CEL 62, CSS, Fall 2021

Lab 6: Firewall & Intrusion Detection System

Name: Kashish Jain
UID: 2019130022
Class: TE Comps

Objectives

In this lab students will explore the Snort Intrusion Detection Systems. The students will study Snort IDS, a signature based intrusion detection system used to detect network attacks. Snort can also be used as a simple packet logger. For the purpose of this lab the students will use snort as a packet sniffer and write their own IDS rules.

Software Requirment

All required files are packed and configured in the provided virtual machine image.

-The VMWare Software - http://apps.eng.wayne.edu/MPStudents/Dreamspark.aspx

- The ubantu 14.04 or Ubantu Long Term Support (LTS) version or Kali linux image
- The ubantu 14.04 or Ubuntu 14.04 Long Term Support (LTS) Version
- Snort: A signature-based Intrusion Detection System https://www.snort.org/#get-started

Implementation

Starting the Lab 1 Virtual Machine

In this lab, we use Ubuntu as our VM image.

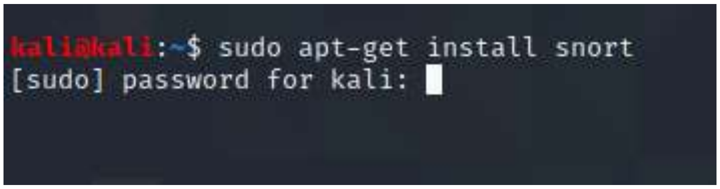
Login the Ubuntu image with username and password

Installing Snort into the Operating System

To install the latest version of the snort, you can follow the installation instruction from the snort website. Note that installation instructions are vary from OSes. The instruction below shows how to install snort from its source code on Linux.

You can find more information here:

https://www.snort.org/#get-started



```
kali@kali:~$ sudo apt-get install snort
[sudo] password for kali: █
```

While you install the snort, you system may miss some libraries. You need to install the required libraries, too.

Snort is software created by Martin Roesch, which is widely used as Intrusion Prevention System [IPS] and Intrusion Detection System [IDS] in the network. It is separated into the five most important mechanisms for instance: Detection engine, Logging, and alerting system, a Packet decoder, Preprocessor, and Output modules.

The program is quite famous to carry out real-time traffic analysis, also used to detect query or attacks, packet logging on Internet Protocol networks, to detect malicious activity, denial of service attacks and port scans by monitoring network traffic, buffer overflows, server message block probes, and stealth port scans.

Snort can be configured in three main modes:

Sniffer mode: it will observe network packets and present them on the console.

Packet logger mode: it will record packets to the disk.

Intrusion detection mode: the program will monitor network traffic and analyze it against a rule set defined by the user.

After that, the application will execute a precise action depend upon what has been identified.

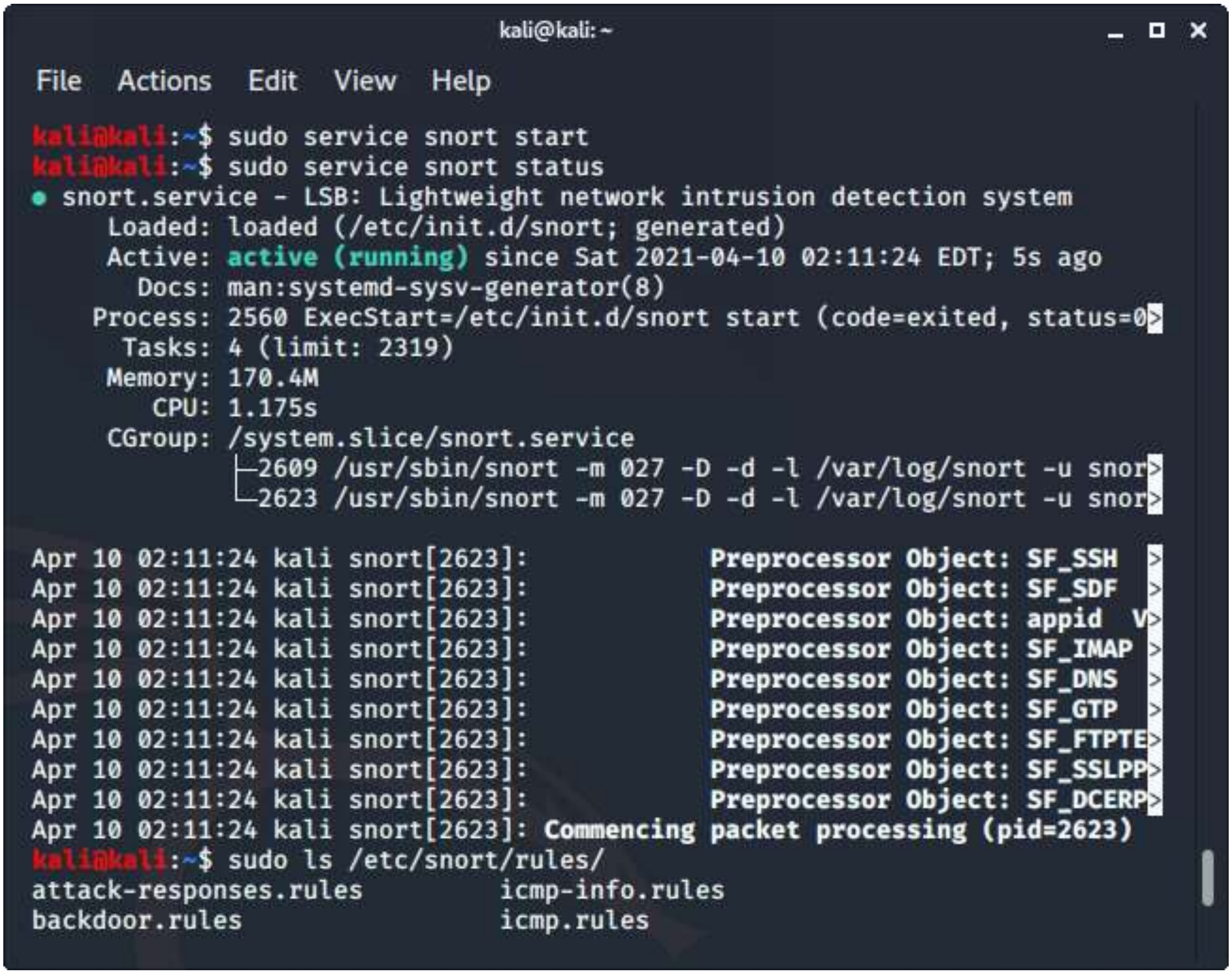
Configuring and Starting the Snort IDS

After installing the Snort, we need to configure it. The configuration file of snort is stored at /etc/snort/snort.conf. The screenshot below shows the commands to configure the Snort. You need to switch to root to gain the permission to read the snort configurations file.

After configuring the Snort, you need to start the Snort. You can simply type the following command to start the service.

```
$ service snort start
```

snort start

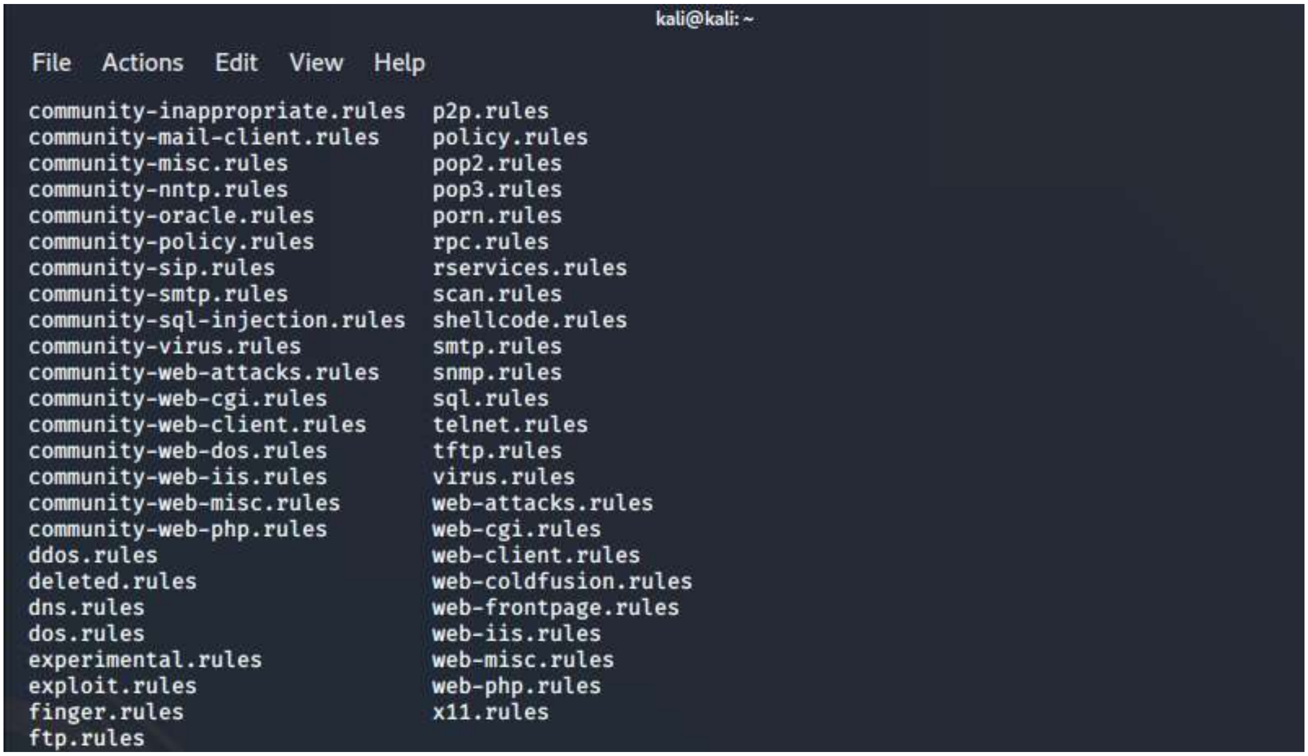


```
kali@kali:~$ sudo service snort start
kali@kali:~$ sudo service snort status
● snort.service - LSB: Lightweight network intrusion detection system
     Loaded: loaded (/etc/init.d/snort; generated)
     Active: active (running) since Sat 2021-04-10 02:11:24 EDT; 5s ago
       Docs: man:systemd-sysv-generator(8)
    Process: 2560 ExecStart=/etc/init.d/snort start (code=exited, status=0>
      Tasks: 4 (limit: 2319)
     Memory: 170.4M
        CPU: 1.175s
     CGroup: /system.slice/snort.service
             ├─2609 /usr/sbin/snort -m 027 -D -d -l /var/log/snort -u snor>
             └─2623 /usr/sbin/snort -m 027 -D -d -l /var/log/snort -u snor>

Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_SSH  >
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_SDF  >
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: appid  V>
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_IMAP >
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_DNS  >
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_GTP  >
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_FTPTE>
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_SSLPP>
Apr 10 02:11:24 kali snort[2623]:            Preprocessor Object: SF_DCERP>
Apr 10 02:11:24 kali snort[2623]: Commencing packet processing (pid=2623)
kali@kali:~$ sudo ls /etc/snort/rules/
attack-responses.rules          icmp-info.rules
backdoor.rules                  icmp.rules
```

Snort Rules

Snort is a signature-based IDS, and it defines rules to detect the intrusions. All rules of Snort are stored under /etc/snort/rules directory. The screenshot below shows the files that contain rules of Snort.

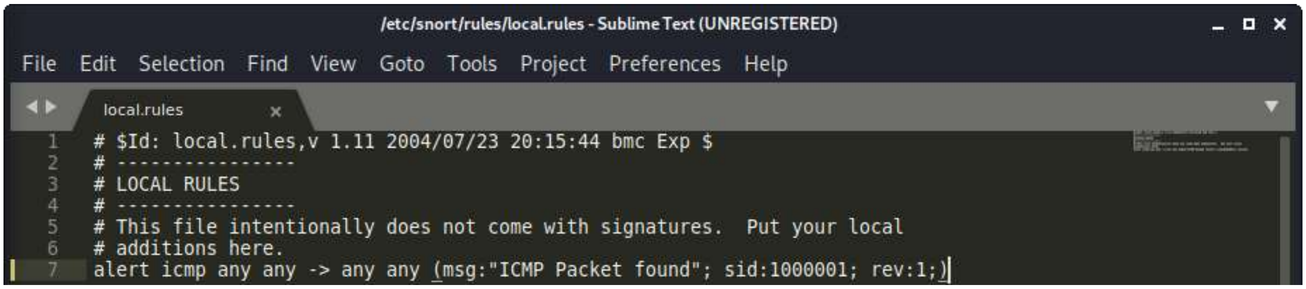
$ ls /etc/snort/rules



```
community-inappropriate.rules  p2p.rules
community-mail-client.rules    policy.rules
community-misc.rules           pop2.rules
community-nntp.rules           pop3.rules
community-oracle.rules         porn.rules
community-policy.rules         rpc.rules
community-sip.rules            rservices.rules
community-smtp.rules           scan.rules
community-sql-injection.rules  shellcode.rules
community-virus.rules          smtp.rules
community-web-attacks.rules    snmp.rules
community-web-cgi.rules        sql.rules
community-web-client.rules     telnet.rules
community-web-dos.rules        tftp.rules
community-web-iis.rules        virus.rules
community-web-misc.rules       web-attacks.rules
community-web-php.rules        web-cgi.rules
ddos.rules                     web-client.rules
deleted.rules                  web-coldfusion.rules
dns.rules                      web-frontpage.rules
dos.rules                      web-iis.rules
experimental.rules             web-misc.rules
exploit.rules                  web-php.rules
finger.rules                   x11.rules
ftp.rules
```

Writing and Adding a Snort Rule

Next, we are going to add a simple snort rule. You should add your own rules at /etc/snort/rules/local.rules. Add the following line into the local.rules file

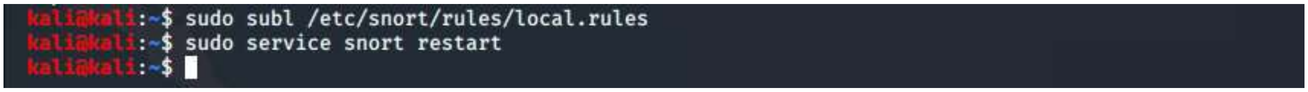

/etc/snort/rules/local.rules - Sublime Text (UNREGISTERED)
File Edit Selection Find View Goto Tools Project Preferences Help
local.rules

```
# $Id: local.rules,v 1.11 2004/07/23 20:15:44 bmc Exp $
# ----------------
# LOCAL RULES
# ----------------
# This file intentionally does not come with signatures.  Put your local
# additions here.
alert icmp any any -> any any (msg:"ICMP Packet found"; sid:1000001; rev:1;)
```

Basically, this rule defines that an alert will be logged if an ICMP packet is found. The ICMP packet could be from any IP address and the rule ID is 1000001. e.g. Make sure to pick a SID greater 1000000 for your own rules.

To make the rule become effective, you need to restart the snort service by typing the following command.

$ service snort restart

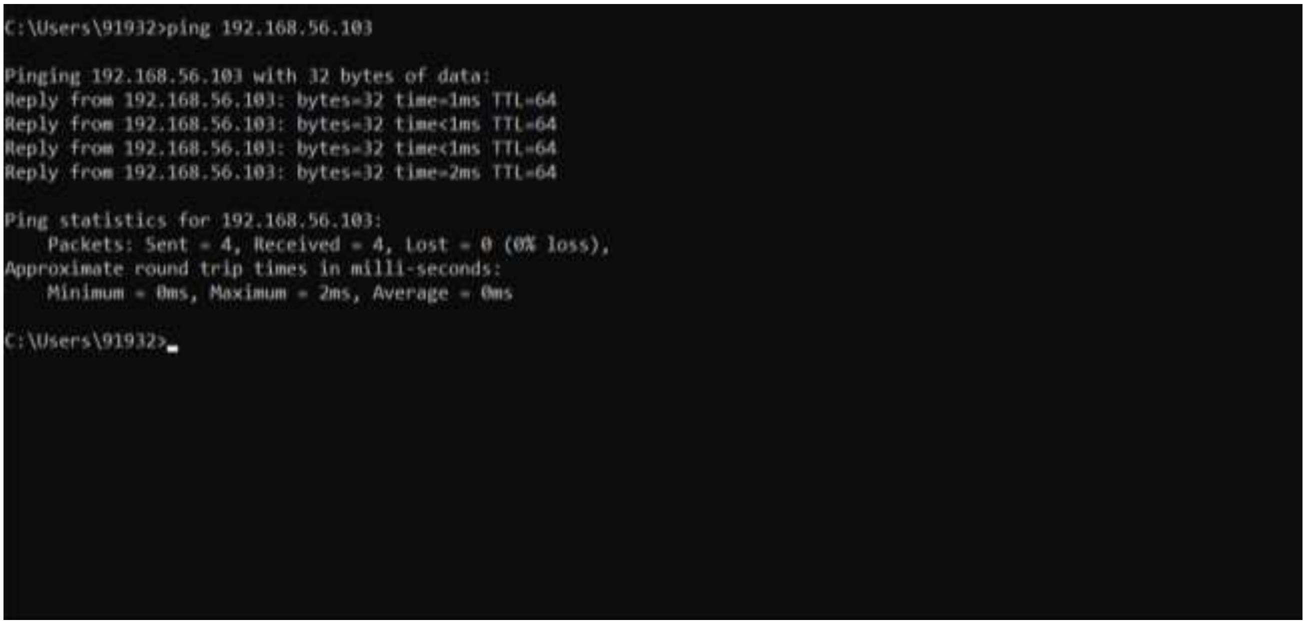


```
kali@kali:~$ sudo subl /etc/snort/rules/local.rules
kali@kali:~$ sudo service snort restart
kali@kali:~$ 
```

Triggering an Alert for the New Rule

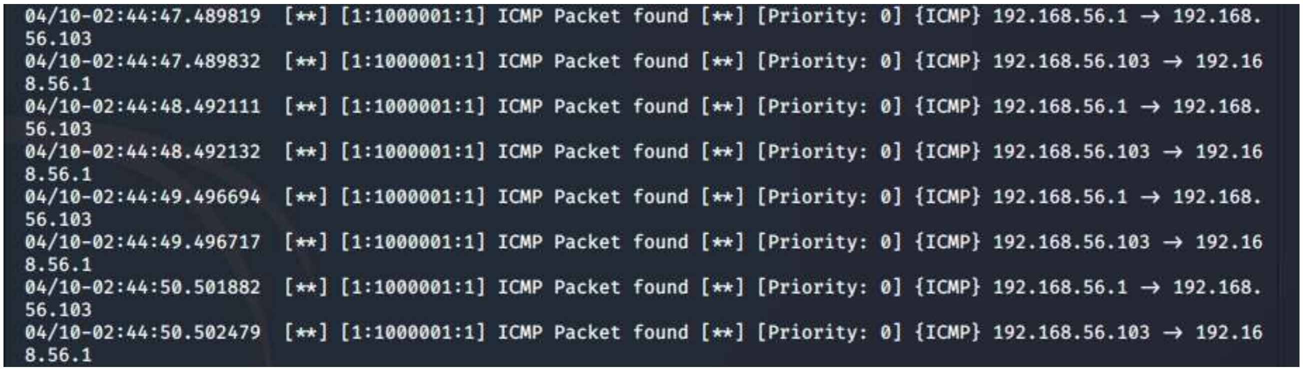
To trigger an alert for the new rule, you only need to send an ICMP message to the VM image where snort runs. First, you need to find the IP address of the VM by typing the following command.

After you have a terminal, you can just type the following command to send ping messages to the VM.

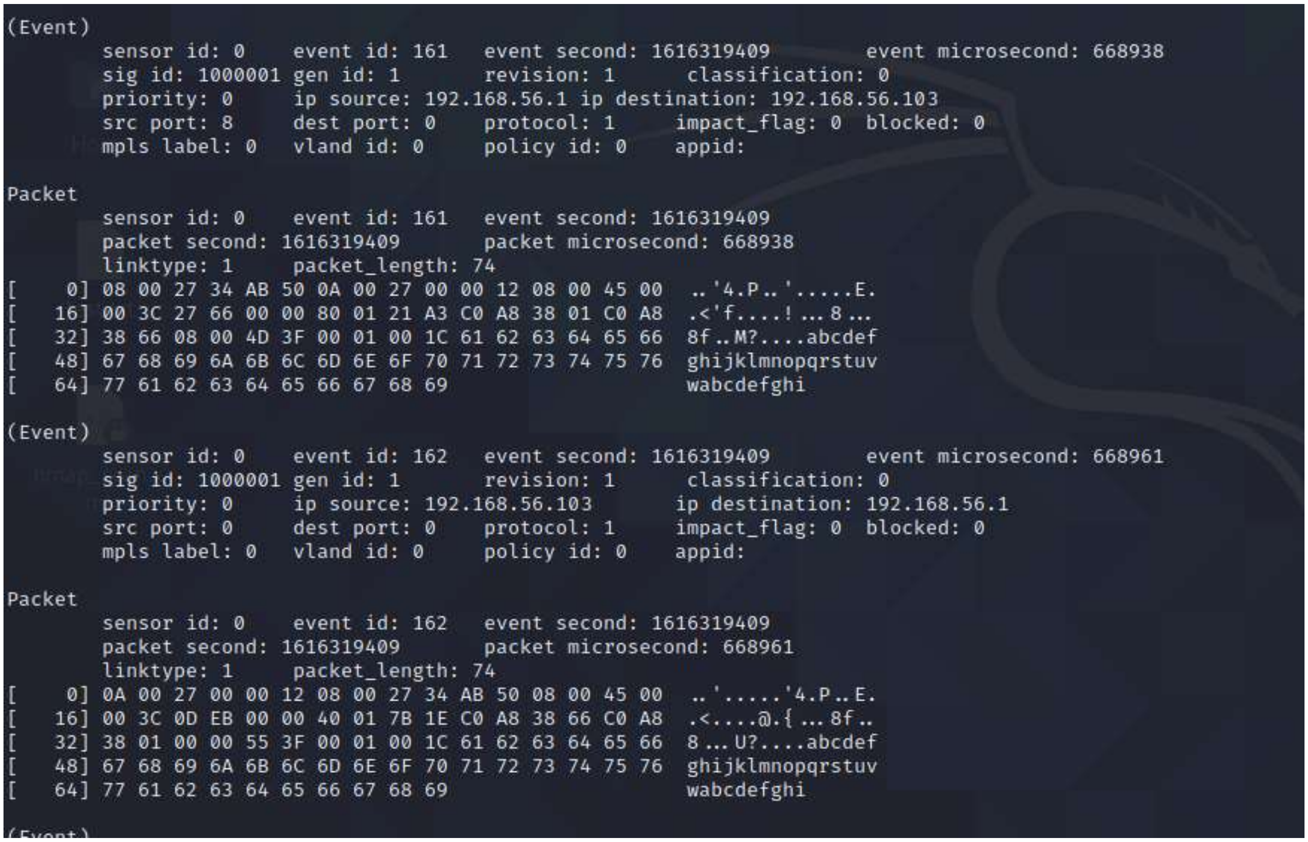


```
C:\Users\91932>ping 192.168.56.103

Pinging 192.168.56.103 with 32 bytes of data:
Reply from 192.168.56.103: bytes=32 time=1ms TTL=64
Reply from 192.168.56.103: bytes=32 time<1ms TTL=64
Reply from 192.168.56.103: bytes=32 time<1ms TTL=64
Reply from 192.168.56.103: bytes=32 time=2ms TTL=64

Ping statistics for 192.168.56.103:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\Users\91932>_
```

After you send the ping messages, the alerts should be triggered and you can find the log messages in /var/log/snort/snort.log. However, the snort.log file will be binary format. You need to use a tool, called u2spewfoo, to read it. Observer terminal on screen with log where you can see that the SID is 1000001, and the alerts are generated by the ICMP messages.



```
04/10-02:44:47.489819  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.1 → 192.168.
56.103
04/10-02:44:47.489832  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.103 → 192.16
8.56.1
04/10-02:44:48.492111  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.1 → 192.168.
56.103
04/10-02:44:48.492132  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.103 → 192.16
8.56.1
04/10-02:44:49.496694  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.1 → 192.168.
56.103
04/10-02:44:49.496717  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.103 → 192.16
8.56.1
04/10-02:44:50.501882  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.1 → 192.168.
56.103
04/10-02:44:50.502479  [**] [1:1000001:1] ICMP Packet found [**] [Priority: 0] {ICMP} 192.168.56.103 → 192.16
8.56.1
```



```
(Event)
        sensor id: 0    event id: 161   event second: 1616319409        event microsecond: 668938
        sig id: 1000001 gen id: 1       revision: 1      classification: 0
        priority: 0     ip source: 192.168.56.1 ip destination: 192.168.56.103
        src port: 8     dest port: 0    protocol: 1     impact_flag: 0  blocked: 0
        mpls label: 0   vland id: 0     policy id: 0    appid:

Packet
        sensor id: 0    event id: 161   event second: 1616319409
        packet second: 1616319409       packet microsecond: 668938
        linktype: 1     packet_length: 74
[    0] 08 00 27 34 AB 50 0A 00 27 00 00 12 08 00 45 00  ..'4.P..'.....E.
[   16] 00 3C 27 66 00 00 80 01 21 A3 C0 A8 38 01 C0 A8  .<'f....!...8...
[   32] 38 66 08 00 4D 3F 00 01 00 1C 61 62 63 64 65 66  8f..M?....abcdef
[   48] 67 68 69 6A 6B 6C 6D 6E 6F 70 71 72 73 74 75 76  ghijklmnopqrstuv
[   64] 77 61 62 63 64 65 66 67 68 69                    wabcdefghi

(Event)
        sensor id: 0    event id: 162   event second: 1616319409        event microsecond: 668961
        sig id: 1000001 gen id: 1       revision: 1      classification: 0
        priority: 0     ip source: 192.168.56.103       ip destination: 192.168.56.1
        src port: 0     dest port: 0    protocol: 1     impact_flag: 0  blocked: 0
        mpls label: 0   vland id: 0     policy id: 0    appid:

Packet
        sensor id: 0    event id: 162   event second: 1616319409
        packet second: 1616319409       packet microsecond: 668961
        linktype: 1     packet_length: 74
[    0] 0A 00 27 00 00 12 08 00 27 34 AB 50 08 00 45 00  ..'.....'4.P..E.
[   16] 00 3C 0D EB 00 00 40 01 7B 1E C0 A8 38 66 C0 A8  .<....@.{...8f..
[   32] 38 01 00 00 55 3F 00 01 00 1C 61 62 63 64 65 66  8...U?....abcdef
[   48] 67 68 69 6A 6B 6C 6D 6E 6F 70 71 72 73 74 75 76  ghijklmnopqrstuv
[   64] 77 61 62 63 64 65 66 67 68 69                    wabcdefghi

(Event)
```

Assignments for Lab 1

1.Read the lab instructions above and finish all the tasks.

2.Answer the questions and justify your answers. Simple yes or no answer will not get any credits.

a. What is a zero-day attack?

- When a hacker manages to exploit the vulnerability before software developers can find a fix, that exploit becomes known as a zero-day attack.
- Zero day attack can take almost any form, because they can manifest as any type of broader software vulnerability. For example, they could take the form of missing data encryption, SQL injection, buffer overflows, missing authorizations, broken algorithms, URL redirects, bugs, or problems with password security.
- This makes zero day attack difficult to proactively find—which in some ways is good news, because it also means hackers will have a hard time finding them. But it also means it's difficult to guard against these vulnerabilities effectively.
- Sony zero-day attack: Sony Pictures was the victim of a zero-day exploit in late 2014. The attack crippled Sony's network and led to the release of sensitive corporate data on file-sharing sites. The compromised data included details of forthcoming movies, business plans, and the personal email addresses of senior Sony executives. The details of the exact vulnerability exploited in the Sony attack remains unknown.

b. Can Snort catch zero-day network attacks? If not, why not? If yes, how?

- Since snort checks with the predefined rules for prevention of attacks and zero-day attacks are unknown to the developers, so without the rules it cannot be prevented, so, snort can't catch zero-day network attacks.
- I read the research paper "Signature Based Intrusion Detection for Zero-Day Attacks: (Not) A Closed Chapter?". The results from the study show that Snort clearly is able to detect zero-days' (a mean of 17% detection). The detection rate is however on overall greater for theoretically known attacks (a mean of 54% detection).

c. Given a network that has 1 million connections daily where 0.1% (not 10%) are attacks. If the IDS has a true positive rate of 95%,and the probability that an alarm is an attack is 95%. What is the false alarm rate?

Number of attacks on the network = 0.1% of 1000000 = 1000 attacks

Number of benign events = 1000000 - 1000 = 999000 events

IDS has a true positive rate of 95% means that out of 1000 attacks, only 950 will set off alarms.

Therefore, Number of true alarms = 950 alarms (actual attacks)

Since 95% of the total alarms are attacks

Number of total alarms = (100 * 950) / 95 = 1000 alarms

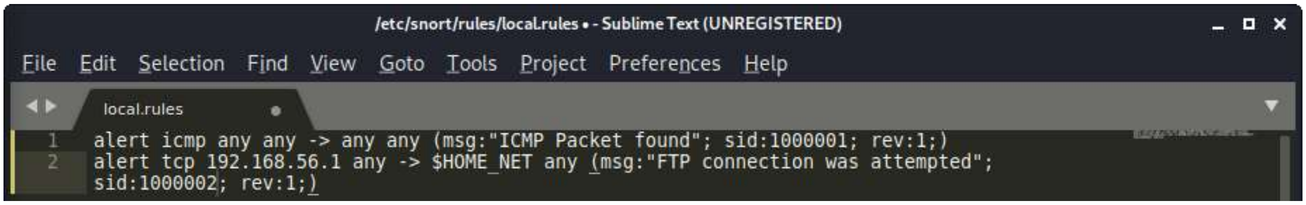
Therefore, Number of false alarms = 1000 – 950 = 50 alarms.

Therefore, False Alarm Rate = (Number of false alarms / Total Benign Events) * 100

= (50 / 999000) * 100 = **0.005%**

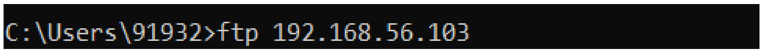
3.Write and add another snort rule and show me you trigger it.

a. The rule you added (from the rules file)

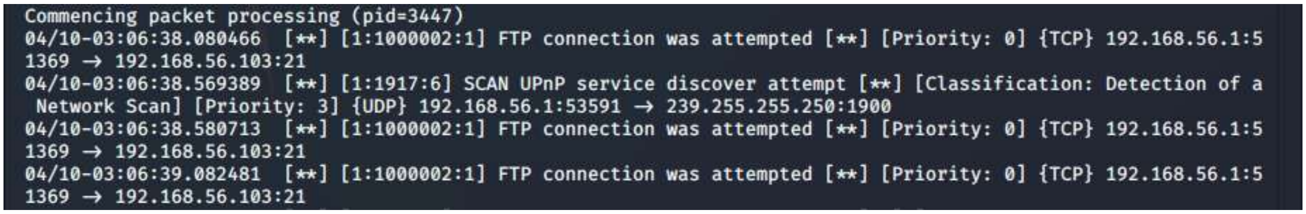


```
alert icmp any any -> any any (msg:"ICMP Packet found"; sid:1000001; rev:1;)
alert tcp 192.168.56.1 any -> $HOME_NET any (msg:"FTP connection was attempted";
sid:1000002; rev:1;)
```

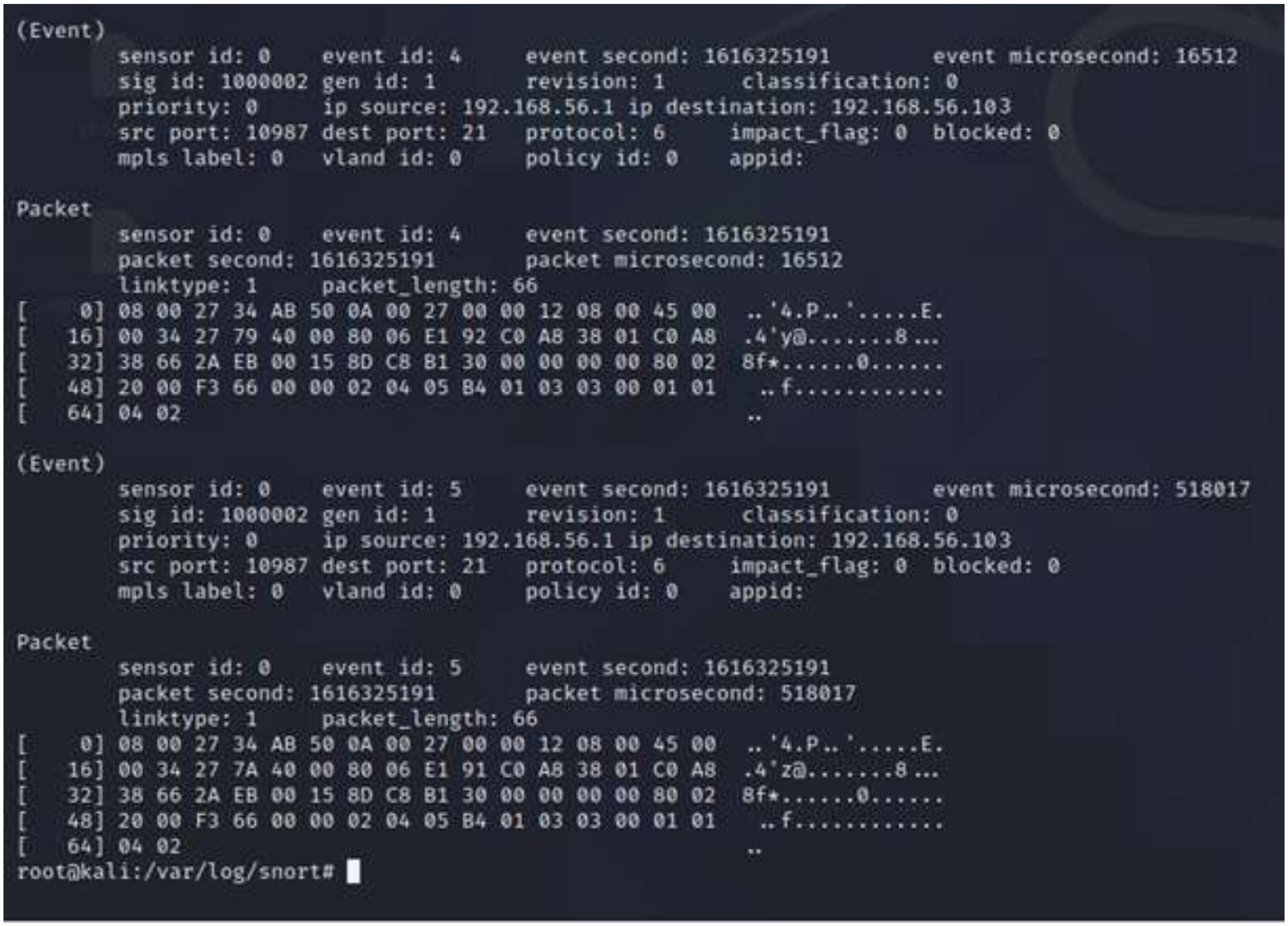
b. A description of how you triggered the alert. The alert itself from the log file (after converting it to readable text)



```
C:\Users\91932>ftp 192.168.56.103
```

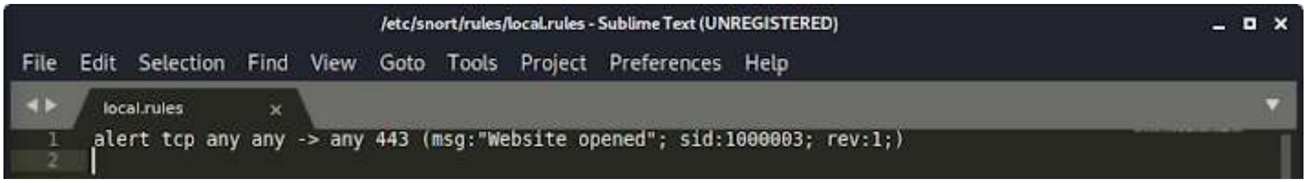


```
Commencing packet processing (pid=3447)
04/10-03:06:38.080466  [**] [1:1000002:1] FTP connection was attempted [**] [Priority: 0] {TCP} 192.168.56.1:5
1369 -> 192.168.56.103:21
04/10-03:06:38.569389  [**] [1:1917:6] SCAN UPnP service discover attempt [**] [Classification: Detection of a
 Network Scan] [Priority: 3] {UDP} 192.168.56.1:53591 -> 239.255.255.250:1900
04/10-03:06:38.580713  [**] [1:1000002:1] FTP connection was attempted [**] [Priority: 0] {TCP} 192.168.56.1:5
1369 -> 192.168.56.103:21
04/10-03:06:39.082481  [**] [1:1000002:1] FTP connection was attempted [**] [Priority: 0] {TCP} 192.168.56.1:5
1369 -> 192.168.56.103:21
```

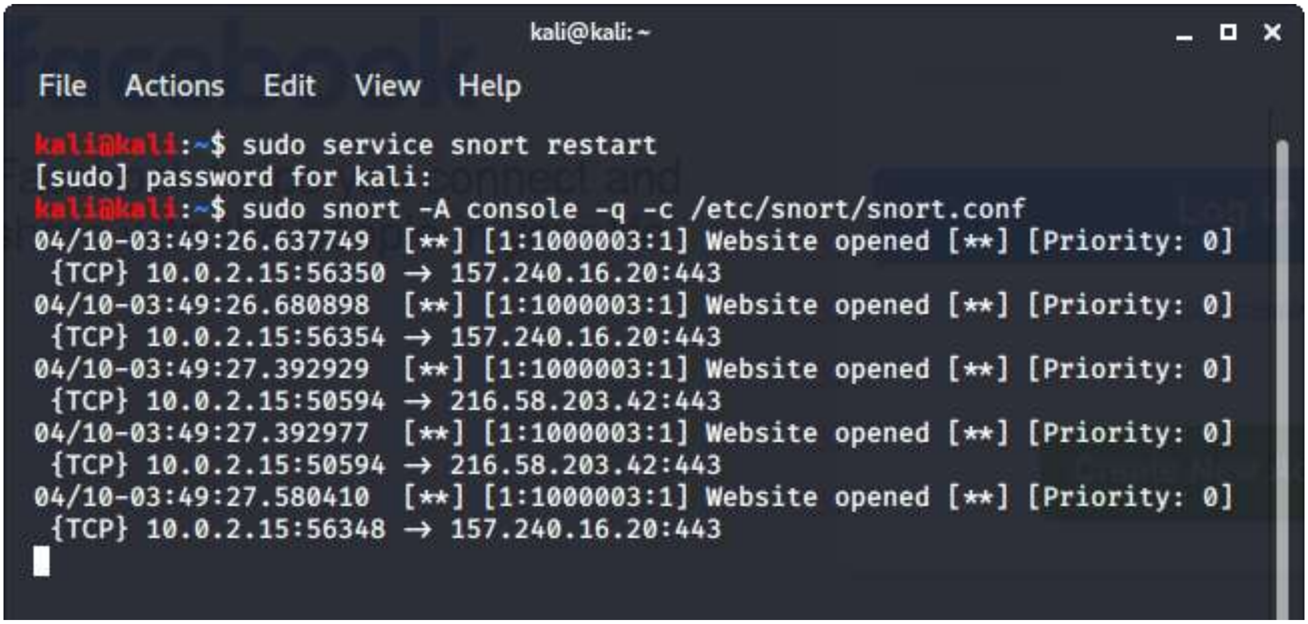


```
(Event)
        sensor id: 0    event id: 4     event second: 1616325191        event microsecond: 16512
        sig id: 1000002 gen id: 1       revision: 1      classification: 0
        priority: 0     ip source: 192.168.56.1 ip destination: 192.168.56.103
        src port: 10987 dest port: 21   protocol: 6     impact_flag: 0  blocked: 0
        mpls label: 0   vland id: 0     policy id: 0    appid:

Packet
        sensor id: 0    event id: 4     event second: 1616325191
        packet second: 1616325191       packet microsecond: 16512
        linktype: 1     packet_length: 66
[    0] 08 00 27 34 AB 50 0A 00 27 00 00 12 08 00 45 00  ..'4.P..'.....E.
[   16] 00 34 27 79 40 00 80 06 E1 92 C0 A8 38 01 C0 A8  .4'y@.......8...
[   32] 38 66 2A EB 00 15 8D C8 B1 30 00 00 00 00 80 02  8f*......0......
[   48] 20 00 F3 66 00 00 02 04 05 B4 01 03 03 00 01 01   ..f............
[   64] 04 02                                            ..

(Event)
        sensor id: 0    event id: 5     event second: 1616325191        event microsecond: 518017
        sig id: 1000002 gen id: 1       revision: 1      classification: 0
        priority: 0     ip source: 192.168.56.1 ip destination: 192.168.56.103
        src port: 10987 dest port: 21   protocol: 6     impact_flag: 0  blocked: 0
        mpls label: 0   vland id: 0     policy id: 0    appid:

Packet
        sensor id: 0    event id: 5     event second: 1616325191
        packet second: 1616325191       packet microsecond: 518017
        linktype: 1     packet_length: 66
[    0] 08 00 27 34 AB 50 0A 00 27 00 00 12 08 00 45 00  ..'4.P..'.....E.
[   16] 00 34 27 7A 40 00 80 06 E1 91 C0 A8 38 01 C0 A8  .4'z@.......8...
[   32] 38 66 2A EB 00 15 8D C8 B1 30 00 00 00 00 80 02  8f*......0......
[   48] 20 00 F3 66 00 00 02 04 05 B4 01 03 03 00 01 01   ..f............
[   64] 04 02                                            ..
root@kali:/var/log/snort#
```

Extra Credit (10pt):Write a rule that will fire when you browse to any site from the machine Snort is running on; it should look for any outbound TCP request to the site you have considered and alert on it.



```
alert tcp any any -> any 443 (msg:"Website opened"; sid:1000003; rev:1;)
```



```
kali@kali:~$ sudo service snort restart
[sudo] password for kali:
kali@kali:~$ sudo snort -A console -q -c /etc/snort/snort.conf
04/10-03:49:26.637749  [**] [1:1000003:1] Website opened [**] [Priority: 0]
 {TCP} 10.0.2.15:56350 → 157.240.16.20:443
04/10-03:49:26.680898  [**] [1:1000003:1] Website opened [**] [Priority: 0]
 {TCP} 10.0.2.15:56354 → 157.240.16.20:443
04/10-03:49:27.392929  [**] [1:1000003:1] Website opened [**] [Priority: 0]
 {TCP} 10.0.2.15:50594 → 216.58.203.42:443
04/10-03:49:27.392977  [**] [1:1000003:1] Website opened [**] [Priority: 0]
 {TCP} 10.0.2.15:50594 → 216.58.203.42:443
04/10-03:49:27.580410  [**] [1:1000003:1] Website opened [**] [Priority: 0]
 {TCP} 10.0.2.15:56348 → 157.240.16.20:443
```

Github Link

https://github.com/kashishvjain/CSS-Lab