Assignment # 5: Netflow Packet Analysis

In [19]:
```
# Nemenamry imports
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import csv
```

In [20]:
```
# Read network data into dataframe
network_data = pd.read_csv('Netflow_dataset.csv')
```

a) Average Packet sizes

In [21]:
```
# a. Average size of the packets across all the traffic captured in the dataset
num_packets = network_data['dpkts'].sum()
num_bytes = network_data['doctets'].sum()
avg_packet_size = num_bytes/num_packets

print('Average Packet sizes', avg_packet_size)
```

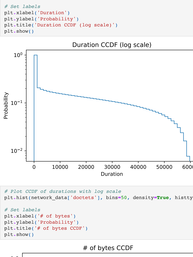
```
Average Packet sizes 748.1808661149954
```

b) Complementary Cumulative Probability Distribution (CCDF)

In [22]:
```
# Calculate flow durations
network_data['duration'] = network_data['last'] - network_data['first']
```

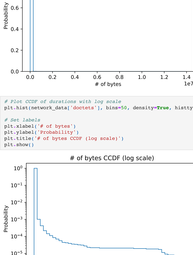
In [23]:
```
# Plot CCDF of durations
plt.hist(network_data['duration'], bins=50, density=True, histtype='step', cumulative=-1)

# Set labels
plt.xlabel('Duration')
plt.ylabel('Probability')
plt.title('Duration CCDF')
plt.show()
```



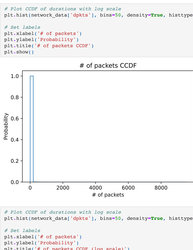
In [24]:
```
# Plot CCDF of durations with log scale
plt.hist(network_data['duration'], bins=50, density=True, histtype='step', cumulative=-1, log=True)

# Set labels
plt.xlabel('Duration')
plt.ylabel('Probability')
plt.title('Duration CCDF (log scale)')
plt.show()
```



In [25]:
```
# Plot CCDF of durations with log scale
plt.hist(network_data['doctets'], bins=50, density=True, histtype='step', cumulative=-1)

# Set labels
plt.xlabel('# of bytes')
plt.ylabel('Probability')
plt.title('# of bytes CCDF')
plt.show()
```

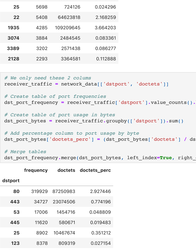


In [26]:
```
# Plot CCDF of durations with log scale
plt.hist(network_data['doctets'], bins=50, density=True, histtype='step', cumulative=-1, log=True)

# Set labels
plt.xlabel('# of bytes')
plt.ylabel('Probability')
plt.title('# of bytes CCDF (log scale)')
plt.show()
```

In [27]:
```
# Plot CCDF of durations with log scale
plt.hist(network_data['dpkts'], bins=50, density=True, histtype='step', cumulative=-1)

# Set labels
plt.xlabel('# of packets')
plt.ylabel('Probability')
plt.title('# of packets CCDF')
plt.show()
```



In [28]:
```
# Plot CCDF of durations with log scale
plt.hist(network_data['dpkts'], bins=50, density=True, histtype='step', cumulative=-1, log=True)

# Set labels
plt.xlabel('# of packets')
plt.ylabel('Probability')
plt.title('# of packets CCDF (log scale)')
plt.show()
```

c) Kind of traffic flowing through router

In [29]:
```
# We only need these 2 column
sender_traffic = network_data[['srcport', 'doctets']]

# Create table of port frequencies
src_port_frequency = sender_traffic['srcport'].value_counts().head(10).to_frame(name='frequency')

# Create table of port usage in bytes
src_port_bytes = sender_traffic.groupby(['srcport']).sum()

# Add percentage column to port usage by byte
src_port_bytes['doctets_perc'] = (src_port_bytes['doctets'] / src_port_bytes['doctets'].sum()) * 100

# Merge tables
src_port_frequency.merge(src_port_bytes, left_index=True, right_on='srcport')
```

Out[29]:

srcport	frequency	doctets	doctets_perc
80	175177	13095855549	43.939229
443	19605	51432480	1.725663
53	12927	3818808	0.128112
0	9176	18939605	0.635462
25	5698	724126	0.024296
22	5408	646238818	2.168259
1935	4285	109209645	3.664203
3074	3884	2484545	0.083361
3389	3202	2574438	0.086377
2128	2293	3364581	0.112888

In [30]:
```
# We only need these 2 column
receiver_traffic = network_data[['dstport', 'doctets']]

# Create table of port frequencies
dst_port_frequency = receiver_traffic['dstport'].value_counts().head(10).to_frame(name='frequency')

# Create table of port usage in bytes
dst_port_bytes = receiver_traffic.groupby(['dstport']).sum()

# Add percentage column to port usage by byte
dst_port_bytes['doctets_perc'] = (dst_port_bytes['doctets'] / dst_port_bytes['doctets'].sum()) * 100

# Merge tables
dst_port_frequency.merge(dst_port_bytes, left_index=True, right_on='dstport')
```

Out[30]:

dstport	frequency	doctets	doctets_perc
80	319929	87250983	2.927446
443	34727	23074506	0.774196
53	17006	1454716	0.048809
445	11620	580671	0.019483
25	8902	10467674	0.351212
123	8378	809319	0.027154
1935	7933	5534241	0.185709
3074	6565	3157339	0.105935
2048	3410	474147	0.015909
0	2965	18207368	0.610894

d) Traffic volumes based on source IP prefix

In [31]:
```
def top_percents(src_addr_volume):
    dec_perc = 0.001
    for dec_perc in [0.001, 0.01, 0.1]:
        percentage = src_addr_volume.iloc[int(len(src_addr_volume) * dec_perc)]['doctets_cumperc']
        print("Top", dec_perc * 100, "% of IP addresses", percentage, "% of all bytes")
        dec_perc *= 10
```

In [32]:
```
# Get source IP addresses bytes used by each
src_addr_volume = network_data[['srcaddr', 'doctets']].groupby('srcaddr').sum().sort_values(by='doctets', ascending=False)

# Add percentage of total bytes that each IP address uses
src_addr_volume['doctets_perc'] = (src_addr_volume['doctets'] / src_addr_volume['doctets'].sum()) * 100

# A cumulative percentage column
src_addr_volume['doctets_cumperc'] = src_addr_volume['doctets_perc'].cumsum()

# Get byte percentage by top 0.1%, 1%, and 10% of IP addresses
top_percents(src_addr_volume)
```

```
Top 0.1% of IP addresses: 59.19753274724272% of all bytes
Top 1.0% of IP addresses: 82.28337412354935% of all bytes
Top 10.0% of IP addresses: 99.39374184403444% of all bytes
```

In [33]:
```
# Get byte volume by source mask
src_mask_volume = network_data[['src_mask', 'doctets']].groupby('src_mask').sum().sort_index()

# Add percentage of whole bytes for each mask
src_mask_volume['doctets_perc'] = (src_mask_volume['doctets'] / src_mask_volume['doctets'].sum()) * 100

# Get the 0 mask entry
mask_length_zero_perc = src_mask_volume.query('src_mask == 0')['doctets_perc'][0]

# Print the percentage
print("Percentage of traffic with source mask of 0:", mask_length_zero_perc, "\n\n")
```

```
Percentage of traffic with source mask of 0: 43.259896063163044
```

In [34]:
```
# Get source IP addresses bytes used by each, but exclude 0 src_mask
src_addr_volume = network_data[['srcaddr', 'doctets', 'src_mask']].query('src_mask != 0').groupby('srcaddr').sum().sort_values(by='do

# Add percentage of total bytes that each IP address uses
src_addr_volume['doctets_perc'] = (src_addr_volume['doctets'] / src_addr_volume['doctets'].sum()) * 100

# A cumulative percentage column
src_addr_volume['doctets_cumperc'] = src_addr_volume['doctets_perc'].cumsum()

# Get byte percentage by top 0.1%, 1%, and 10% of IP addresses
print("Excluding 0 source masks...")
top_percents(src_addr_volume)
```

```
Excluding 0 source masks...
Top 0.1% of IP addresses: 38.31265457093309156 of all bytes
Top 1.0% of IP addresses: 64.91075901566285 of all bytes
Top 10.0% of IP addresses: 95.92718057374526 of all bytes
```

e) Institution with 128.112.0.0/16 address block

In [35]:
```
# Grab source addresses, # of packets, and # of bytes
inst_data = network_data[['srcaddr', 'dpkts', 'doctets']]

# True if source address is in address block 128.112
inst_data['from_institution'] = inst_data['srcaddr'].str.startswith('128.112')

# Find # of packets and # of bytes sent by in and out of institution
inst_data = inst_data.groupby('from_institution').sum()

inst_data['dpkts_perc'] = (inst_data['dpkts'] / inst_data['dpkts'].sum()) * 100

inst_data['doctets_perc'] = (inst_data['doctets'] / inst_data['doctets'].sum()) * 100

print('Traffic sent from institution...')
inst_data
```

```
Traffic sent from institution...
```

Out[35]:

from_institution	dpkts	doctets	dpkts_perc	doctets_perc
False	1840525	2956566572	98.995741	99.299076
True	39352	20890679	1.014259	0.700924

In [36]:
```
# Grab source addresses, # of packets, and # of bytes
inst_data = network_data[['dstaddr', 'dpkts', 'doctets']]

# True if source address is in address block 128.112
inst_data['to_institution'] = inst_data['dstaddr'].str.startswith('128.112')

# Find # of packets and # of bytes sent by in and out of institution
inst_data = inst_data.groupby('to_institution').sum()

inst_data['dpkts_perc'] = (inst_data['dpkts'] / inst_data['dpkts'].sum()) * 100

inst_data['doctets_perc'] = (inst_data['doctets'] / inst_data['doctets'].sum()) * 100

print('Traffic Sent to institution...')
inst_data
```

```
Traffic Sent to institution...
```

Out[36]:

to_institution	dpkts	doctets	dpkts_perc	doctets_perc
False	3922903	2915128992	98.531051	97.808441
True	56974	65318259	1.468449	2.191559