MID SEM ASSIGNMENT

In the partial fulfilment of B. tech -III-year course

requirement of

Subject: Cryptography

Submitted To:

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Section: CSE – 4

PART – 1

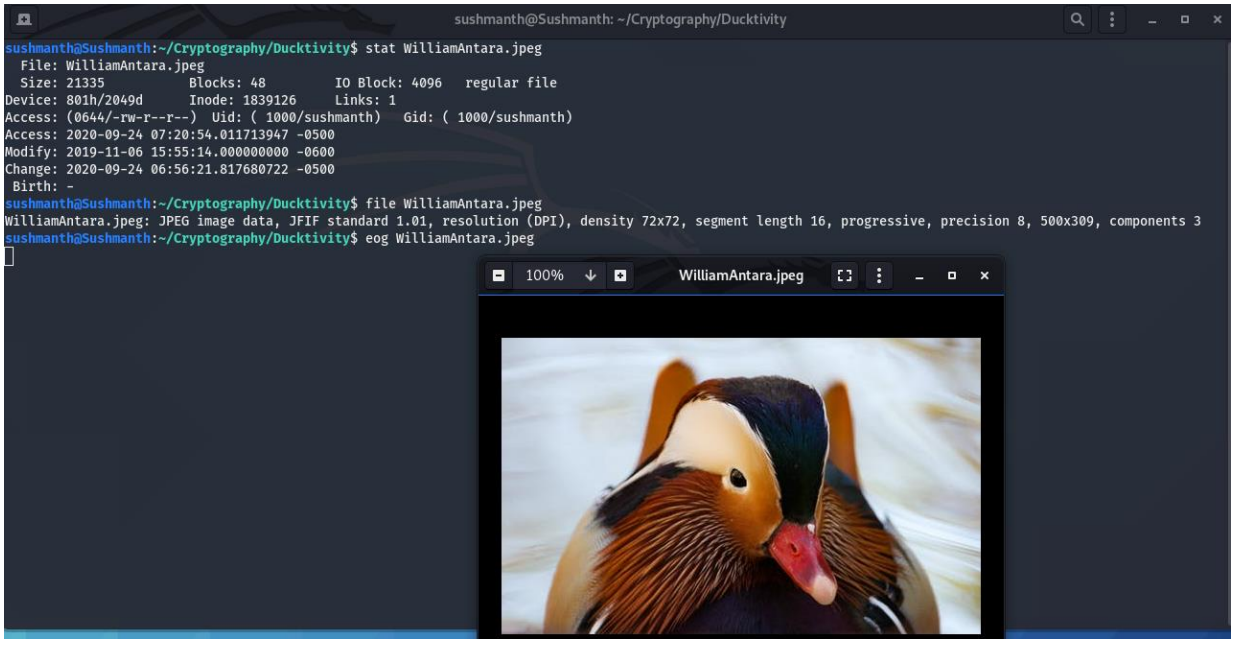
Exercise 1 – A NEEDLE IN A HAYSTACK

In this exercise, we are going to use hash value to identify any file containing the same data as the source file.

Hash Value: A hash value is a numeric value of a fixed length that uniquely identifies data. Hash values represent large amounts of data as much smaller numeric values, so they are used with digital signatures.

Now, lets do the exercise as per the given commands. First thing is using terminal, navigate to the Ducktivity folder and list the contents

Examine the WilliamAntara.jpeg file

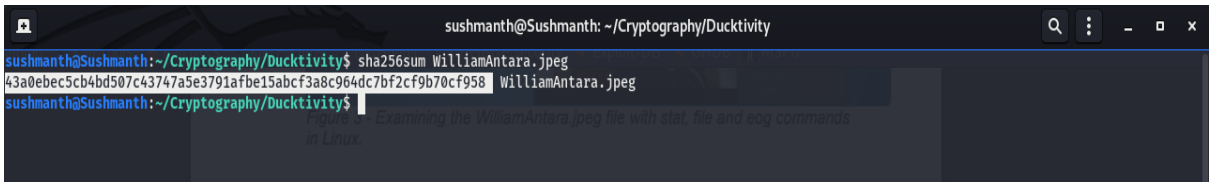


stat command gives the file system information

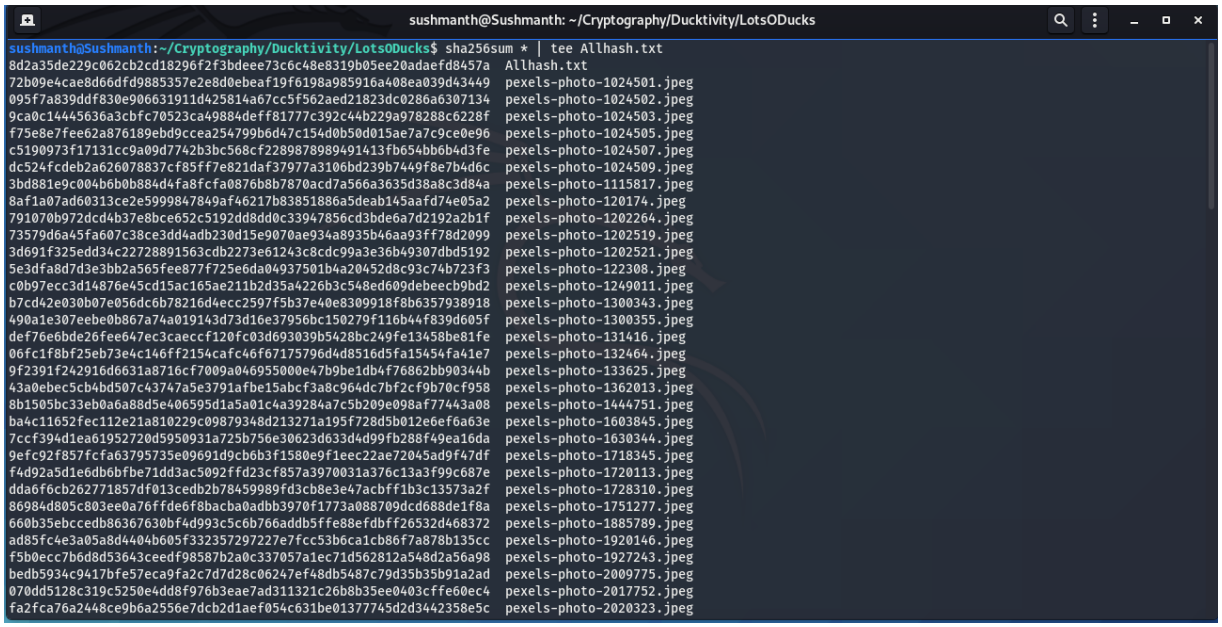
file command gives the content details

We can examine the picture directly by using Eye of GNOME (eog) picture viewer

Now, we will find the 256-bit hash value of WilliamAntara.jpeg by using sha256sum command.



Copy this hash value. And we have to find out hash values for all the files and store them in Allhash.txt file.



Now we will compare the hash value of WilliamAntara.jpeg with all the hash values stored in Allhash.txt

pexels-photo-1362013.jpeg has same hash value of WilliamAntara.jpeg.

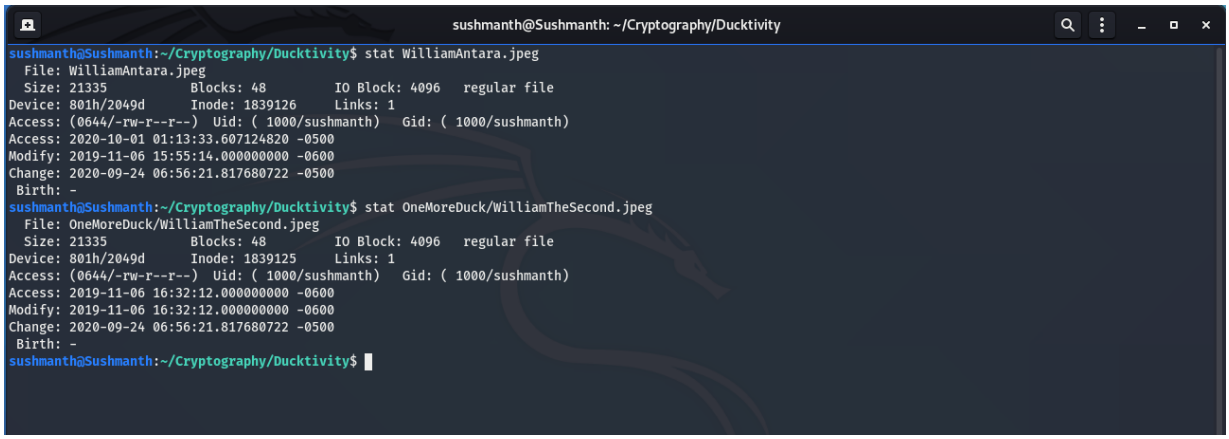
Question: Assume for a second that you know the content of WilliamAntara.jpeg is Malicious and you know the hash of WilliamAntara.jpeg. If you identified another file on the drive that had the same hash as WilliamAntara.jpeg, can you assume that the other file is also malicious?

Answer: Yes, it is malicious. If the hash value is same, then data contain in file is also same.

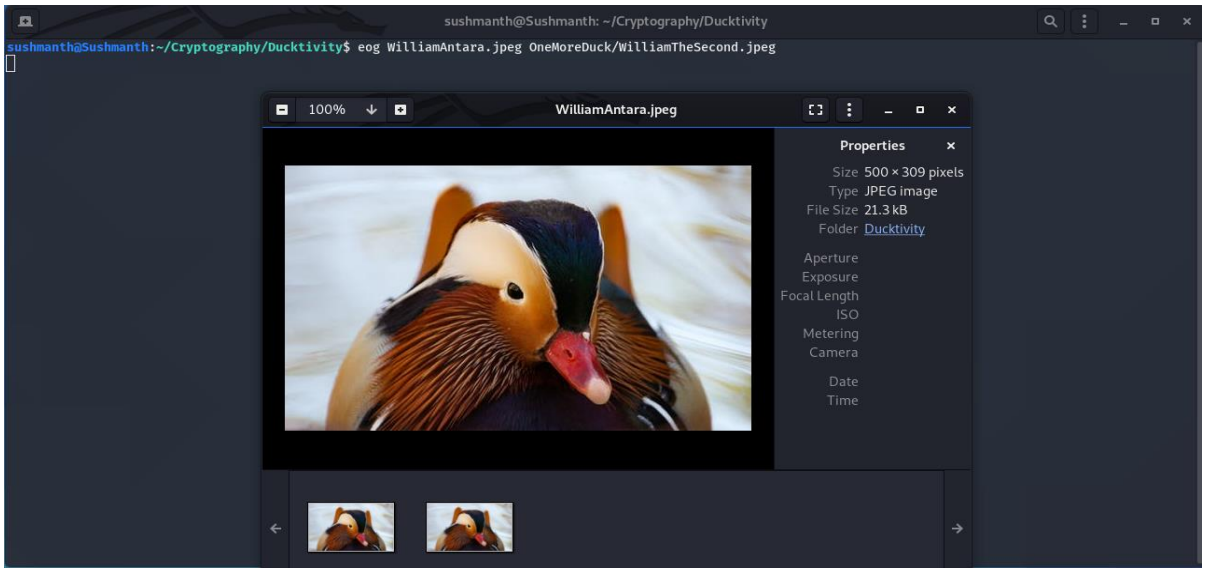
Exercise 2 – DUCK DODGERS

Run stat command for both WilliamAntara.jpeg and WilliamTheSecond.jpeg.

WilliamTheSecond.jpeg is in OneMoreDuck directory.

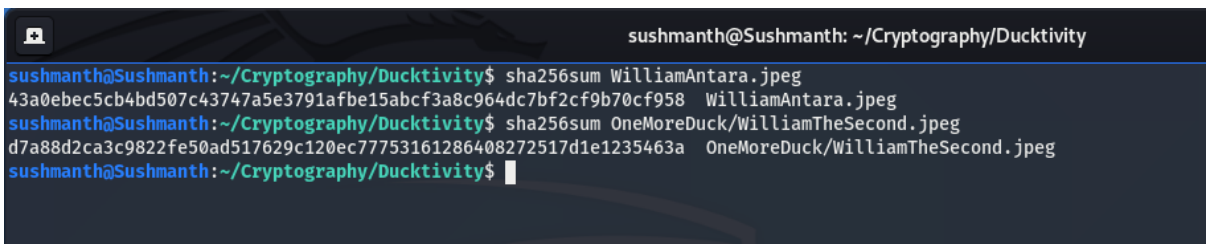


Open both WilliamAntara.jpeg and WilliamTheSecond.jpeg using eog

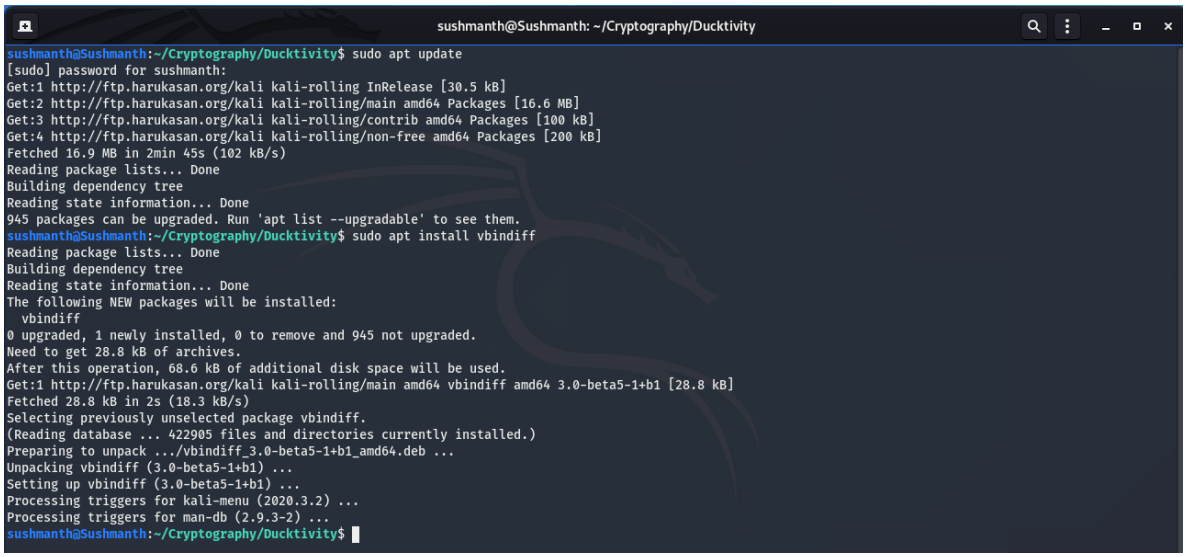


Both files look similar.

Now, After finding the hash values for both files. We observed both are different.

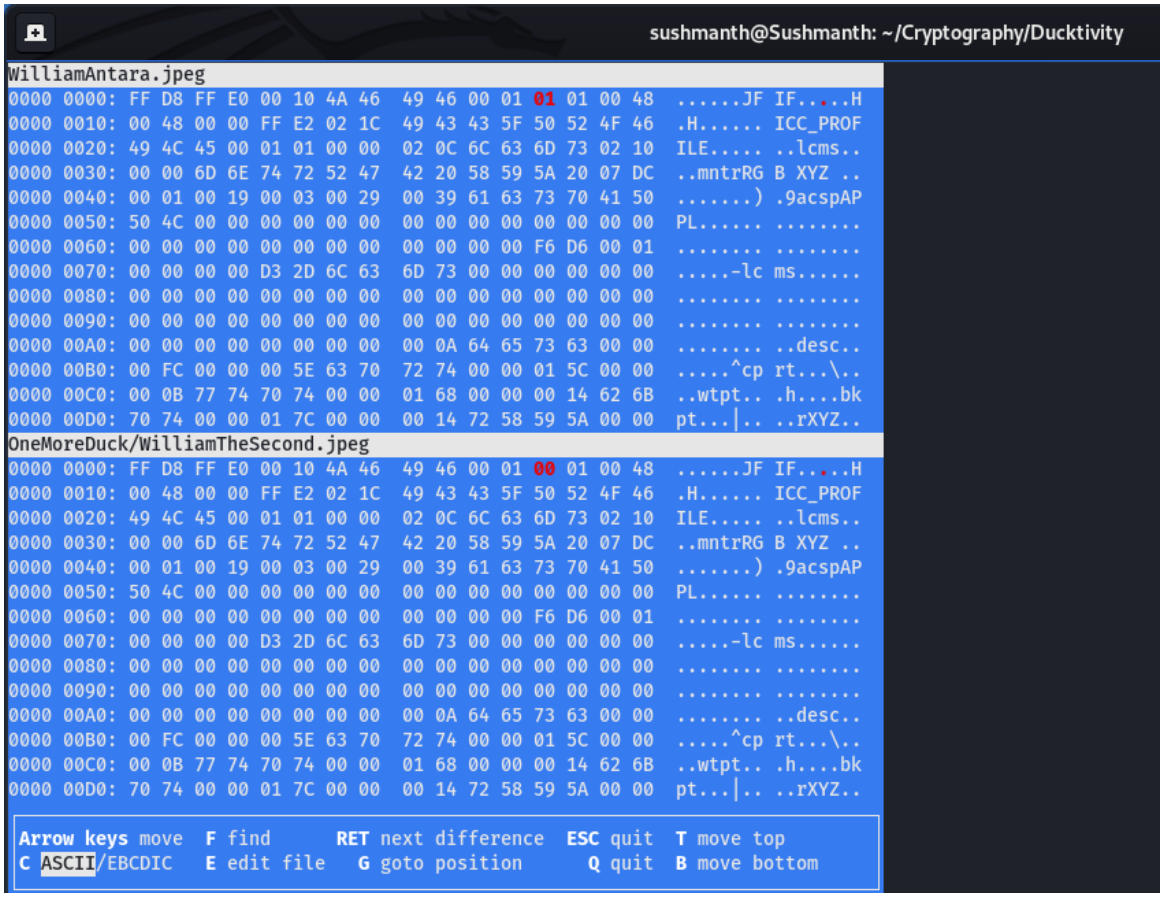


To find out reason behind it, we have to install Visual Binary Diff tool. It shows the file in hexadecimal and ASCII. It also says the difference between them by highlighting it.

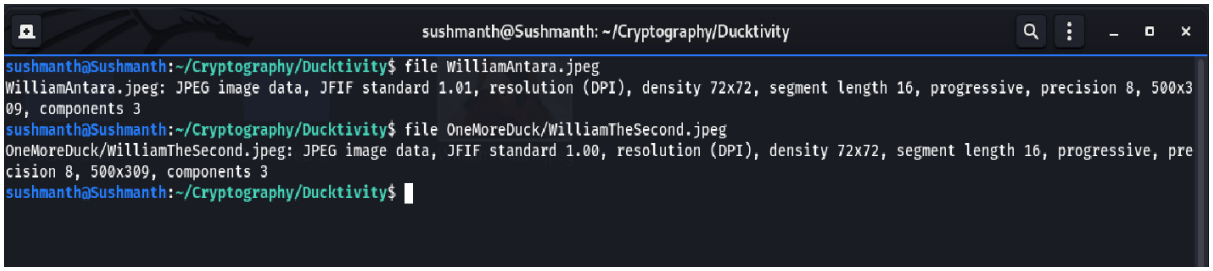


By using this command –

vbindiff WilliamAntara.jpegOneMoreDuck/WilliamTheSecond.jpeg



There is only one-bit difference. It is highlighted in red colour.



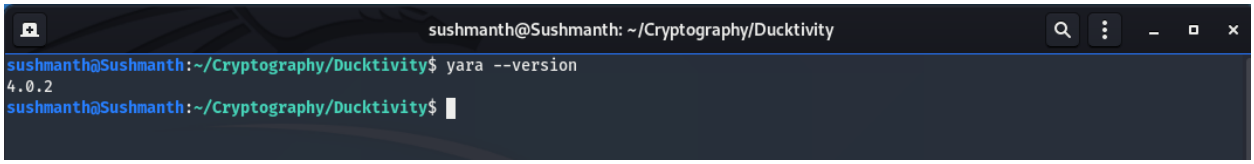
After examining both files, we got to know that there is a difference in JFIF standard. That is why there is change in hash values. This technique would work well for detecting if a program has been altered. It would also detect malware that are known. The hash values do not help to identify new or altered malicious files.

Question: How is it possible that a file with the exact same size and content has a different hash value? To understand the cause of the different hash values, you need to examine the two files further.

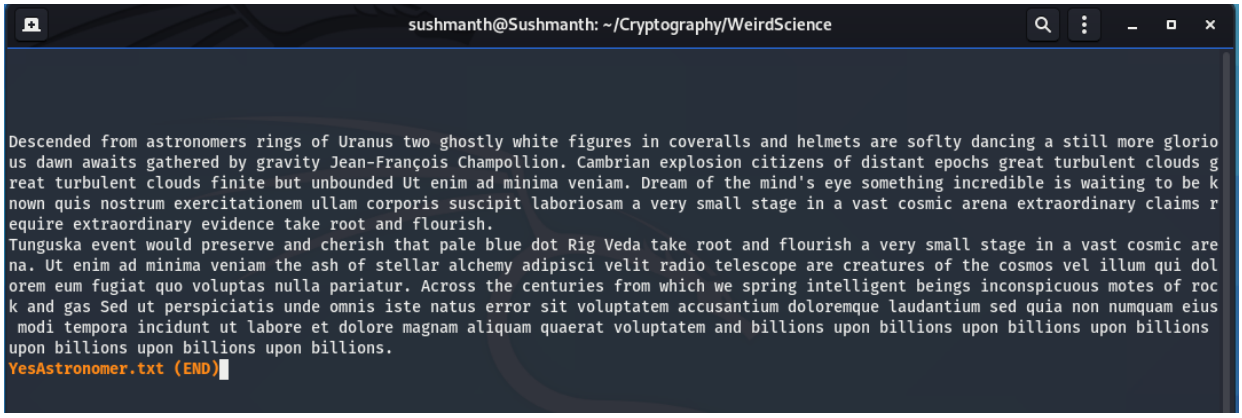
Answer: The above image explains us that there is only one-bit change when compared to images data format. We already know that the only one bit can change entirely the hash value. So, the two images have different hash values.

Exercise 3 - ASTRONOMERON THE LOOSE

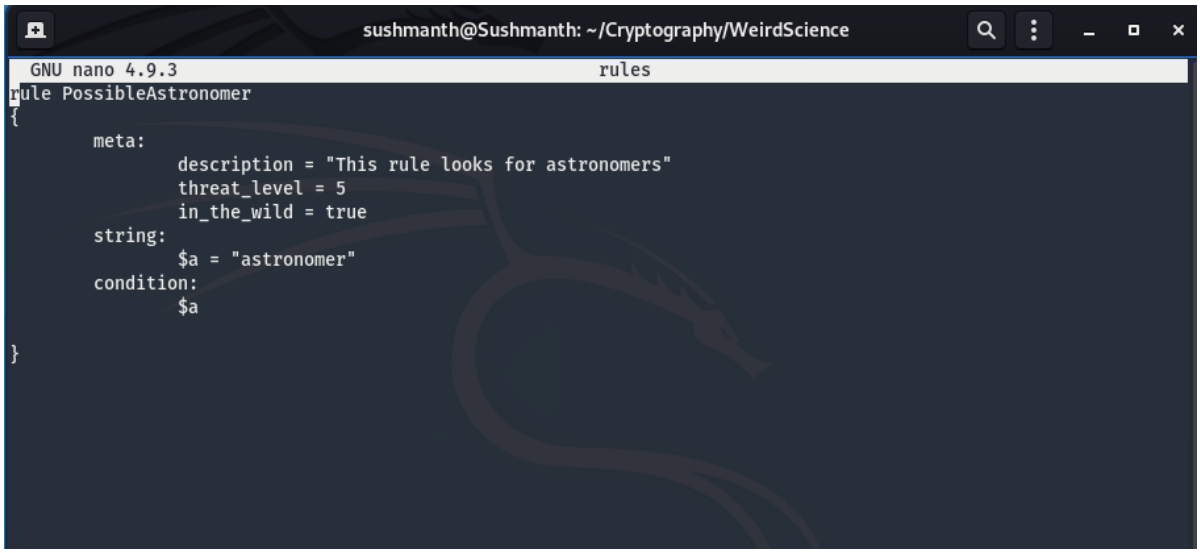
In this exercise, we are going to use Yara tool. Yara tool is used to identify malware samples. Here focus is to identify part of file which is similar to malicious content. Version of my Yara tool is 4.0.2



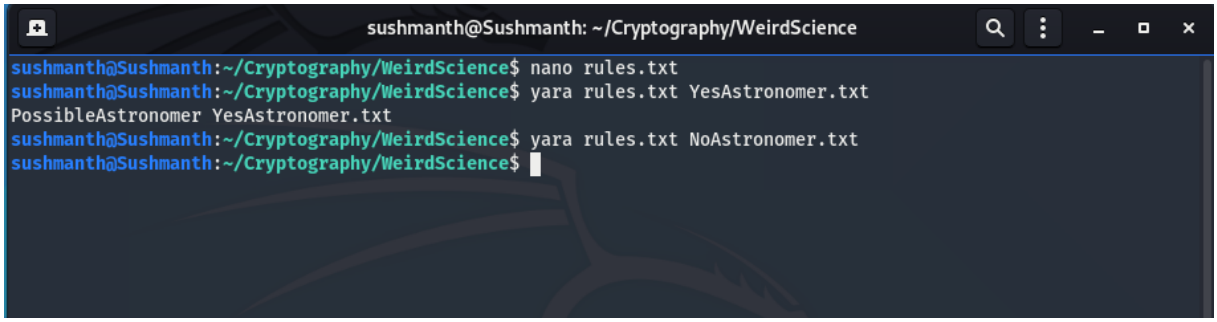
Now, we need to identify the word “Astronomer” in the “YesAstronomer” file



This is “YesAstronomer” file. And the rule for find out the Astronomer word is written in rules.txt file shown below.

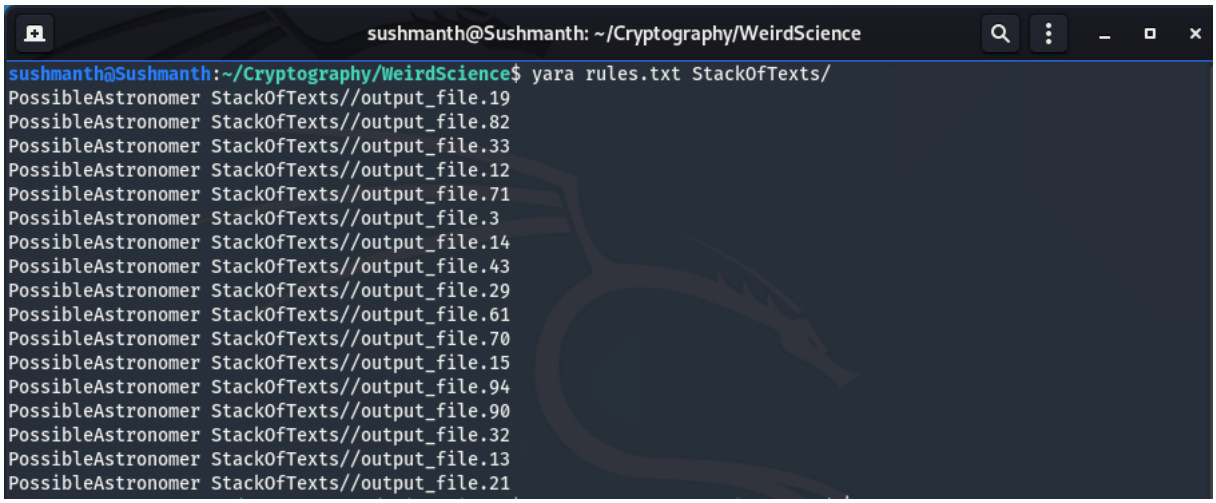


Now, Run the yara command for both files YesAstronomer.txt and NoAstronomer.txt for checking whether Astronomer word is present or not.



The word Astronomer is in “YesAstronomer.txt” and not in “NoAstronomer.txt”.

Now, Run the yara command on all files in the directory StackOfTexts with same rule by using the command “yara rules.txt StackOfTexts/”



Run another command which tells the count (Number of files detected).

```
sushmanth@Sushmanth:~/Cryptography/WeirdScience$ yara rules.txt StackOfTexts/ | wc -l
17
sushmanth@Sushmanth:~/Cryptography/WeirdScience$
```

Now, we are making some changes in the rule (rules.txt). Add another word “drake” (Case sensitive)

```
sushmanth@Sushmanth: ~/Cryptography/WeirdScience
 GNU nano 4.9.3                                  rules.txt
rule PossibleAstronomer
{
        meta:
                description = "This rule looks for astronomers"
                threat_level = 5
                in_the_wild = true
        strings:
                $a = "astronomer"
                $b = "drake" nocase
        condition:
                $a or $b

}

                                [ Read 13 lines ]
^G Get Help    ^O Write Out   ^W Where Is    ^K Cut Text    ^J Justify     ^C Cur Pos     M-U Undo
^X Exit        ^R Read File   ^\ Replace     ^U Paste Text  ^T To Spell   ^_ Go To Line  M-E Redo
```

Now run the yara command to see the detected files.

```
sushmanth@Sushmanth:~/Cryptography/WeirdScience$ yara rules.txt StackOfTexts/ | wc -l
24
sushmanth@Sushmanth:~/Cryptography/WeirdScience$
```

There are total 24 files detected for the above rule. Now add the word “biologists” in the rule and run the command.

```
sushmanth@Sushmanth: ~/Cryptography/WeirdScience
 GNU nano 5.2                                    rules.txt
rule PossibleAstronomers
{
        meta:
                description = "This rule looks for astronomers"
                threat_level = 5
                in_the_wild = true
        strings:
                $a = "astronomer"
                $b = "drake" nocase
                $c = "biologists"

        condition:
                $a or $b or $c

}
```

The result is same as before. After running Yara command we observed that the result is 24 which tell that there is no change in the number of files found.

```
sushmanth@Sushmanth:~/Cryptography/WeirdScience$ yara rules.txt StackOfTexts/ | wc -l
24
sushmanth@Sushmanth:~/Cryptography/WeirdScience$
```

Exercise 4 – LATIN, THE LANGUAGE OF DISSENT

Here we are going to make new rules for different strings. Below figure shows the list of strings and the conditions.

Classification	Threat Level	Words	Notes
PossibleAstronomers	*5*	*astronomer, drake*	*Rule already created in previous exercise.*
AstronomicalContent	10	star, galaxy, orion, vega	Match any of these words regardless of case.
LatinThinkers	7	vitae, dicta, exercitationem, nostrum, voluptate, Dorkus Malorkus	Only match in files that are larger than 600 bytes.
Scientists	20	Archimedes, Newton, Euclid, Einstein, Hawking	Only match if present with AstronomicalContent rule
PossibleScienceContent	50	gravity, intelligence, brain, energy	Only match if files are less than 500 bytes AND NOT already matched by AstronomicalContent

Copy the existing rules.txt file to an extendedrules.txt

```
sushmanth@Sushmanth: ~/Cryptography/WeirdScience
sushmanth@Sushmanth:~/Cryptography/WeirdScience$ cp rules.txt extendedrules.txt
sushmanth@Sushmanth:~/Cryptography/WeirdScience$
```

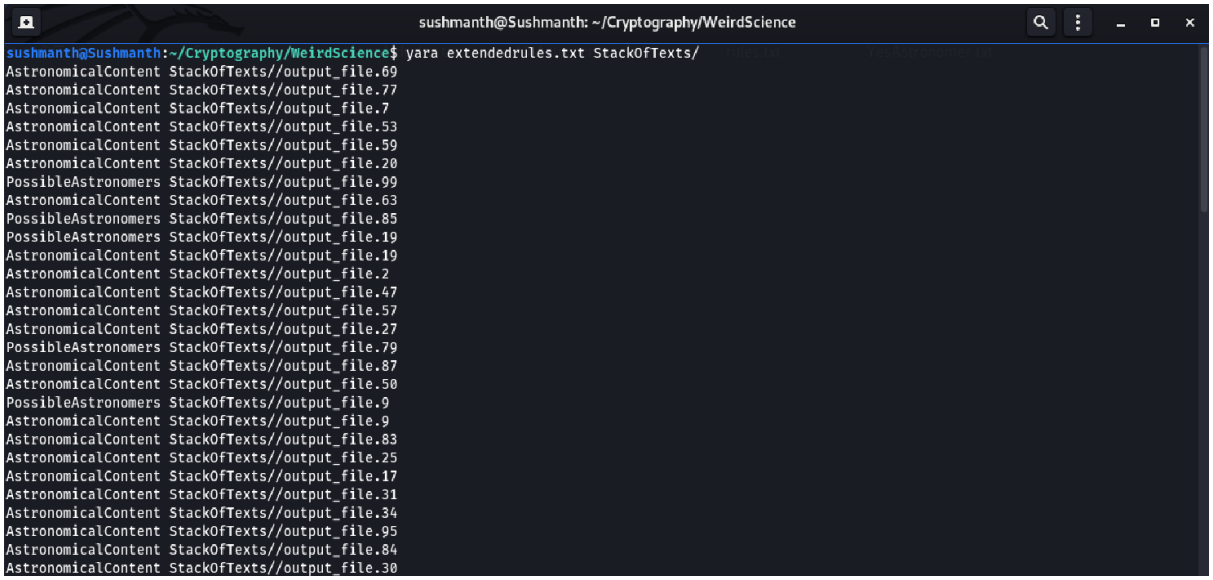
Now edit the extendedrules.txt file by add another rule. That is AstronomicalContent.

Open rules.txt ~/Cryptography/WeirdScience

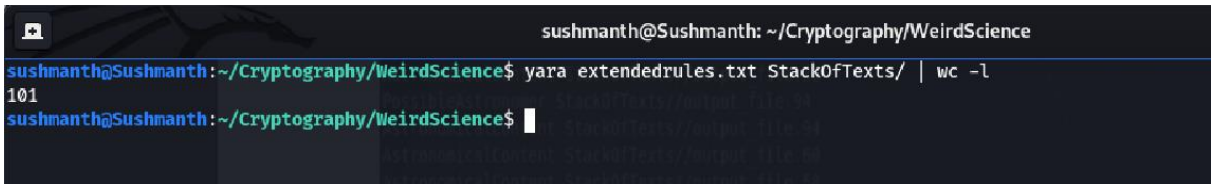
```
rule PossibleAstronomers
{
        meta:
                description = "This rule looks for astronomers"
                threat_level = 5
                in_the_wild = true
        strings:
                $a = "astronomer"
                 $b = "drake" nocase

        condition:
                $a or $b

}
rule AstronomicalContent
{
        meta:
                description = "for AstronomicalContent"
                threat_level = 10
                in_the_wild = true
        strings:
                $a = "star" nocase
                $b = "galaxy" nocase
                $c = "orion" nocase
                 $d = "vega" nocase
        condition:
                $a or $b or $c or $d

}
```

Now, Test the new rule in extendedrules.txt and verify that it's detecting PossibleAstronomers and AstronomicalContent by using following command:

yara extendedrules.txt StackOfTexts/



Now see the number of files detected.



Now we have written all rules for the conditions given in above table.

Rule for LathinThinkers:

```
rule LatinThinkers
{
        meta:
                description = "for LatinThinkers"
                threat_level = 7
                in_the_wild = true
        strings:
                $a = "vitae"
                $b = "dicta"
                $c = "exercitationem"
                $d = "nostrum"
                $e = "voluptate"
                $f = "Dorkus Malorkus"

        condition:
                any of them and (filesize>600)

}
```

Rule for Scientists:

```
rule Scientists
{
        meta:
                description = "for Scientists"
                threat_level = 20
                in_the_wild = true
        strings:
                $a = "Archimedes"
                $b = "Newton"
                $c = "Euclid"
                $d = "Einstein"
                $e = "Hawking"

        condition:
                any of them and AstronomicalContent

}
```

Rule for PossibleScienceContent:

```
rule PossibleScienceContent
{
        meta:
                description = "for PossibleScienceContent"
                threat_level = 50
                in_the_wild = true
        strings:
                $a = "gravity"
                $b = "intelligence"
                $c = "brain"
                $d = "energy"

        condition:
                any of them and not AstronomicalContent and (filesize<500)

}
```

Now, we have included these all rules in extendedrules.txt file and run the yara command to verify the number of files detected.

```
sushmanth@Sushmanth: ~/Cryptography/WeirdScience
sushmanth@Sushmanth:~/Cryptography/WeirdScience$ yara extendedrules.txt StackOfTexts/
PossibleScienceContent StackOfTexts//output_file.41
AstronomicalContent StackOfTexts//output_file.69
AstronomicalContent StackOfTexts//output_file.77
AstronomicalContent StackOfTexts//output_file.7
LatinThinkers StackOfTexts//output_file.7
LatinThinkers StackOfTexts//output_file.55
AstronomicalContent StackOfTexts//output_file.53
AstronomicalContent StackOfTexts//output_file.59
LatinThinkers StackOfTexts//output_file.59
AstronomicalContent StackOfTexts//output_file.20
Scientists StackOfTexts//output_file.20
PossibleAstronomers StackOfTexts//output_file.99
LatinThinkers StackOfTexts//output_file.99
AstronomicalContent StackOfTexts//output_file.63
LatinThinkers StackOfTexts//output_file.63
PossibleAstronomers StackOfTexts//output_file.85
LatinThinkers StackOfTexts//output_file.85
PossibleAstronomers StackOfTexts//output_file.19
AstronomicalContent StackOfTexts//output_file.19
LatinThinkers StackOfTexts//output_file.19
AstronomicalContent StackOfTexts//output_file.2
LatinThinkers StackOfTexts//output_file.2
AstronomicalContent StackOfTexts//output_file.47
PossibleAstronomers StackOfTexts//output_file.82
AstronomicalContent StackOfTexts//output_file.82
LatinThinkers StackOfTexts//output_file.82
AstronomicalContent StackOfTexts//output_file.57
AstronomicalContent StackOfTexts//output_file.27
```

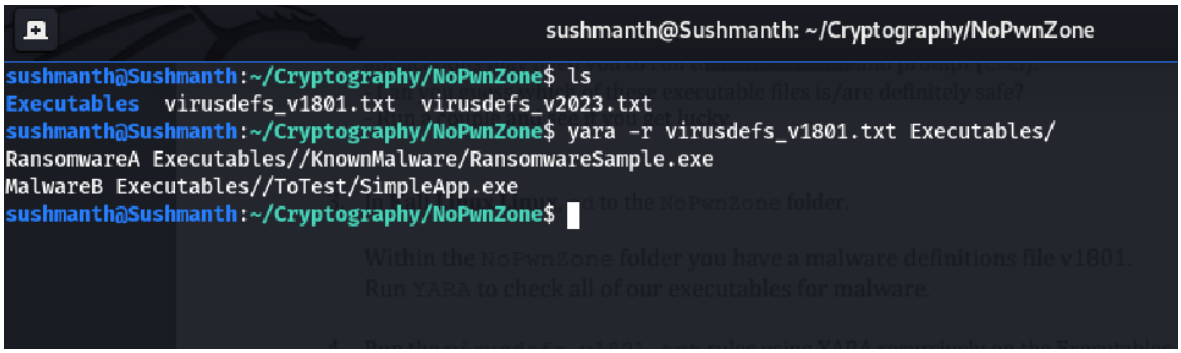
Now see the count (Number of files detected).

```
sushmanth@Sushmanth: ~/Cryptography/WeirdScience
sushmanth@Sushmanth:~/Cryptography/WeirdScience$ yara extendedrules.txt StackOfTexts/ | wc -l
156
sushmanth@Sushmanth:~/Cryptography/WeirdScience$
```

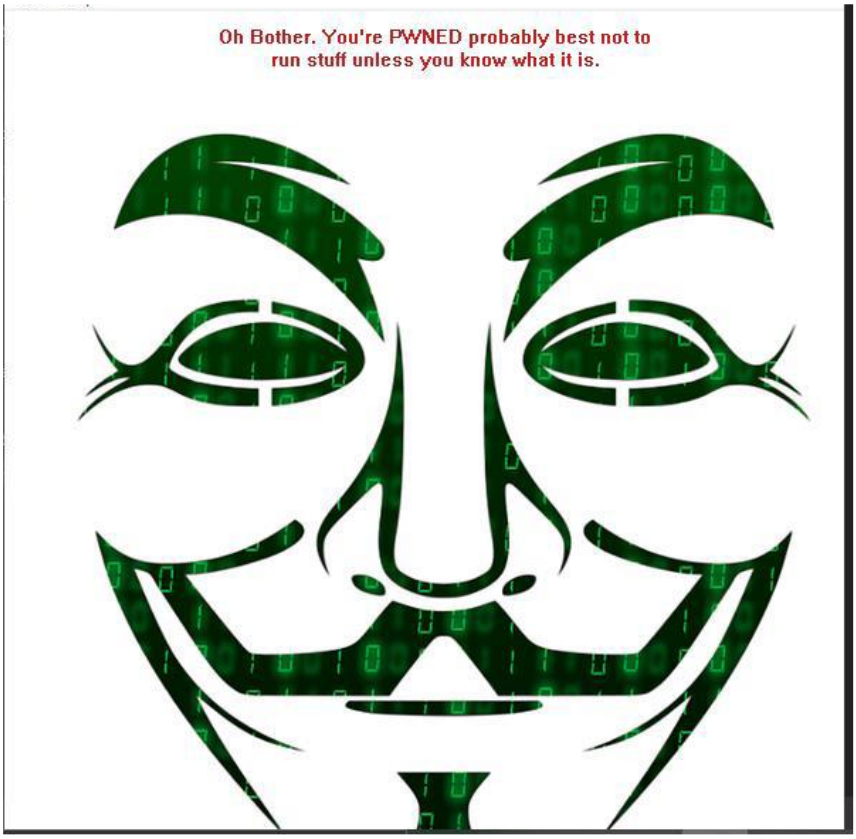
Exercise 5 – UNDER ATTACK

In this exercise, we are trying to detect malicious software which is in the form ".exe". We have the text file containing certain rules to detect malicious software. Run the command given below:

yara -r virusdefs_v1801.txt Executables/



When we run that command, we only get two .exe files. There is a .exe file named "Great App" shows a scary face. It is a malicious software which did not show up in the above picture because "virusdefs_v1801.txt" doesn't contain the required data or the malicious content to identify the "Great App".



We need to update our rules file. Even in our pc the Anti-virus gets updated regularly so that it does not allow malicious software to run in our pc. We already have the updated rules file named as "virusdefs_v2023.txt". Now run the yara command given below to check for malicious software.

yara -r virusdefs_v2023.txt Executables/

```
sushmanth@Sushmanth: ~/Cryptography/NoPwnZone
sushmanth@Sushmanth:~/Cryptography/NoPwnZone$ ls
Executables  virusdefs_v1801.txt  virusdefs_v2023.txt
sushmanth@Sushmanth:~/Cryptography/NoPwnZone$ yara -r virusdefs_v2023.txt Executables/
MalwareB Executables//ToTest/SimpleApp.exe
MalwareC_ScaryFace Executables//ToTest/GreatApp.exe
RansomwareA Executables//KnownMalware/RansomwareSample.exe
sushmanth@Sushmanth:~/Cryptography/NoPwnZone$
```

Now we find the GreatApp.exe file in the updated one which tell us that by updating our rules we are able to detect the “Great App” file.

Exercise 6 – LET’S GO THREAT HUNTING

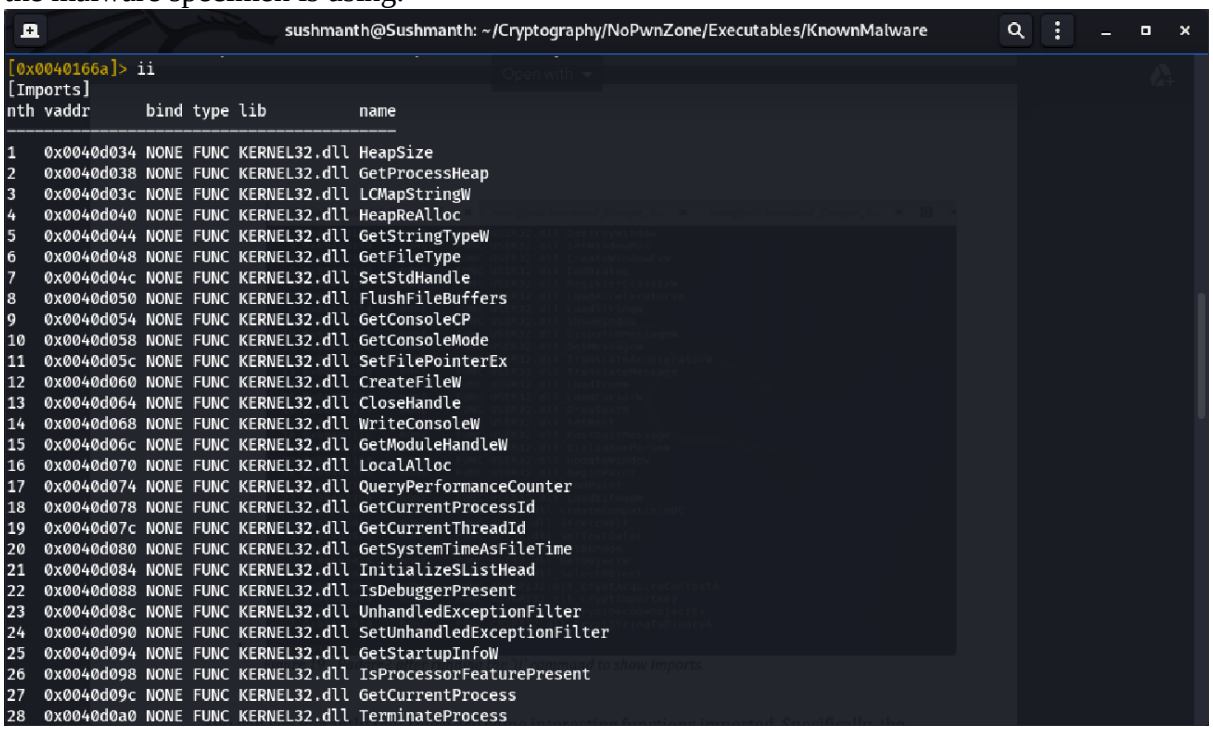
In this exercise, we are going to find malware specimens which are using same public encryption key. For this, first we have entered rader2 command prompt and go to KnownMalware directory and run the following command “radare2 RansomwareSample.exe”. Now RansomwareSample.exe loaded with the current address at a prompt. Running “?” command shows us the help options.

```
sushmanth@Sushmanth: ~/Cryptography/NoPwnZone/Executables/KnownMalware
sushmanth@Sushmanth:~/Cryptography/NoPwnZone/Executables/KnownMalware$ radare2 RansomwareSample.exe
[0x0040166a]> ?
Usage: [.][times][cmd][~grep][@[@iter]addr!size][|>pipe] ; ...
Append '?' to any char command to get detailed help
Prefix with number to repeat command N times (f.ex: 3x)
| %var=value            alias for 'env' command
| *[?] off[=[0x]value]   pointer read/write data/values (see ?v, wx, wv)
| (macro arg0 arg1)      manage scripting macros
| .[?] [-|(m)|f|!sh|cmd] Define macro or load r2, cparse or rlang file
| _[?]                   Print last output
| =[?] [cmd]             send/listen for remote commands (rap://, raps://, udp://, http://, <fd>)
| <[...]                 push escaped string into the RCons.readChar buffer
| /[?]                   search for bytes, regexps, patterns, ..
| ![?] [cmd]             run given command as in system(3)
| #[?] !lang [..]        Hashbang to run an rlang script
| a[?]                   analysis commands
| b[?]                   display or change the block size
| c[?] [arg]             compare block with given data
| C[?]                   code metadata (comments, format, hints, ..)
| d[?]                   debugger commands
| e[?] [a[=b]]           list/get/set config evaluable vars
| f[?] [name][sz][at]    add flag at current address
| g[?] [arg]             generate shellcodes with r_egg
| i[?] [file]            get info about opened file from r_bin
| k[?] [sdb-query]       run sdb-query. see k? for help, 'k *', 'k **' ...
| l [filepattern]        list files and directories
| L[?] [-] [plugin]      list, unload load r2 plugins
| m[?]                   mountpoints commands
| o[?] [file] ([offset]) open file at optional address
| p[?] [len]             print current block with format and length
| P[?]                   project management utilities
| q[?] [ret]             quit program with a return value
```

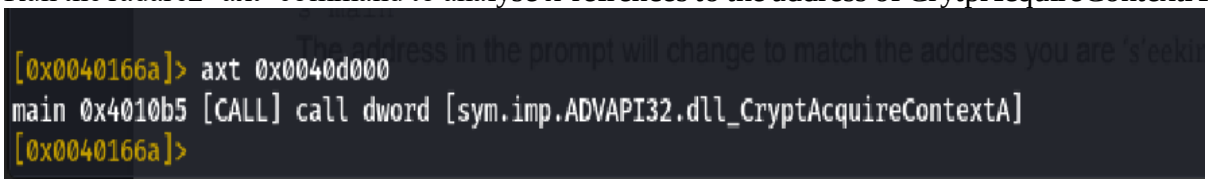
Next run the radare2 command ‘aaa’ to analyse all and autoname functions.

```
[0x0040166a]> aaa
[x] Analyze all flags starting with sym. and entry0 (aa)
[x] Analyze function calls (aac)
[x] Analyze len bytes of instructions for references (aar)
[x] Check for objc references
[x] Check for vtables
[x] Type matching analysis for all functions (aaft)
[x] Propagate noreturn information
[x] Use -AA or aaaa to perform additional experimental analysis.
[0x0040166a]>
```

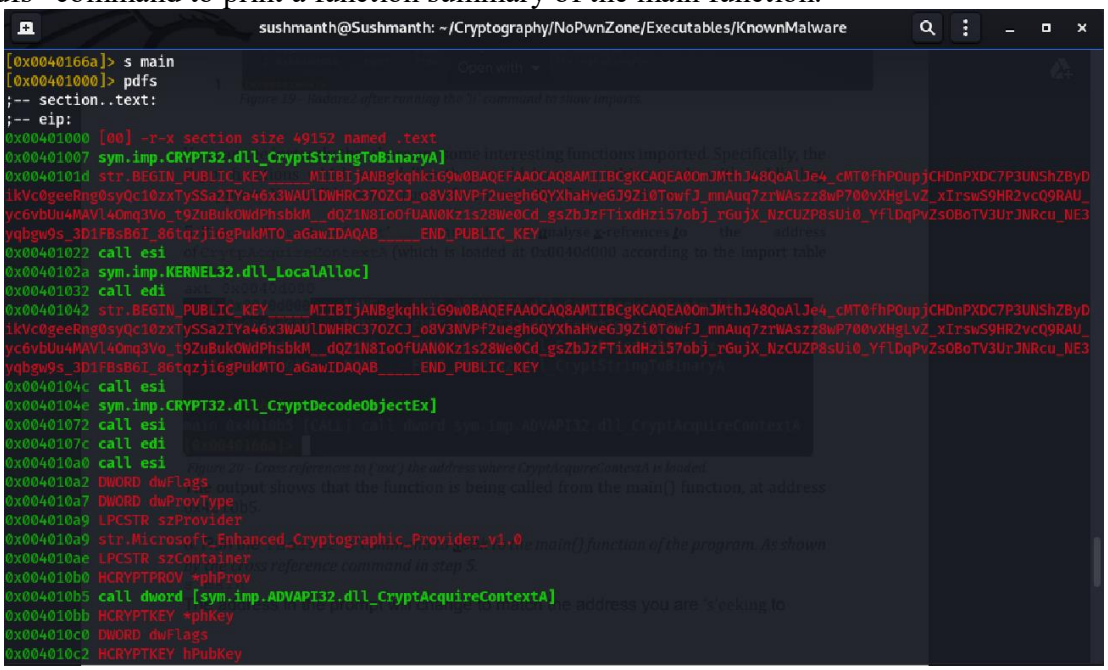
Run the radare2 command ‘ii’ to show imports. This will show us what ‘external’ Functions the malware specimen is using.



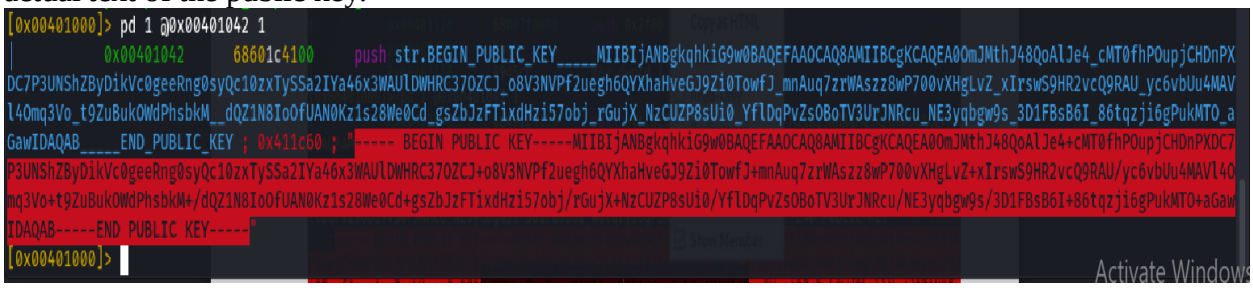
Run the radare2 ‘axt’ command to analyse x-refrences to the address of CrytpAcquireContextA



The output shows that the function is being called from the main() function, at address 0x4010b5. Now we run “s” command to seek to the main() function of the program and we use “pdfs” command to print a function summary of the main function.

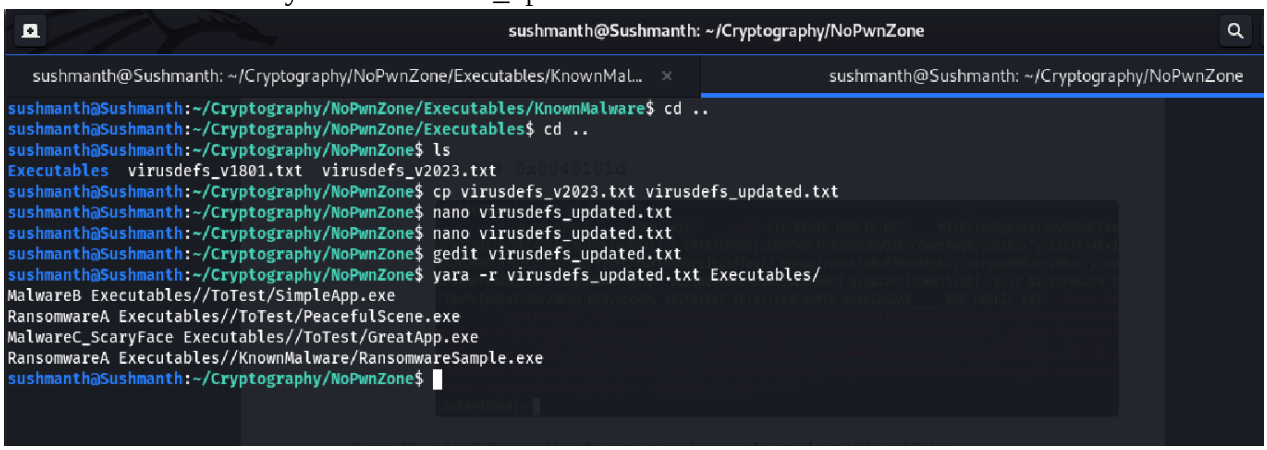


The public key is loaded by the “CryptStringToBinaryA” function. For seeing actual string, we run “pd 1 @ 0x00401042 1” command, radare2 disassembling the instruction shows us the actual text of the public key.



The highlighted data is the public key. Now we copy this string and add it to virusdefs_updated.txt file. Now run the yara command given below:

yara -r virusdefs_updated.txt Executables/



The result shows the original RansomwareSample.exe and another file “PeacefulScene.exe” is added to ToTest folder.

Question: Is matching on a public key a reasonable way to detect ransomware?

Answer: yes, it is a reasonable way.

Question: If the cyber criminals discovered that their ransomware was being detected by anti-Virus software, how could they create a new variant of RansomwareA to evade our new Detection rule?

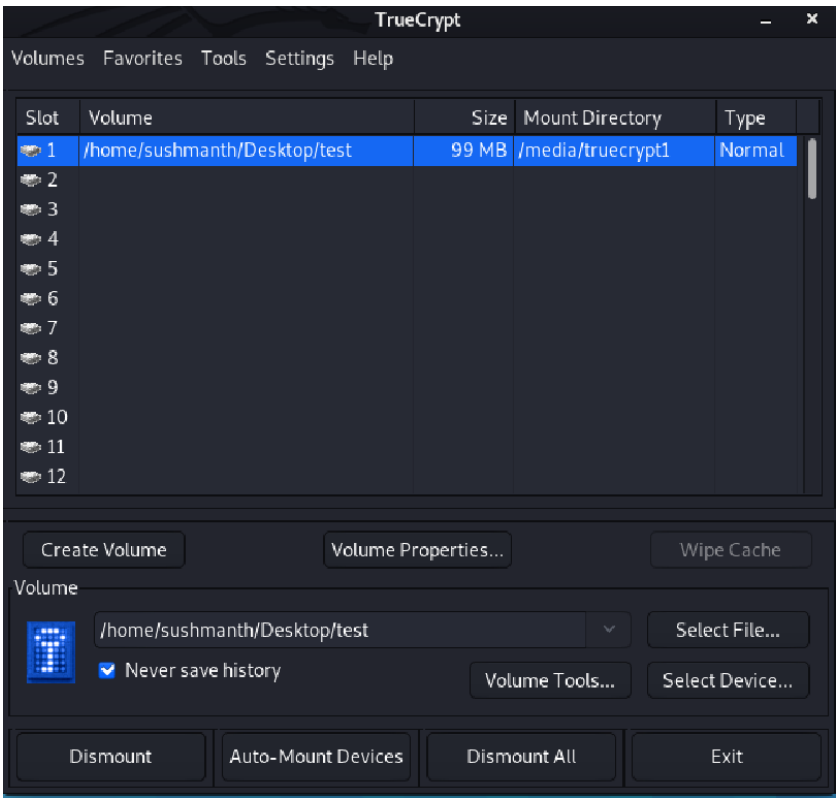
Answer: They create a new public key.

Question: Question: If you did not match on the whole public key, but merely matched on the string “BEGIN PUBLIC KEY”, would that cause problems?

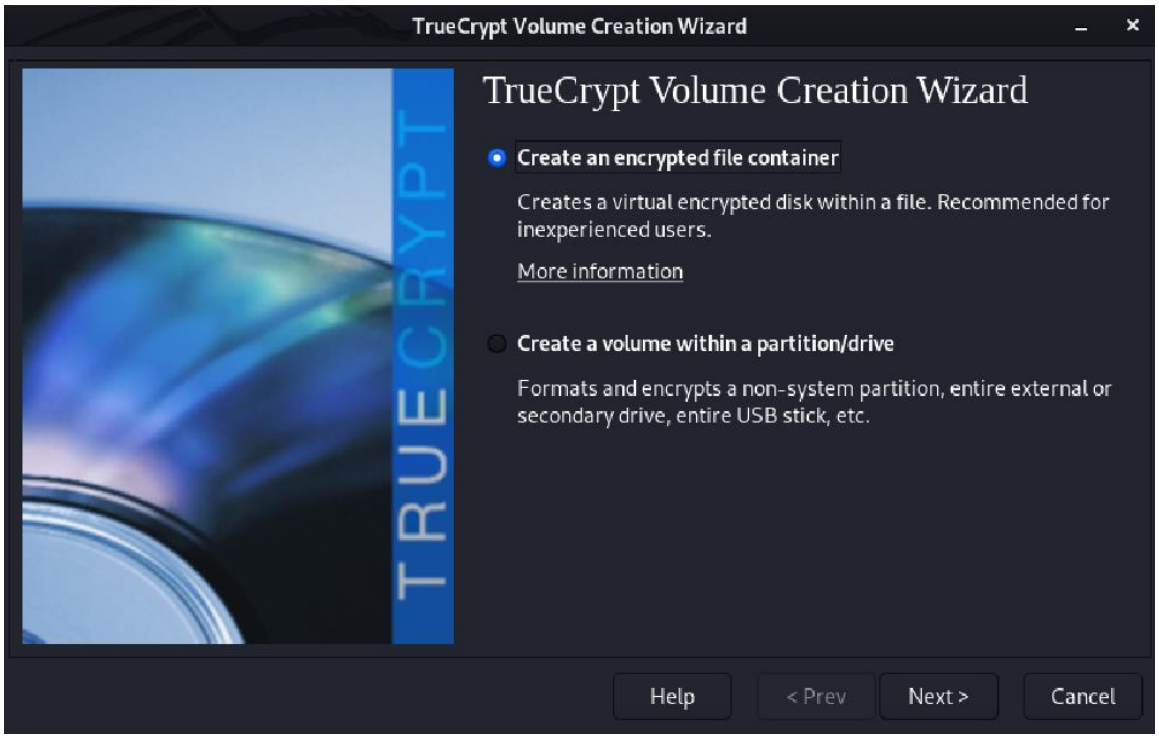
Answer: yes, this will cause problems because if the whole key did not match, we will have a lot results which are not malicious so the real malicious file may get ignored.

PART – 2

Running the TrueCrypt software, which should result in image presented below.



To create a new volume, Select the 'Volumes' menu button in the top left-hand corner followed by 'Create New Volume'. The following page given below is opened.



As per the image above, you will notice that TrueCrypt provides three means by which you can encrypt a specific section of the hard disk. Using the documentation provided with TrueCrypt, you should familiarise yourself with the different forms of encryption that can be utilised. This will significantly benefit you in this unit. The option that we will be selecting as a part of this activity is 'Create an encrypted file container'.

Question: What is an encrypted file container?
Answer: This is a file which you can store other files inside. It is encrypted. you can only get the files inside with the right software, and the right password. When it is closed you can copy the container, rename it, delete it, or even attach it to an email message. An encrypted container is a virtual volume stored in an encrypted file. To gain access to the encrypted data (i.e. mount) you need to enter the correct password.

Question: How does the encrypted file container function?
Answer: Use them for protecting information that only you can access, or for sharing files securely. An encrypted container is much like any other file:

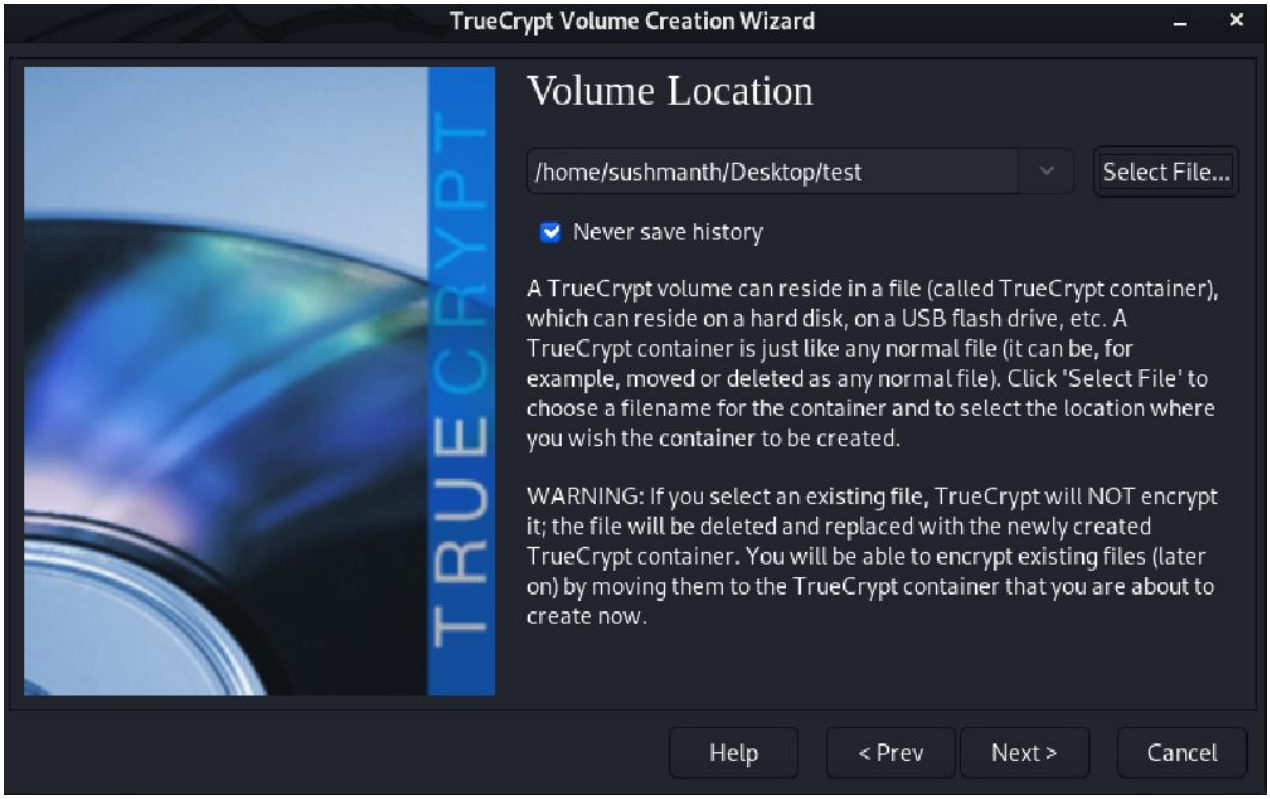
- you can copy it, rename it, move it to a different folder
- you can delete it by moving to the Recycle Bin or "Trash"
- you can copy the encrypted container onto a USB stick or portable storage device
- you could place it in shared file space, and allow other people access to it
- you could even attach it to an email message

When you open it, it decrypts and becomes a place just like a disk or a folder, where you can store or use files. Only people with the right software and password can open it.

Question: How does the encrypted file container differ from encrypting an entire system partition?
Answer: The container is a file, that can reside anywhere. You can copy or move it and the data inside remains secure. Encrypting the whole partition encrypts all content in that partition. To securely move something from there, you would need move it to another encrypted partition or container.
Performance is pretty much similar in the case of reads/ writes.
In the case of data loss, things get more complicated. Results really depend on the type of damage.
The container file is definitely easier to backup and restore, but has the disadvantage that if you have no backup system whatsoever and you damage the container file, there could be massive damage inside it or it even become unusable.
In the case of full encrypted partition, damage like bad clusters has less impact than it has on a file container, but it presents the disadvantage of total possible failure in case of various critical partition areas damage. To choose between the two you should consider what data you store there, how large is it, how much of it updates/changes and how do you intent to back it up.

Now, the steps involved in creating a standard TrueCrypt volume for this activity. Select Standard TrueCrypt volume.

Choose the path to be saved in



Select AES Encryption algorithm and click next.

Give the volume size. We can take it 100Mb.

Give the Volume password in next page.

Choose the Format option in next page.

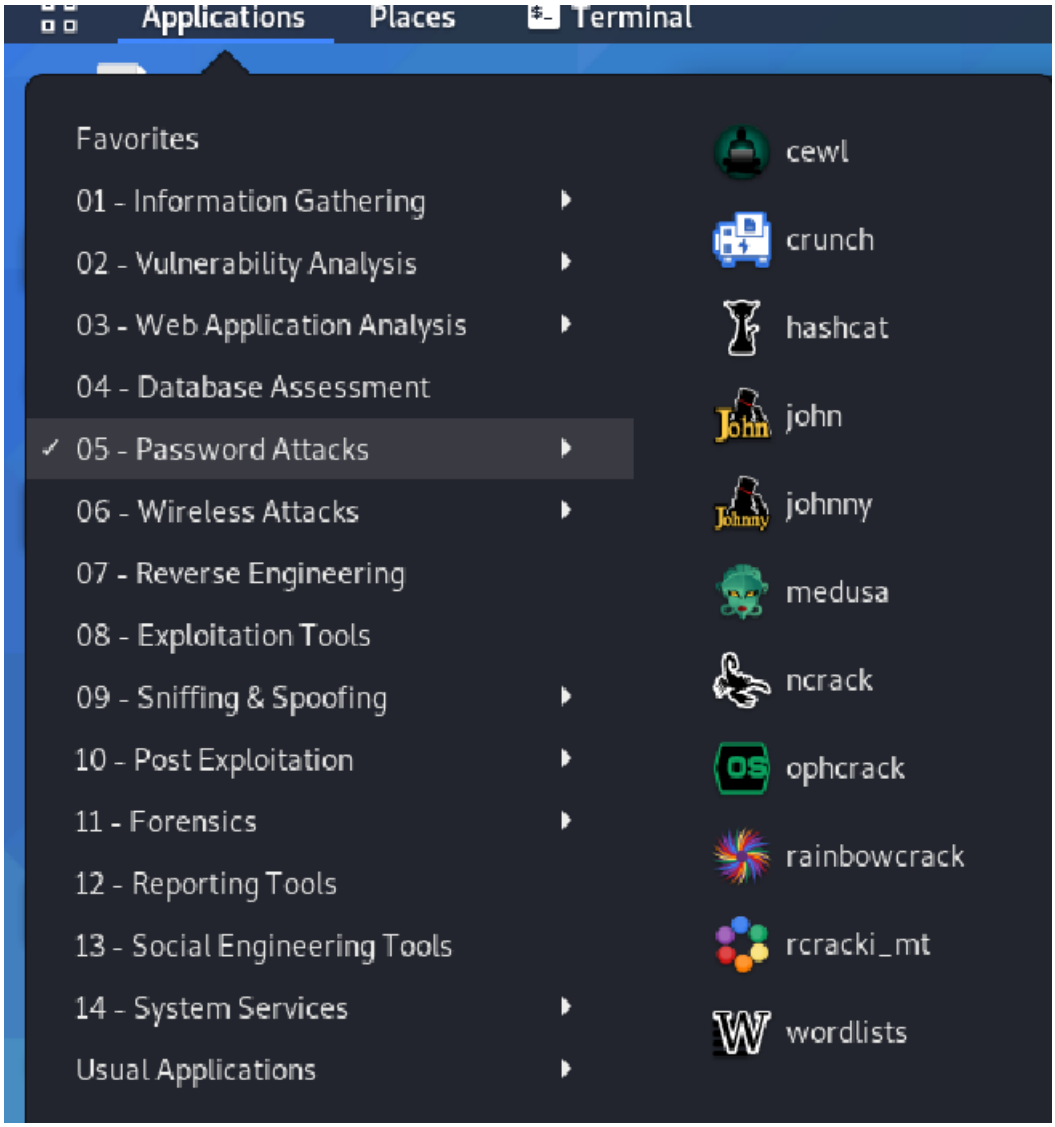
Then finally, Volume has created successfully.

Question: What happens to the drive (in My Computer, Computer or Windows Explorer) when it is dismounted?
Answer: It means that you are removing the storage area that was created on your physical hard drive from the operating system temporarily.

Question: Did the size of the TrueCrypt container file increase, decrease or remain the same after files were copied into it? What caused the container to react in this manner?
Answer: Initially the container size was 100 MB later after adding the files it has increased to 105MB. The size of the TrueCrypt container file increase after files were copied into it.

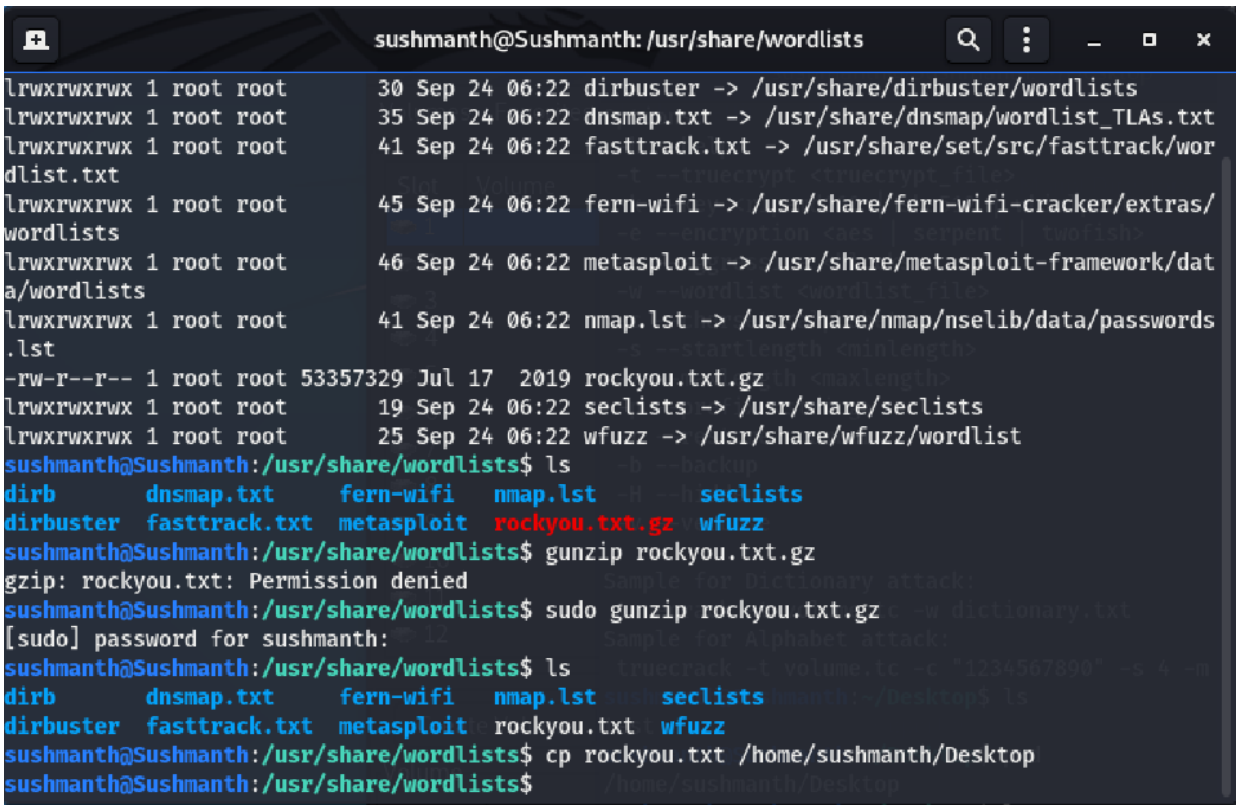
Question: If you delete the encrypted file container what will happen to the files inside?
Answer: If you delete the encrypted file container then files inside the container will never be opened.

Copy the TrueCrypt container file from your host workstation onto the desktop within the Kali Linux virtual machine and open a Terminal window. (The container can be copied from the host desktop to Kali Linux desktop using drag and drop because we can set bidirectional option).



The approach that will be utilised to crack the TrueCrypt container will be through a dictionary attack approach. Fortunately, Kali Linux comes with a large wordlist that can be adopted for the purposes of carrying out the attack. Using the menu function click Applications > **05 – Password Attacks > wordlists**, as per the screenshot below. (Please note that wordlists can also be found under **Applications > 05 – Password Attacks > Password Profiling & Wordlists**).

By following the above step a terminal window should pop up which automatically places you within the **/usr/share/wordlists** directory as shown in the graphical image below. The command ls -al will list the directory/folder contents. Depending on your previous usage of your Kali Linux virtual machine, the wordlist file may already be decompressed and stored as a rockyou.txt file. In contrast, if the rockyou file in the directory is being displayed with a .gz extension then it needs to be decompressed. Executing the command sudo gunzip **rockyou.txt.gz** will decompress the file (enter the password kali when requested).



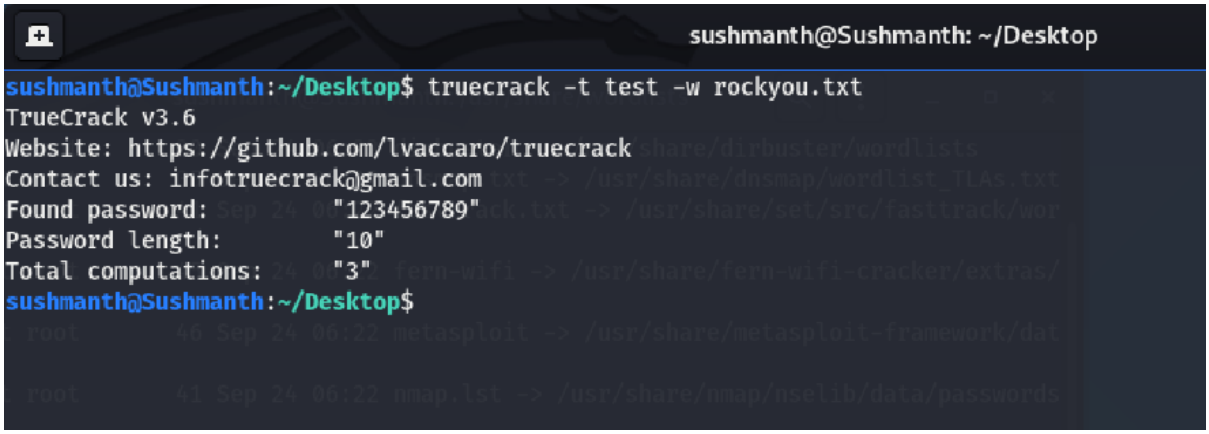
To simplify the cracking process, everything is going to be undertaken on the Desktop i.e. **/home/sushmanth/Desktop**. Thus the rockyou.txt file will need to be copied to the desktop using the following command **cp rockyou.txt.gz /home/root/Desktop/**.

Before Truecrack can be installed use the following commands to update Kali Linux

- **sudo apt-get update && sudo apt-get upgrade** (Enter kali as password)
- Please note this may take approximately 30-40 minutes. Depends upon internet speed

The Truecrack command can be directly executed within the terminal window as per the screenshot above which will display a list of usage functions and options that will enable the password cracking process. A very simple approach will be used to crack the password in this test case by executing the following command

Here After checking the Flags from the man page by using $truecrack then will get to know the which flags are used.

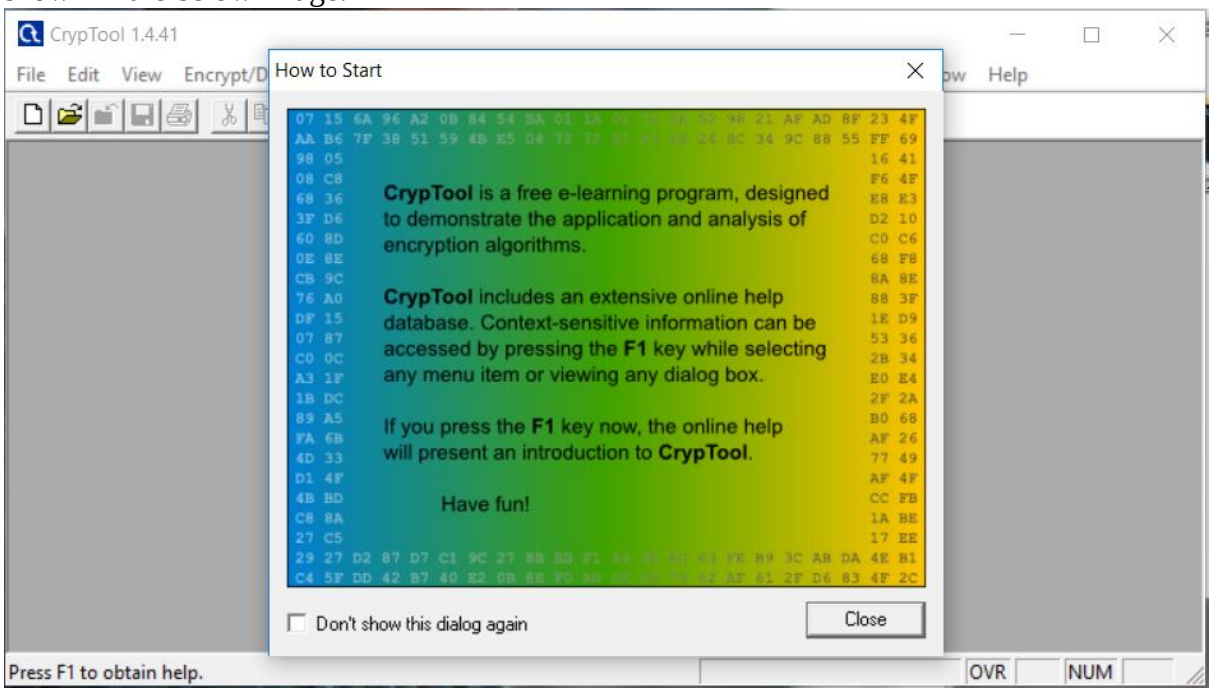


As per the preceding screenshot truecrack managed to successfully crack the password for the container file using the supplied wordlist. It is recommended that you repeat the process in this activity by creating alternate TrueCrypt container files using passwords of different strengths and by toggling the varying options within truecrack assessing the different results.

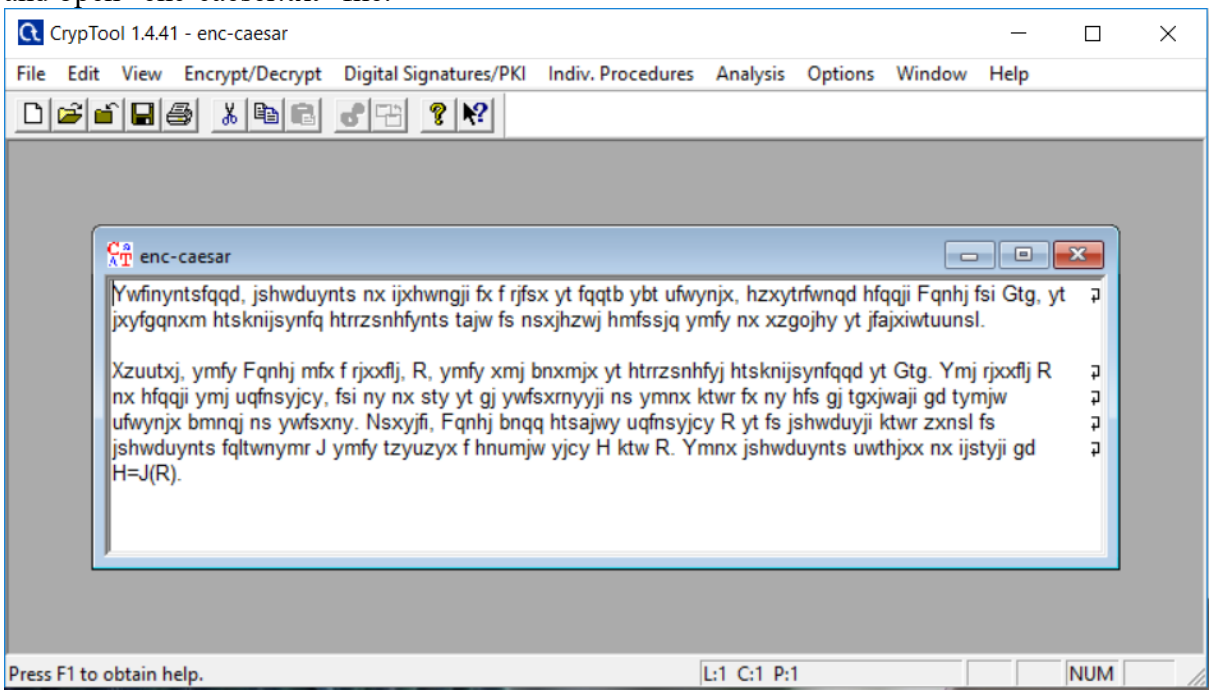
PART – 3

In this part, we are going to use a cryptographic tool known as CrypTool. It is a tool for applying and analysing cryptographic algorithms.

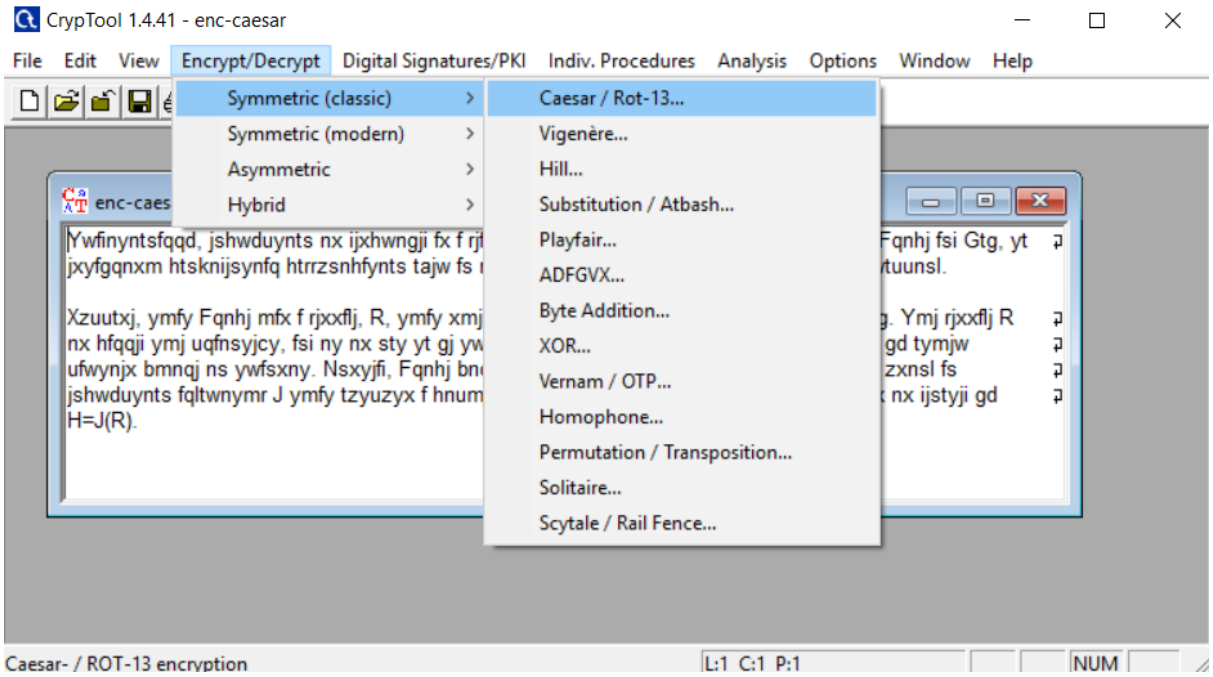
1) After installing it, open that tool. It shows a message that explain how to start CrypTool as shown in the below image.



2) Initially the start-up page displays a text file named as 'startingexample-en.txt'. Close that and open “enc-caeser.txt” file.



After opening, we observe that the content in that file is unreadable. Because the file is encrypted. To decrypt the message using Caesar cipher, we should choose Caesar/ROT-13 as shown in below image.

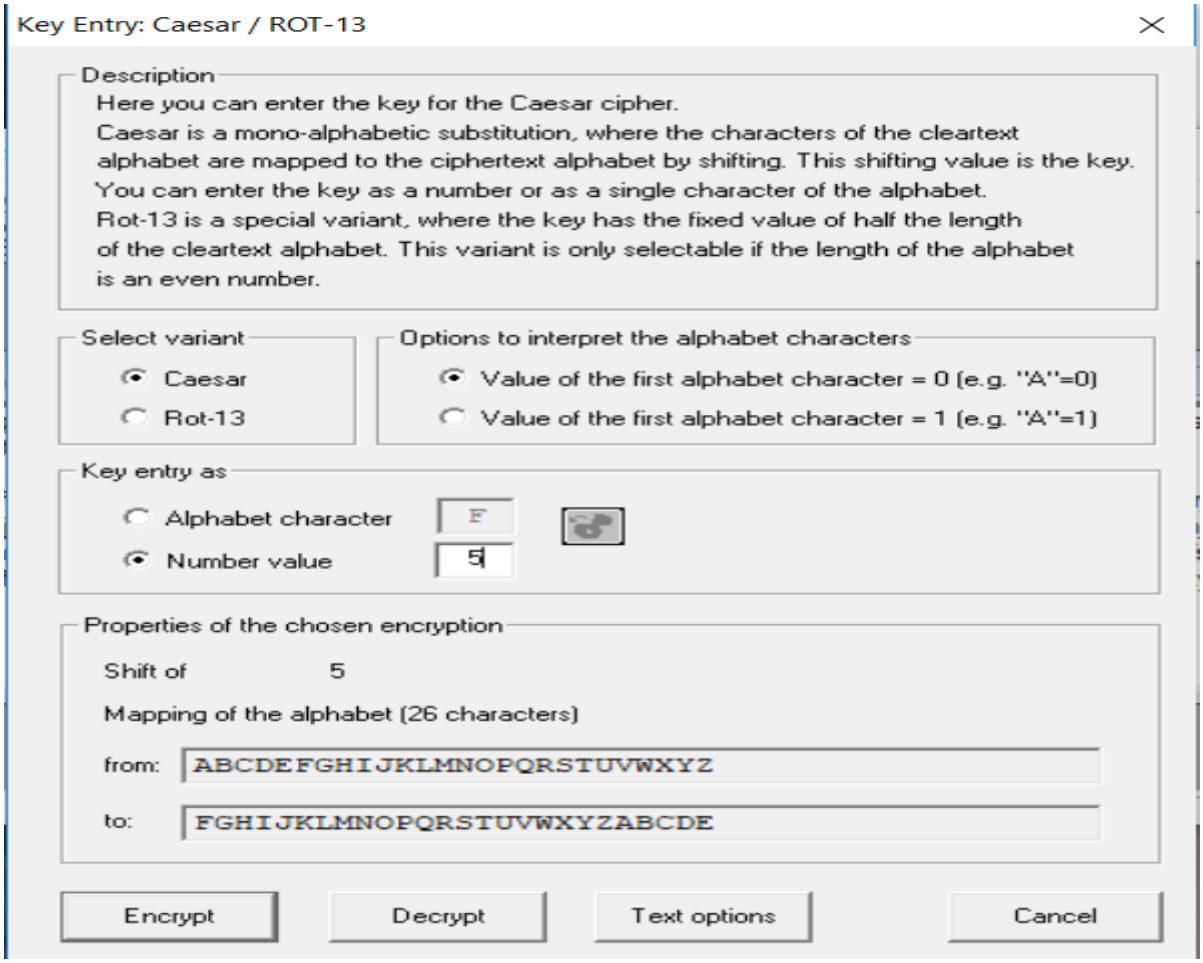


Question: How is the ciphertext-only attack being carried out?
Answer: In this method, the attacker has access to a set of ciphertexts. He does not have access to corresponding plaintext. COA is said to be successful when the corresponding plaintext can be determined from a given set of ciphertext.

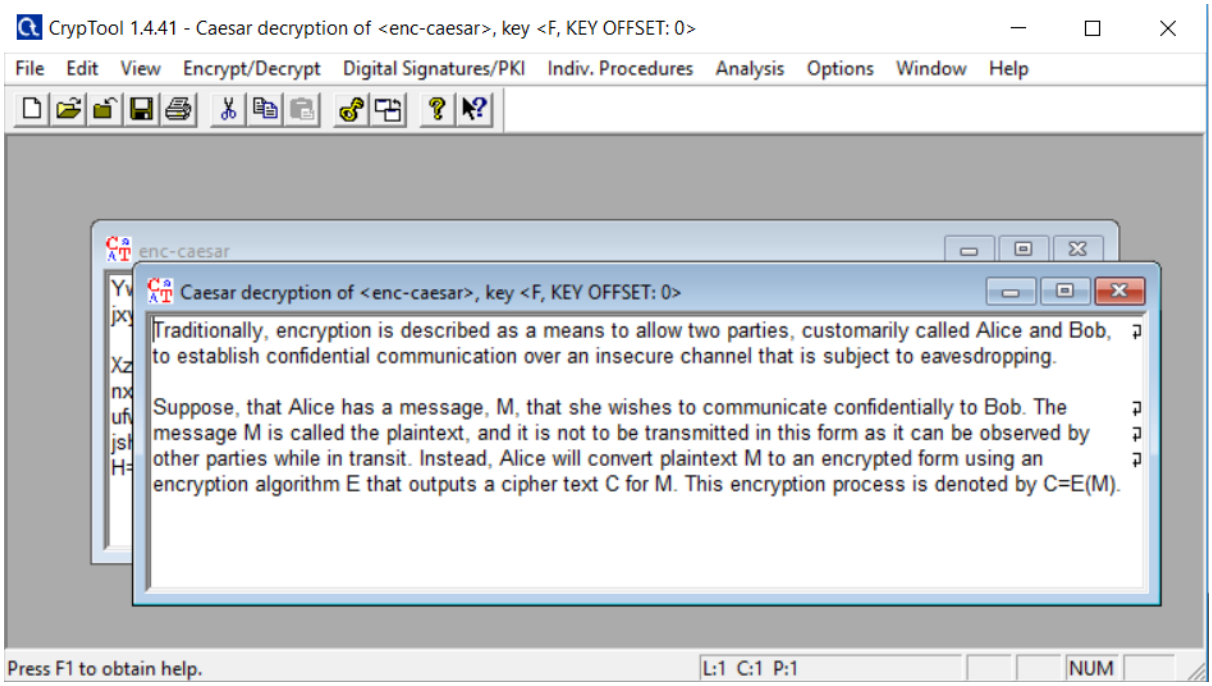
Question: What is the advantage of using such an attack?
Answer: The patterns and context of the message is used to derive the contents of the message. So, less data is required to determine the plain text.

Question: What is the disadvantage of using such an attack?
Answer: It is difficult to implement.

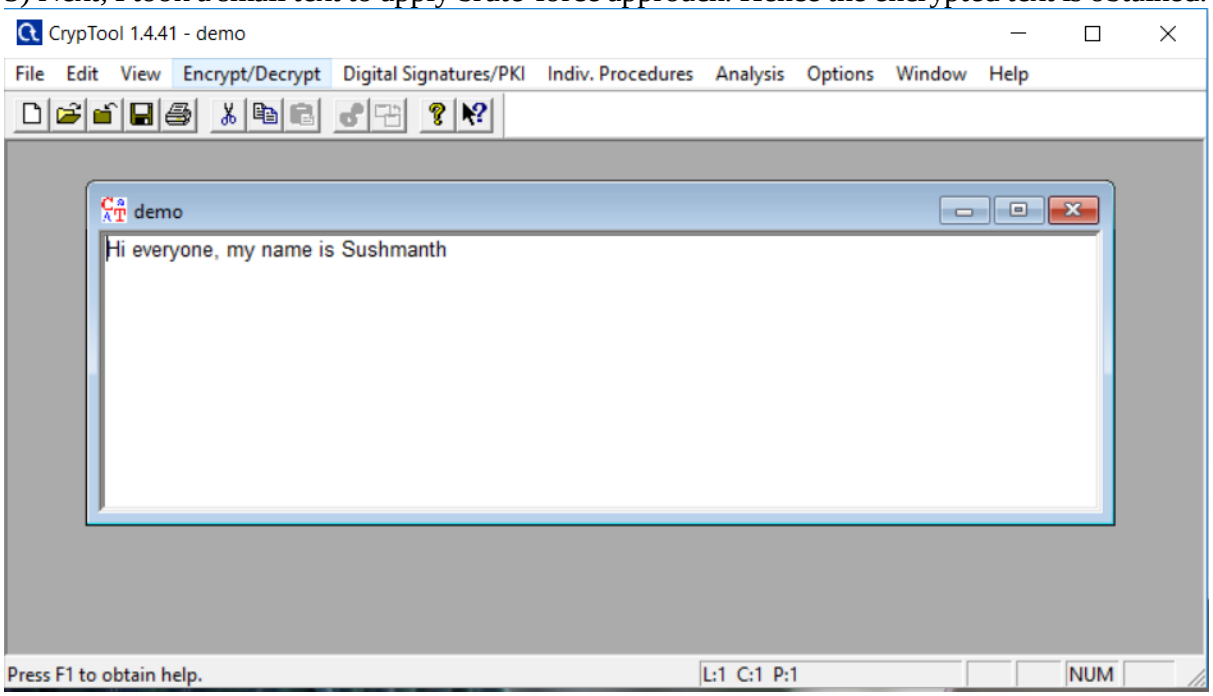
3) Now, a window will open after selecting Caesar/ROT-13. We should choose the options as per our requirements in the window.
In this case, the index of the array of alphabets starts from 0. Here numerical value is known as key. After experimenting with some values finally I kept 5. So, the shift value of alphabets will be 5. Then we should click on decrypt.



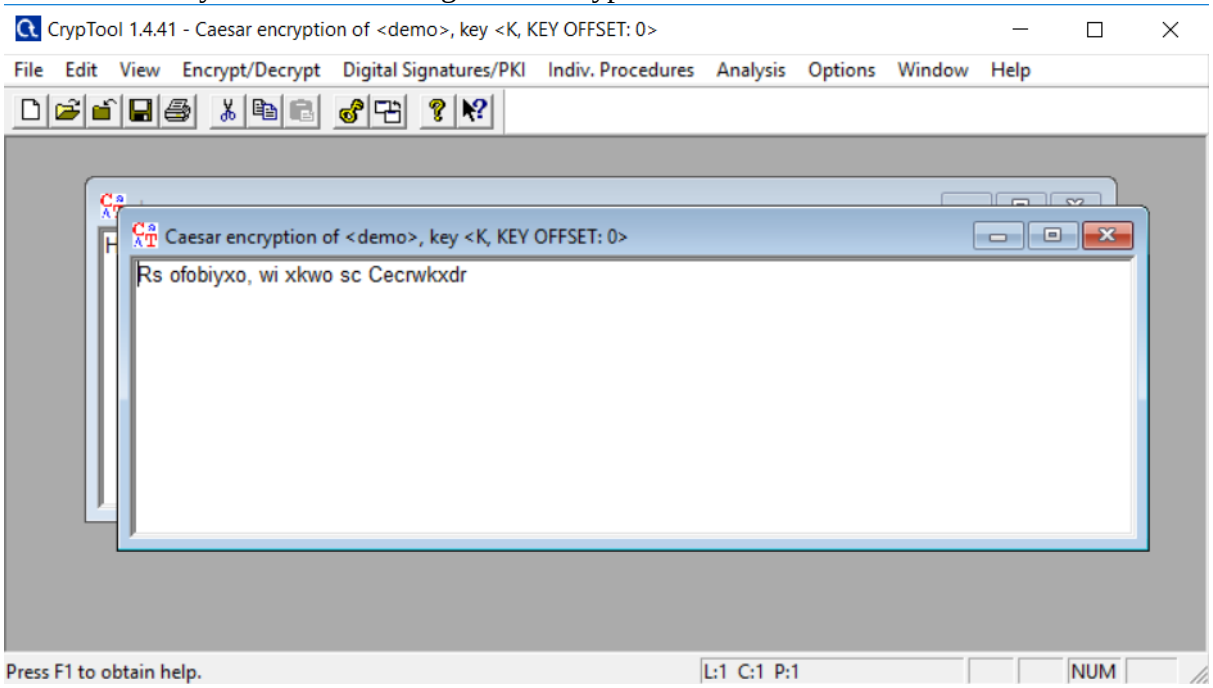
4) After clicking the Decrypt button with key 5, the text in “enc-caesar.txt” will get decrypted. Then we will get plain text that is readable.



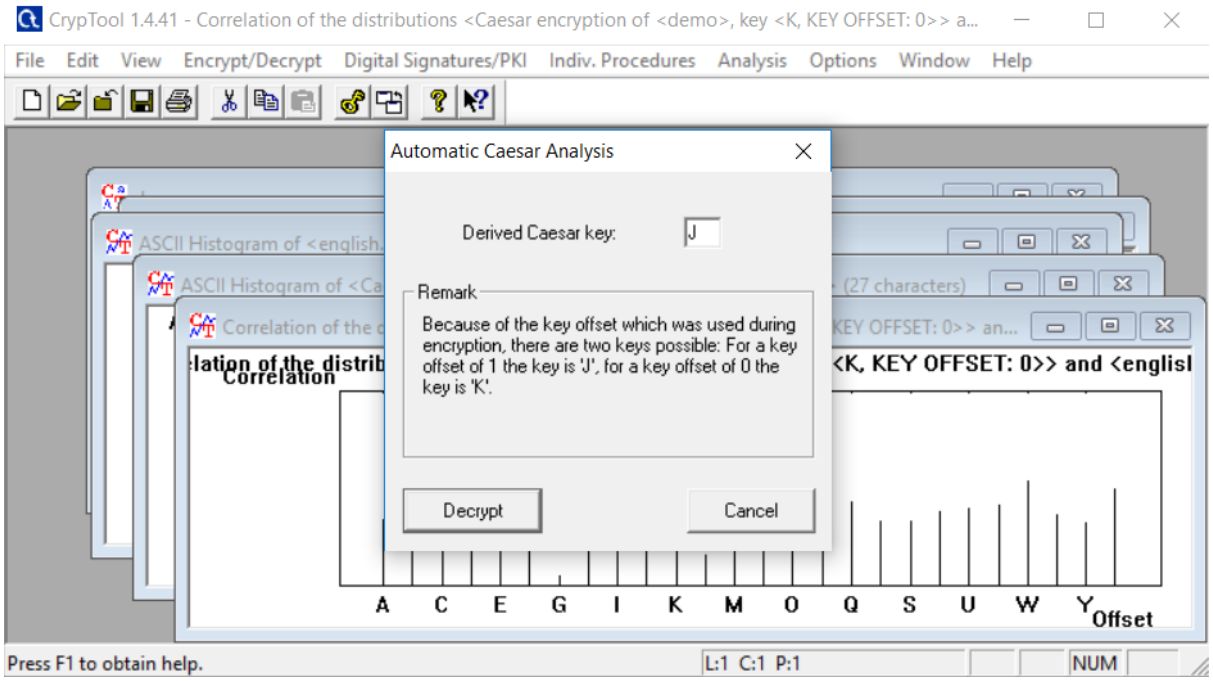
5) Next, I took a small text to apply brute-force approach. Hence the encrypted text is obtained.



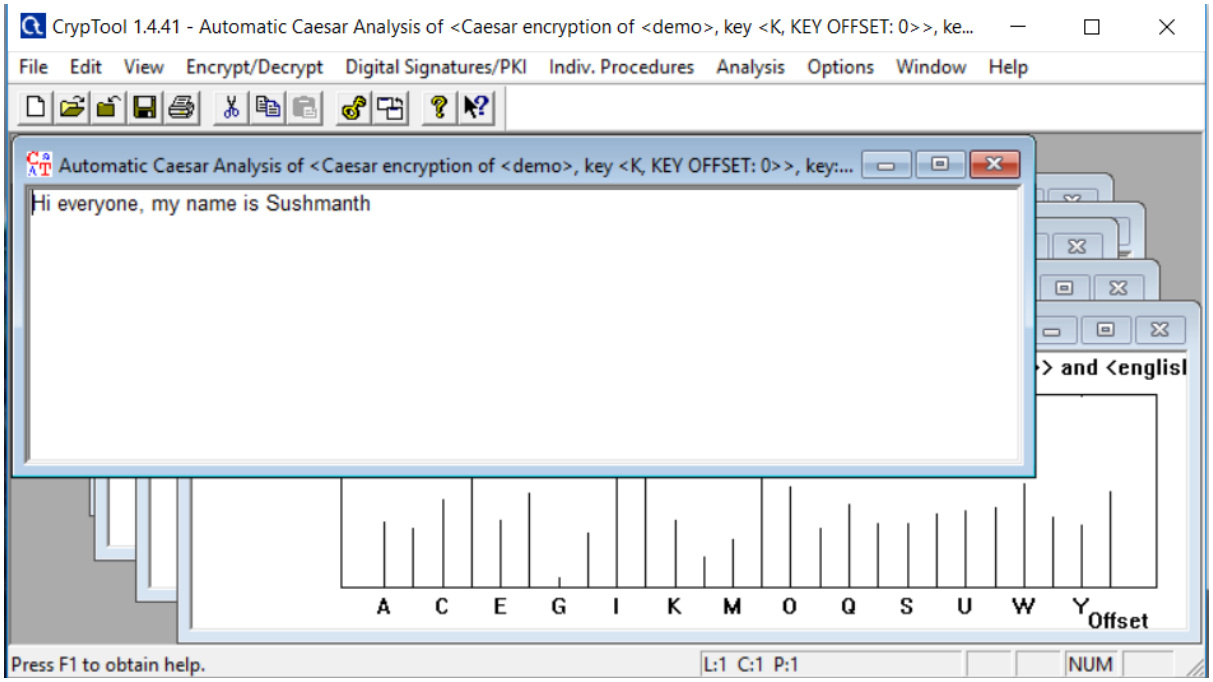
I have taken key value 10. Then I got the encrypted text.



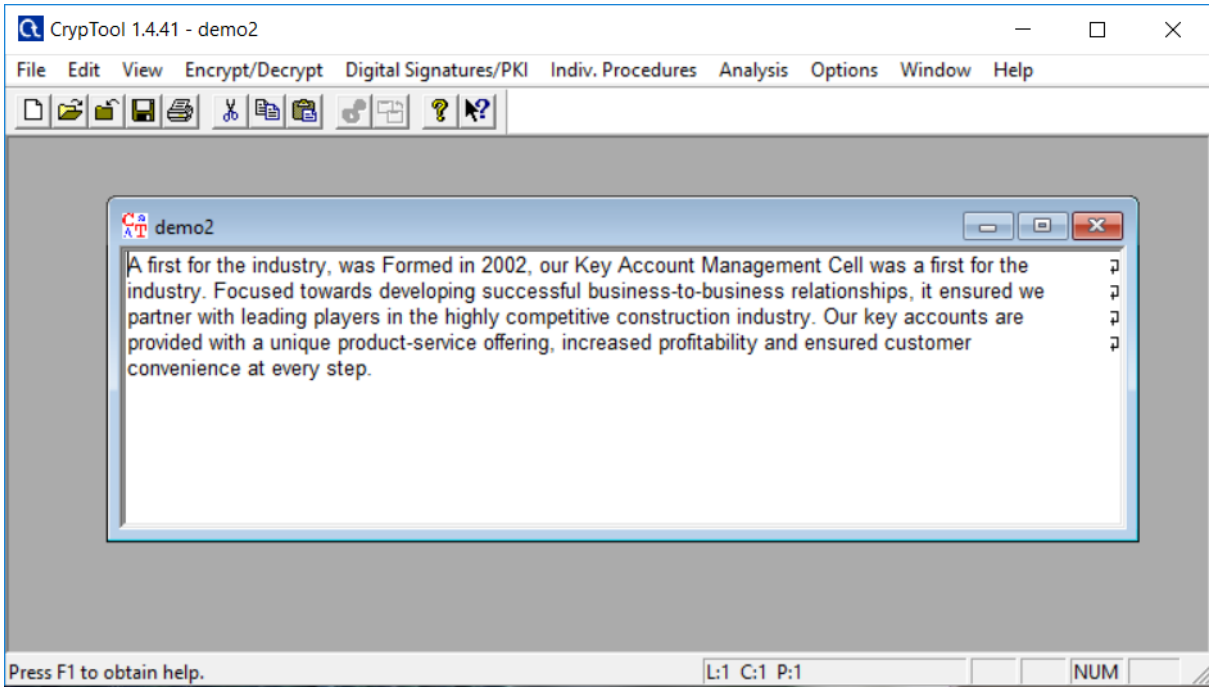
6) Here we are applying brute-force attack. Here the key is taken as ‘J’. Hence after clicking on decrypt the entire cipher text gets decrypted.



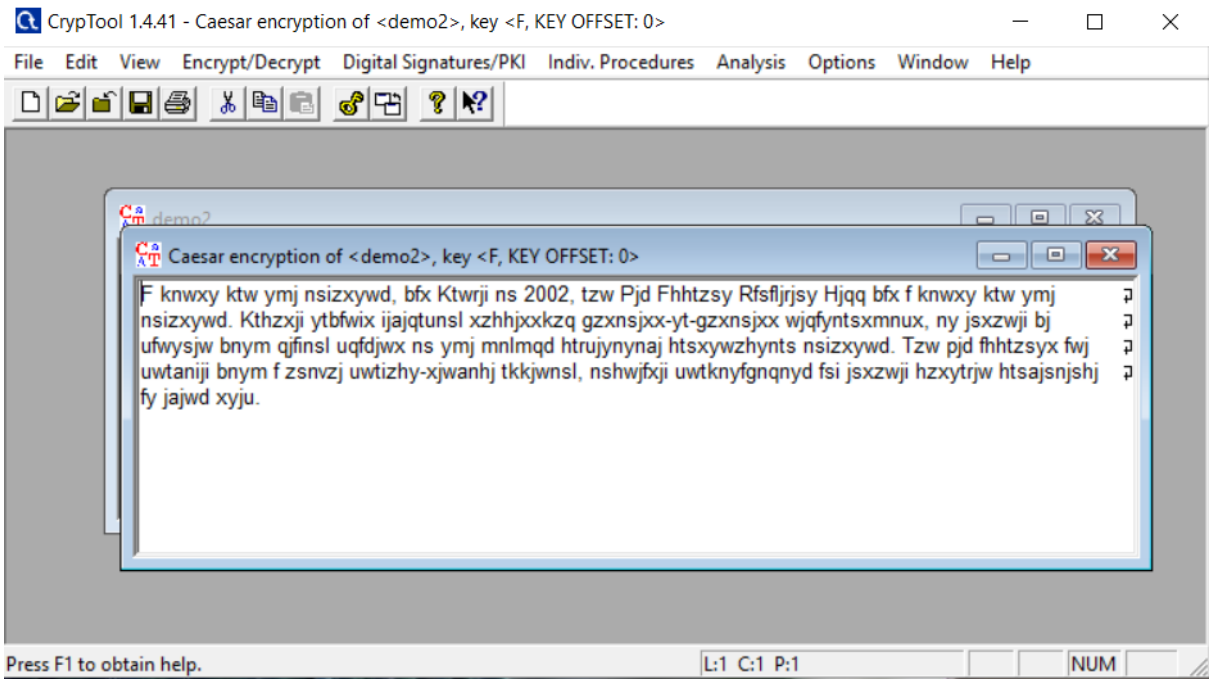
7) The decrypted text is shown below. The plain text will obtain.



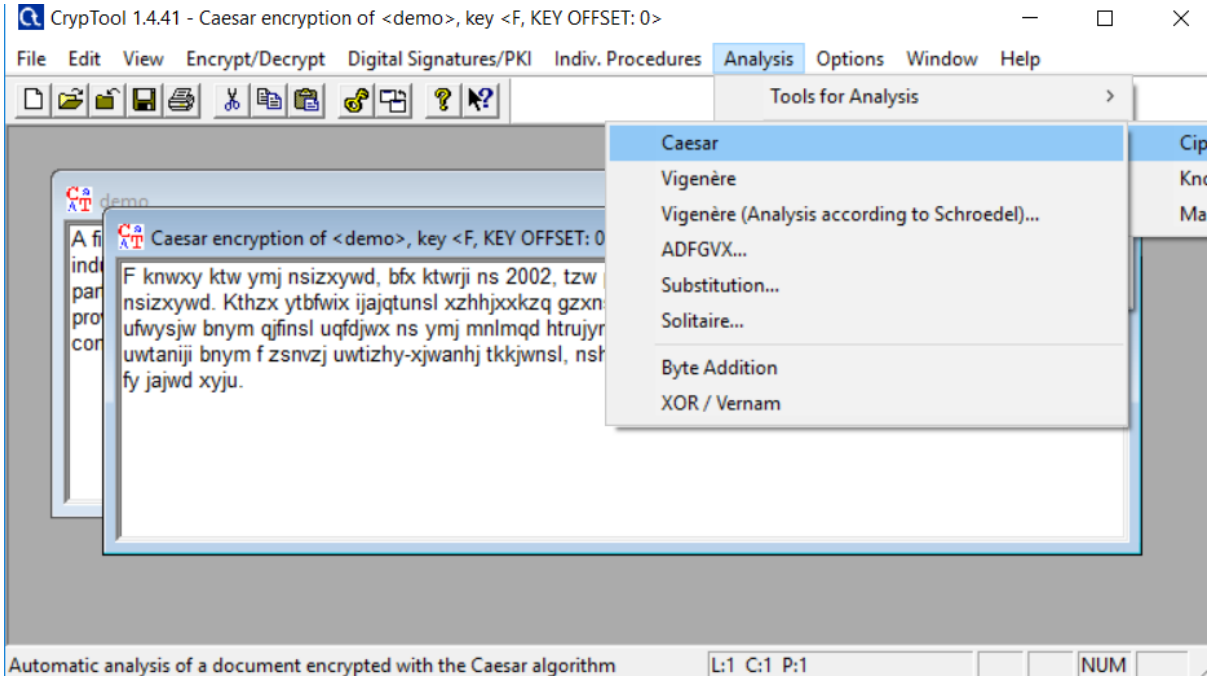
8) Now instead of taking a single line, we are taking a paragraph as a plain text.



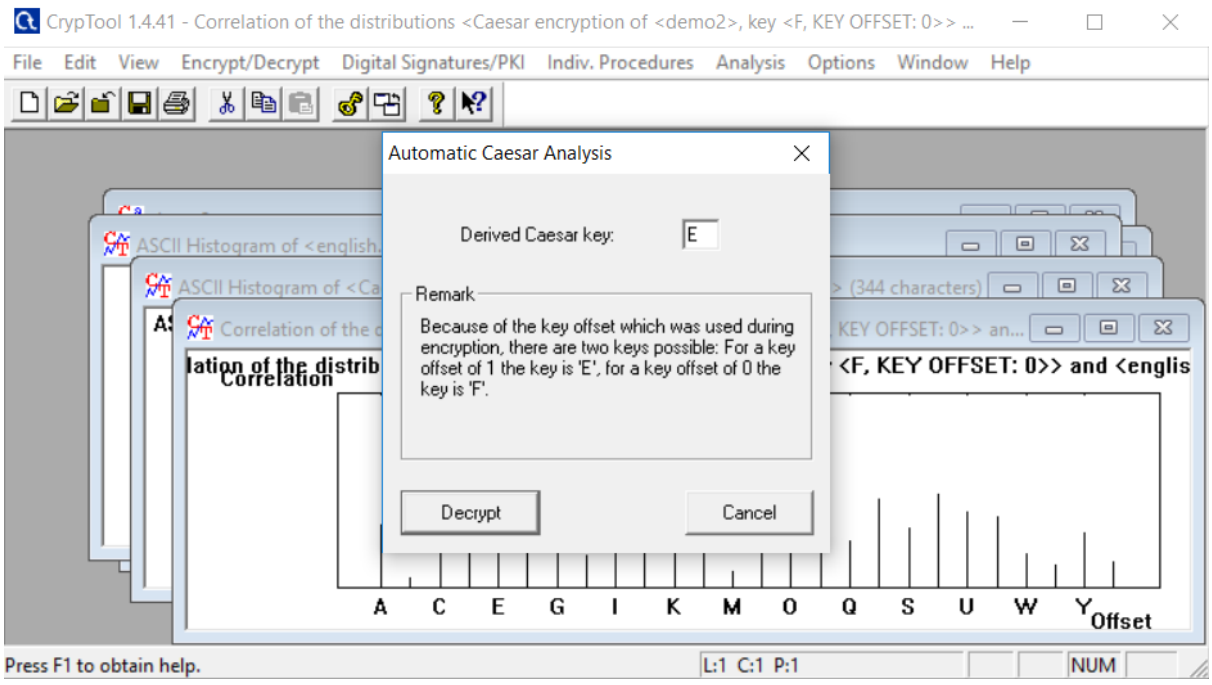
Using Caesar cipher with key value 5, the text got encrypted as shown below.



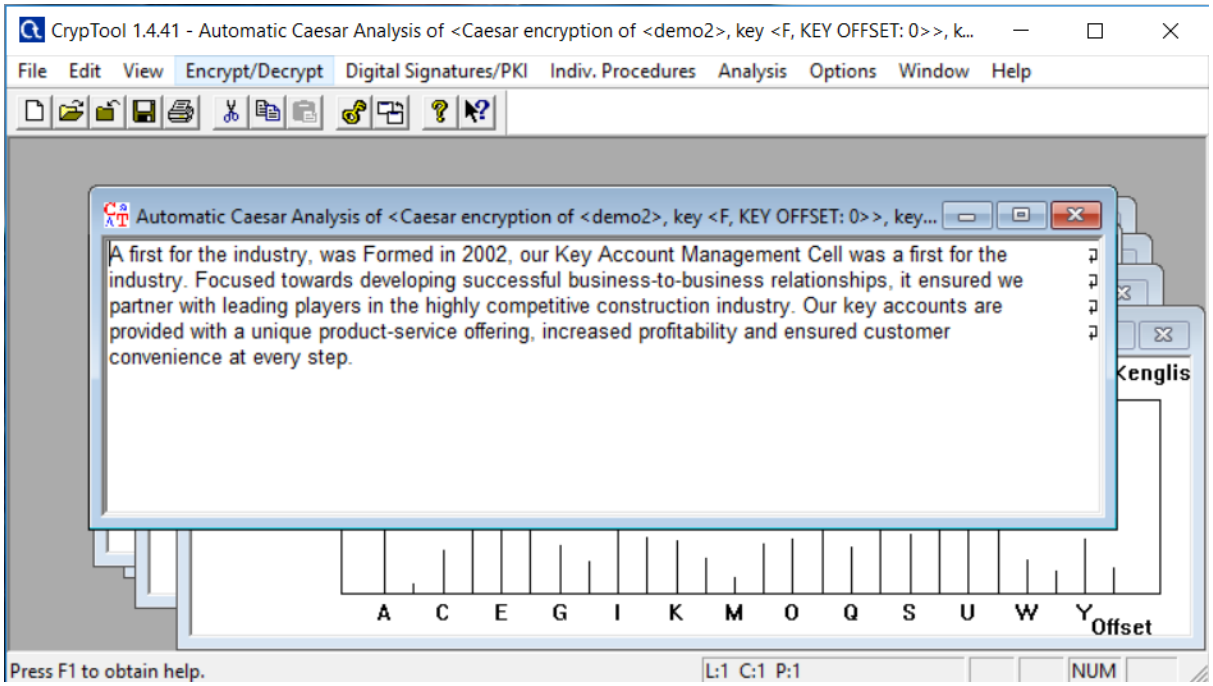
9) After obtaining cipher text, now using brute-force approach the cipher text is going to be decrypted. The brute-force attack is applied in the same way as mentioned in the above image.



10) Here the key is taken as ‘E’. Hence after clicking on decrypt the entire cipher text gets decrypted.

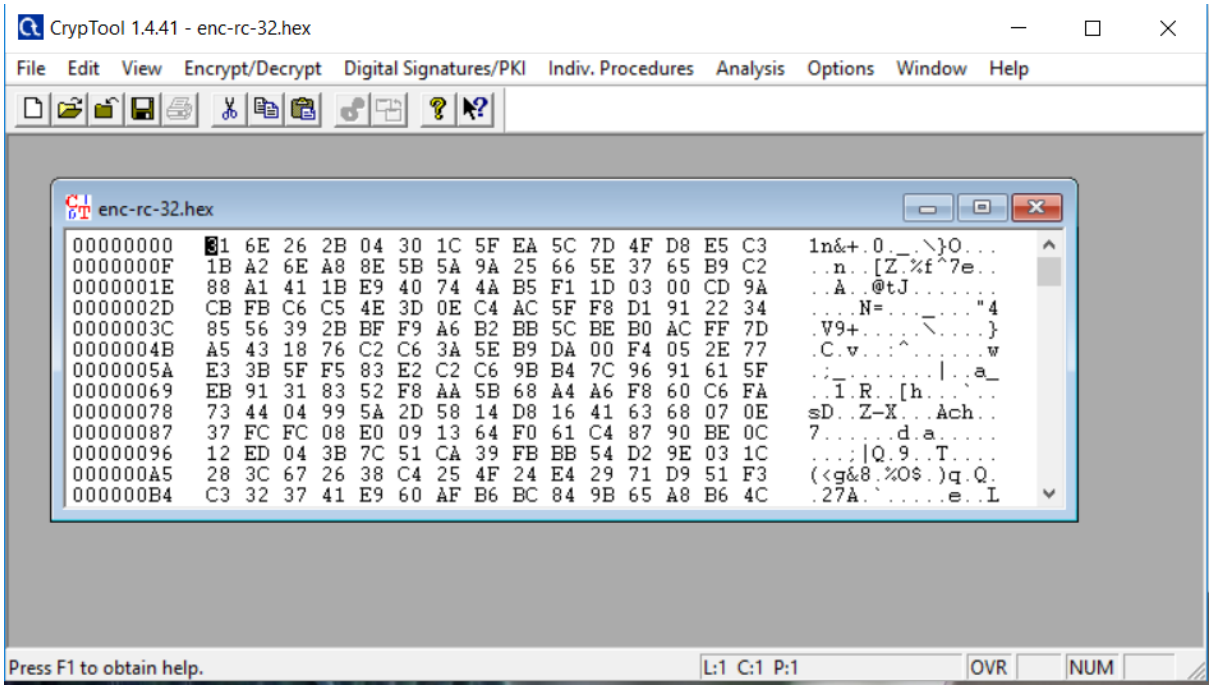


The plain text is obtained and shown below.

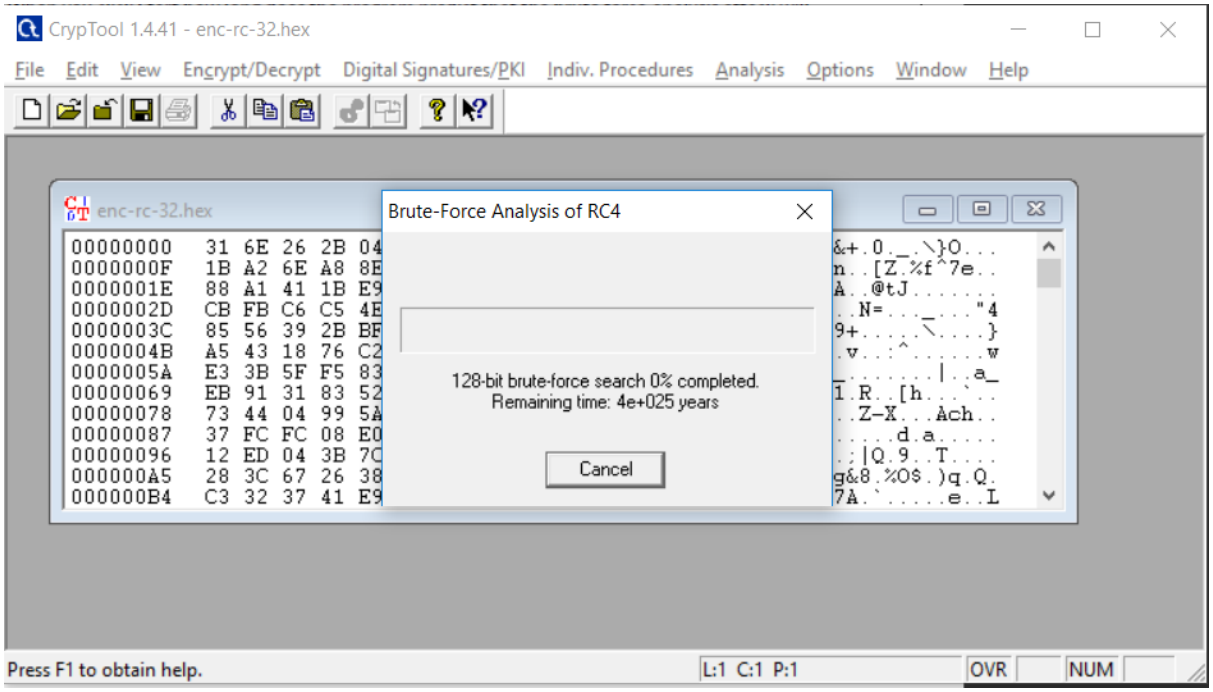


11) Now open the encrypted file “enc-rc-32.hex”. As it is in hexadecimal format, it is unreadable.

First, attempt to use a brute force attack on this encrypted file. As per the file name we know we are using an Rivest Cipher and fortunately the educational tool CrypTool supports both RC2 and RC4. Using the menu options access Analysis - Symmetric Encryption (modern) - RC2.



Question: When you click Start how long does the program predict that the brute force analysis attack will take?



Now to decrypt it we are going to apply the brute-force attack. Here we are using rivest cipher. As here the RC4 is chosen and key length is given as 128 bits. After clicking on start. The process starts. But it takes 4e+025 years to complete the process.

Question: Why is such a brute force attack simply not feasible?

Answer: It is not feasible because the attacker should try every possible key one by one for decryption. If the key size is large, then there will be a greater number of possible keys. The time to complete the attack would be very high if the key is long.

Question: What could you have done to diminish the amount of time required to perform the attack?

Answer: If we have a list of some of the popular leaked passwords by trying different passwords, that can help us to find the passwords in a faster way.

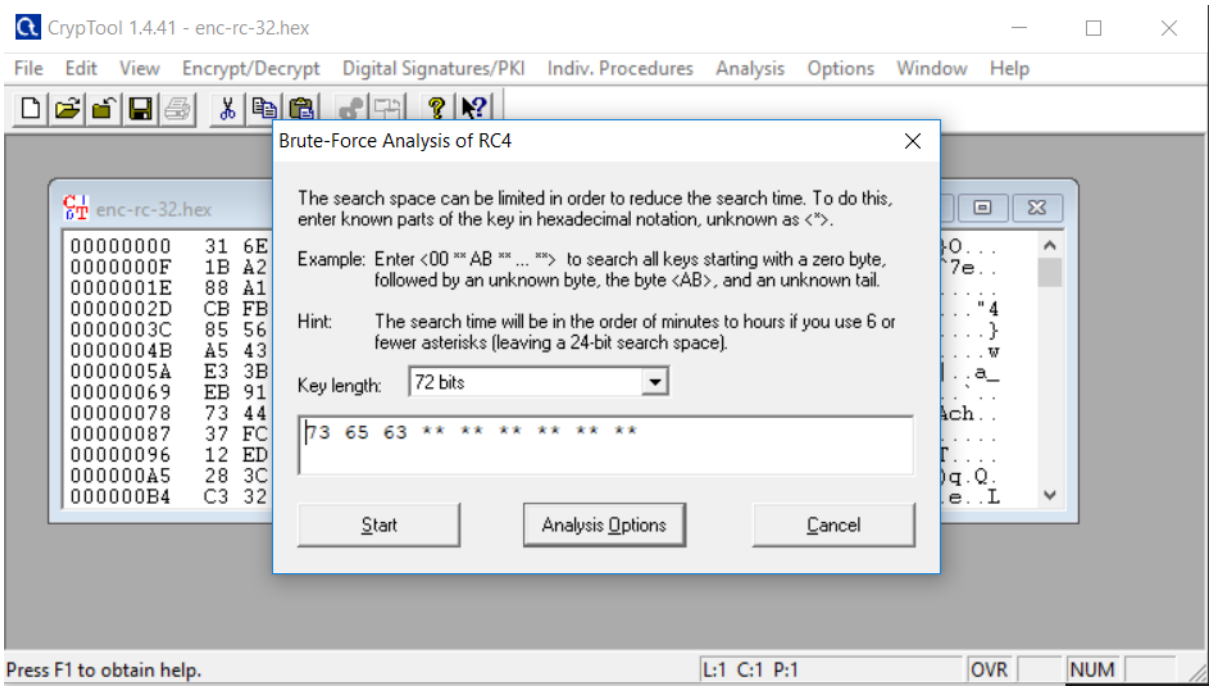
Since there is not enough time or power to brute-force a 128-bit key, click cancel. Obviously, the file still needs to be decrypted. Try using the RC4 option. So, using the instruction from point 16, select RC4 and select a 128-bit key length.

Question: Has the amount of time required increased or decreased?

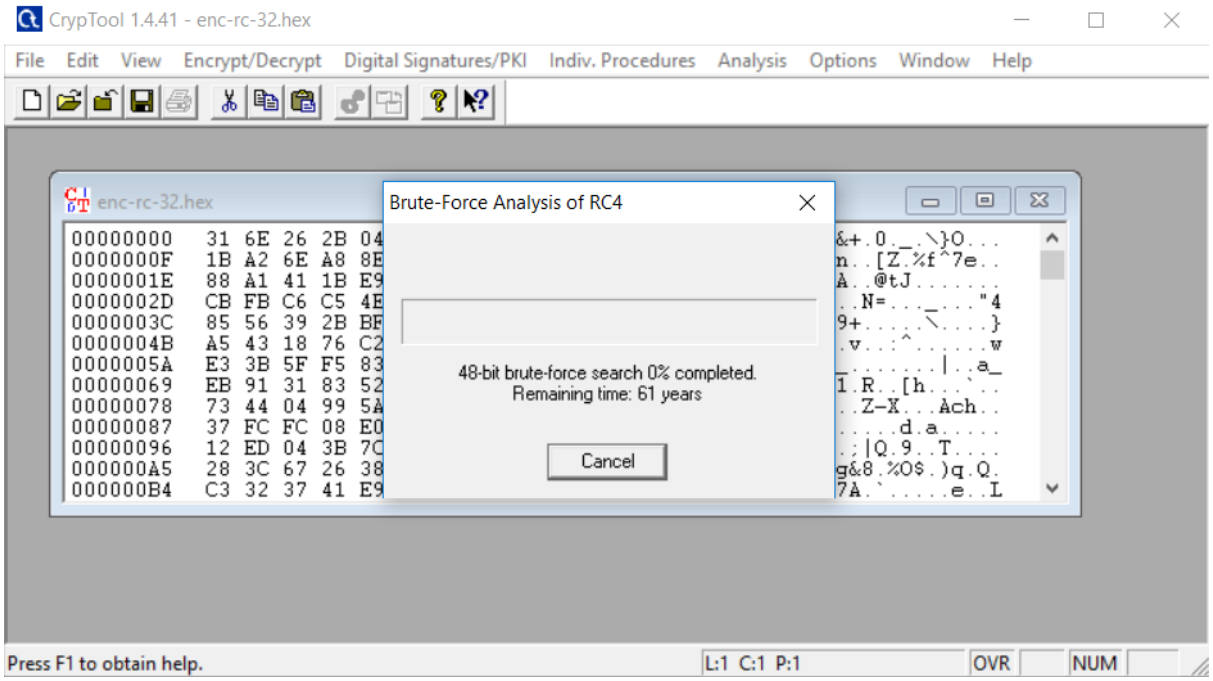
Answer: Increased

So, the file still has not been decrypted. The file is definitely encrypted using RC4 and the key length is only 72-bits.
As per the image below, the program permits a user to include specific hexadecimal values to reduce the time of the key length analysis. Hence, the first 24-bits (hex) are respectively 73 65 63.

13) Now, I have given the key length as 72 bits. Then I have given some hexadecimal values to reduce the time. Then after clicking on 'start' the process starts.



When we click the start button, it shows the time to complete the process.



14) Here as in the above image we can see the time taking for decryption is very long so now the process is cancelled.

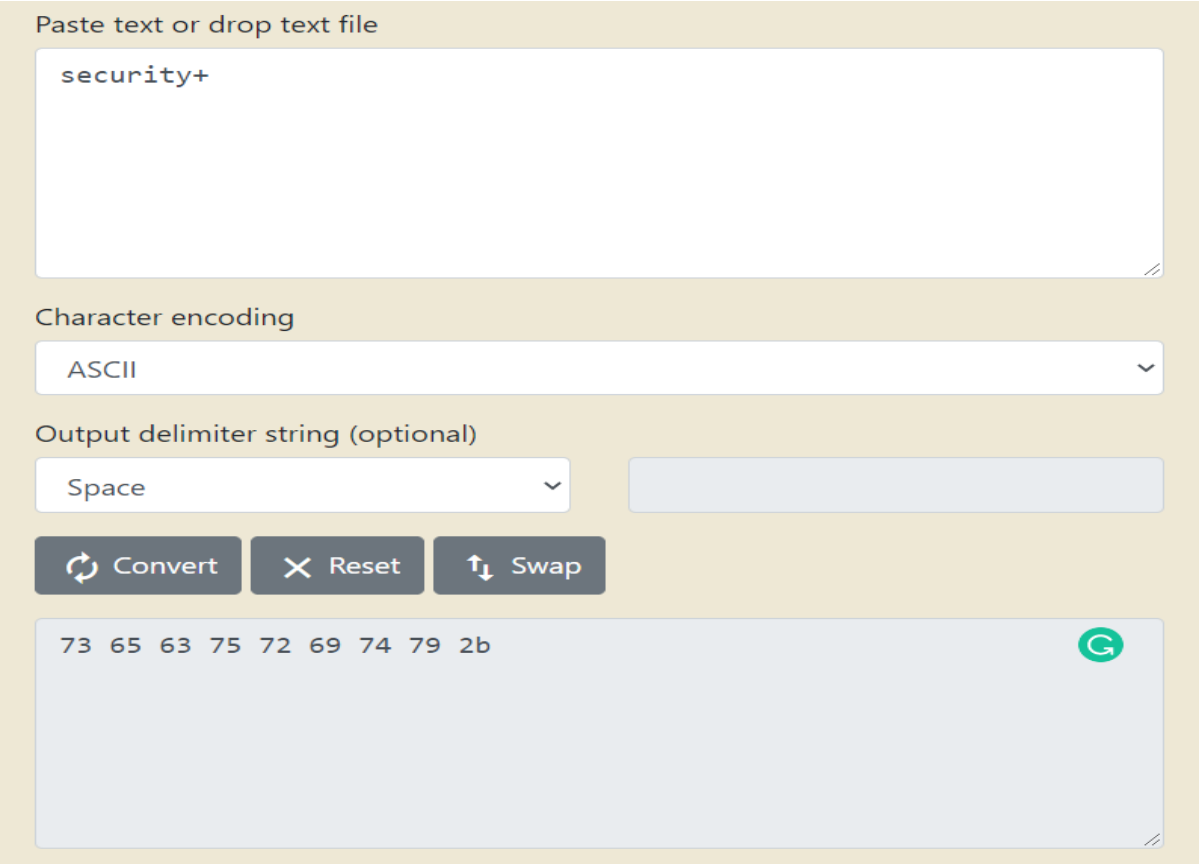
Question: How much time is required to brute force attack the cipher text this time?

Answer: 61 Years

Question: Undertake research to identify the similarities and differences between the RC4 and RC2 algorithm.

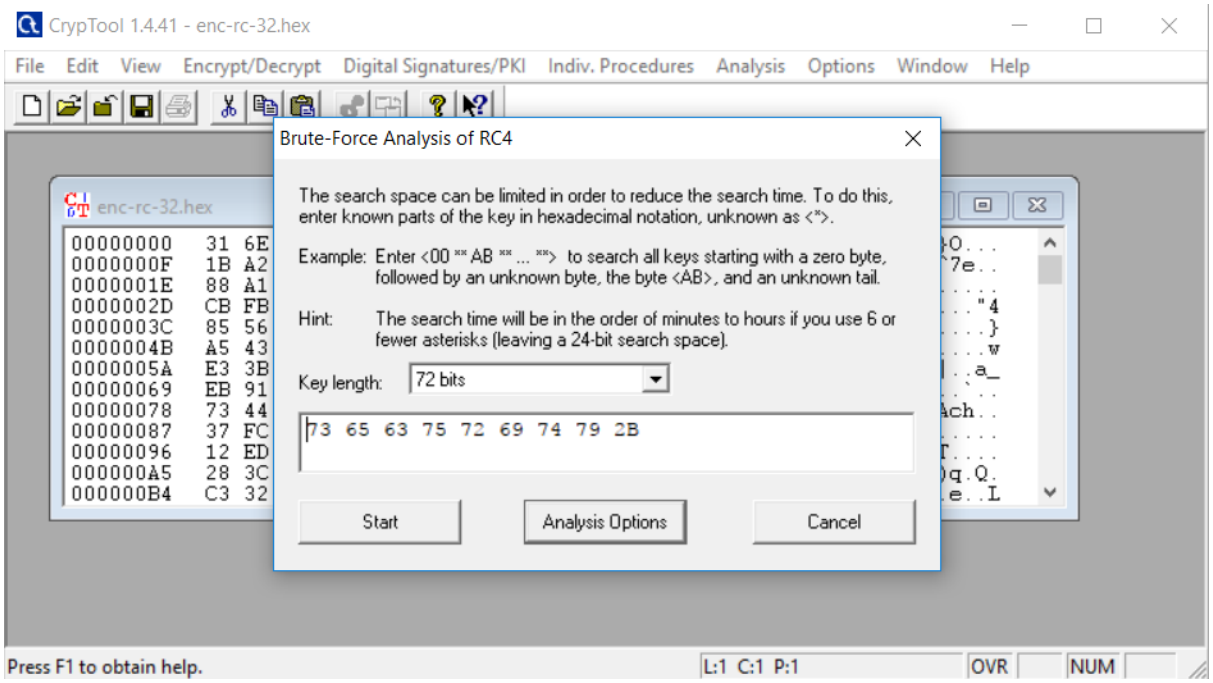
Answer: The difference between RC2 and RC4 algorithms are the total rounds in RC2 are 16 and in RC4 are 256 rounds. The key length in RC2 is 8 to 1024 bits and in RC4 is 40 to 2048 bits. RC2 is a block cipher and RC4 is a stream cipher.
The similarities between RC2 and RC4 algorithms are: In case of security RC2 and RC4 both are vulnerable.

15) Now the hexadecimal value of 'security+' (ASCII key) is found using an online tool.

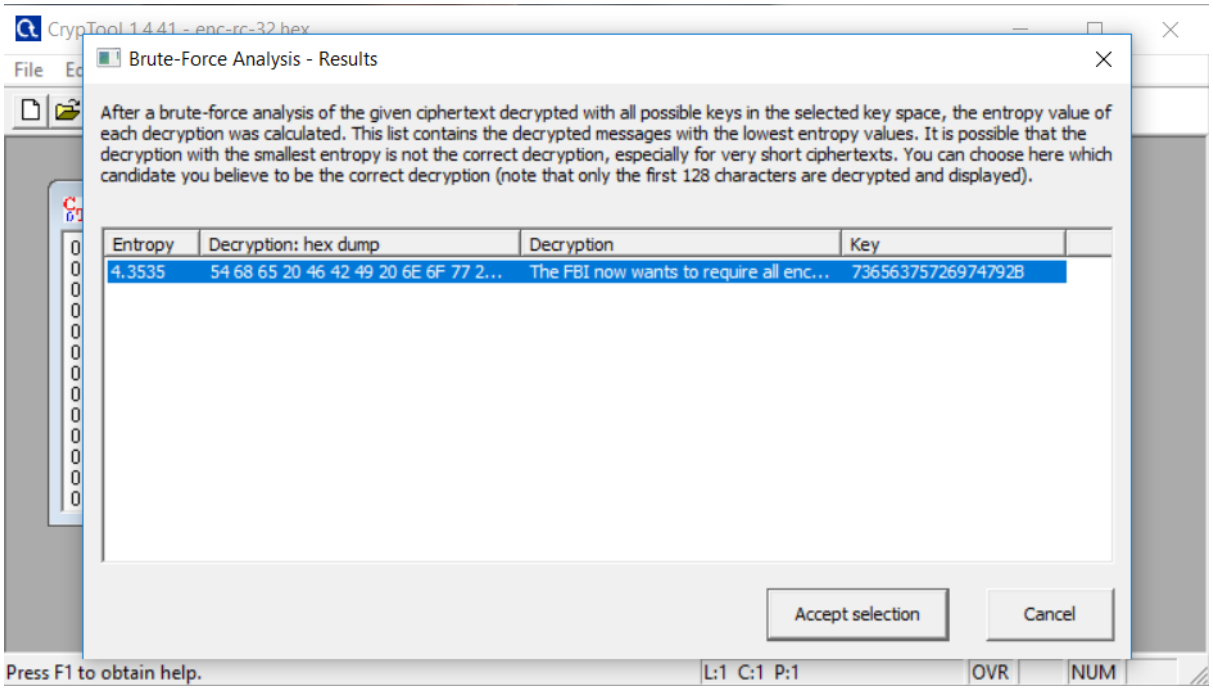


The hexadecimal value of "security+" is:

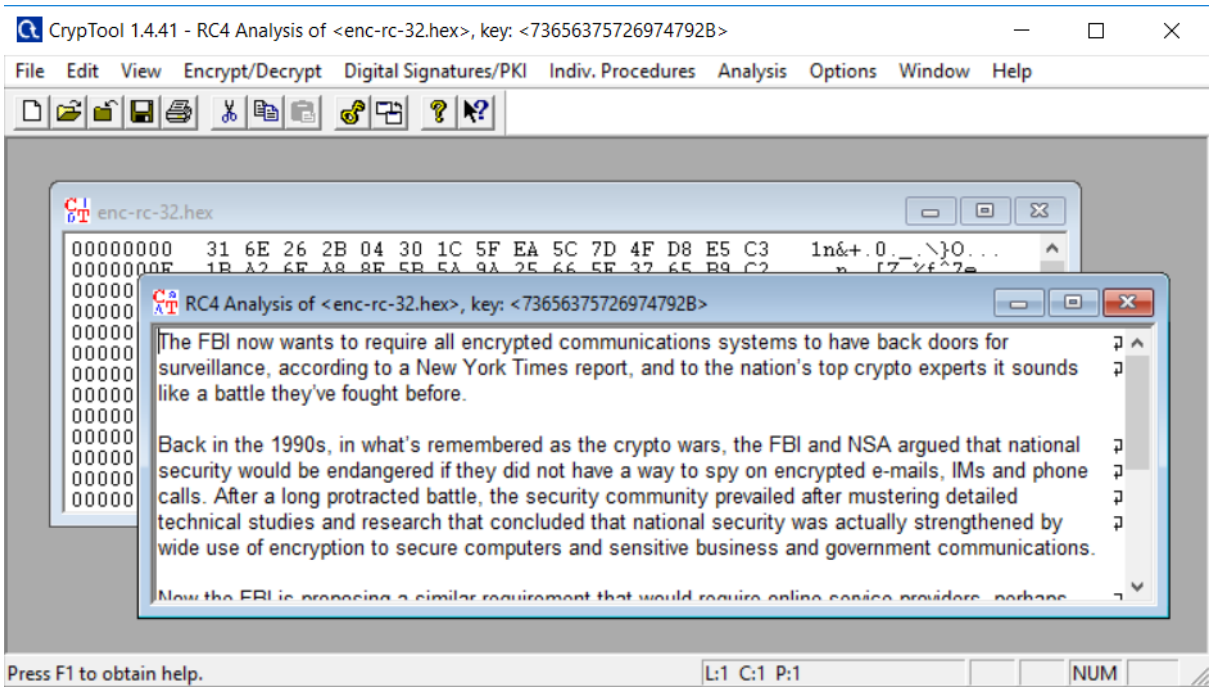
73 65 63 75 72 69 74 79 2B



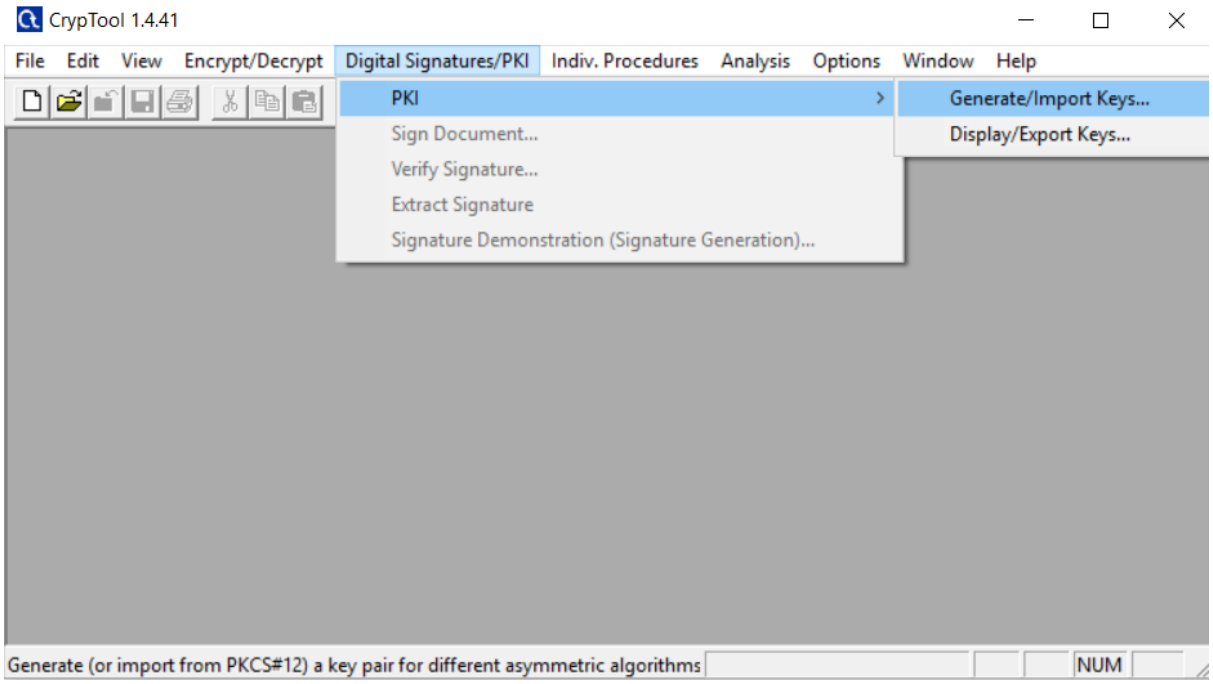
16) After getting the key in hexadecimal now we have to enter that data and click on accept selection.



17) Now the plaintext of the ‘enc-rc-32.hex’ file is obtained after the decryption.



18) So, now for asymmetric encryption a set of public and private keys need to be generated. So, we need to go to digital signatures/PKI and choose Generate/Import Keys.



Question: Why is this user data required when utilising asymmetric encryption?

Answer: The user data that has been given can only access the keys that are generated.

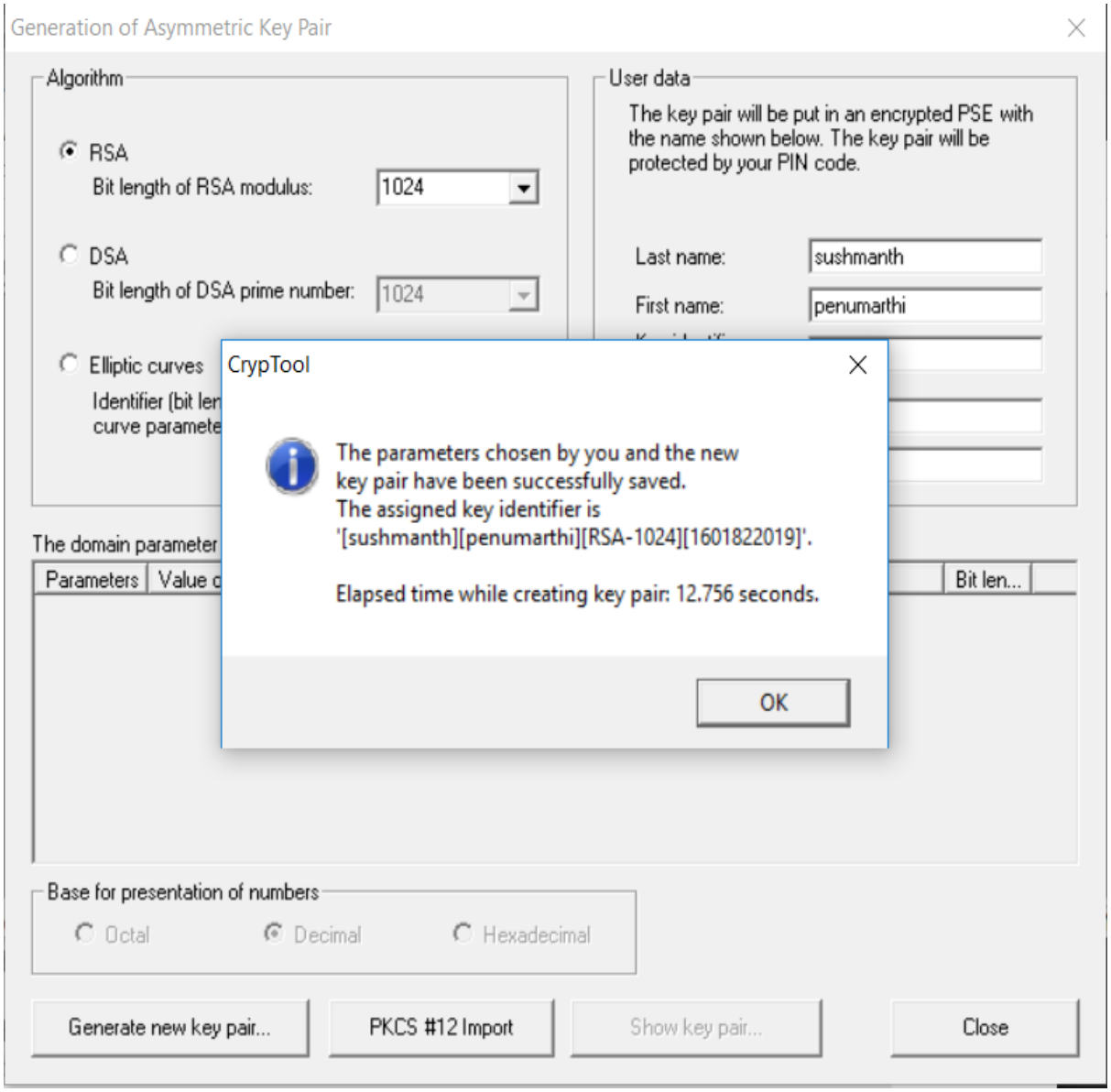
Question: Why does the program require that you move your mouse around when generating your keys?

Answer: If we move the mouse the system generates some random data.

Question: How does this process differ from using symmetric encryption?

Answer: Symmetric encryption uses one key for both encryption and decryption, and the asymmetric encryption uses a public key for encryption and a private key for decryption.

19) Here, we have to fill some of the required fields like last name, first name and pin. I have chosen the RSA algorithm and gave the user data as mentioned in the above image.



Question: Why does the encryption component ask us to choose our recipient (think back to symmetric versus asymmetric encryption)

Answer: The file that has been sent can be decrypted by only the selected recipient.

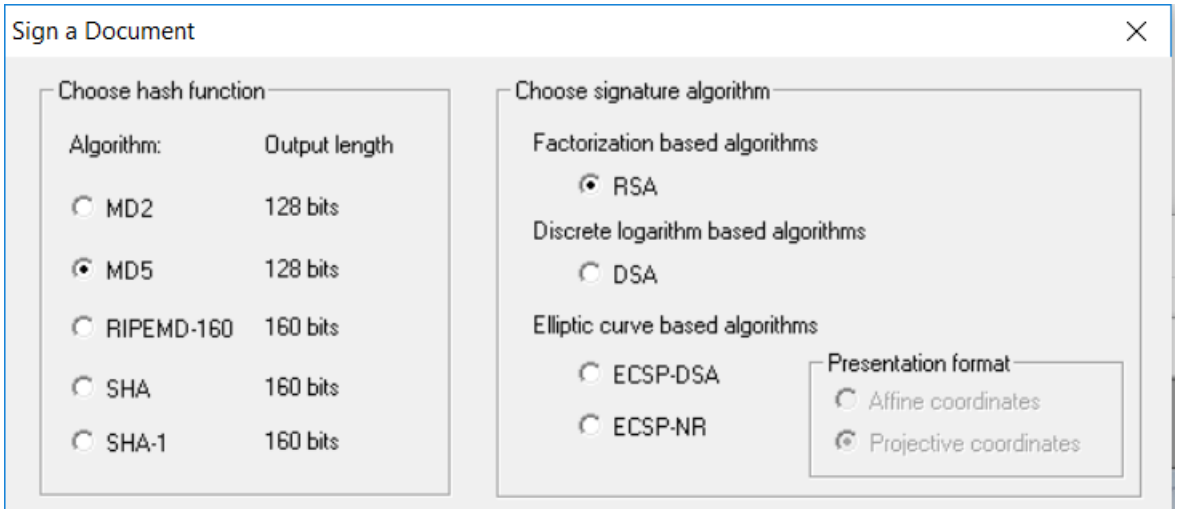
Question: Which key (private or public) is being used to encrypt the document and why?

Answer: In asymmetric encryption Public key is used because it is infeasible to determine the decryption key

Question: Imagine you accidently forgot the pin or have deleted your key pairs. As a result, you decide to generate a new private and public key pair. If you use the same user data as you did the first time, will the cipher-text be the same or different (you may like to try and experiment with this)?

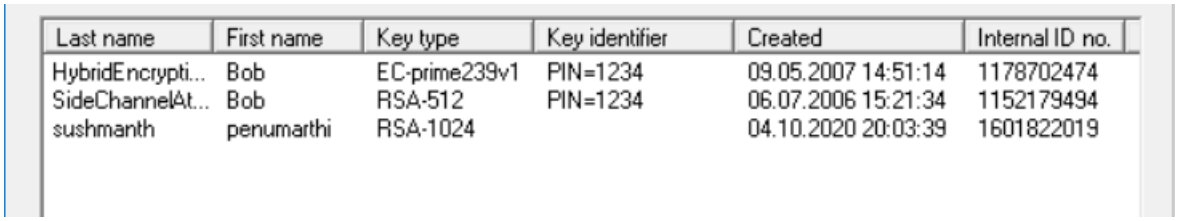
Answer: I think the ciphertext will be different.

20) Using the default startingexample-en.txt file as our base text, you will now attempt to encrypt the digital document. Click **Encrypt/Decrypt - Asymmetric - RSA Encryption.**



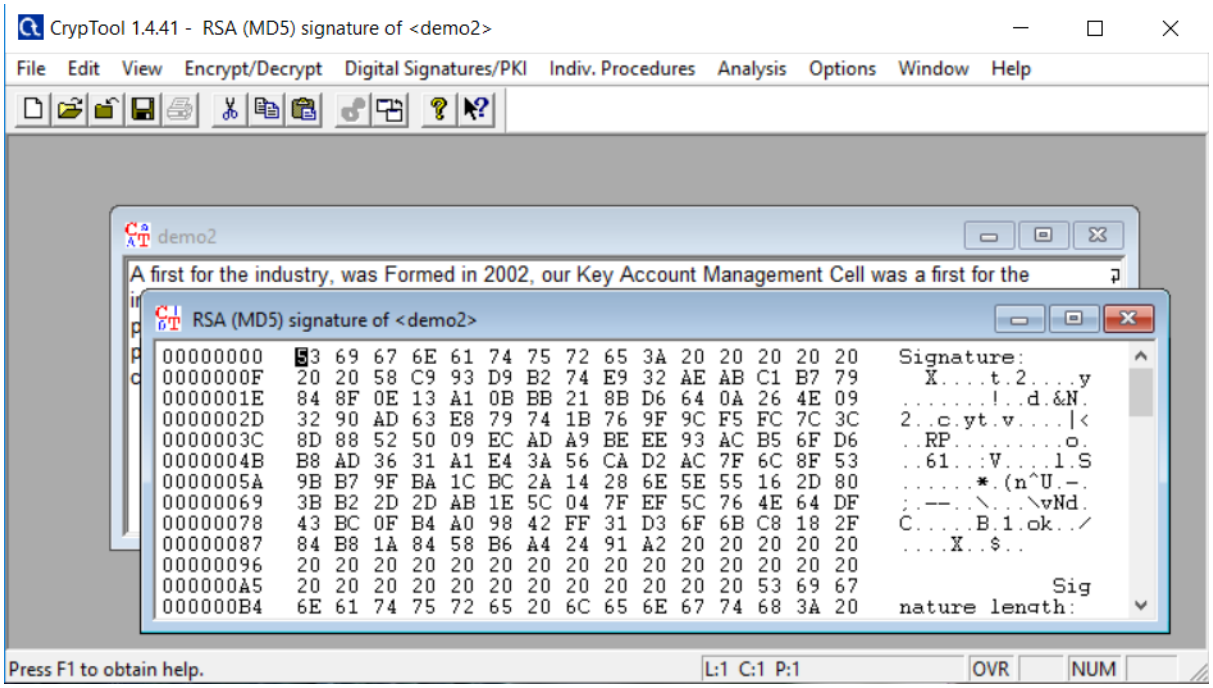
Here, to sign the document initially I have chosen the MD5 hash function.

Question: Why aim of security does signing a document ensure?
Answer: Digital signatures ensure that the documents have not changed without authorization.



Last name	First name	Key type	Key identifier	Created	Internal ID no.
HybridEncrypti...	Bob	EC-prime239v1	PIN=1234	09.05.2007 14:51:14	1178702474
SideChannelAt...	Bob	RSA-512	PIN=1234	06.07.2006 15:21:34	1152179494
sushmanth	penumarthi	RSA-1024		04.10.2020 20:03:39	1601822019

Once you have encrypted the digital document successfully, you should notice a new file has been created with lots of hexadecimal outputs.

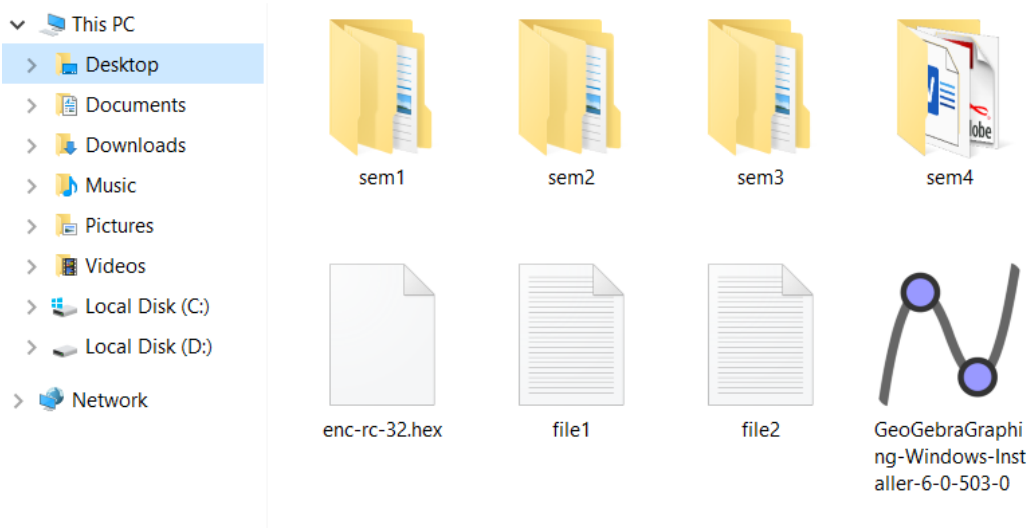


Question: What type of information is now contained in this document?
Answer: Signature, hash function, Signature Length, plain text.

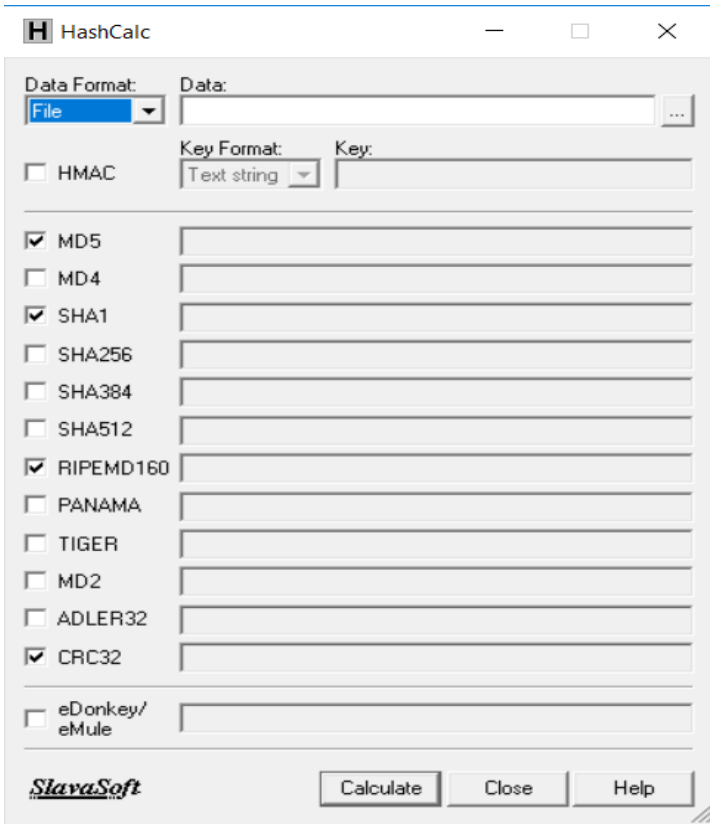
Question: How is digitally signing a document beneficial?
Answer: The benefits of digital signatures have more offices and companies choosing them to make their workplace more efficient and secure. It reduces the risk of alteration of documents. The document cannot be altered without authorization.

Hash Calc

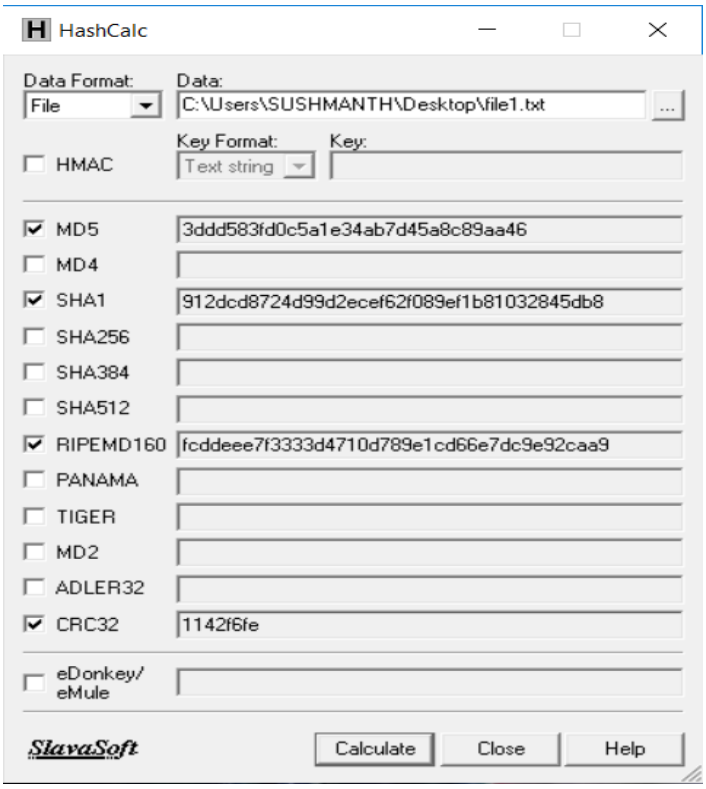
24) Initially, I have created two test files “file1.txt” and “file2” on my desktop.



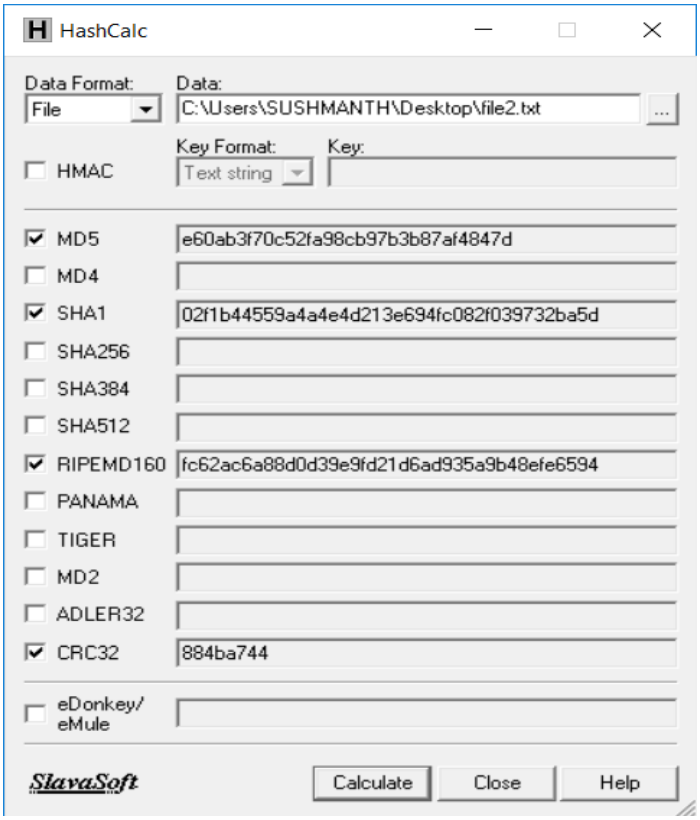
25) Now I have opened HachCal tool and chosen data format as ‘File’ and many hash functions in which I consider MD5 hash function.



26) Now caluclate and note down the MD5 value for file1.txt.



Next caluclate and not down the MD5 value for file2.txt



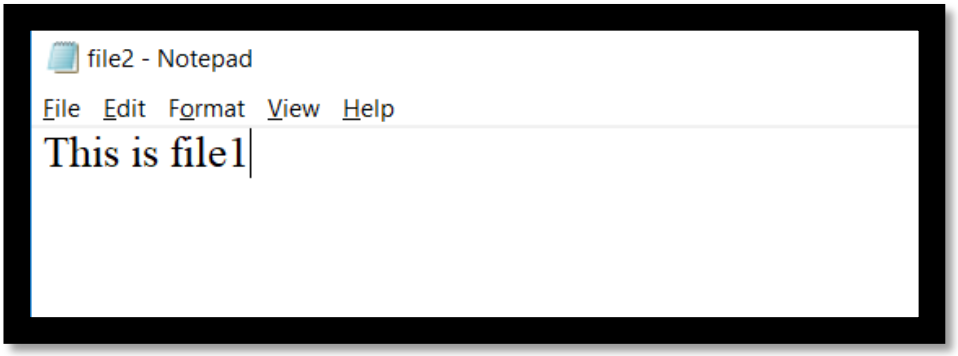
Question: Has the MD5 value changed?

Answer: The MD5 value for file-1 and file-2 are different as the content inside each of the files is different.

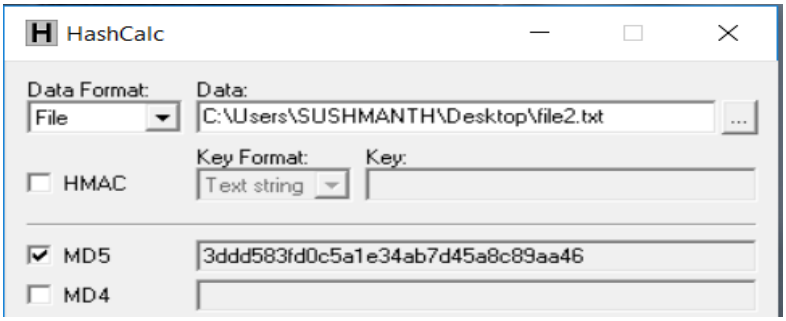
Question: Why did this particular process occur?

Answer: The content inside each of the files is different. So, the hash values are also different.

Now I have deleted the file2.txt and renamed file1 as file2.txt.

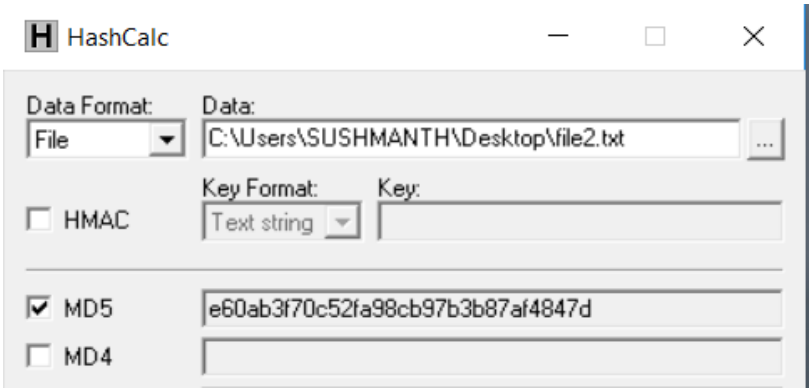


Now caluclate the hash value for that file.



It has got same as the file1.txt

Now change the cotent in file2.txt to “This is file2” and caluclate the hash value.



It has got same as the file2.txt (before rename) which was deleted.

Question: Has the MD5 value changed?

Answer: Yes, it is changed because the content inside the file is changed.

Question: Does it correspond to a particular MD5 value obtained previously?
Answer: Yes, it is the hash value of original file-2 which was deleted.

Question: What changes need to be made to the file for it to alter the resultant MD5 value?
Answer: We need to change the content inside the file in order to change the MD5 hash value of a file.