OSINT Toolkit for Reconnaissance phase of Penetration Testing

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***Abstract*— This research paper describes how we created a user-friendly toolkit to help security experts gather information from different sources and analyse it during penetration testing. The toolkit allows for quick and efficient data collection and seamlessly integrates with other tools used in penetration testing. By following a step-by-step approach, we built and tested the toolkit before making it available for use. Existing tools for information gathering are limited by either being passive or active in their approach, which is a drawback. However, this toolkit overcomes that limitation by offering both active and passive tools for gathering information. With this toolkit, penetration testers can identify weaknesses in a system's security and help improve cybersecurity overall. Our research contributes to better OSINT toolkit development and enhances cybersecurity practices for everyone involved.**

***Key Terms*—**Penetration Testing, Cybersecurity, Information Gathering, Security Assessment, Vulnerability Assessment, Reconnaissance.

I. INTRODUCTION

As more and more information is stored and sent digitally, the importance of information security as a business has grown in recent years. Therefore, there is a rising demand for trained experts who can identify vulnerabilities in networks and devise countermeasures to keep sensitive data safe online. Penetration testing is an integral part of information security since it allows for the identification of potential weak points in a system by simulating an attack. Organisations may strengthen their security and reduce the likelihood of attacks by conducting penetration tests to find vulnerabilities in their systems [1].

Penetration testers rely heavily on Open Source Intelligence (OSINT) technologies, which enable them to collect and evaluate data from a broad variety of public sources, such as social media, online forums, and the internet in general. With this knowledge in hand, both attacking and defending teams may better plan their moves and focus in on areas of weakness. Building OSINT tools is a tough and intricate process that calls for knowledge of information security, software development, and data analysis. The potential benefits of these capabilities, which include strengthening computer system security and protecting businesses and individuals from cyber-attacks, are significant though [2].

II. LITERATURE REVIEW

2.1 Reconnaissance phase of penetration testing

The reconnaissance phase is one of the most critical stages in the penetration testing process. It involves gathering information about the target organization's network, systems, and applications. This information can be used to identify potential vulnerabilities and attack vectors [3]. Several studies have highlighted the importance of the reconnaissance phase of penetration testing. The study was conducted by Anwar et al. [4] regarding the importance of the reconnaissance phase of penetration testing. The study aimed to highlight the critical role that information gathering plays in the penetration testing process. The researchers conducted a survey of penetration testers to gather information about their information gathering practices during the reconnaissance phase. The survey results showed that 88% of the respondents considered information gathering to be the most important phase of the penetration testing process.

2.2 OSINT for reconnaissance in various fields

OSINT (Open-Source Intelligence) is a critical component of reconnaissance in various fields, including military, law enforcement, and cyber security. The study by Bojic et al. [5] focused on the use of OSINT in the reconnaissance phase of penetration testing. The authors noted that OSINT can provide valuable information about the target organization's network, systems, and applications. They also pointed out that OSINT can be used to gather information on the target organization's employees, customers, and partners, which can be used to identify potential vulnerabilities and attack vectors. The study found that OSINT can be used to gather valuable information on the target organization's network, including IP address ranges, domain name system (DNS) records, and network topology [6]. This information can be used to identify potential vulnerabilities, such as open ports, misconfigured firewalls, and outdated software versions. The authors also noted that OSINT can be used to gather information on the target organization's systems and applications, including their technology stack, known vulnerabilities, and common attack vectors.

Fasan and Torre [7] conducted a study on the use of OSINT in military reconnaissance. The study aimed to explore the effectiveness of OSINT as a tool for gathering intelligence about the enemy. The researchers used a case study approach, analyzing data from military operations in Syria and Ukraine.

The study found that OSINT is an effective tool for gathering intelligence about the enemy. It enables military commanders to gather information about the enemy's tactics, techniques, and procedures, which can be used to develop effective strategies and tactics. The study by Langanke et al. explored the use of OSINT in cybersecurity intelligence gathering. The authors highlighted the importance of OSINT in the reconnaissance phase of penetration testing, as it can provide valuable information that can be used to identify potential vulnerabilities and attack vectors. It recommends that cyber security professionals use a range of OSINT tools, including search engines, social media monitoring tools, and dark web monitoring tools.

2.3 OSINT importance in Penetration Testing

Jake Williams' article "Open-Source Intelligence: A Guide to Using OSINT for Threat Intelligence" [8] is a comprehensive review of the use of OSINT in penetration testing. The article begins by discussing the importance of reconnaissance in the early stages of a penetration testing project, highlighting that the success of the testing depends heavily on the quality of the information gathered. Williams emphasizes that OSINT is an essential part of the reconnaissance process, as it provides information that is not publicly available through traditional channels. He explains that the use of OSINT can help to identify potential targets, their infrastructure, and possible vulnerabilities. Williams provides practical examples of how OSINT tools and techniques, such as social media analysis, data mining, and reconnaissance, can be used to gather this critical information. The article also stresses the importance of understanding the limitations of OSINT, including the potential for false or misleading information. Williams notes that OSINT should be used in. Additionally, it provides practical guidance on using OSINT tools and techniques, while also acknowledging the limitations of OSINT and the importance of validating information from multiple sources.

In the research paper "A Comprehensive Review of Open-Source Intelligence Tools for Penetration Testing," Yung-Chih Chen and Chih-Hung Lin [9] focus on evaluating several popular OSINT tools that are commonly used in penetration testing. The paper provides an in-depth review of each tool and evaluates their effectiveness in gathering information on potential targets, detecting vulnerabilities, and identifying potential attack vectors. The authors begin by providing a background on penetration testing and the role of OSINT in the process. They then review several OSINT tools, including Shodan, Maltego, Recon-ng, the Harvester, and SpiderFoot. For each tool, the authors provide a detailed overview of its features, strengths, and weaknesses.

III. SIMILAR SYSTEMS

3.1 Maltego

Maltego is a GUI based powerful and user-friendly OSINT (Open Source Intelligence) tool that is widely used for information gathering and reconnaissance during penetration testing, investigations, and other security assessments. Maltego supports a wide range of data sources, including social media platforms, public records, DNS information, and more [10].

3.2 The Harvester

The Harvester was designed to be a command-line tool, using Python scripts to interact with various search engines and data sources to extract information on the target. . It can be used to collect information about email addresses, domain names, usernames, and IP addresses associated with a target. The Harvester is often used by security professionals during reconnaissance and penetration testing to gather information about a target's online presence and identify potential vulnerabilities [10].

3.3 Recon-ng

The tool is designed to be used from the command line, with a focus on simplicity, speed, and flexibility [11]. Recon-ng allows users to automate various reconnaissance tasks, including information gathering, port scanning, and vulnerability scanning. It supports a range of data sources and APIs, including Google, Shodan, and FOCA, and can be used to gather information about domain names, IP addresses, email addresses, social media profiles, and more.

TABLE 1. Comparison of similar systems

Tool	**Maltego**	**The Harvester**	**Recon-ng**
Type of UI	GUI	Command-line tool	Command-line tool
Purpose	OSINT and link analysis	Email, subdomain, and host information gathering	OSINT and reconnaissance
Cost	Paid	Free	Free
Source Code	Closed source	Open source	Open source
OS Supported	Windows , macOS, Linux	Windows, macOS, Linux	Windows, macOS, Linux
Modules	Large library of pre-built and custom modules	Basic modules for email and domain enumeration	Extensible framework with many community modules
Visualization	Powerful and intuitive graphical interface	None	None
Ease of Use	User-friendly interface with drag-and-drop	Command-line interface with options and switches	Command-line interface with module-based commands
Advantages	Rich feature set with	Simple and effective for email	Flexible and extensible with

	advanced analysis options	and domain searches	community modules
Disadvantages	Paid versions are expensive, closed source	Limited to email and domain searches	Steeper learning curve than other tools

Comparing similar OSINT tools can help researchers and developers understand the strengths and weaknesses of existing tools and identify gaps or areas for improvement. By analyzing and comparing the features, user interface, advantages, disadvantages, and security of existing tools, researchers can identify opportunities to improve on existing tools or develop entirely new tools to address specific needs or use cases. Also, researchers and developers may identify the need for a graphical OSINT tool with more flexible visualization capabilities or better integration with specific data sources [12].

IV. PROPOSED WORKFLOW

Fig 1. represents the activity diagram of the system. The activity flow of this proposed system are as follows:

- Start: The diagram starts with an initial node representing the beginning of the system.
- Print Main Menu: An activity is initiated to print the main menu options of the OSINT toolkit for the user.
- User Input: The system asks tool number and waits for the user's input. This is represented by a user action symbol.
- Tool Selection: Based on the user's input, respective tool appears.

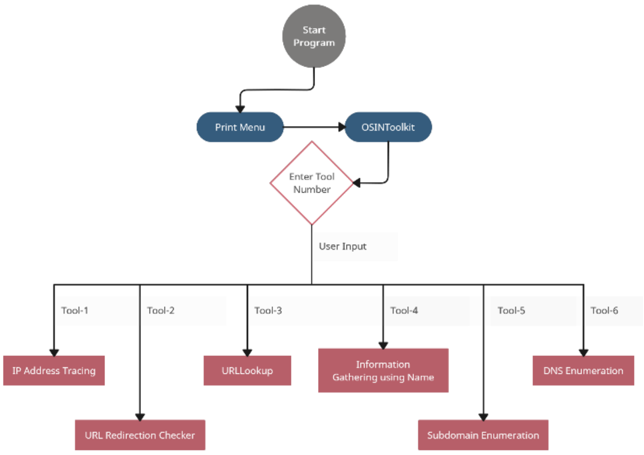
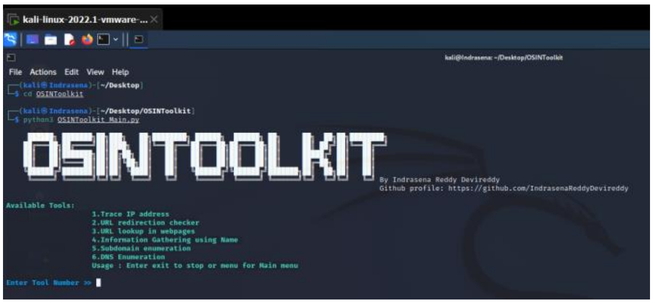


Fig 1. Proposed System

V. RESULTS AND DISCUSSION

The OSINT Toolkit is a set of Python scripts that work together to perform a wide range of intelligence-related tasks. This system's features allow for a wide variety of tasks, such as IP tracking, URL analysis, data collection, enumerating subdomains, getting contact information, and retrieving DNS records. They let users to inspect data about the internet and networks and gain valuable insights.

5.1 Main Menu

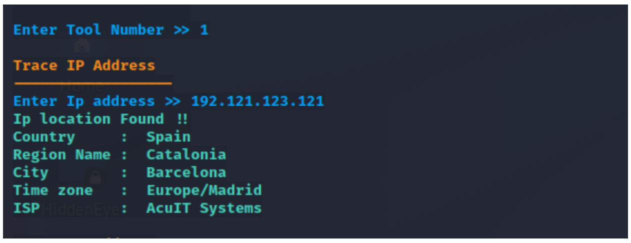


```
kali@Indrasena: ~/Desktop/OSINToolkit
┌──(kali㉿Indrasena)-[~/Desktop]
└─$ cd OSINToolkit

┌──(kali㉿Indrasena)-[~/Desktop/OSINToolkit]
└─$ python3 OSINToolkit_Main.py
 OSINTOOLKIT
                                  By Indrasena Reddy Devireddy
                                  Github profile: https://github.com/IndrasenaReddyDevireddy
Available Tools:
              1.Trace IP address
              2.URL redirection checker
              3.URL lookup in webpages
              4.Information Gathering using Name
              5.Subdomain enumeration
              6.DNS Enumeration
              Usage : Enter exit to stop or menu for Main menu

Enter Tool Number >> 
```

Fig 2. Toolkit Title and Main Manu

Fig.2 represents the title of the toolkit and displays main menu along with all the available tools. The user can input the number of the tool they want to use or type "exit" to quit the program. Based on the user's input, the corresponding tool will be executed.

5.2 IP Address Tracing

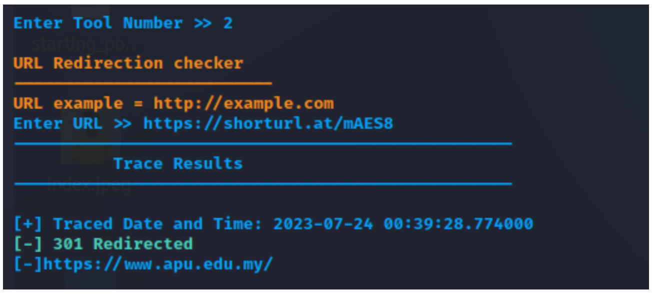


```
Enter Tool Number >> 1

Trace IP Address

Enter Ip address >> 192.121.123.121
Ip location Found !!
Country     :  Spain
Region Name :  Catalonia
City        :  Barcelona
Time zone   :  Europe/Madrid
ISP         :  AcuIT Systems
```

Fig 3. IP address tracking

Fig. 3 shows the result from first tool i.e., IP address tracing. This tool will display a prompt asking you to enter an IP address. If the IP address is valid and the location is found, it will print the details such as the country, region name, city, time zone, and ISP or it will notify you that the location is not found, or the IP address is invalid. The IP address tracing provides penetration testers with geolocation details of target IP addresses, enabling validation of geographical locations, identification of potential misconfigurations, and detection of suspicious activities and security risks based on location.

5.3 URL Redirection Checker

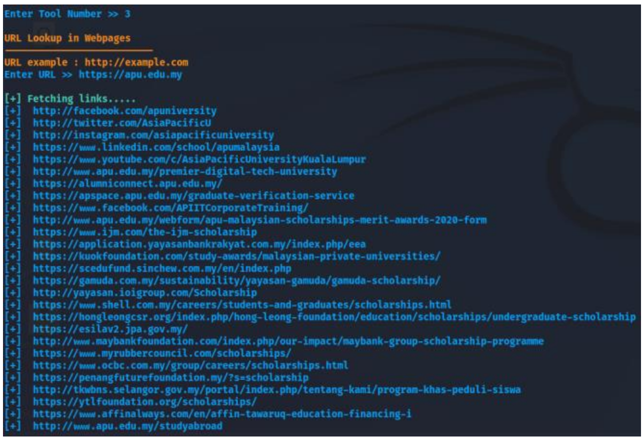


```
Enter Tool Number >> 2

URL Redirection checker

URL example = http://example.com
Enter URL >> https://shorturl.at/mAES8

        Trace Results

[+] Traced Date and Time: 2023-07-24 00:39:28.774000
[-] 301 Redirected
[-]https://www.apu.edu.my/
```

Fig 4. Redirection Checker

Fig. 4 represents the second tool from the toolkit is URL Redirection checker to find the actual redirected website. In the above image in Fig.4 shortened URL is entered and it displays the actual website it is redirected with traced date and time. Penetration testers can use the URL redirection checker to identify open redirection vulnerabilities in web applications. Open redirection vulnerabilities occur when an attacker can craft a malicious URL that redirects users to a different, potentially malicious website.

5.4 URL Lookup



```
Enter Tool Number >> 3

URL Lookup in Webpages
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URL example : http://example.com
Enter URL >> https://apu.edu.my

[+] Fetching links.....
[+]  http://facebook.com/apuniversity
[+]  http://twitter.com/AsiaPacificU
[+]  http://instagram.com/asiapacificuniversity
[+]  https://www.linkedin.com/school/apumalaysia
[+]  https://www.youtube.com/c/AsiaPacificUniversityKualaLumpur
[+]  http://www.apu.edu.my/premier-digital-tech-university
[+]  https://alumniconnect.apu.edu.my/
[+]  https://apspace.apu.edu.my/graduate-verification-service
[+]  https://www.facebook.com/APIITCorporateTraining/
[+]  http://www.apu.edu.my/webform/apu-malaysian-scholarships-merit-awards-2020-form
[+]  https://www.ijm.com/the-ijm-scholarship
[+]  https://application.yayasanbankrakyat.com.my/index.php/eea
[+]  https://kuokfoundation.com/study-awards/malaysian-private-universities/
[+]  https://scedufund.sinchew.com.my/en/index.php
[+]  https://gamuda.com.my/sustainability/yayasan-gamuda/gamuda-scholarship/
[+]  http://yayasan.ioigroup.com/Scholarship
[+]  https://www.shell.com.my/careers/students-and-graduates/scholarships.html
[+]  https://hongleongcsr.org/index.php/hong-leong-foundation/education/scholarships/undergraduate-scholarship
[+]  https://esilav2.jpa.gov.my/
[+]  http://www.maybankfoundation.com/index.php/our-impact/maybank-group-scholarship-programme
[+]  https://www.myrubbercouncil.com/scholarships/
[+]  https://www.ocbc.com.my/group/careers/scholarships.html
[+]  https://penangfuturefoundation.my/?s=scholarship
[+]  http://tkwbns.selangor.gov.my/portal/index.php/tentang-kami/program-khas-peduli-siswa
[+]  https://ytlfoundation.org/scholarships/
[+]  https://www.affinalways.com/en/affin-tawaruq-education-financing-i
[+]  http://www.apu.edu.my/studyabroad
```
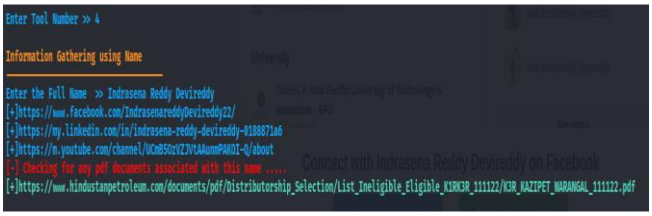

Fig 5. Websites Lookups

Fig. 5 illustrates the URL Lookup in websites is the third tool from the toolkit. Users may enter a URL, and it will retrieve all the anchor tags (hyperlinks) on the website that is connected to that URL. The URL of the APU website was used as an example to list the related hyperlinks, as shown in the above figure. With the use of this tool, penetration testers may swiftly access and review all of the linkages (URLs) that are present on a website. As a result, it is easier to see possible security problems including broken links, external connections that lead to dubious or malicious websites, and hidden links that might be a security concern.

5.5 Information Gathering

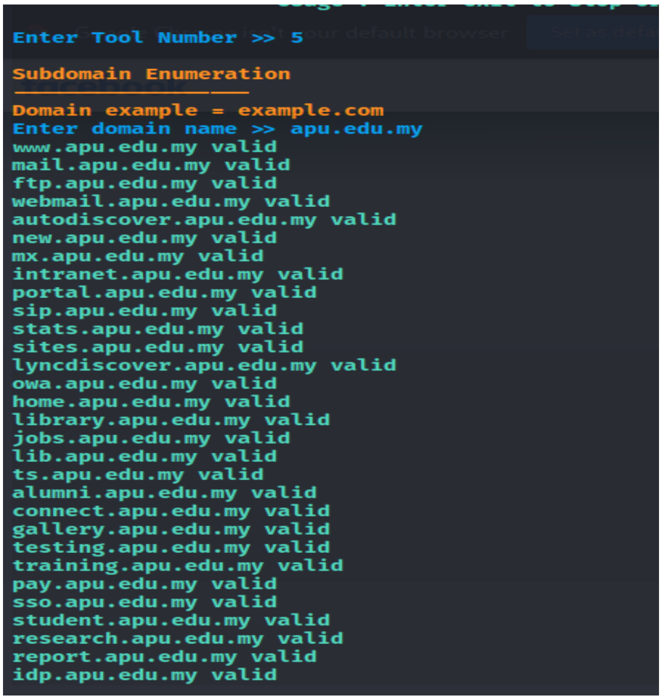


```
Enter Tool Number >> 4

Information Gathering using Name
________________________________

Enter the Full Name  >> Indrasena Reddy Devireddy
[+]https://www.facebook.com/IndrasenareddyDevireddy22/
[+]https://my.linkedin.com/in/indrasena-reddy-devireddy-0188871a6
[+]https://m.youtube.com/channel/UCmB5OzVZJVtAAunmPAKOI-Q/about
[-] Checking for any pdf documents associated with this name .....
[+]https://www.hindustanpetroleum.com/documents/pdf/Distributorship_Selection/List_Ineligible_Eligible_K1RK3R_111122/K3R_KAZIPET_WARANGAL_111122.pdf
```

Fig 6. Information Gathering

Fig 6 shows the fourth tool output from the toolkit is Information gathering tool. It uses Google search to locate websites and social media accounts connected to the supplied name as well as PDF files that include the name. The identified social network links are also opened in the default web browser. The developer of the toolkit utilised his name to locate his information. Using this tool, penetration testers may look for prospective social media accounts, websites, and PDF files linked to the target's name. These findings can provide them useful information about the target's online presence and potential security threats. Assessing social engineering risks, acquiring OSINT (Open-Source Intelligence), and comprehending the target's online exposure may all benefit from this knowledge.

5.6 Subdomain Enumeration

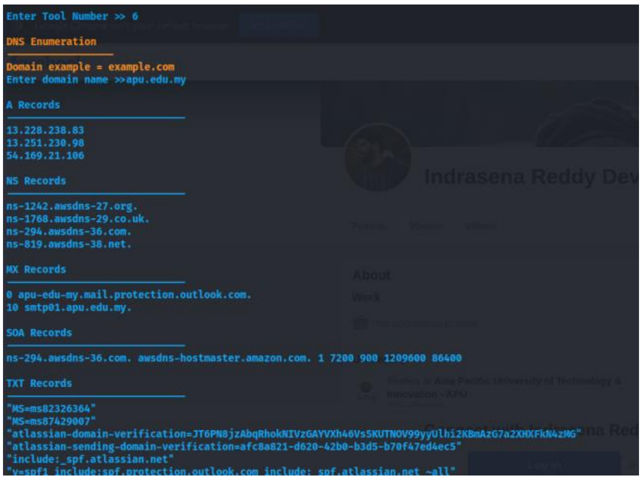


```
Enter Tool Number >> 5

Subdomain Enumeration
_____________________

Domain example = example.com
Enter domain name >> apu.edu.my
www.apu.edu.my valid
mail.apu.edu.my valid
ftp.apu.edu.my valid
webmail.apu.edu.my valid
autodiscover.apu.edu.my valid
new.apu.edu.my valid
mx.apu.edu.my valid
intranet.apu.edu.my valid
portal.apu.edu.my valid
sip.apu.edu.my valid
stats.apu.edu.my valid
sites.apu.edu.my valid
lyncdiscover.apu.edu.my valid
owa.apu.edu.my valid
home.apu.edu.my valid
library.apu.edu.my valid
jobs.apu.edu.my valid
lib.apu.edu.my valid
ts.apu.edu.my valid
alumni.apu.edu.my valid
connect.apu.edu.my valid
gallery.apu.edu.my valid
testing.apu.edu.my valid
training.apu.edu.my valid
pay.apu.edu.my valid
sso.apu.edu.my valid
student.apu.edu.my valid
research.apu.edu.my valid
report.apu.edu.my valid
idp.apu.edu.my valid
```

Fig 6. Subdomain Enumeration

Fig.6 shows the subdomain Enumeration of the fifth tool from the toolkit. It requests a domain name from the user and then tries to resolve DNS records for each subdomain in the list of preset subdomains that is added to the supplied domain. The APU domain was entered to locate its domains in the picture above. This tool aids penetration testers in locating subdomains, or hidden areas of a website that may not be readily apparent. It gives testers a wider understanding of the target's possible weak spots by enabling them to analyse these subdomains for potential security flaws.

5.7 DNS Enumeration



```
Enter Tool Number >> 6

DNS Enumeration
_______________

Domain example = example.com
Enter domain name >>apu.edu.my

A Records
______________________________

13.228.238.83
13.251.230.98
54.169.21.106

NS Records
______________________________

ns-1242.awsdns-27.org.
ns-1768.awsdns-29.co.uk.
ns-294.awsdns-36.com.
ns-819.awsdns-38.net.

MX Records
______________________________

0 apu-edu-my.mail.protection.outlook.com.
10 smtp01.apu.edu.my.

SOA Records
______________________________

ns-294.awsdns-36.com. awsdns-hostmaster.amazon.com. 1 7200 900 1209600 86400

TXT Records
______________________________

"MS=ms82326364"
"MS=ms87429007"
"atlassian-domain-verification=JT6PN8jzAbqRhokNIVzGAYVXh46Vs5KUTNOV99yyUlhi2KBmAzG7a2XHXFkN4zMG"
"atlassian-sending-domain-verification=afc8a821-d620-42b0-b3d5-b70f47ed4ec5"
"include:_spf.atlassian.net"
"v=spf1 include:spf.protection.outlook.com include:_spf.atlassian.net ~all"
```

Fig 7. DNS Enumeration

Fig. 7 shows the last tool from the system is DNS Enumeration. A (IPv4), AAAA (IPv6), NS (Name Server), CNAME (Canonical Name), MX (Mail Exchange), PTR (Pointer), SOA (Start of Authority), and TXT (Text) records are just a few of the DNS entries that may be listed off by the penetration tester for a specific domain [13]. The penetration tester may learn important details about the infrastructure and DNS settings of the target domain with this tool. This data helps in identifying any setup errors, out-of-date DNS records, or discrepancies that hostile actors could take advantage of. This tool was used to discover DNS records for the APU domain, as seen above.

VI. Conclusion

In conclusion, this research paper successfully developed a user-friendly OSINT toolkit for penetration testing. The toolkit combines various open-source tools and data sources to help penetration testers gather valuable information about their targets from publicly available data. It streamlines the testing process, allowing testers to identify potential vulnerabilities more efficiently and make informed decisions to enhance the security of the systems they assess. While there is room for improvement, the toolkit's effectiveness has been demonstrated in real-world scenarios [14]. Its contribution lies in empowering cybersecurity professionals with better intelligence-gathering capabilities, leading to improved security measures and a safer digital environment.

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