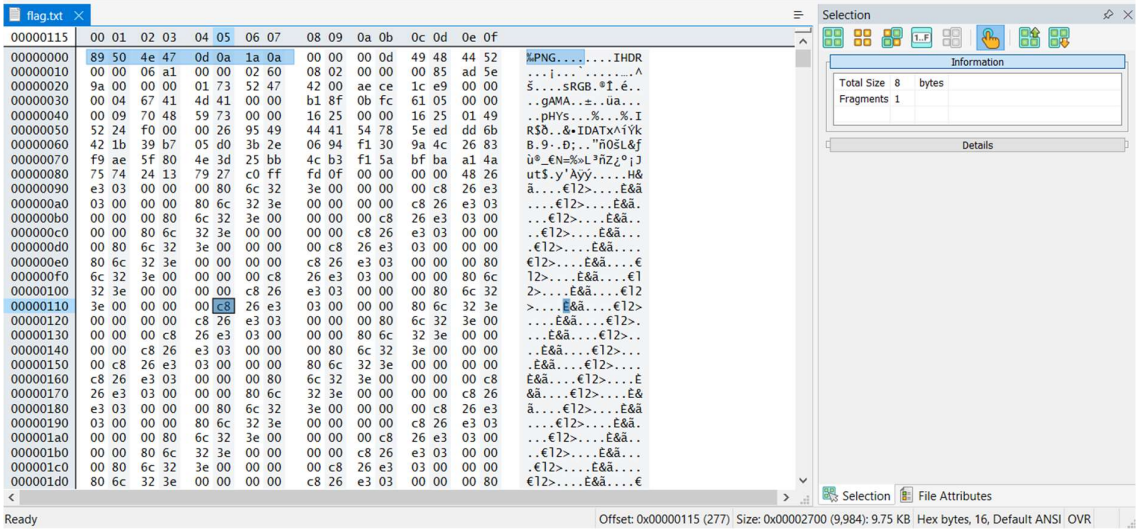
f. The flag obtained from garden.jpg is 'picoCTF{more_than_m33ts_the_3y3f20F5be9}'.

Task 3

a. To find the flag within flag.txt, we have to open the file in a hex editor.

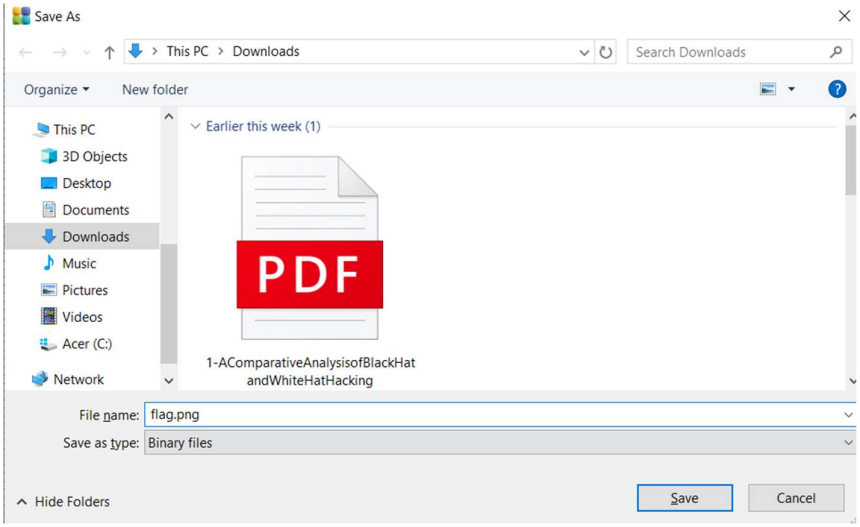


b. First, we examine the file signature and determine if this file is using the correct file extension. After checking, we realized that the correct file type is actually a PNG file, but this file was saved as a .txt file.

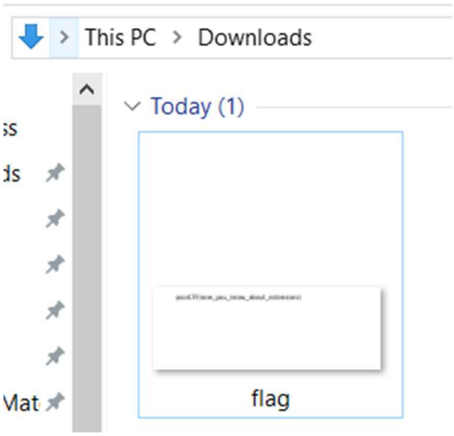


c. To obtain the flag, we have to save the file using the correct file extension. Use the 'Save As' function to save the file.

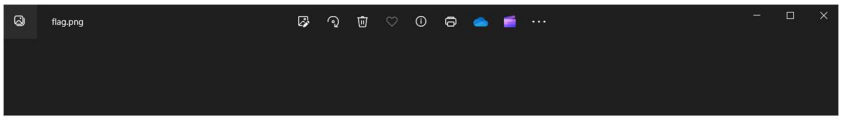
d. The file can be saved as a PNG file by adding ".png" after the file name.



e. After saving the file, the file can now be viewed as an image file.



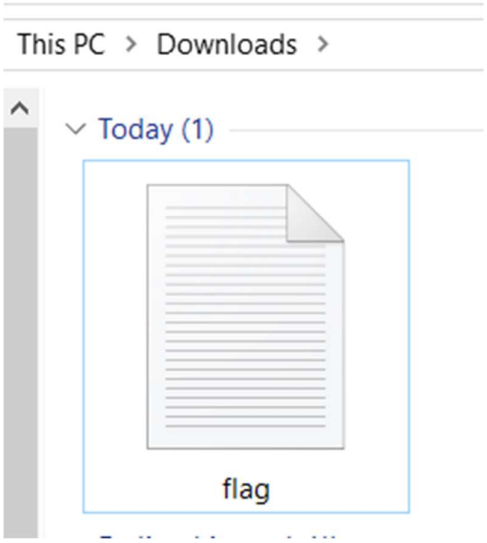
f. By opening the file, we can now obtain the flag.



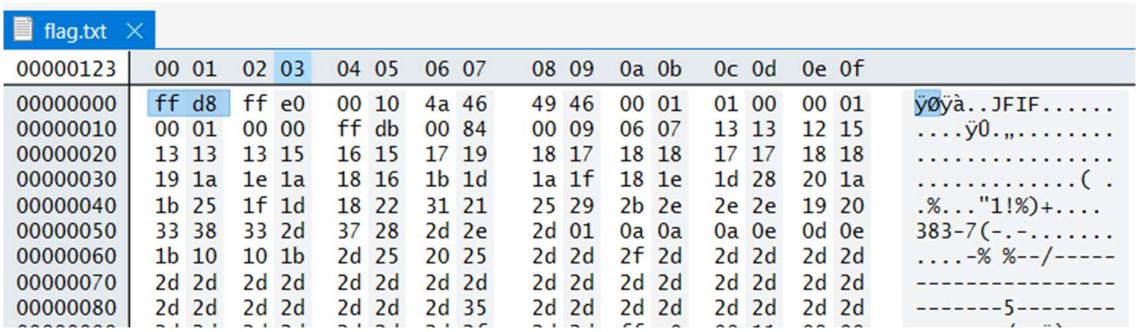
picoCTF{now_you_know_about_extensions}

Task 4

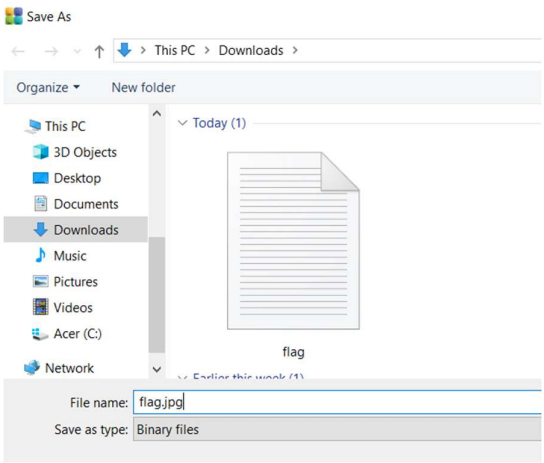
a. This is a .txt file containing a flag.



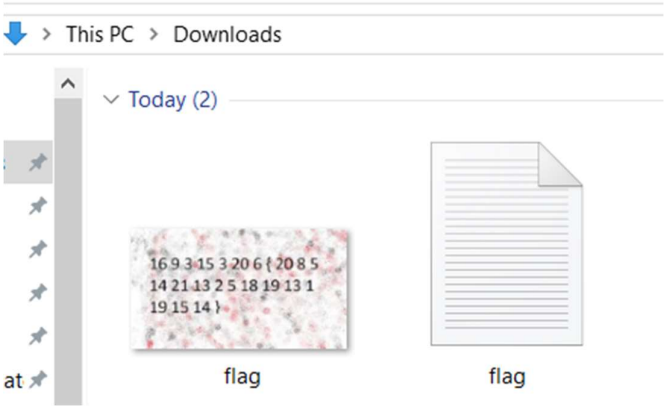
b. First, we open the file and examine if it is saved in the correct file extension,



c. From the file signature, we know that this file is supposed to be a JPG file. Next, we have to save this file using the .jpg extension.



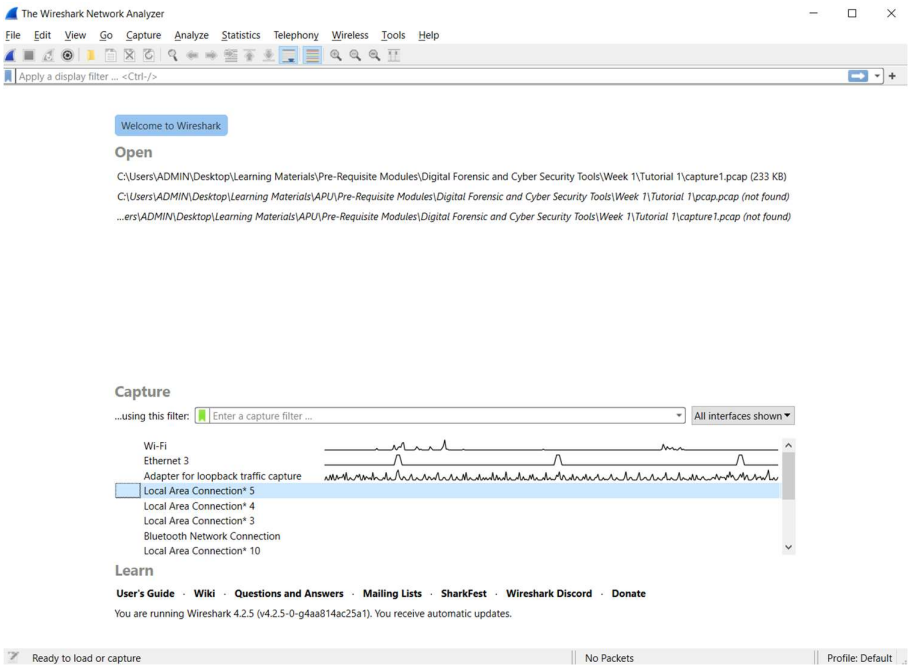
d. Once saved, the file now can be opened as an image file, in which the flag can be obtained.



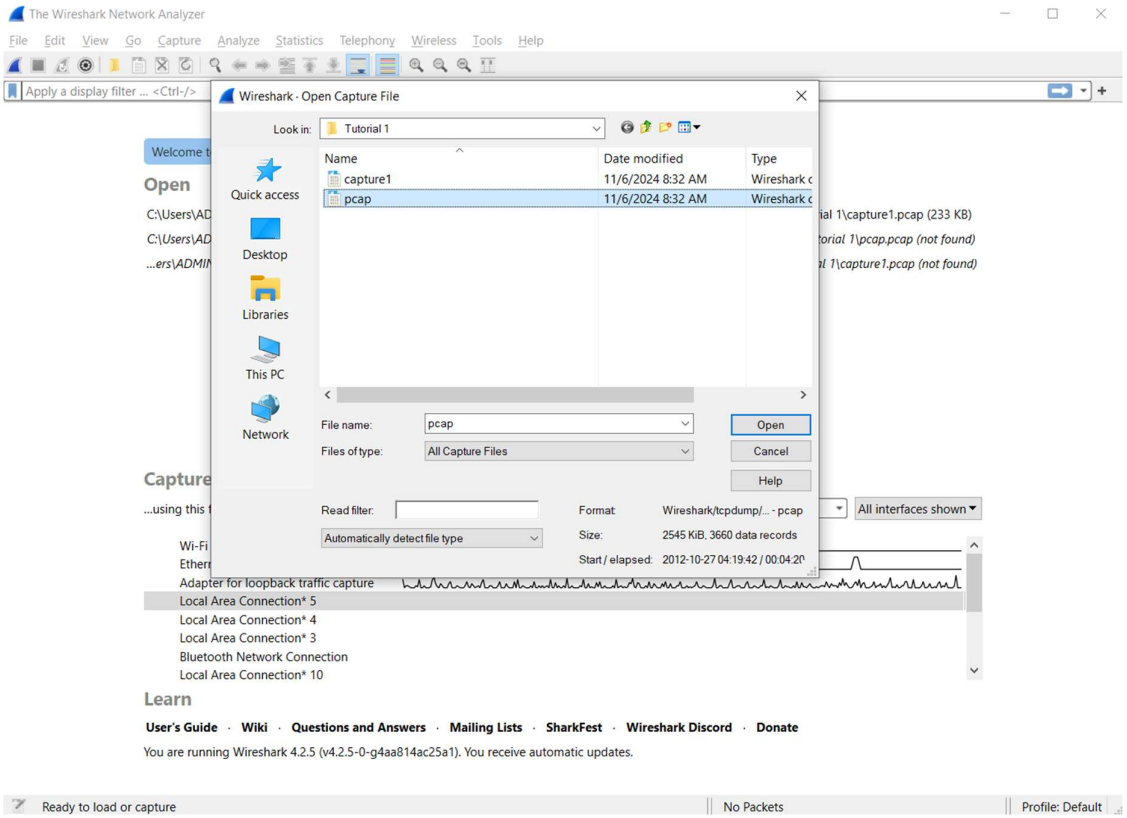
e. The flag contained within the file is ’16 9 3 15 3 20 6 { 20 8 5 14 21 13 2 5 18 19 13 1 19 15 14 }’.

Tool 2: Wireshark

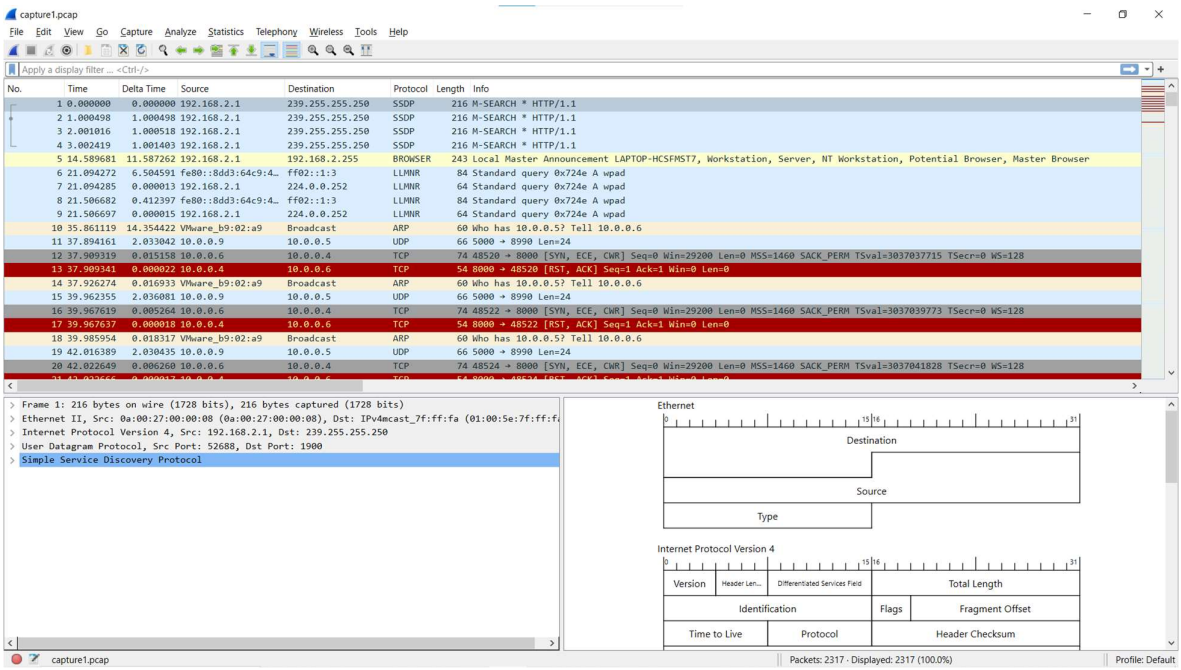
a. To analyze the given pcap file, first we have to open the Wireshark Network Analyzer.



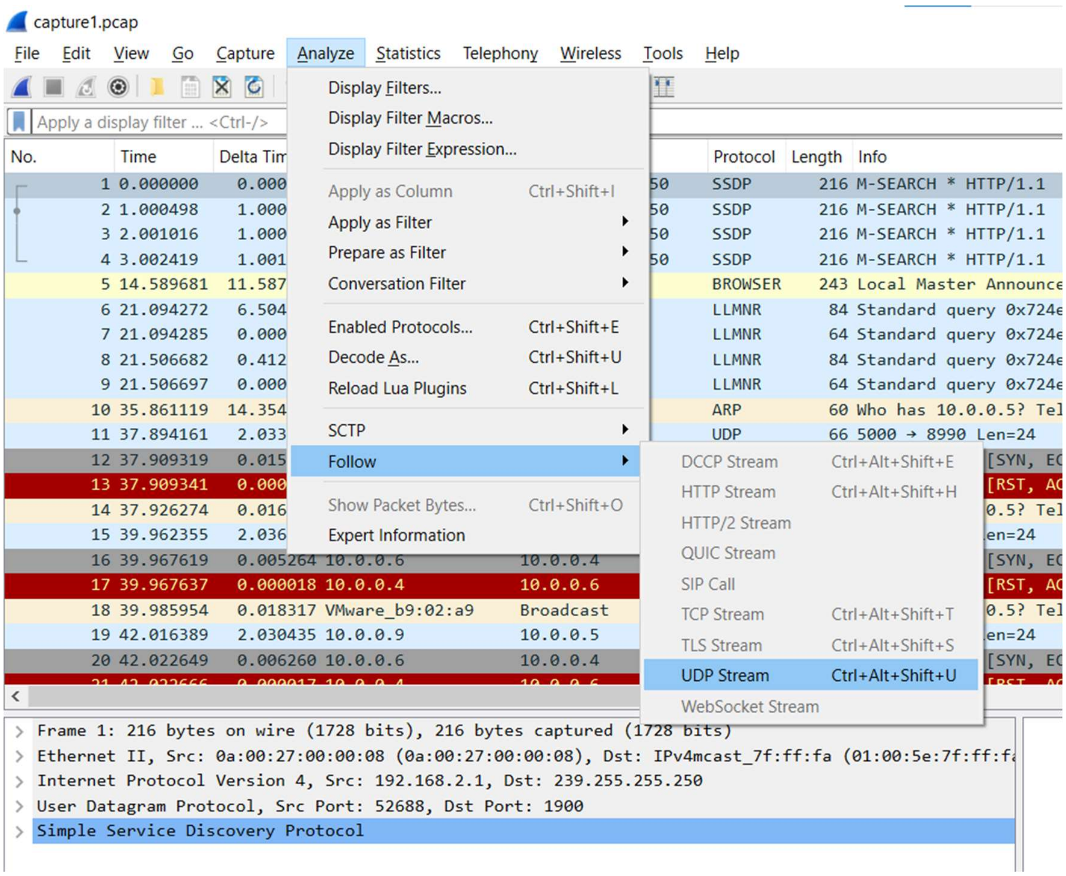
b. Then, look for the pcap file named ‘capture1.pcap’.



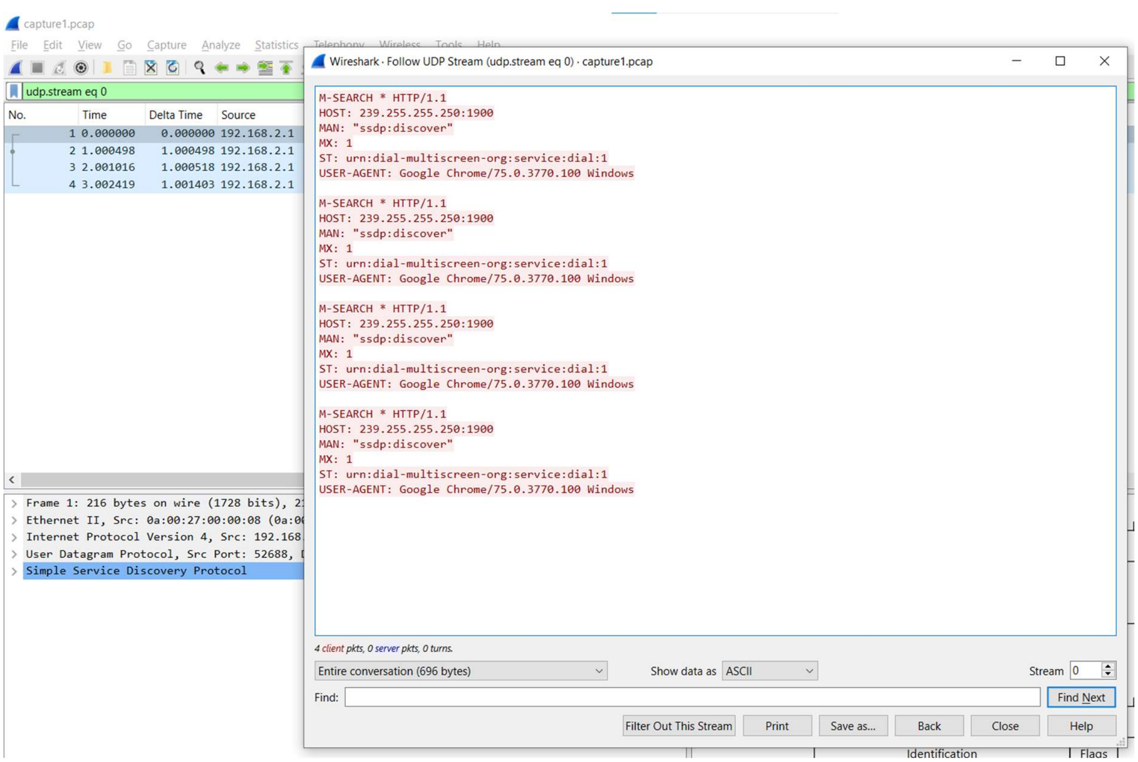
c. Once the file is opened, it will show this interface:



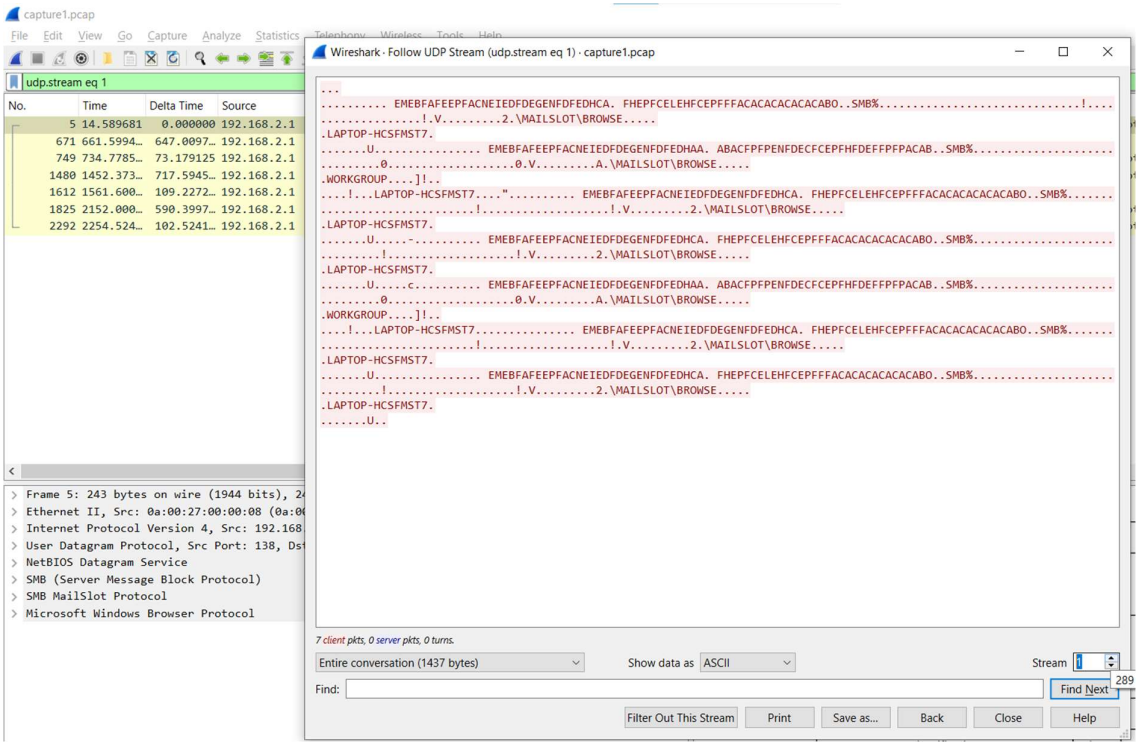
d. To find the flag, we have to analyze the file and follow the UDP stream.

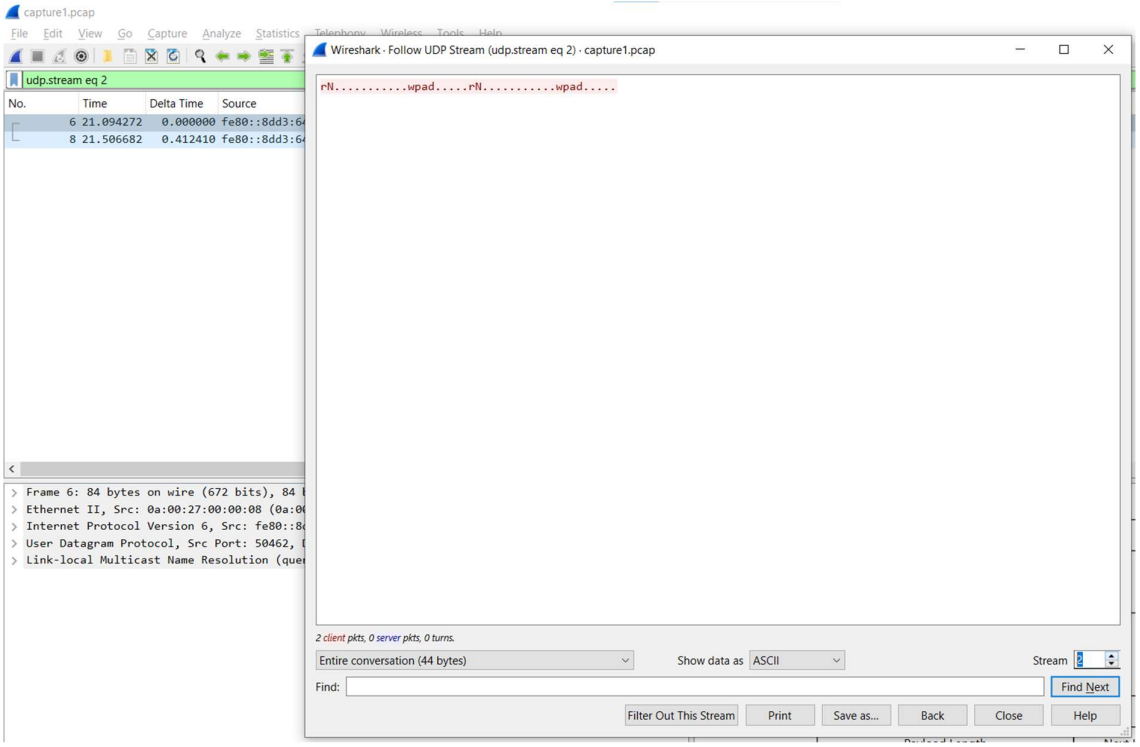


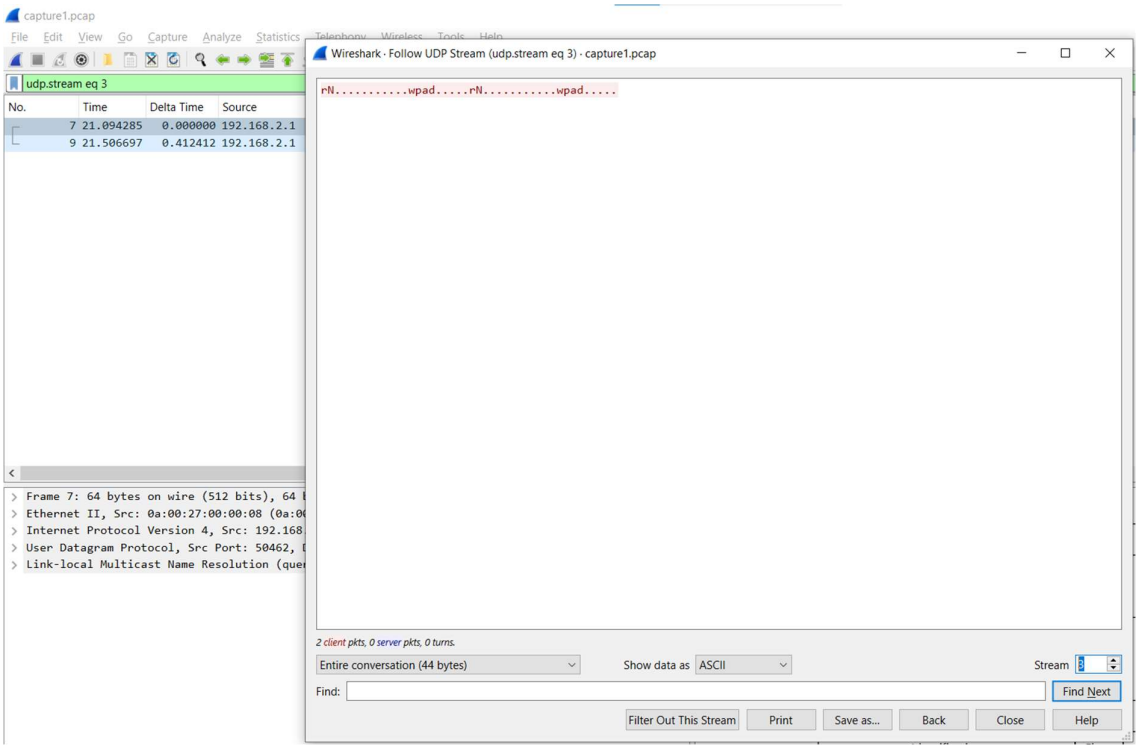
e. This window will pop up, which represents UDP stream 0.



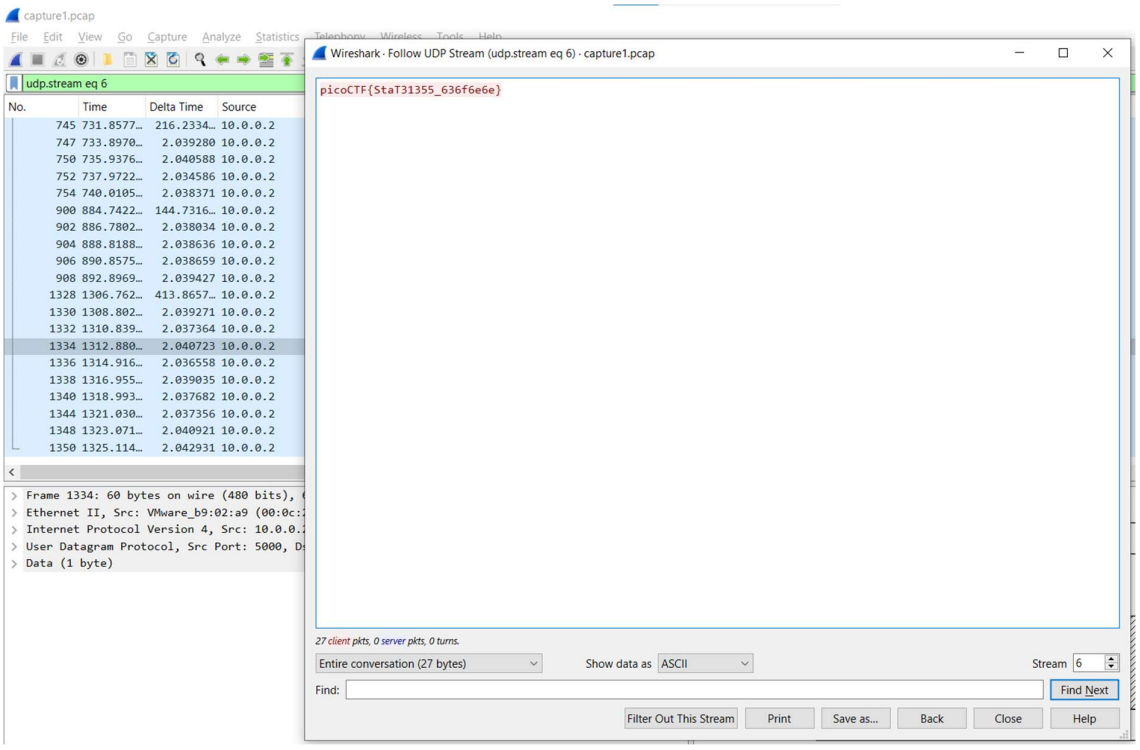
f. We follow to the next streams until we find the flag.







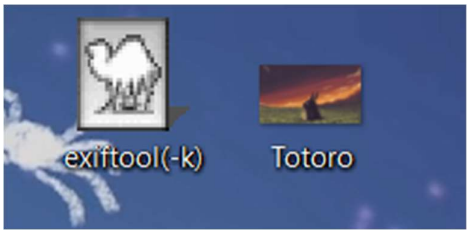
g. On stream number 6, we found the flag, which is 'picoCTF{StaT31355_636f6e6e}'.



Tool 3: Exif Tool

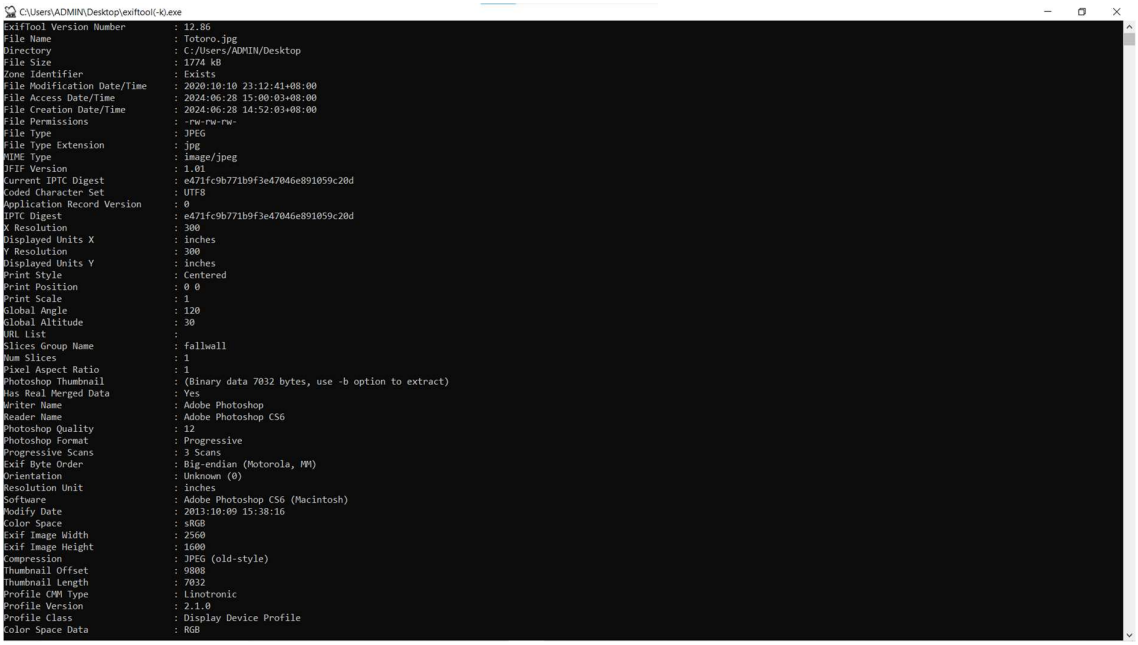
Image File

a. To obtain the metadata from an image file, first I saved the ExifTool executable and a JPG image file in the same directory, which is on my Desktop directory.



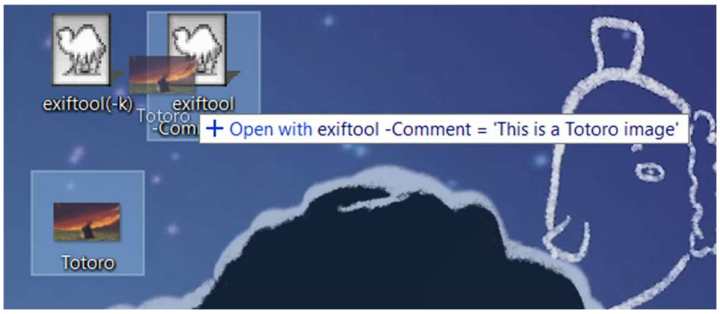
b. Next, I can drag the image file to overlap with the exiftool icon. This gives me the option to open the image file with exiftool.

c. Then, the exiftool executable will open automatically and display the metadata of the image file.

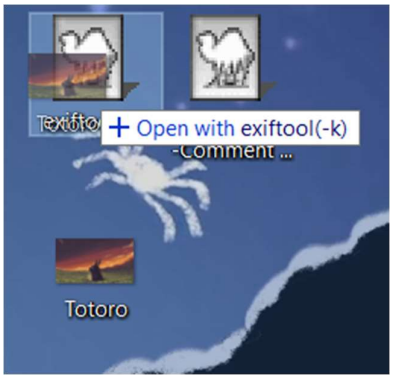


d. To add a comment to the image file, we can create a copy of the exiftool executable and change the argument tag -Comment to add a comment.

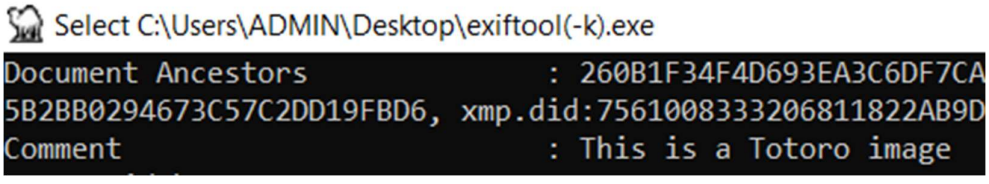
e. Next, drag and drop the image file on top of the executable with the comment argument.



f. A window will pop up and close automatically when the update is performed, we can then check if the comment is added by dragging and dropping the image file on the first exiftool executable without the argument tag.

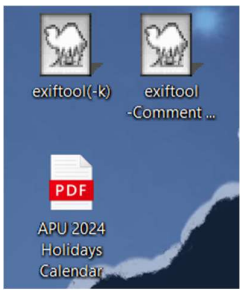


g. When inspecting the metadata, we can now see the newly added comment to the file.



PDF File

a. The same steps apply for a PDF file. First, the PDF file and exiftool executable are saved within the same directory.



b. Next, drag and drop the PDF file onto the exiftool executable.

c. A window will pop up automatically and we can now view the metadata of the PDF file.

```
C:\Users\ADMIN\Desktop\exiftool(-k).exe
ExifTool Version Number         : 12.86
File Name                       : APU 2024 Holidays Calendar.pdf
Directory                       : C:/Users/ADMIN/Desktop
File Size                       : 358 kB
Zone Identifier                 : Exists
File Modification Date/Time     : 2024:05:21 22:22:09+08:00
File Access Date/Time           : 2024:06:28 15:13:30+08:00
File Creation Date/Time         : 2024:06:28 15:13:29+08:00
File Permissions                : -rw-rw-rw-
File Type                       : PDF
File Type Extension             : pdf
MIME Type                       : application/pdf
PDF Version                     : 1.5
Linearized                      : Yes
XMP Toolkit                     : Adobe XMP Core 9.0-c001 79.14ecb42, 2022/12/02-19:12:44
Format                          : application/pdf
Title                           : 202311-03 PH-Schedule Leave 2024(Student)-D1
Metadata Date                   : 2023:12:21 14:47:35+08:00
Modify Date                     : 2023:12:21 14:47:35+08:00
Create Date                     : 2023:12:21 14:47:35+08:00
Creator Tool                    : Adobe Illustrator 27.4 (Macintosh)
Thumbnail Width                 : 256
Thumbnail Height                : 188
Thumbnail Format                : JPEG
Thumbnail Image                 : (Binary data 18803 bytes, use -b option to extract)
Instance ID                     : uuid:6faf2842-df14-2e49-8ada-0237db35c937
Document ID                     : xmp.did:c7fb31e8-c946-4da0-85d4-457a0edc3f9b
Original Document ID            : uuid:5D20892493BFDB11914A8590D31508C8
Rendition Class                 : proof:pdf
Derived From Instance ID        : uuid:5d3e37cb-1d16-6843-aabe-d480fa2f0279
Derived From Document ID        : xmp.did:a170ed09-1a77-43d7-b045-978aab46b8e5
Derived From Original Document ID: uuid:5D20892493BFDB11914A8590D31508C8
Derived From Rendition Class    : default
History Action                  : saved, saved
```

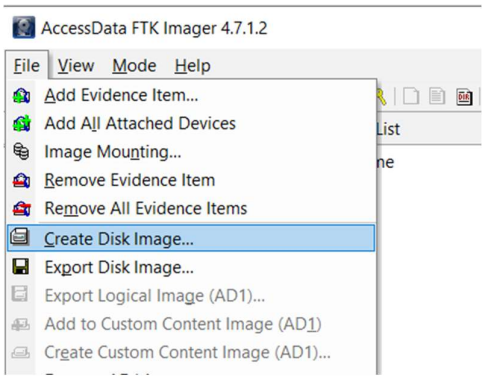
d. To add a comment to the PDF file, I will use the exiftool executable copy that I created earlier, but the argument tag is changed to -keywords. The keyword will act as the comment of the file.

h. Drag and drop the PDF file on top of the executable with the 'keywords' argument.

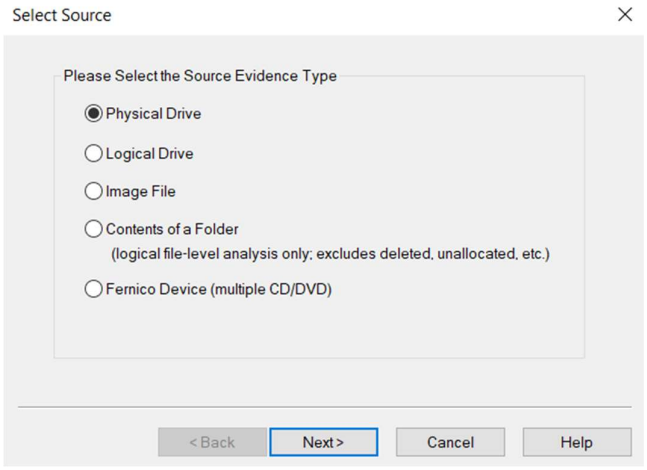
III. Portfolio 2: Imaging Tools

FTK Imager

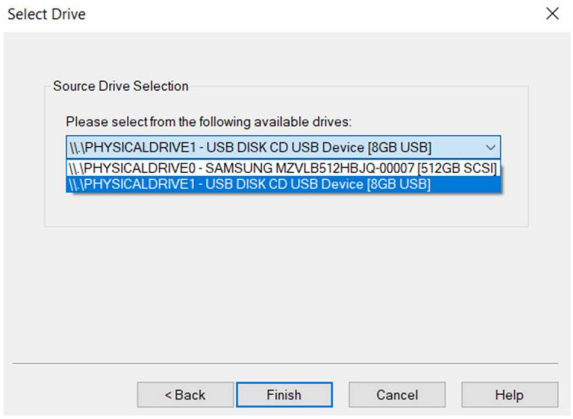
a. To create a disk image of a USB drive, we can use the 'Create Disk Image' function of FTK Imager.



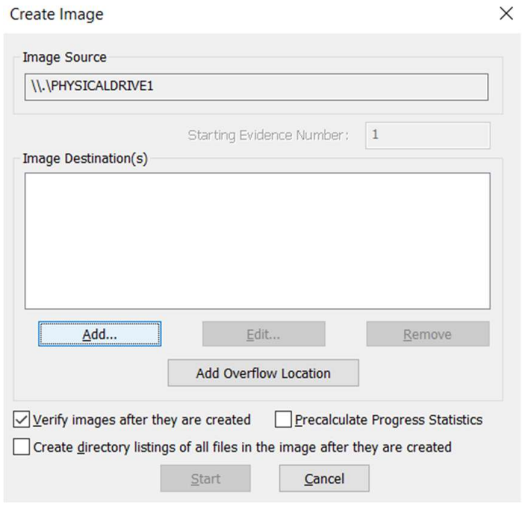
b. Then, choose the physical drive as the source type of the image.



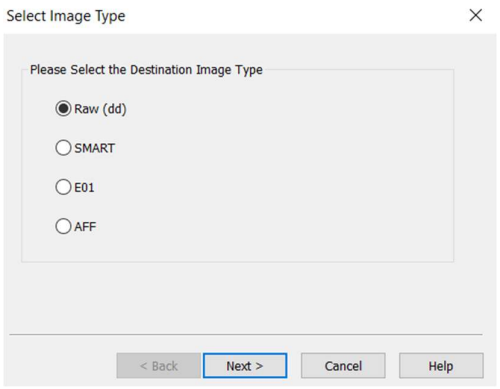
c. The USB drive is then chosen from the list of available drives.



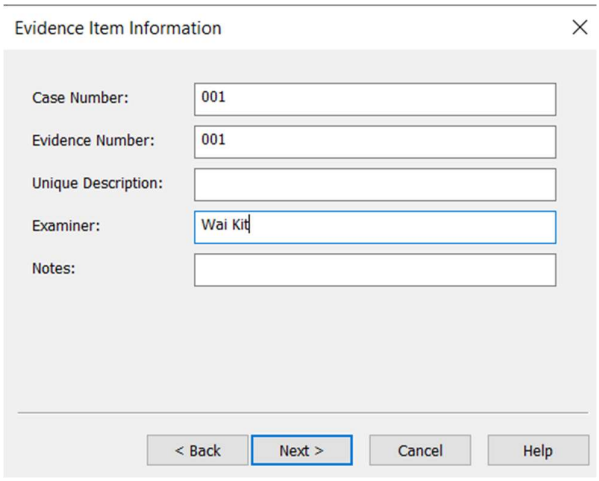
d. The details of the process to create the image will be displayed. We will add an image destination to store the image files.



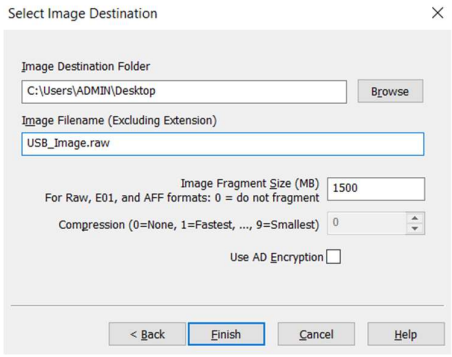
e. The destination image will be saved as type Raw (dd).



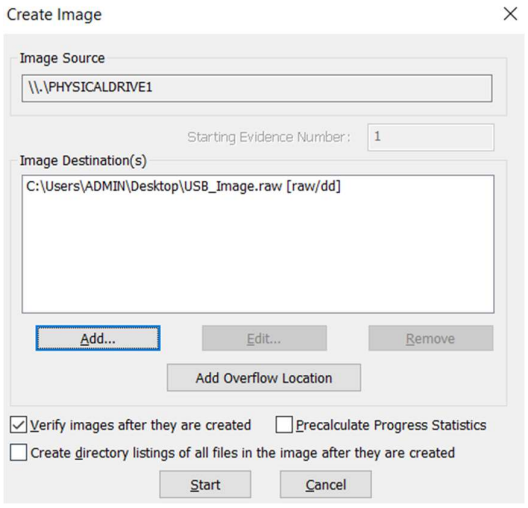
f. Next, the case number, evidence number, and examiner name are provided.



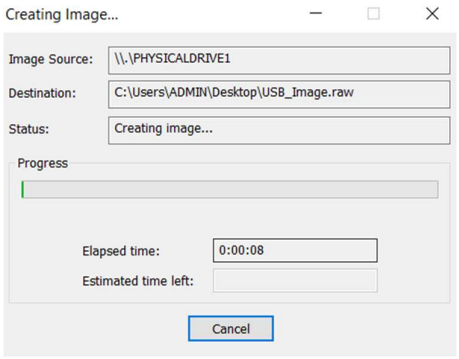
g. Then, we choose the destination folder and the filename to save the image. The image fragment size will be 1500 MB.



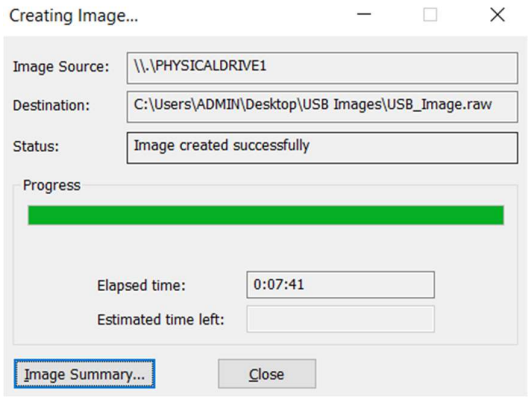
h. Once the destination is provided, we can now start creating the image.



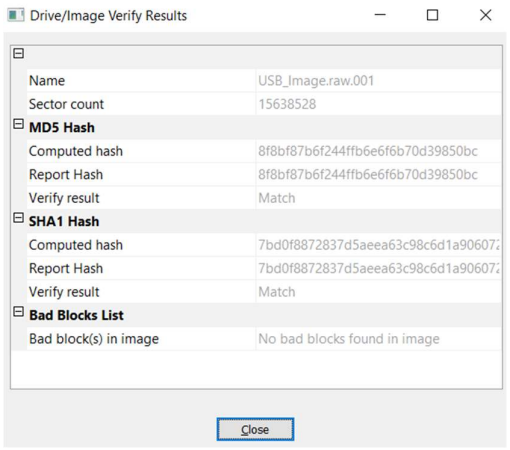
i. This window will show the progress and time elapsed of the imaging process.



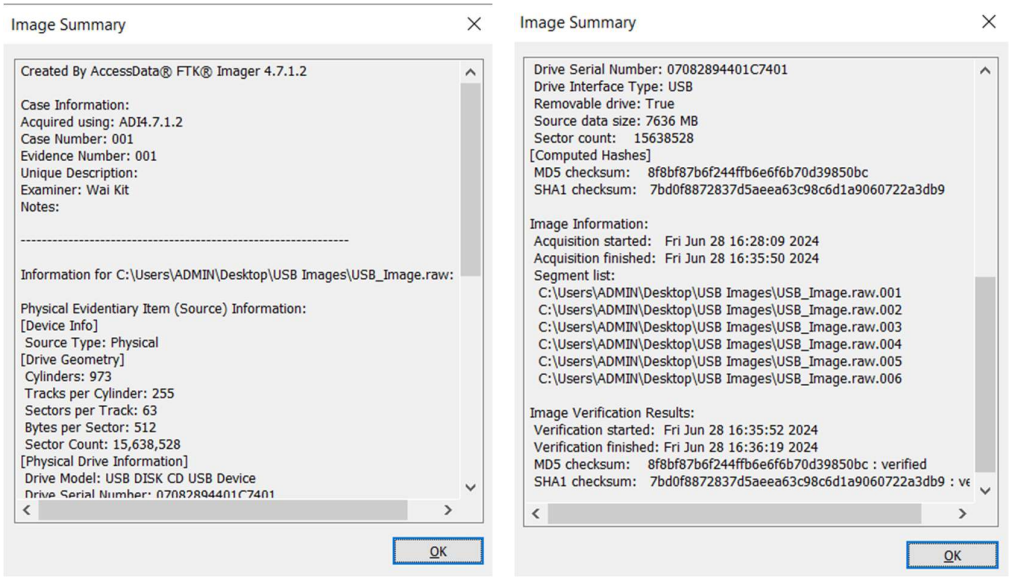
j. The imaging of this USB drive took 7 minutes and 41 seconds to complete.



k. The image results are verified and there are no imaging errors.



l. The image summary is as follows:



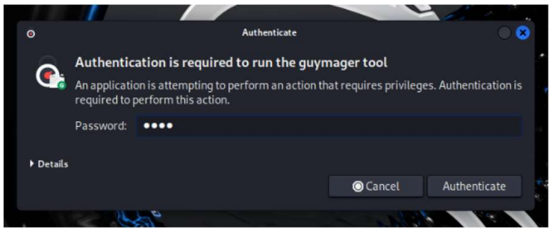
m. There are a total of 6 image files created and saved within the directory, with the addition of one information file about the imaging.

```
C:\Users\ADMIN>cd C:\Users\ADMIN\Desktop\USB Images

C:\Users\ADMIN\Desktop\USB Images>dir
 Volume in drive C is Acer
 Volume Serial Number is 083C-B766

 Directory of C:\Users\ADMIN\Desktop\USB Images

28/06/2024  04:35 PM    <DIR>          .
28/06/2024  04:35 PM    <DIR>          ..
28/06/2024  04:29 PM     1,572,864,000 USB_Image.raw.001
28/06/2024  04:36 PM             1,632 USB_Image.raw.001.txt
28/06/2024  04:31 PM     1,572,864,000 USB_Image.raw.002
28/06/2024  04:32 PM     1,572,864,000 USB_Image.raw.003
28/06/2024  04:34 PM     1,572,864,000 USB_Image.raw.004
28/06/2024  04:35 PM     1,572,864,000 USB_Image.raw.005
28/06/2024  04:35 PM       142,606,336 USB_Image.raw.006
               7 File(s)  8,006,927,968 bytes
               2 Dir(s)  141,518,319,616 bytes free
```

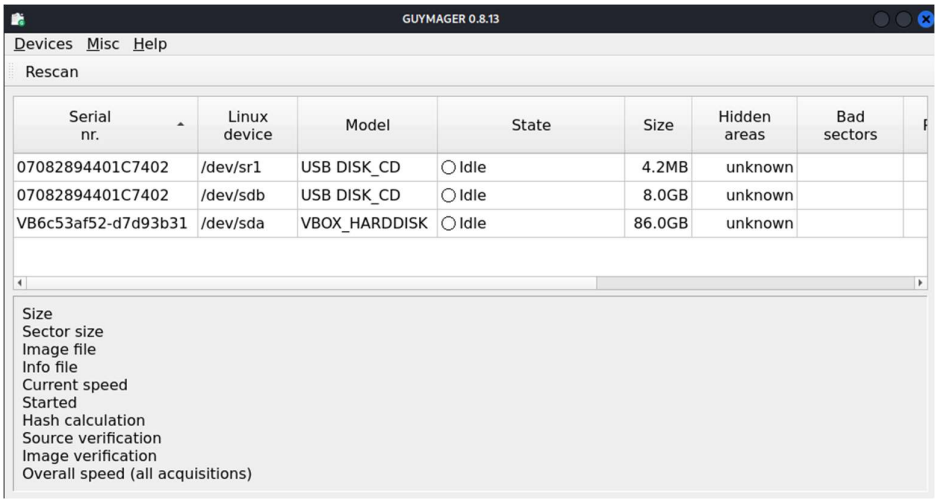
Guymager

To perform the USB drive imaging in Kali Linux, I will use the Guymager tool.

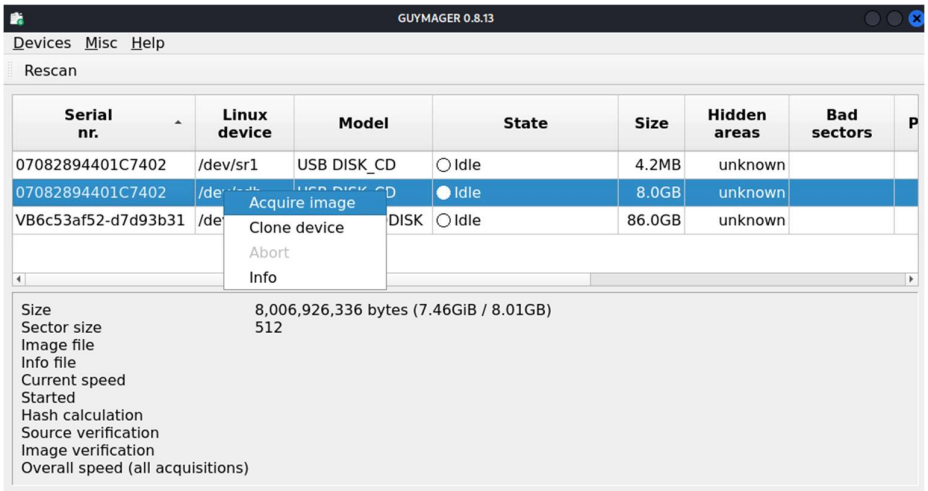
a. First, when opening the app, it will ask for authentication since root access is required.



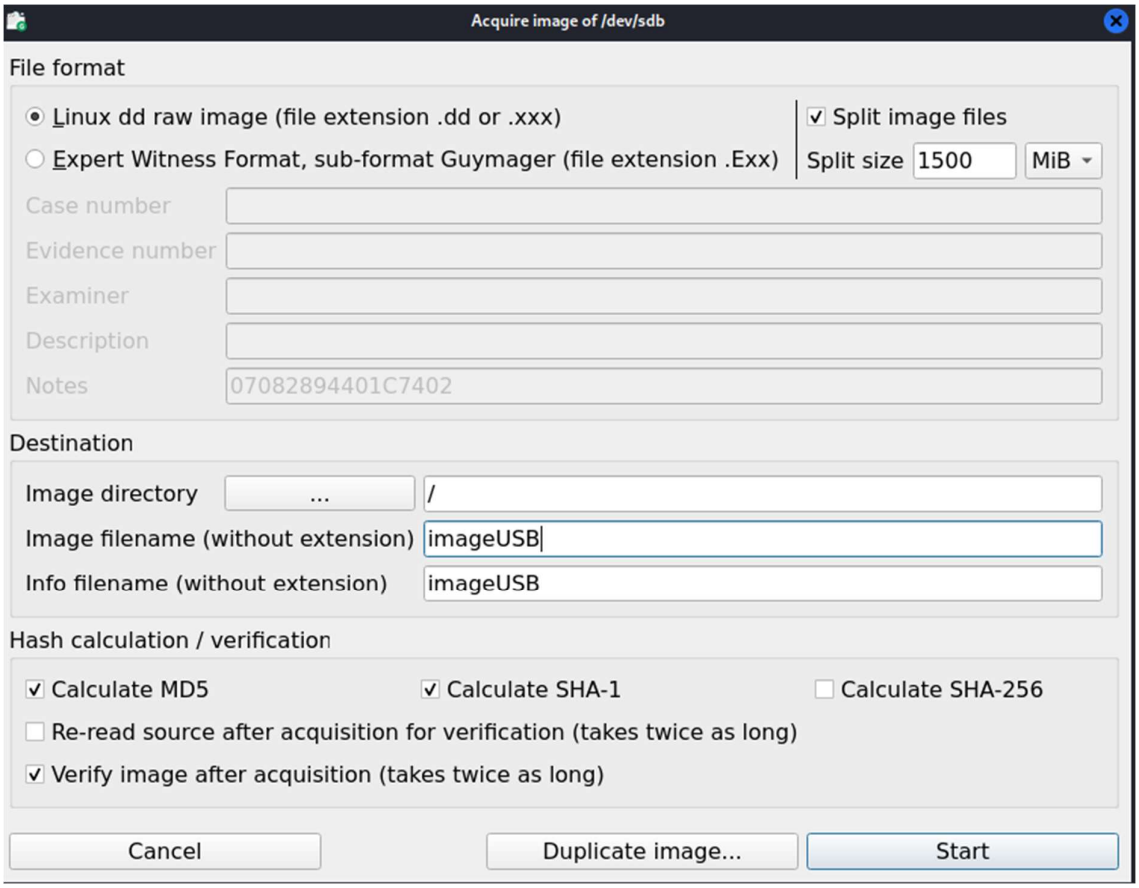
b. Once opened, the Guymager app will show this interface.



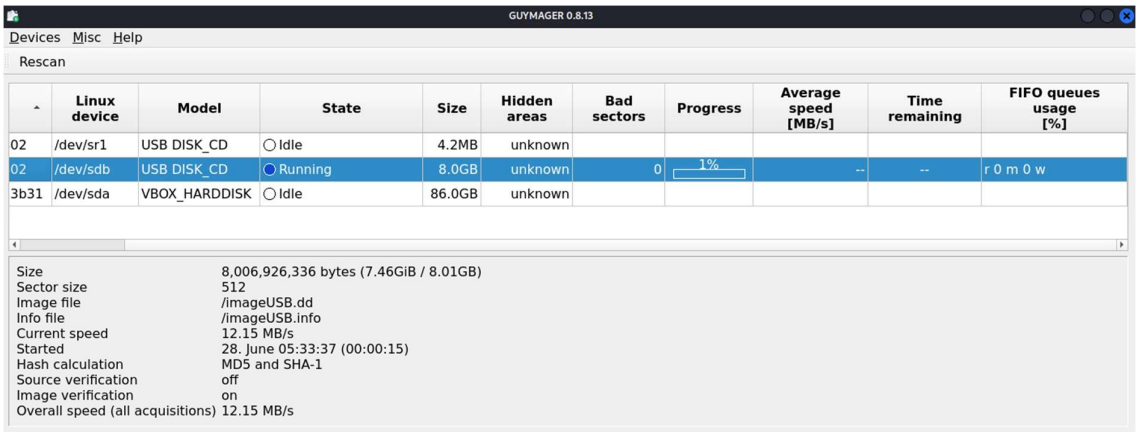
c. I selected my USB drive that is shown in the list of available drives. The image can then be acquired by clicking the ‘Acquire image’ option.



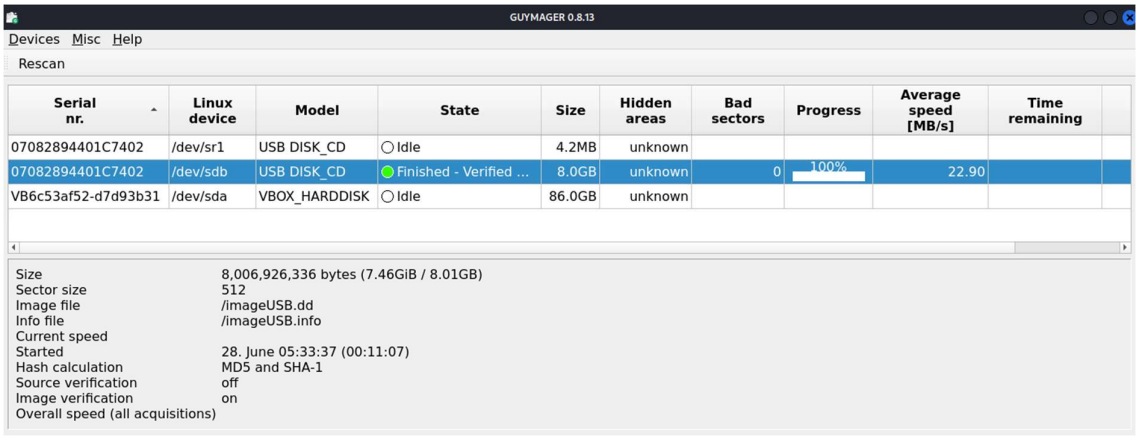
d. Next, we have to specify the file format and destination. I will save the image files as Raw (dd) type and save the results in a folder. The split size will be 1500 MB as well.



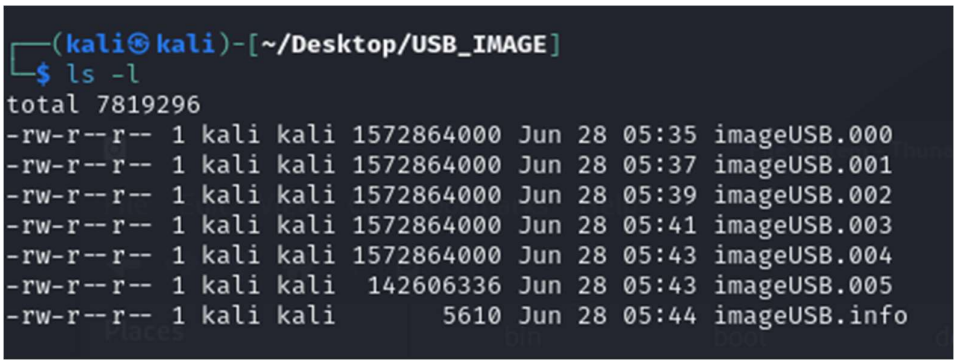
e. Once the process starts, the state is shown as Running and the progress bar is displayed. At the bottom part, additional information like the speed and time elapsed are also provided.



f. Once the imaging is done, the state is changed to 'Finished – Verified & ok'. A total of 11 minutes and 7 seconds is used for the entire process.



g. We can then check the image files using the terminal as shown below:



Comparison Between FTK Imager and Guymager

FTK Imager and Guymager both produced six files as the imaging results, and each corresponding image file from both tools has the same exact size. Additionally, the images from both tools were verified using the MD5 and SHA-1 hashes.

In Table 2 below, the differences between both tools will be discussed.

Table 2: Differences between FTK Imager and Guymager

FTK Imager	Guymager
Used in local Windows machine.	Used in Kali Linux virtual machine.
Faster, took 7 minutes and 41 seconds to complete the USB drive imaging and verification of image files.	Slower, took 11 minutes and 7 seconds to complete the USB drive imaging and verification of image files.

Offers a comprehensive graphical user interface (GUI) with intuitive options for various forensic imaging tasks.	Also provides a GUI, but its interface is simpler and more straightforward compared to FTK Imager.
Supports a wide range of imaging formats and offers advanced options like compression, verification, and imaging of specific partitions.	Focuses on core imaging tasks with support for various formats and basic imaging settings.
A basic version is available for free, but it requires a license for full forensic use.	Open-source and freely available, comes pre-installed in Kali Linux.

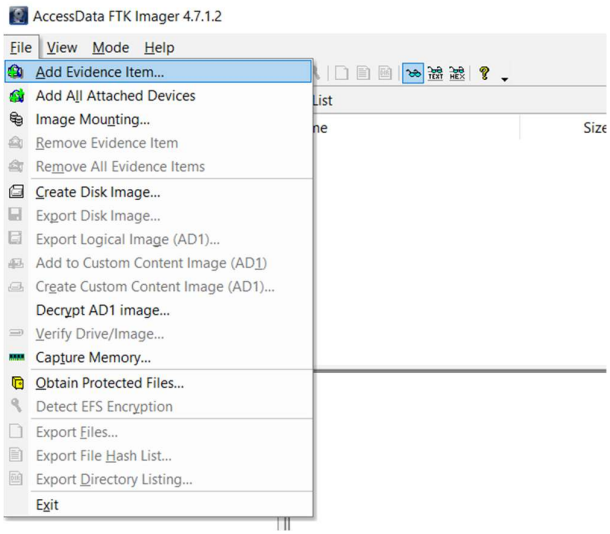
IV. Portfolio 3: Investigation Tools

An image file named 'DraftComplete.dd' that contains the forensic image of the Compact Flash (CF) memory card was provided. This file will be used to conduct a forensic investigation to find out the contents of the CF and determine whether Bruce Armiter was involved in unauthorized data transfer or theft of sensitive information from Draft Complete, Inc.

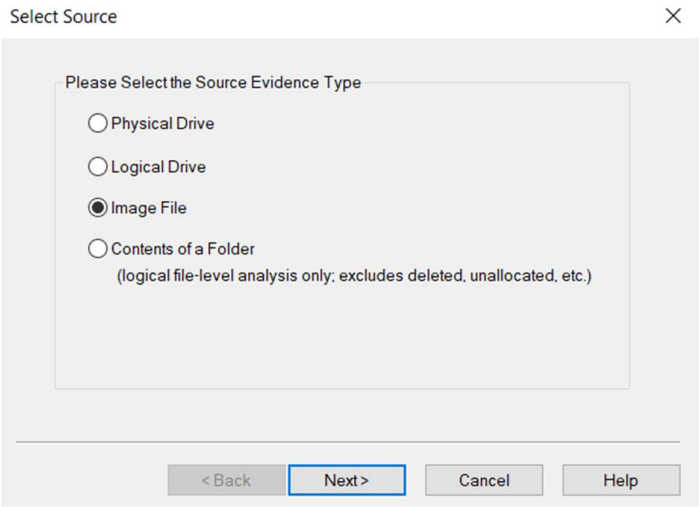
FTK Imager – Windows-based Tool

This investigation can be done using the FTK Imager, which is a powerful forensic tool that can not only be used to perform imaging, but it can also analyze disk images. The steps to conduct the investigation are as follows:

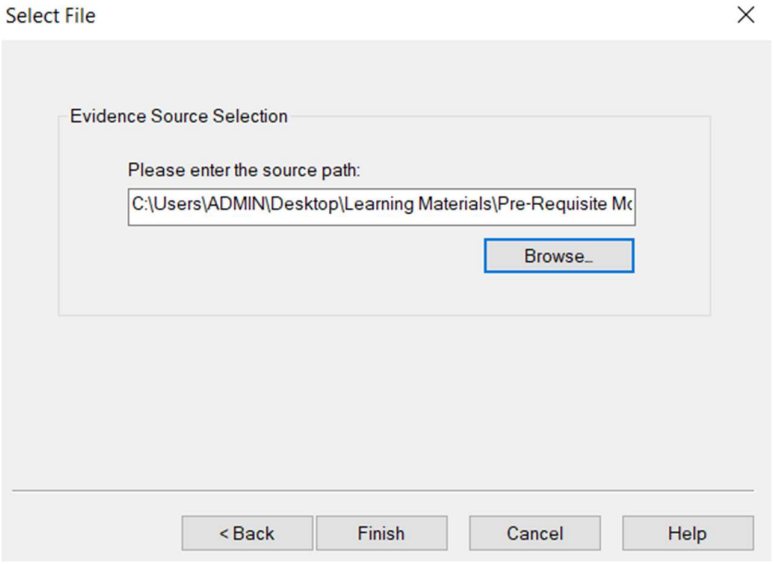
a. Add the .dd file as an evidence item in FTK Imager.



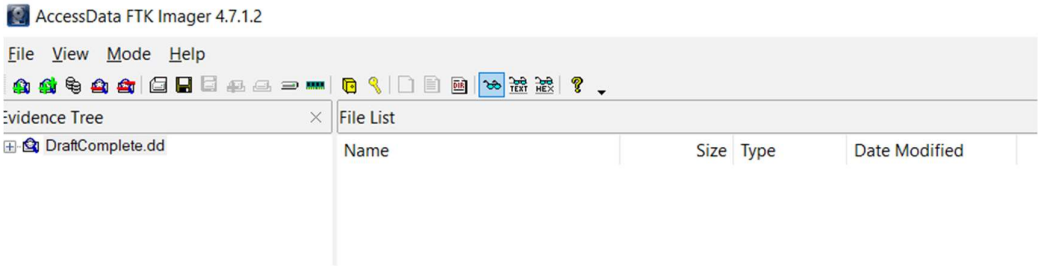
b. It will then ask for the type of the source file, in this case we will be analyzing an image file.



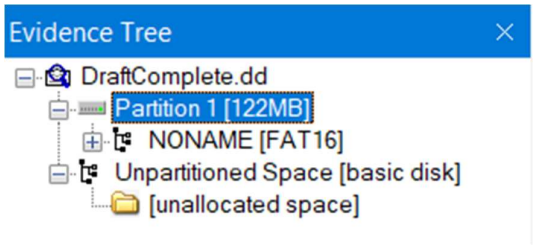
c. Next, enter the source path of the DraftComplete.dd file.



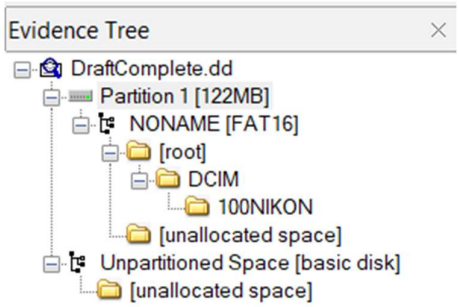
d. After providing the source path and clicking Finish, the image file is now added to the evidence tree.



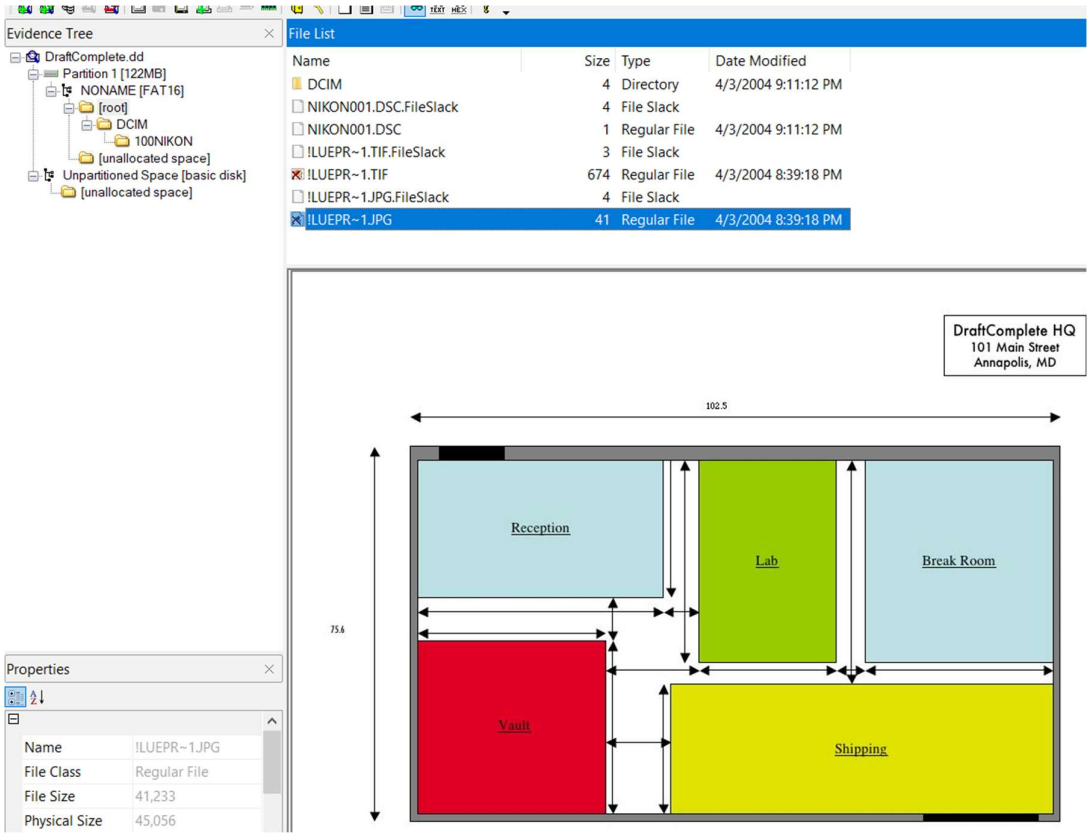
e. By expanding the image file, we can see that there are two partitions, which are Partition 1 and Unpartitioned Space. According to Lelii (n.d.), a partition is a logical segment of a hard disk that operating systems and file systems treat as an individual unit. This allows the OSes and file systems to handle data on each partition as though it were a separate hard drive.



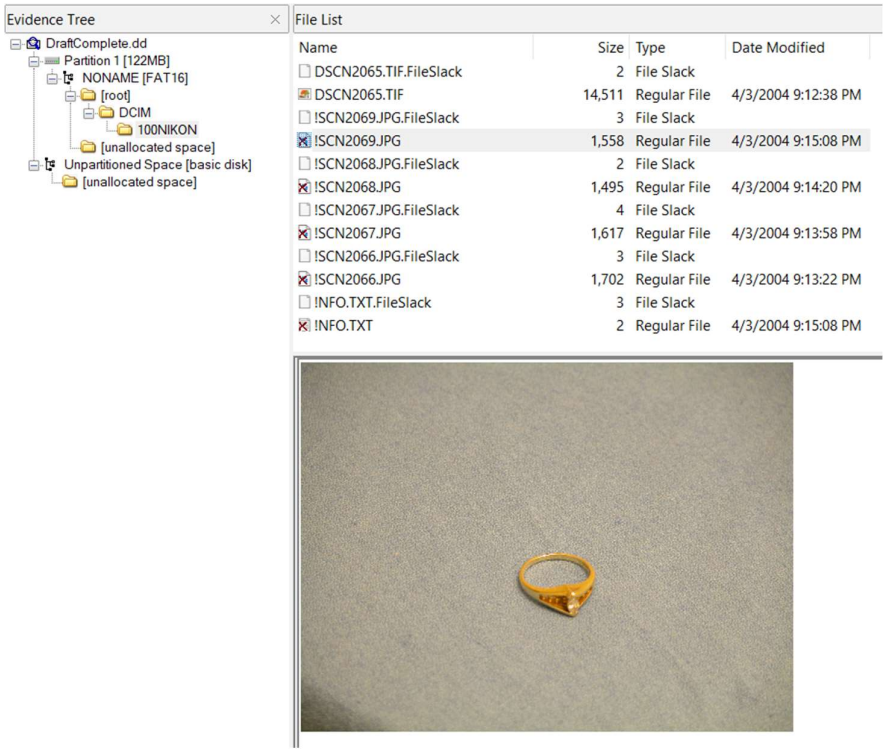
f. By expanding Partition 1, we can see that there is a root folder with subfolders. We can examine each folder individually to find any information related to pictures of new products and the Draft Complete, Inc. HQ building schematics.

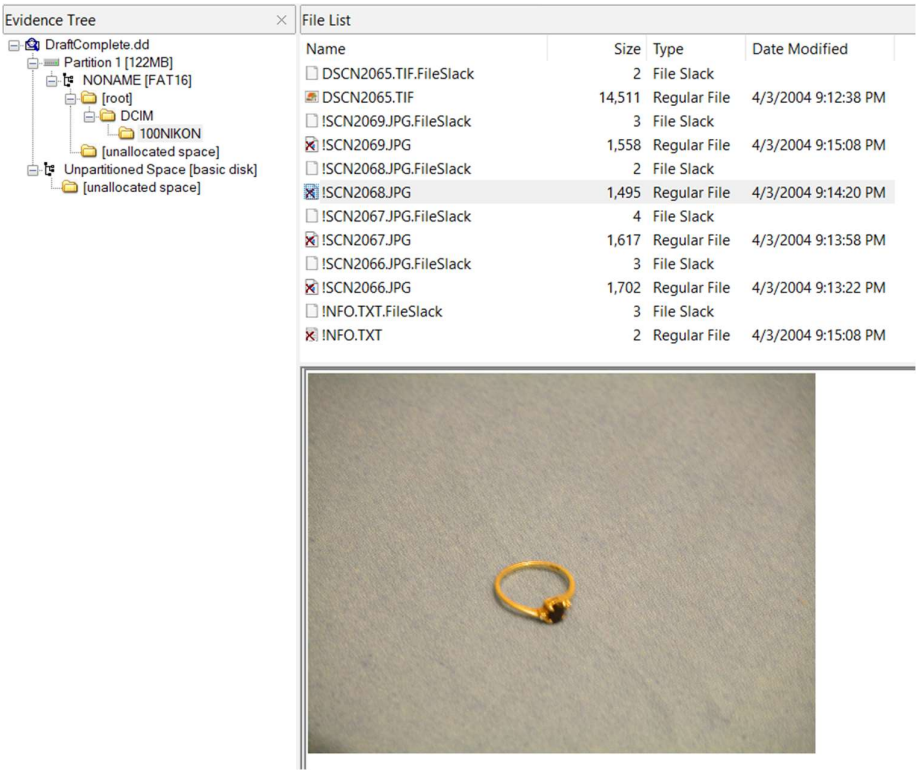


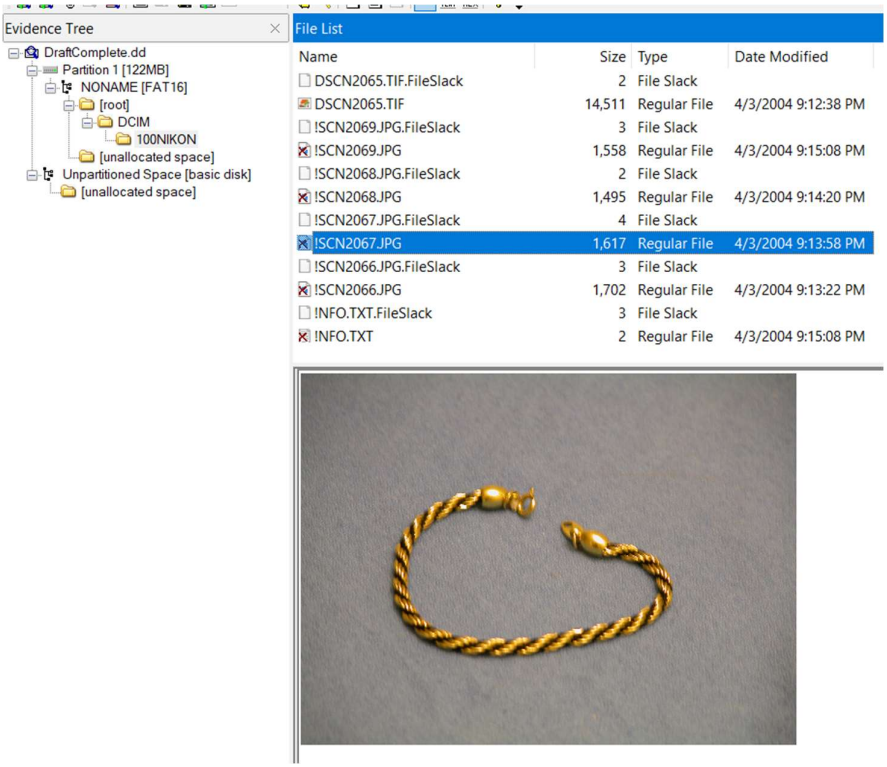
g. In the root folder, there is a JPG file that shows the company's building schematics. This evidence supports the guard's statement as the file obtained matches the guard's suspicion.

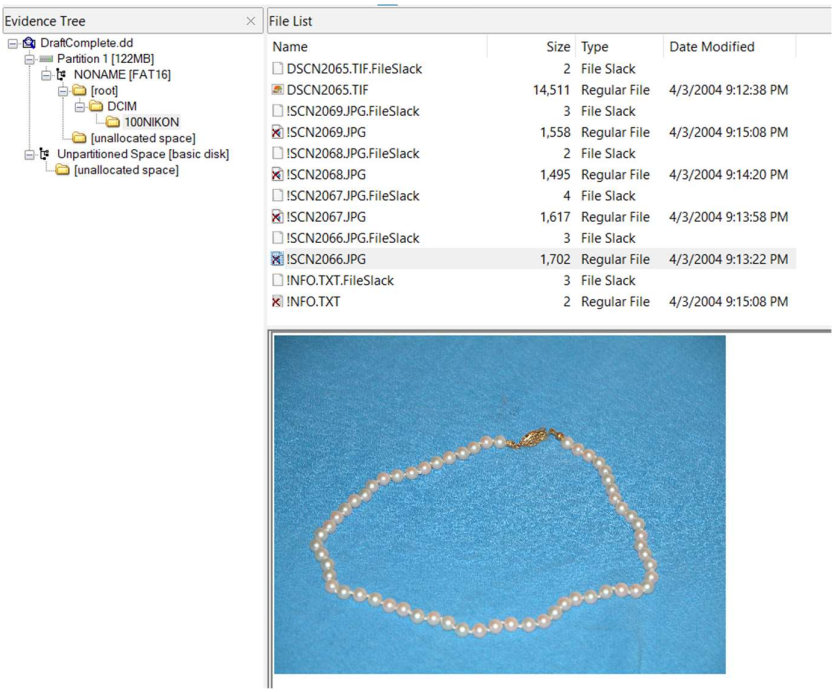


h. Further inspection of the files revealed images of a few different types of jewelry, saved as JPG files. These images can prove the claims of the guard.




Evidence Tree
DraftComplete.dd
Partition 1 [122MB]
NONAME [FAT16]
[root]
DCIM
100NIKON
[unallocated space]
Unpartitioned Space [basic disk]
[unallocated space]
File List
Name Size Type Date Modified
DSCN2065.TIF.FileSlack 2 File Slack
DSCN2065.TIF 14,511 Regular File 4/3/2004 9:12:38 PM
!SCN2069.JPG.FileSlack 3 File Slack
!SCN2069.JPG 1,558 Regular File 4/3/2004 9:15:08 PM
!SCN2068.JPG.FileSlack 2 File Slack
!SCN2068.JPG 1,495 Regular File 4/3/2004 9:14:20 PM
!SCN2067.JPG.FileSlack 4 File Slack
!SCN2067.JPG 1,617 Regular File 4/3/2004 9:13:58 PM
!SCN2066.JPG.FileSlack 3 File Slack
!SCN2066.JPG 1,702 Regular File 4/3/2004 9:13:22 PM
!NFO.TXT.FileSlack 3 File Slack
!NFO.TXT 2 Regular File 4/3/2004 9:15:08 PM


Evidence Tree
DraftComplete.dd
Partition 1 [122MB]
NONAME [FAT16]
[root]
DCIM
100NIKON
[unallocated space]
Unpartitioned Space [basic disk]
[unallocated space]
File List
Name Size Type Date Modified
DSCN2065.TIF.FileSlack 2 File Slack
DSCN2065.TIF 14,511 Regular File 4/3/2004 9:12:38 PM
!SCN2069.JPG.FileSlack 3 File Slack
!SCN2069.JPG 1,558 Regular File 4/3/2004 9:15:08 PM
!SCN2068.JPG.FileSlack 2 File Slack
!SCN2068.JPG 1,495 Regular File 4/3/2004 9:14:20 PM
!SCN2067.JPG.FileSlack 4 File Slack
!SCN2067.JPG 1,617 Regular File 4/3/2004 9:13:58 PM
!SCN2066.JPG.FileSlack 3 File Slack
!SCN2066.JPG 1,702 Regular File 4/3/2004 9:13:22 PM
!NFO.TXT.FileSlack 3 File Slack
!NFO.TXT 2 Regular File 4/3/2004 9:15:08 PM



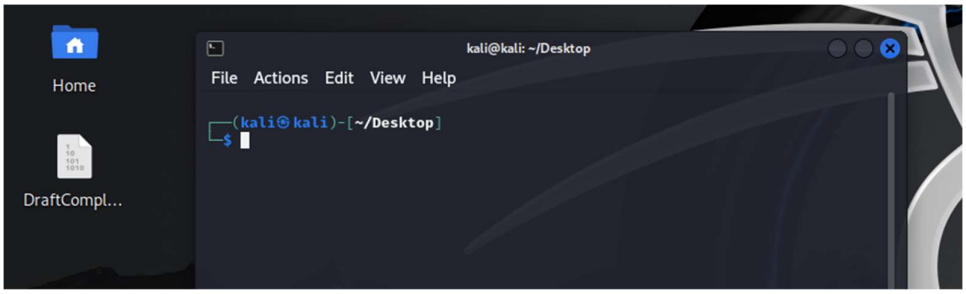
Foremost is a forensic program to recover lost files based on their headers, footers, and internal data structures. Foremost can work on image files, such as those generated by dd

Foremost – Linux-based Tool

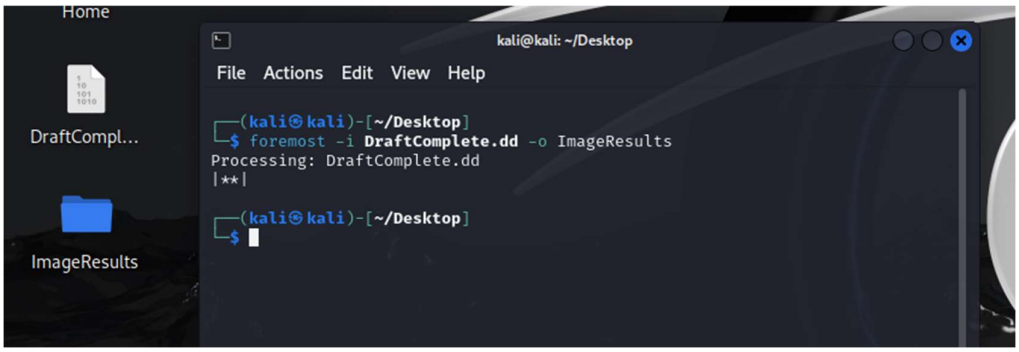
Similarly, the same investigation can be done using a Linux-based tool. We will be using Foremost in Kali Linux to analyze the image file. According to Kali (n.d.), Foremost is a forensic application designed to recover lost files by identifying their headers, footers, and internal data structures. It can operate on image files, such as those created by dd.

The steps to operate on the image file are:

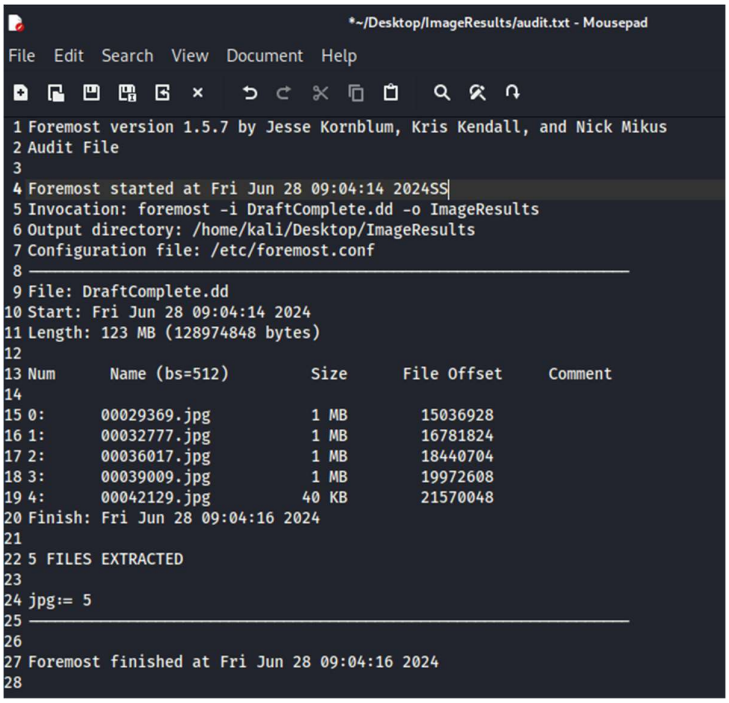
a. Open the terminal and change directory to where the DraftComplete.dd is saved, in this case the file was saved in /Desktop.



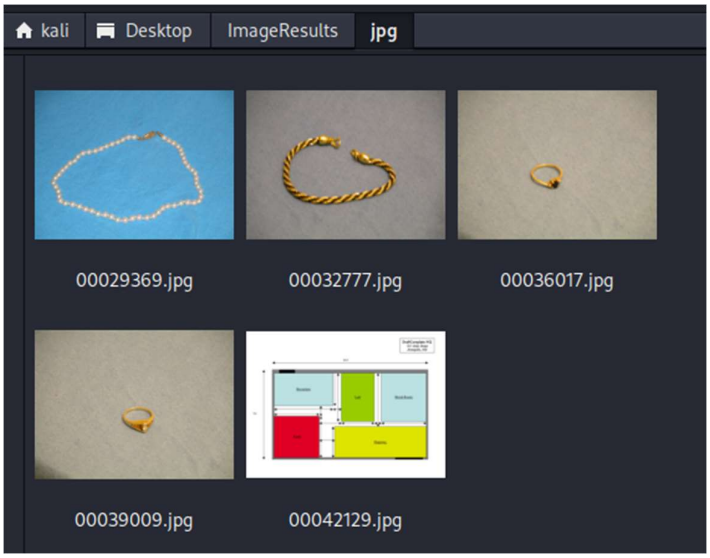
b. Next, we can use commands the foremost -i DraftComplete.dd -o ImageResults command to analyze the image file and store the results in a directory called ‘ImageResults’.



c. In the ImageResults folder, there is a subfolder and a .txt file which is an audit file that contains information about the findings. The content of the audit file is:



d. From the audit file, we can see that there are a total of 5 JPG files extracted from the image file. When we open the jpg subfolder, the 5 JPG files that were extracted are saved here.



e. These 5 JPG files are the same images that we extracted using FTK Imager, which supports the guard's statement.

Summary of Case Findings

During the forensic investigation of the disk image file DraftComplete.dd using FTK Imager, several key discoveries were made that support the security guard's suspicions. The disk image was found to contain two partitions, which are Partition 1 and Unpartitioned Space. Partition 1 contains the main file system, while the unpartitioned space remains unused and does not contain any files. By expanding Partition 1, we accessed the root folder, which contains subfolders and several files relevant to the investigation.

Detailed examination of the root folder revealed various files, including a JPG file that depicts the schematics of Draft Complete, Inc.'s headquarters. This file directly supports the security guard's suspicion that sensitive information about the building layout was being smuggled out. Additionally, several JPG files containing images of different types of high-end jewelry were discovered in the same directory. These files indicate potential unauthorized access and illegal disclosure of product designs.

Both FTK Imager and Foremost were used to extract data from the DraftComplete.dd disk image. While FTK Imager extracted the entire file system, providing a complete view of all directories and files, Foremost focused on recovering files based on their headers, footers, and internal data structures. In this case, both tools successfully extracted the same JPG files containing the company's building schematics and jewelry images. However, FTK Imager

extracted data from the whole file system, while Foremost only retrieved the JPG files, demonstrating the different capabilities and focuses of these forensic tools.

The forensic analysis of the DraftComplete.dd disk image provides substantial evidence to support the security guard's concerns. The presence of the company's building schematics and images of new jewelry products on the Compact Flash (CF) memory card suggests that Bruce Armiter was indeed involved in the unauthorized transfer of sensitive information from the company. This evidence can be used to support further investigation and potential legal actions against the suspect for data theft and intellectual property violations.

V. Conclusion

In conclusion, this portfolio has provided a practical exploration of essential tools and methodologies in digital forensics and cybersecurity. From Hex Editor and Wireshark for analysing files and network traffic to Exif Tool for extracting metadata, each tool serves a critical role in uncovering insights and securing digital environments. The demonstrations using FTK Imager and Guymager in Kali Linux underscore the importance of proper imaging techniques in preserving digital evidence and conducting thorough investigations. These tools not only facilitate technical proficiency but also highlight the interdisciplinary nature of cybersecurity, where proactive measures and effective response strategies are essential.

The investigation into the Draft Complete, Inc. case further illustrates the practical application of these forensic tools. By utilizing FTK Imager and Foremost, we successfully identified and extracted crucial evidence, such as the company's building schematics and images of high-end jewelry products. This evidence supports the suspicion that Bruce Armiter was involved in the unauthorized transfer of sensitive information from Draft Complete, Inc. The case underscores the value of thorough forensic analysis in uncovering illicit activities and providing a basis for further legal action. Overall, this portfolio demonstrates the significance of comprehensive forensic methodologies in both routine cybersecurity tasks and complex investigations.

VI. References

Kali (n.d.). foremost | Kali Linux tools. https://www.kali.org/tools/foremost/

Lelli, S. (n.d.). What is partition? | Definition from TechTarget. TechTarget. https://www.techtarget.com/searchstorage/definition/partition

VII. Appendix

None