Student Name : Liew Zhi Li

Group : TS4

Date : 01/04/2020

LAB 4: ANALZING NETWORK DATA LOG

You are provided with the data file, in .csv format, in the working directory. Write the program to extract the following informations.

Exercise 4A: TOp TALKERS and LISTENERS

One of the most commonly used function in analyzing data log is finding out the IP address of the hosts that send out large amount of packet and hosts that receive large number of packets, usually know as TOP TALKERS and LISTENERS. Based on the IP address we can obtained the organization who owns the IP address.

List the TOP 5 TALKERS

Rank	IP address	# of packets	Organisation
1	193.62.192.8	3041	European Bioinformatics Institute
2	155.69.160.32	2975	Nanyang Technological University
3	130.14.250.11	2604	National Library of Medicine (NLM)
4	14.139.196.58	2452	Indian Institute of Technology (IIT), Guwahati
5	140.112.8.139	2056	National Taiwan University

TOP 5 LISTENERS

Rank	IP address	# of packets	Organisation
1	103.37.198.100	3841	A*STAR
2	137.132.228.15	3715	National University of Singapore
3	202.21.159.244	2446	Republic Polytechnic
4	192.101.107.153	2368	Pacific Northwest National Laboratory (PNNL-Z)
5	103.21.126.2	2056	Indian Institute of Technology Bombay

Exercise 4B: TRANSPORT PROTOCOL

Using the IP protocol type attribute, determine the percentage of TCP and UDP protocol

	Header value	Transport layer protocol	# of packets
1	6	TCP	56064
2	17	UDP	9462
3	50	ESP	1698
4	47	GRE	657
5	41	IPv6	104
6	1	ICMP	74
7	58	IPv6-ICMP	4
8	103	PIM	1
9	0	HOPOPT	1

Total Number Of Packets = 68065
Percentage of TCP Protocols = (56064/ 68065)*100=82.37%
Percentage of UDP Protocols = (9462/ 68065)*100=13.9%

Exercise 4C: ApplicationS PROTOCOL

Using the Destination IP port number determine the most frequently used application protocol. (For finding the service given the port number https://www.adminsub.net/tcp-udp-port-finder/)

Rank	Destination IP port number	# of packets	Service
1	443	13423	HTTPS
2	80	2647	HTTP
3	52866	2068	Apple Xsan. Filesystem Access
4	45512	1356	Unassigned
5	56152	1341	Apple Xsan. Filesystem Access

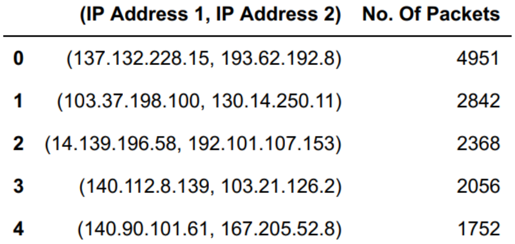
Exercise 4D: Traffic

The traffic intensity is an important parameter that a network engineer needs to monitor closely to determine if there is congestion. You would use the IP packet size to calculate the estimated total traffic over the monitored period of 15 seconds. (Assume the sampling rate is 1 in 1000)

Total Traffic (MB)	71.98

Exercise 4E: ADDITIONAL ANALYSIS

Fig. 1 belows illustrates the top 5 bidirectional communication pairs of IP addresses.
The first four pairs of IP addresses in Fig. 1 can be found in the Top 5 Talkers/Listeners tables in Exercise 4A.
The IP address 193.62.192.8 from the top 1st pair is the top 1st talker among all of the IP addresses in Exercise 4A table.
The IP address 103.37.198.100 from the top 2nd pair is the top 2nd listener in Exercise 4A table.



	(IP Address 1, IP Address 2)	No. Of Packets
0	(137.132.228.15, 193.62.192.8)	4951
1	(103.37.198.100, 130.14.250.11)	2842
2	(14.139.196.58, 192.101.107.153)	2368
3	(140.112.8.139, 103.21.126.2)	2056
4	(140.90.101.61, 167.205.52.8)	1752

Fig. 1: Top 5 Bidirectional Communication Pairs

Fig. 2 below illustrates the barchart visualization of top 5 bidirectional communication pairs of IP addresses.

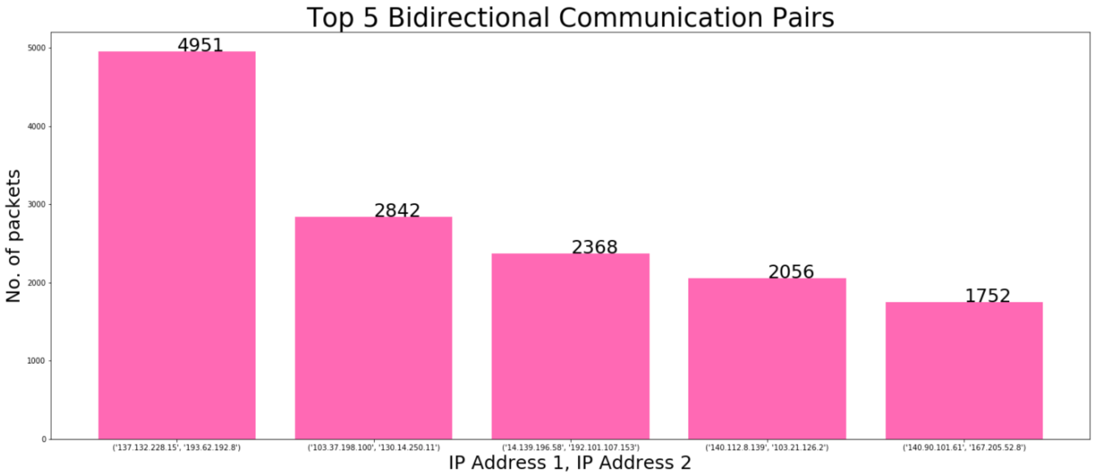


Fig. 2: Barchart for Top 5 Bidirectional Communication Pairs

The top 1st communication pair (193.62.192.8, 137.132.228.15) is between European Bioinformatics Institute and National University of Singapore and has sent a total of 4951 packets to each other.

The top 2nd communication pair (130.14.250.11, 103.37.198.100) is between National Library of Medicine (NLM) and A*STAR and has sent a total of 2842 packets to each other.

The top 3rd communication pair (14.139.196.58, 192.101.107.153) is between Indian Institute of Technology (IIT), Guwahati and Pacific Northwest National Laboratory (PNNL-Z) and has sent a total of 2368 to each other.

The top 4th communication pair (140.112.8.139, 103.21.126.2) is between National Taiwan University and Indian Institute of Technology Bombay and has sent a total of 2056 packets to each other.

The top 5th communication pair (137.132.228.15, 193.62.192.8) is between National University of Singapore and European Bioinformatics Institute and has sent a total of 1752 packets to each other.

Exercise 4F: SOFTWARE CODE

The following page is the source code in the Python Jupyter notebook file “Lab4-LiewZhiLi-U1821610C.ipynb”.

CZ3006 Lab 4 - Analyzing Network Traffic Log Data using Python

Import the necessary libraries ¶

In [398]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

Import the traffic data CSV file

In [399]:

```
# init header
header = ["Type", "sflow_agent_address", "inputPort", "outputPort", "src_MAC", "dst_MAC", "ethernet_type", "in_vlan", "out_vlan", "src_IP", "dst_IP", "IP_protocol", "ip_tos", "ip_ttl", "src_port", "dst_port", "tcp_flags", "packet_size", "IP_size", "sampling rate","Row 21"]

# replace with the correct file
data = pd.read_csv('SFlow_Data_lab4.csv.csv', header=None, names=header, index_col=False)

# count no. of "FLOW" columns and "CNTR" columns
data["Type"].value_counts()

# first column can be "FLOW" or "CNTR"
# we want to look at entries with Type == "FLOW", thus, we extract those columns.
data = data[data.Type == 'FLOW']
```

EXERCISE 4A: TOP 5 TALKERS AND LISTENERS

List the TOP 5 TALKERS

In [400]:

```
top_5_talkers = data['src_IP'].value_counts()
print("IP address\tNo. of packets")
top_5_talkers.head(n=5)
```

```
IP address      No. of packets
```

Out[400]:

```
193.62.192.8     3041
155.69.160.32    2975
130.14.250.11    2604
14.139.196.58    2452
140.112.8.139    2056
Name: src_IP, dtype: int64
```

Organisation for that IP Address

Using https://whatismyipaddress.com (https://whatismyipaddress.com) or https://www.whatismyip.com/ip-whois-lookup/ (https://www.whatismyip.com/ip-whois-lookup/):

193.62.192.8 belongs to: European Bioinformatics Institute

155.69.160.32 belongs to: Nanyang Technological University

130.14.250.11 belongs to: National Library of Medicine (NLM)

14.139.196.58 belongs to: Indian Institute of Technology (IIT), Guwahati

140.112.8.139 belongs to: National Taiwan University

List the TOP 5 LISTENERS

In [401]:

```
top_5_listeners = data['dst_IP'].value_counts()
print("IP address\tNo. of packets")
top_5_listeners.head(n=5)
```

```
IP address      No. of packets
```

Out[401]:

```
103.37.198.100     3841
137.132.228.15     3715
202.21.159.244     2446
192.101.107.153    2368
103.21.126.2       2056
Name: dst_IP, dtype: int64
```

Organisation for that IP Address

Using [https://whatismyipaddress.com/ip-lookup (https://whatismyipaddress.com/ip-lookup)](https://whatismyipaddress.com/ip-lookup):

103.37.198.100 belongs to: A*STAR

137.132.228.15 belongs to: National University of Singapore

202.21.159.244 belongs to: Republic Polytechnic

192.101.107.153 belongs to: Pacific Northwest National Laboratory (PNNL-Z)

103.21.126.2 belongs to: Indian Institute of Technology Bombay

EXERCISE 4B: TRANSPORT PROTOCOL

PERCENTAGE OF TCP AND UDP PROTOCOL

Use this website to find which value corresponds to which transport layer protocol: [https://www.iana.org/assignments/protocol-numbers/protocol-numbers.xhtml (https://www.iana.org/assignments/protocol-numbers/protocol-numbers.xhtml)](https://www.iana.org/assignments/protocol-numbers/protocol-numbers.xhtml)

In [402]:

```
ip_protocol = data['IP_protocol'].value_counts()
print("Top 5 Most Used IP Protocols")
print("IP Protocol\tNo. of packets")
ip_protocol.head(n=5)
```

```
Top 5 Most Used IP Protocols
IP Protocol     No. of packets
```

Out[402]:

```
6     56064
17     9462
50     1698
47      657
41      104
Name: IP_protocol, dtype: int64
```

In [403]:

```
total_number_of_packets = data['IP_protocol'].count()
print("Total no. of packets: ",total_number_of_packets)
print()

row = 0
UDP_TCP = 0
print("Header Value\tNo. of packets\t% of packets")
for i in ip_protocol:
    print(ip_protocol.index[row],'\t\t',i,'\t\t',round((i/total_number_of_packets)*100,
2),'%')
    row = row + 1
```

```
Total no. of packets:  68065

Header Value    No. of packets  % of packets
6                56064           82.37 %
17               9462            13.9 %
50               1698            2.49 %
47               657             0.97 %
41               104             0.15 %
1                74              0.11 %
58               4               0.01 %
103              1               0.0 %
0                1               0.0 %
```

EXERCISE 4C: TOP 5 APPLICATIONS PROTOCOL

In [404]:

```
top_5_applications = data['dst_port'].value_counts()
print("Dest. IP port No.\tNo. of packets")
top_5_applications.head(n=5)
```

```
Dest. IP port No.       No. of packets
```

Out[404]:

```
443      13423
80        2647
52866     2068
45512     1356
56152     1341
Name: dst_port, dtype: int64
```

Service

443: Hypertext Transfer Protocol over TLS/SSL (HTTPS)

0: Reserved port

56152: Dynamic and/or Private Ports

43930: Private/Unassigned ports

80: Hypertext Transfer Protocol (HTTP)

EXERCISE 4D: TOTAL TRAFFIC

In [405]:

```
# Calculate Total Traffic in MB
total_size_Bytes = data["IP_size"].sum()

# Assumption: Using 1 Kilobyte (KB) = 1000 bytes, not 1 Kilobyte (KB) = 1024 bytes
total_size_MegaBytes = total_size_Bytes/1000/1000

sampling_rate = 1000
time_seconds = 15*60

total_traffic = total_size_MegaBytes*sampling_rate/time_seconds
print("\nTotal Traffic in MB over 15 seconds: %.2f Mbps" % (total_traffic))
```

```
Total Traffic in MB over 15 seconds: 71.98 Mbps
```

EXERCISE 4E: ADDITIONAL ANALYSIS

Top 5 Bidirectional Communication Pairs

In [406]:

```
data_new = data[(data["src_IP"] != "") & (data["dst_IP"] != "")].groupby(["src_IP", "ds
t_IP"]).size()
IP_pairs = {}

for i in data_new.iteritems():
    if (i[0][0],i[0][1]) in IP_pairs:
        IP_pairs[i[0][0],i[0][1]] += i[1]
    elif (i[0][1],i[0][0]) in IP_pairs:
        IP_pairs[i[0][1],i[0][0]] += i[1]
    else:
        IP_pairs[i[0][0],i[0][1]] = i[1]

data_sorted = sorted(IP_pairs.items(), key=lambda k: k[1], reverse = True)[0:5]

data_4E=pd.DataFrame(data_sorted)
data_4E.columns = ["(IP Address 1, IP Address 2)","No. Of Packets"]
data_4E
```

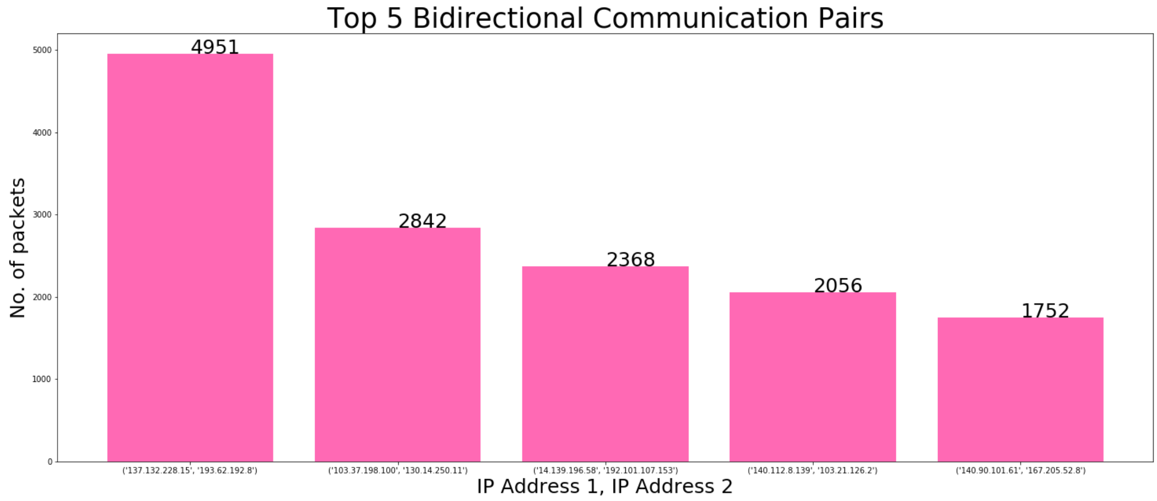
Out[406]:

	(IP Address 1, IP Address 2)	No. Of Packets
0	(137.132.228.15, 193.62.192.8)	4951
1	(103.37.198.100, 130.14.250.11)	2842
2	(14.139.196.58, 192.101.107.153)	2368
3	(140.112.8.139, 103.21.126.2)	2056
4	(140.90.101.61, 167.205.52.8)	1752

Barchart Visualization of Top 5 Bidirectional Communication Pairs

In [407]:

```
fig, axes = plt.subplots(figsize=(25, 10))
row = [i for i in data_4E.index]

plt.xlabel("IP Address 1, IP Address 2", fontsize = 25)
plt.ylabel("No. of packets", fontsize = 25)
plt.title("Top 5 Bidirectional Communication Pairs", fontsize = 35)

plt.bar(row, data_4E["No. Of Packets"], align = "center", color="hotpink")

for i, v in enumerate(data_4E["No. Of Packets"]):
    axes.text(i, v, str(v), fontsize = 25)

labels = ["",data_4E.loc[0][0],data_4E.loc[1][0],data_4E.loc[2][0],data_4E.loc[3][0],data_4E.loc[4][0]]
axes.set_xticklabels(labels)

plt.show()
```



Findings

Using https://whatismyipaddress.com (https://whatismyipaddress.com) or https://whatismyipaddress.com/ip-lookup (https://whatismyipaddress.com/ip-lookup)

The top 1st communication pair (193.62.192.8, 137.132.228.15) is between European Bioinformatics Institute and National University of Singapore, and has sent a total of 4951 packets to each other.

The top 2nd communication pair (130.14.250.11, 103.37.198.100) is between National Library of Medicine (NLM) and A*STAR, and has sent a total of 2842 packets to each other.

The top 3rd communication pair (14.139.196.58, 192.101.107.153) is between Indian Institute of Technology (IIT), Guwahati and Pacific Northwest National Laboratory (PNNL-Z), and has sent a total of 2368 to each other.

The top 4th communication pair (140.112.8.139, 103.21.126.2) is between National Taiwan University and Indian Institute of Technology Bombay, and has sent a total of 2056 packets to each other.

The top 5th communication pair (137.132.228.15, 193.62.192.8) is between National University of Singapore and European Bioinformatics Institute, and has sent a total of 1752 packets to each other.