router_log_analysis

August 29, 2023

1 Analysing Router Logs

We will first import necessary libraries

[1]:

```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.dates as mdates
import random

# changing style
plt.style.use('default')
plt.rcParams["font.family"] = "Jetbrains Mono"
```

1.1 Strategy

1. We will try and simluate a few attacks on a router, and check whether those attacks can be detected in hindsight.
2. To do that we will start with generating some demo data for a router, inspired by my home router. This will be a monitor of active DHCP Clients.
3. We will then try and analyse the data to find out anomalies in normal usage.

2 Generating *normal* demo data

[2]:

```python
# columns
data = {
    'MAC' : [],
    'IP Address': [],
    'Device Name': [],
    'Interface': [],
    'Requested IP': [],
    'Time': []
}
```

[3]:

```python
# Creating a pandas dataframe

normal_log_db = pd.DataFrame(data)
```

```
normal_log_db
```

[3]:
```
Empty DataFrame
Columns: [MAC, IP Address, Device Name, Interface, Requested IP, Time]
Index: []
```

[4]:
```
# Writing functions for columns that we wanna generate randomly
def generate_mac_address():
    mac = [random.randint(0x00, 0xff) for i in range(6)]
    return ':'.join(map(lambda x: "%02x" % x, mac))


def generate_dest_ip_address():
    # define the weights for each website
    website_weights = {'Youtube': 15, 'Instagram': 10, 'Facebook': 8, 'Twitter':
 ↪ 5, 'Other': 2}

    # create a list of websites based on their weights
    websites = []
    for website, weight in website_weights.items():
        websites.extend([website] * weight)

    # randomly select a website from the list
    website = random.choice(websites)

    # generate a random IP address for the website
    if website == 'Youtube':
        return ('216.58.194.45' , website)
    elif website == 'Instagram':
        return ('3.213.31.34' , website)
    elif website == 'Facebook':
        return ('69.63.176.22' , website)
    elif website == 'Twitter':
        return ('104.244.42.12' , website)
    else:
        return ('192.168.1.53' , website)

def generate_device_ip_address():
    # define a list of 10 predefined IP addresses
    ips = ['192.168.1.10', '192.168.1.20', '192.168.1.30', '192.168.1.40', '192.
 ↪168.1.50',
           '192.168.1.60', '192.168.1.70', '192.168.1.80', '192.168.1.90', '192.
 ↪168.1.100']

    # generate a random integer between 0 and 9
    index = random.randint(0, 9)
    # return the IP address at the selected index
    return ips[index]

def generate_device_name():
    device_names = ['iPhone', 'Samsung', 'OnePlus', 'Nokia', 'Xiaomi', 'Oppo',␣
  ↪'Vivo', 'Realme', 'Micromax', 'Lenovo']
    return random.choice(device_names)

def generate_interface():
    interfaces = ['5gz', '2.4gz']
    return random.choice(interfaces)

def generate_date_time():
    # generate random date and time, but only in the range of a few days
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = random.randint(0, 10)

    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
  ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = end_date.hour
    if hour < 6:
        # almost no traffic between 2am and 6am
        hour = random.randint(6, 23)
    elif hour < 9:
        # more traffic during the morning hours
        hour = random.randint(6, 10)
    elif hour < 18:
        # most traffic during the daytime
        hour = random.randint(9, 17)
    else:
        # less traffic during the evening hours
        hour = random.randint(17, 23)

    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)

    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')
```

```
def gen_protocols():
    protocols = ['TCP', 'UDP', 'DHCP', 'HTTP', 'HTTPS', 'FTP', 'SMTP', 'POP3',␣
 ↪'IMAP', 'DNS', 'ICMP']
    ports = {
        'TCP': 21,          # HTTP
        'UDP': 53,          # DNS
        'DHCP': 67,         # DHCP Server
        'HTTP': 80,         # Hypertext Transfer Protocol
        'HTTPS': 443,       # HTTP Secure (TLS/SSL)
        'FTP': 21,          # File Transfer Protocol (Control)
        'SMTP': 25,         # Simple Mail Transfer Protocol
        'POP3': 110,        # Post Office Protocol v3
        'IMAP': 143,        # Internet Message Access Protocol
        'DNS': 53,          # Domain Name System
        'ICMP': None        # Internet Control Message Protocol (does not use␣
 ↪ports)
    }
    weights = [0.3, 0.2, 0.1, 0.15, 0.1, 0.05, 0.05, 0.025, 0.025, 0.025, 0.030]
    selection = random.choices(protocols, weights=weights)[0]
    return (selection, ports[selection])
```

[5]:

```
# Generate normal data, consider a home environment. with 10 users. across a␣
 ↪span of 10 days. Visiting 100 websites per device per day.

normal_log_db = pd.DataFrame(columns=['MAC', 'IP Address', 'Device Name',␣
 ↪'Interface', 'Requested IP', 'Time'])

for i in range(10):
    temp_df = pd.DataFrame({
        'MAC' : [generate_mac_address() for j in range(100)],
        'IP Address': [generate_device_ip_address() for j in range(100)],
        'Device Name': [generate_device_name() for j in range(100)],
        'Interface': [generate_interface() for j in range(100)],
        'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
        'Requested Website': [generate_dest_ip_address()[1] for j in␣
 ↪range(100)],
        'Protocol': [gen_protocols()[0] for j in range(100)],
        'Port': [gen_protocols()[1] for j in range(100)],
        'Time': [generate_date_time() for j in range(100)]
    })

    normal_log_db = pd.concat([normal_log_db, temp_df], ignore_index=True)

normal_log_db
```

[5]:

```
                   MAC     IP Address Device Name Interface    Requested IP  \
0    87:f1:20:92:23:58   192.168.1.60      iPhone     2.4gz  216.58.194.45
1    85:f7:d5:30:88:31   192.168.1.80        Oppo     2.4gz   69.63.176.22
2    bc:34:18:65:0a:ab  192.168.1.100      iPhone     2.4gz    3.213.31.34
3    7c:98:6a:ce:01:3d   192.168.1.90      iPhone       5gz    3.213.31.34
4    19:56:ab:0d:af:3f  192.168.1.100      Realme     2.4gz  104.244.42.12
..                 …            …         …       …            …
995  1d:b8:e4:8c:cf:6f   192.168.1.20      Realme     2.4gz    3.213.31.34
996  06:b3:c5:e5:ca:3e   192.168.1.80    Micromax     2.4gz    3.213.31.34
997  46:b9:89:c6:bc:0a  192.168.1.100     OnePlus     2.4gz    3.213.31.34
998  d0:aa:4f:d9:17:a1   192.168.1.90      Realme       5gz  216.58.194.45
999  61:8a:3f:44:f2:d4   192.168.1.80      Xiaomi     2.4gz  216.58.194.45

                    Time Requested Website Protocol   Port
0    2023-01-09 08:39:54           Youtube      TCP   21.0
1    2023-01-02 10:56:14          Facebook    HTTPS   21.0
2    2023-01-04 12:40:38          Facebook    HTTPS   53.0
3    2023-01-05 10:11:18         Instagram    HTTPS   21.0
4    2023-01-08 22:37:53           Youtube      TCP   21.0
..                   …               …      …    …
995  2023-01-07 13:08:10             Other      TCP   67.0
996  2023-01-03 10:42:07             Other     HTTP  110.0
997  2023-01-01 16:18:56          Facebook     HTTP   53.0
998  2023-01-04 20:35:42           Youtube      UDP    NaN
999  2023-01-07 17:49:28         Instagram     HTTP   53.0

[1000 rows x 9 columns]
```

[6]:

```
# now sort data by time
normal_log_db = normal_log_db.sort_values(by=['Time'])
normal_log_db
```

[6]:

```
                   MAC    IP Address Device Name Interface    Requested IP  \
292  69:8f:cc:61:87:94  192.168.1.20     Samsung     2.4gz    3.213.31.34
621  a0:b3:3b:98:6e:50  192.168.1.60      Realme       5gz    3.213.31.34
472  f7:c2:d8:bd:23:aa  192.168.1.90    Micromax     2.4gz  216.58.194.45
735  f6:b5:15:4e:47:c6  192.168.1.70       Nokia     2.4gz  216.58.194.45
156  81:5a:20:33:bc:d4  192.168.1.90        Vivo     2.4gz    3.213.31.34
..                 …           …         …       …            …
988  5c:44:da:b9:35:3a  192.168.1.90       Nokia     2.4gz  216.58.194.45
514  d0:f7:cd:86:35:4a  192.168.1.40      Xiaomi       5gz  216.58.194.45
466  2b:e5:d3:04:69:30  192.168.1.60       Nokia     2.4gz  104.244.42.12
587  16:40:16:c4:0b:f2  192.168.1.40      iPhone       5gz  216.58.194.45
971  d7:0b:4e:95:68:e0  192.168.1.60     OnePlus       5gz  104.244.42.12

                    Time Requested Website Protocol   Port
292  2023-01-01 06:03:58         Instagram      UDP   21.0
```

```
621  2023-01-01 06:35:45           Youtube      TCP   53.0
472  2023-01-01 07:07:14           Youtube     HTTP  443.0
735  2023-01-01 07:32:13           Youtube     DHCP   80.0
156  2023-01-01 07:38:11          Facebook      TCP   53.0
..                   …               …      …    …
988  2023-01-11 23:19:57          Facebook      TCP   67.0
514  2023-01-11 23:20:35             Other     DHCP   53.0
466  2023-01-11 23:24:48         Instagram    HTTPS   21.0
587  2023-01-11 23:25:57         Instagram      TCP   21.0
971  2023-01-11 23:49:31           Twitter    HTTPS   80.0

[1000 rows x 9 columns]
```

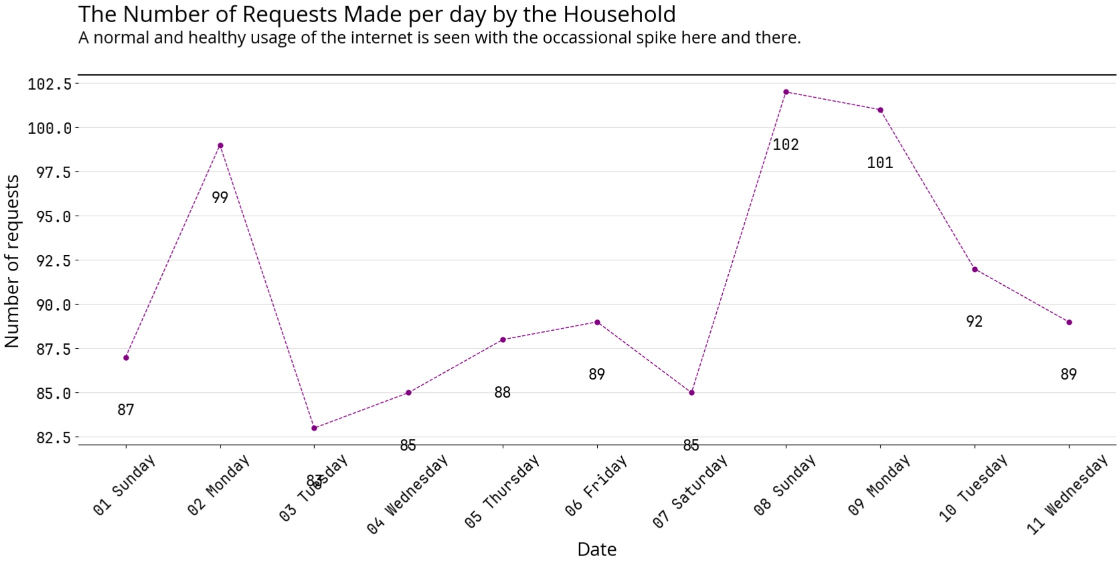
[7]:

```
# let us plot the number of requests per day
normal_log_db['Time'] = pd.to_datetime(normal_log_db['Time'])
normal_log_db['Date'] = normal_log_db['Time'].dt.date

# sort data by date
normal_log_db = normal_log_db.sort_values(by=['Date'])

normal_log_db.head()

# now let us plot the number of requests per day
dates = normal_log_db['Date'].value_counts()

# sorting dates
dates = dates.sort_index()

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'The Number of Requests Made per day by the Household'
subtitle = 'A normal and healthy usage of the internet is seen with the␣
 ↪occassional spike here and there. '

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)

plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)
```

```
# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# plotting as a time series
plt.plot_date(dates.index, dates.values, color='purple', marker='o',␣
 ↪linestyle='dashed', linewidth=1, markersize=5)

# also put labels on the markers a little over the markers for visibility
for i in range(len(dates)):
    plt.text(dates.index[i], dates.values[i]-3, dates.values[i], ha='center',␣
 ↪va='center', color='black', fontsize=16)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Date', fontsize=20, fontname="Open Sans")
plt.ylabel('Number of requests', fontsize=20, fontname="Open Sans")

# change space on top of chart we are actually adjusting the scale of the plot␣
 ↪as well.
plt.subplots_adjust(top=0.8, wspace=0.3)

# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# tilt the x-axis labels by 45 degrees
for tick in ax.get_xticklabels():
    tick.set_rotation(45)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.4)
# plt.grid(axis='x', alpha=0.2)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# customize the tick labels
```

```
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %A'))

plt.show()
```

```
/tmp/ipykernel_1371293/2093802530.py:45: UserWarning: marker is redundantly
defined by the 'marker' keyword argument and the fmt string "o" (-> marker='o').
The keyword argument will take precedence.
  plt.plot_date(dates.index, dates.values, color='purple', marker='o',
linestyle='dashed', linewidth=1, markersize=5)
```

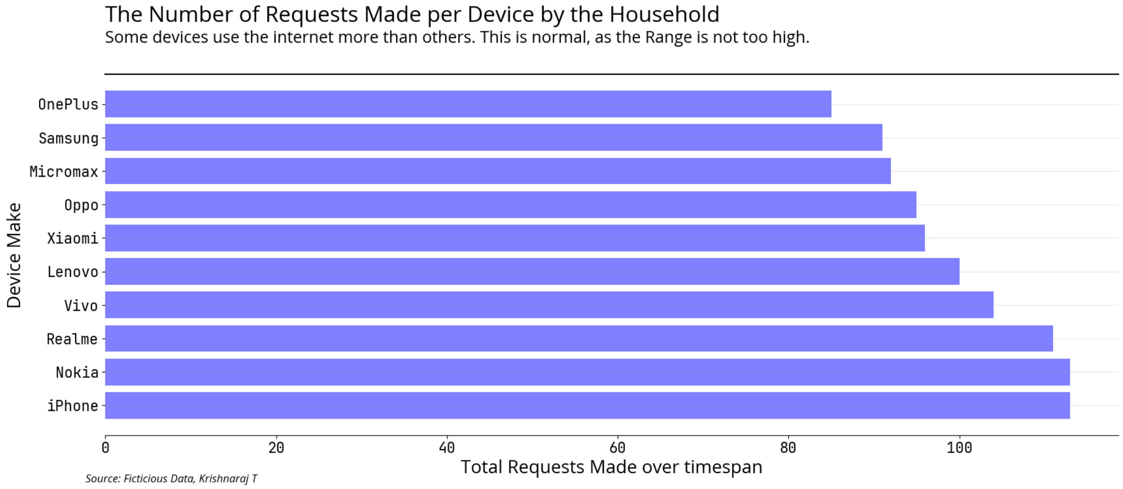


[8]:
```
# let us now plot the number of requests per device

devices = normal_log_db['Device Name'].value_counts()

# sorting devices in descending order
devices = devices.sort_values(ascending=False)

# plotting

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'The Number of Requests Made per Device by the Household'
subtitle = 'Some devices use the internet more than others. This is normal, as␣
  ↪the Range is not too high.'
```

```python
# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.3)
# plt.grid(axis='x', alpha=0.2)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)


# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open Sans")
plt.ylabel('Device Make', fontsize=20, fontname="Open Sans")


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
```

```
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

plt.barh(devices.index, devices.values, color='blue', alpha=0.5)
```

```
[8]: <BarContainer object of 10 artists>
```

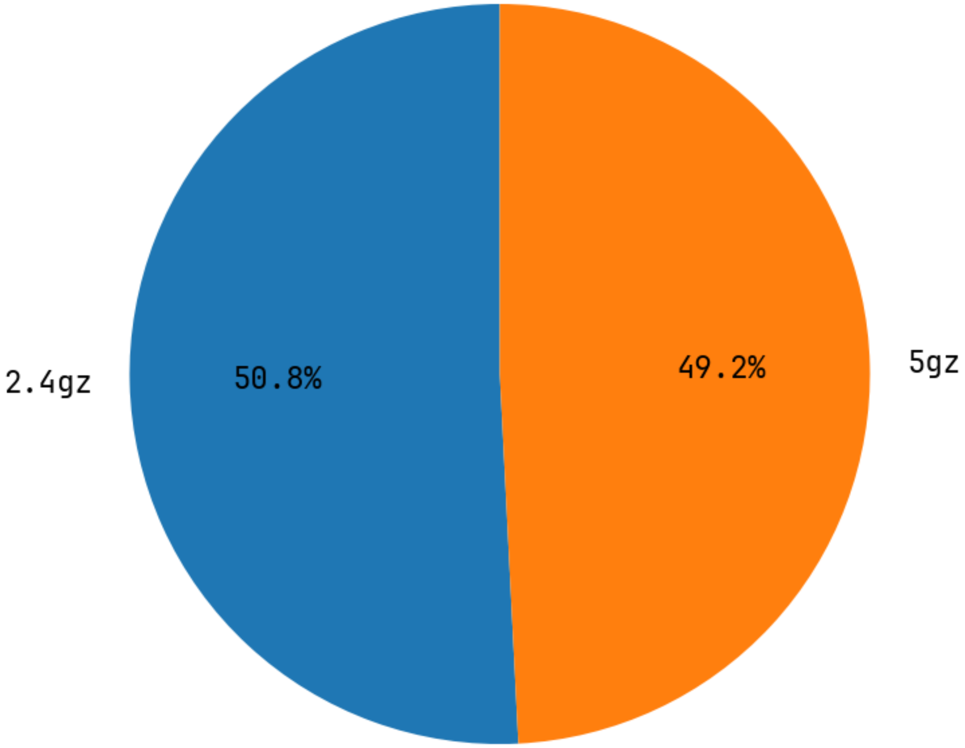


```
[9]: import matplotlib.pyplot as plt

# assuming you have a DataFrame called `normal_log_db` with a column called␣
 ↪'Interface'
interface_counts = normal_log_db['Interface'].value_counts()

# creating the plot.
fig, ax = plt.subplots(figsize=(10, 10))

# informative title + subtitle
title = 'Distribution of Requests by Interface'
subtitle = 'It is normal to see an equal distribution of requests across␣
 ↪interfaces.'

# add title + subtitle to plot
```

```
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# set the font size of the labels
plt.rcParams['font.size'] = 16

# Create a pie chart to show the distribution of requests per interface
plt.pie(interface_counts.values, labels=interface_counts.index, autopct='%1.
 ↪1f%%', startangle=90)


# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

# display the plot
plt.show()
```

Distribution of Requests by Interface

It is normal to see an equal distribution of requests across interfaces.



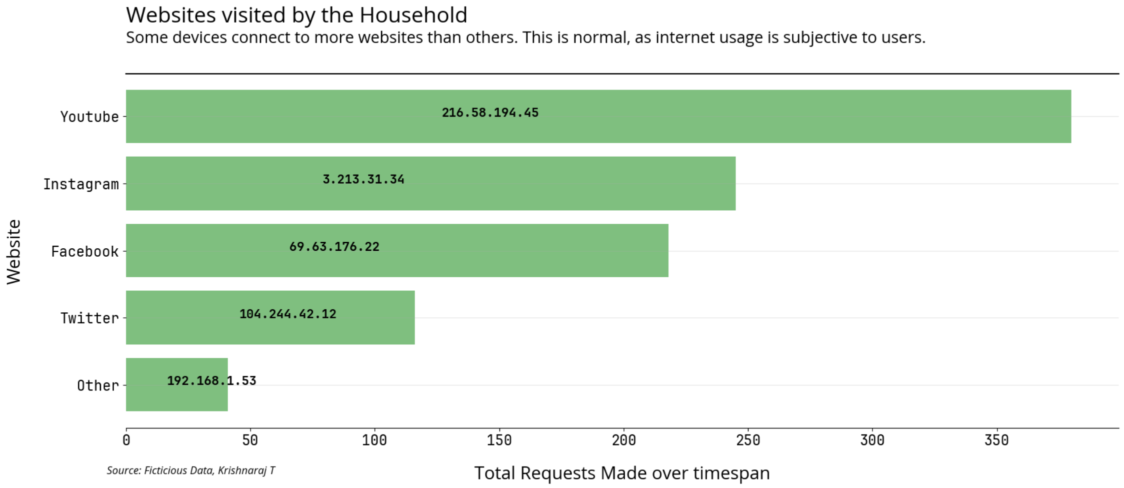
Source: Ficticious Data, Krishnaraj T

[10]:

```
import matplotlib.pyplot as plt

# assuming you have a DataFrame called `normal_log_db` with columns called 'Requested IP' and 'Requested Website'
destination_ips = normal_log_db['Requested IP'].value_counts()
destination_ips = destination_ips.sort_values(ascending=False)

destination_websites = normal_log_db['Requested Website'].value_counts()
destination_websites = destination_websites.sort_values(ascending=False)
```

```
destination_ips = destination_ips.iloc[::-1]
destination_websites = destination_websites.iloc[::-1]

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Websites visited by the Household'
subtitle = 'Some devices connect to more websites than others. This is normal,␣
  ↪as internet usage is subjective to users. '

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.3)
# plt.grid(axis='x', alpha=0.2)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)


# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
```

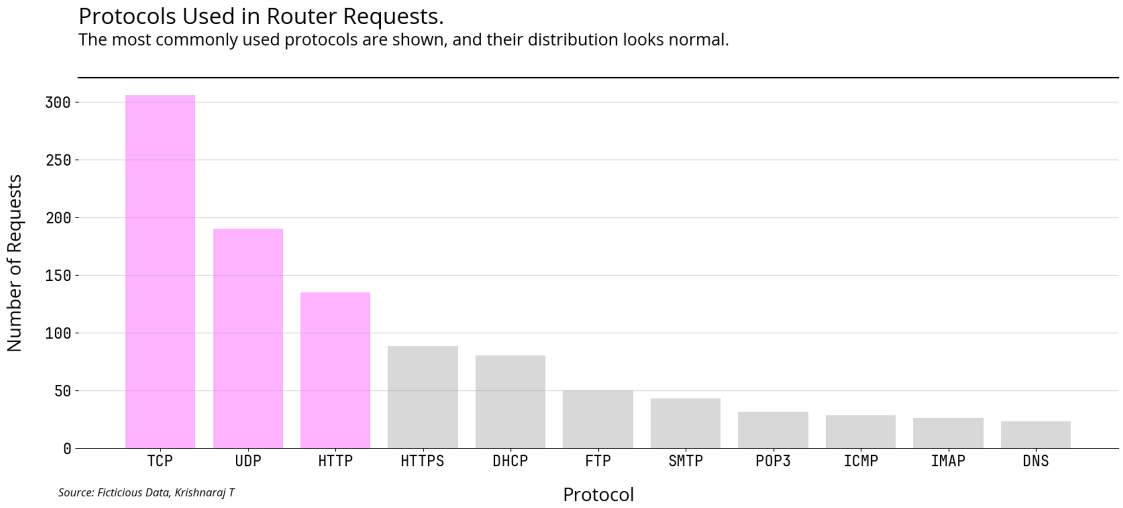
```
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
 ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# set the y-axis tick labels to the website names
plt.yticks(range(len(destination_websites)), destination_websites.index)

# invert the y-axis so that the website names are displayed from top to bottom
# plt.gca().invert_yaxis()

# add the names of the websites inside their individual bars
for i, v in enumerate(destination_ips.index):
    plt.text(x=destination_ips.values[i] / 3, y=i, s=v, color='black',␣
 ↪fontweight='bold', fontsize=14)


# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

plt.barh(range(len(destination_websites)), destination_websites.values,␣
 ↪color='green', alpha=0.5)


plt.show()
```



[11]:

```
# let us now plot what protocols were used to make requests
# count the number of requests for each protocol

protocol_counts = normal_log_db['Protocol'].value_counts()

# set the color of the first rectangle to pink and the color of the other␣
 ↪rectangles to gray
colors = ['magenta'] * 3 + ['gray'] * (len(protocol_counts) - 3)

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Protocols Used in Router Requests. '
subtitle = 'The most commonly used protocols are shown, and their distribution␣
 ↪looks normal.'

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

plt.bar(protocol_counts.index, protocol_counts.values, color=colors, alpha=0.3)

# set the title and axis labels
# ax.set_title('Protocols Used to Make Requests')
ax.set_xlabel('Protocol')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)


# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)
```

```
[11]: Text(0.11, 0.02, 'Source: Ficticious Data, Krishnaraj T')
```



Protocols Used in Router Requests.

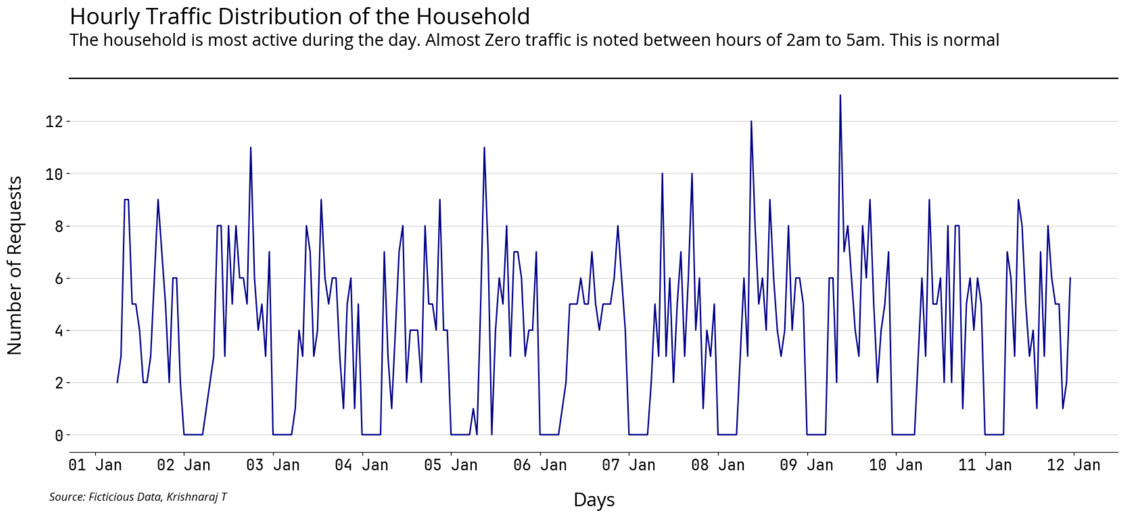
The most commonly used protocols are shown, and their distribution looks normal.

Source: Ficticious Data, Krishnaraj T

```
[12]: import matplotlib.pyplot as plt
import pandas as pd

temp_df = normal_log_db.copy()
# convert the 'Time' column to a datetime object
temp_df['Time'] = pd.to_datetime(temp_df['Time'])

# set the 'Time' column as the index
temp_df.set_index('Time', inplace=True)

# resample the data by hour and count the number of requests
hourly_counts = temp_df.resample('H').count()['MAC']


# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Hourly Traffic Distribution of the Household'
```

```
subtitle = 'The household is most active during the day. Almost Zero traffic is␣
 ↪noted between hours of 2am to 5am. This is normal'

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
 ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
```

```
ax.set_xlabel('Days')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)

plt.plot(hourly_counts.index, hourly_counts.values, color='darkblue')

# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

# customize the tick labels
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %b'))
```


Hourly Traffic Distribution of the Household

The household is most active during the day. Almost Zero traffic is noted between hours of 2am to 5am. This is normal

Source: Ficticious Data, Krishnaraj T

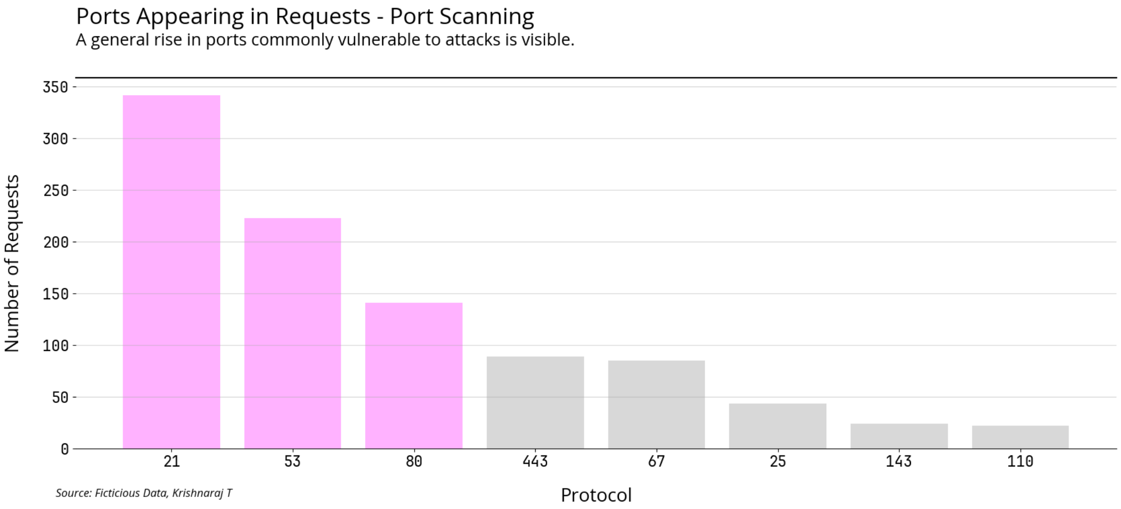
[13]:

```
# let us now plot what protocols were used to make requests
# count the number of requests for each protocol

port_counts = normal_log_db['Port'].value_counts()
```

```
# change indices from float to int
port_counts.index = port_counts.index.astype(int)
port_counts.index = port_counts.index.astype(str)

port_counts.index

# set the color of the first rectangle to pink and the color of the other rectangles to gray
colors = ['magenta'] * 3 + ['gray'] * (len(port_counts) - 3)

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Ports Appearing in Requests - Port Scanning'
subtitle = 'A general rise in ports commonly vulnerable to attacks is visible.'

# add title + subtitle to plot
plt.text(
    x=0.125, y=0.90, s=title, fontname="Open Sans",
    fontsize=24, ha='left', transform=fig.transFigure
)
plt.text(
    x=0.125, y=0.86, s=subtitle, fontname="Open Sans",
    fontsize=18, ha='left', transform=fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9],   # x co-ords
    [.80, .80],   # y co-ords
    transform=fig.transFigure,
    clip_on=False,
    color='k',
    linewidth=1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis='y', alpha=0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
```

```
plt.gca().spines[['left', 'right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
  ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)

# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

plt.bar(port_counts.index, port_counts.values, color=colors, alpha=0.3)

# set the title and axis labels
# ax.set_title('Protocols Used to Make Requests')
ax.set_xlabel('Protocol')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)


# footnote
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x=0.11,
    y=0.02,
    s=footnote,
    fontname='Open Sans',
    fontstyle='italic',
    fontsize=12,
    ha='left',
    transform=fig.transFigure
)
```

```
[13]: Text(0.11, 0.02, 'Source: Ficticious Data, Krishnaraj T')
```


Ports Appearing in Requests - Port Scanning

A general rise in ports commonly vulnerable to attacks is visible.

Source: Ficticious Data, Krishnaraj T

3 Let us now simulate some attacks

3.1 DDOS Attack

[14]:

```
# Writing functions for columns that we wanna generate randomly
def generate_attacker_mac_address():
    return '1c:8c:f5:0d:d2:53'


def generate_dest_ip_address():
    # define the weights for each website
    website_weights = {'Youtube': 15, 'Instagram': 10, 'Facebook': 8, 'Twitter':
 ↪ 5, 'Other': 2}

    # create a list of websites based on their weights
    websites = []
    for website, weight in website_weights.items():
        websites.extend([website] * weight)

    # randomly select a website from the list
    website = random.choice(websites)

    # generate a random IP address for the website
    if website == 'Youtube':
        return ('216.58.194.45' , website)
    elif website == 'Instagram':
        return ('3.213.31.34' , website)
    elif website == 'Facebook':
        return ('69.63.176.22' , website)
    elif website == 'Twitter':
        return ('104.244.42.12' , website)
    else:
        return ('192.168.1.53' , website)

def generate_attacker_ip_address():
    ip = '192.168.1.20'
    return ip

def generate_device_name():
    device_names = ['iPhone', 'Samsung', 'OnePlus', 'Nokia', 'Xiaomi', 'Oppo',␣
  ↪'Vivo', 'Realme', 'Micromax', 'Lenovo']
    return random.choice(device_names)

def generate__attacker_interface():
    interfaces = ['5gz', '2.4gz']
    return random.choice(interfaces)

def generate_date_time():
    # generate random date and time, but only in the range of a few days
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = random.randint(0, 10)

    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
  ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = end_date.hour
    if hour < 6:
        # almost no traffic between 2am and 6am
        hour = random.randint(6, 23)
    elif hour < 9:
        # more traffic during the morning hours
        hour = random.randint(6, 10)
    elif hour < 18:
        # most traffic during the daytime
        hour = random.randint(9, 17)
    else:
        # less traffic during the evening hours
        hour = random.randint(17, 23)
    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)

    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')

def generate_attacker_date_time():
    # generate random date and time, but only on 4th day
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = 4

    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
 ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = 19

    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)

    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')

def gen_attacker_protocols():
    protocols = ['TCP', 'UDP', 'DHCP', 'HTTP', 'HTTPS', 'FTP', 'SMTP', 'POP3',␣
 ↪'IMAP', 'DNS', 'ICMP']
    ports = {
        'TCP': 21,          # HTTP
        'UDP': 53,          # DNS
        'DHCP': 67,         # DHCP Server
        'HTTP': 80,         # Hypertext Transfer Protocol
        'HTTPS': 443,       # HTTP Secure (TLS/SSL)
        'FTP': 21,          # File Transfer Protocol (Control)
        'SMTP': 25,         # Simple Mail Transfer Protocol
        'POP3': 110,        # Post Office Protocol v3
        'IMAP': 143,        # Internet Message Access Protocol
        'DNS': 53,          # Domain Name System
        'ICMP': None        # Internet Control Message Protocol (does not use␣
 ↪ports)
    }
    weights = [0.2, 0.2, 0.3, 0.15, 0.0, 0.05, 0.05, 0.025, 0.025, 0.025, 0.35]
    selection = random.choices(protocols, weights=weights)[0]
    return (selection, ports[selection])
```

[15]:

```
# Generate ddos attack data, consider a home environment. with 10 users. across␣
 ↪a span of 10 days. Visiting 100 websites per device per day.

ddos_log_db = pd.DataFrame(columns=['MAC', 'IP Address', 'Device Name',␣
 ↪'Interface', 'Requested IP', 'Time'])

for i in range(10):


    # check if time columns is on 4th jan
    if i == 4:
        temp_df = pd.DataFrame({
            'MAC' : [generate_mac_address() for j in range(100)],
            'IP Address': [generate_attacker_ip_address() for j in range(100)],
            'Device Name': [generate_device_name() if j > 50 else 'Vivo' for j␣
 ↪in range(100)],
            'Interface': [generate_interface() for j in range(100)],
            'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
            'Requested Website': [generate_dest_ip_address()[1] for j in␣
 ↪range(100)],
            'Protocol': [gen_attacker_protocols()[0] for j in range(100)],
            'Port': [gen_attacker_protocols()[1] for j in range(100)],
            'Time': [generate_attacker_date_time() if j < 50 else␣
 ↪generate_date_time() for j in range(100)]
        })

    else:
        temp_df = pd.DataFrame({
            'MAC' : [generate_mac_address() for j in range(100)],
            'IP Address': [generate_device_ip_address() for j in range(100)],
            'Device Name': [generate_device_name() for j in range(100)],
            'Interface': [generate_interface() for j in range(100)],
            'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
            'Requested Website': [generate_dest_ip_address()[1] for j in␣
 ↪range(100)],
            'Protocol': [gen_protocols()[0] for j in range(100)],
            'Port': [gen_protocols()[1]  for j in range(100)],
            'Time': [generate_date_time() for j in range(100)]
    })

    ddos_log_db = pd.concat([ddos_log_db, temp_df], ignore_index=True)

ddos_log_db
```

[15]:

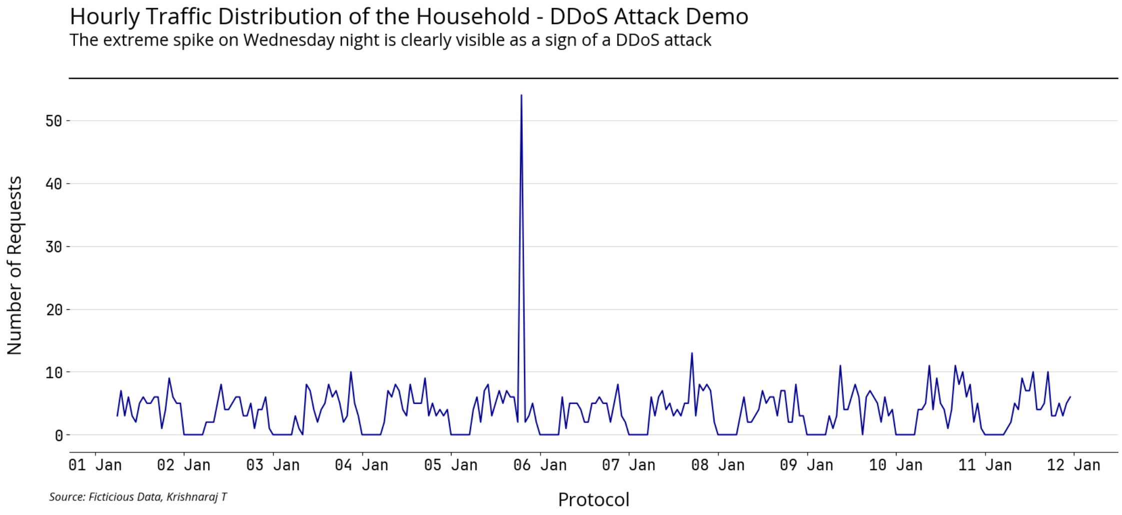
```
                       MAC    IP Address Device Name Interface   Requested IP  \
0    ac:89:3d:ce:66:83  192.168.1.20      Lenovo     2.4gz  216.58.194.45
1    0d:da:8e:61:96:71  192.168.1.10      iPhone     2.4gz   69.63.176.22
2    cb:bc:fe:b7:b8:b5  192.168.1.90      Realme       5gz   69.63.176.22
3    4b:5d:a0:17:a6:b0  192.168.1.40        Oppo     2.4gz  216.58.194.45
4    bf:37:eb:cf:7a:5d  192.168.1.40      iPhone     2.4gz   69.63.176.22
..                 …             …          …       …            …
995  5a:27:4f:5a:e3:44  192.168.1.60     Samsung     2.4gz  216.58.194.45
996  41:b7:80:10:39:f3  192.168.1.70        Vivo       5gz  216.58.194.45
997  e0:10:27:af:54:56  192.168.1.50    Micromax     2.4gz  216.58.194.45
998  1f:73:de:ae:87:cc  192.168.1.40       Nokia       5gz   69.63.176.22
999  00:da:84:e1:77:71  192.168.1.70     Samsung     2.4gz  216.58.194.45

                    Time Requested Website Protocol  Port
0    2023-01-10 11:51:02         Instagram     HTTP  53.0
1    2023-01-04 06:48:03          Facebook      FTP  53.0
2    2023-01-06 06:33:14          Facebook      UDP  67.0
3    2023-01-06 17:52:46             Other      TCP   NaN
4    2023-01-08 14:29:35           Youtube      UDP  21.0
..                   …                 …      …     …
995  2023-01-11 17:47:55           Twitter    HTTPS  25.0
996  2023-01-03 21:55:14         Instagram      TCP  53.0
997  2023-01-03 09:33:54           Youtube      UDP  80.0
998  2023-01-08 15:51:07           Youtube      TCP  53.0
999  2023-01-02 10:17:00          Facebook     POP3  21.0

[1000 rows x 9 columns]
```

[16]:

```python
import matplotlib.pyplot as plt
import pandas as pd

temp_df = ddos_log_db.copy()
# convert the 'Time' column to a datetime object
temp_df['Time'] = pd.to_datetime(temp_df['Time'])

# set the 'Time' column as the index
temp_df.set_index('Time', inplace=True)

# resample the data by hour and count the number of requests
hourly_counts = temp_df.resample('H').count()['MAC']


# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Hourly Traffic Distribution of the Household - DDoS Attack Demo'
```

```
subtitle = 'The extreme spike on Wednesday night is clearly visible as a sign␣
 ↪of a DDoS attack'

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
 ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
```

```
# ax.set_title('Protocols Used to Make Requests')
ax.set_xlabel('Protocol')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)

plt.plot(hourly_counts.index, hourly_counts.values, color='darkblue')

# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

# customize the tick labels
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %b'))
```



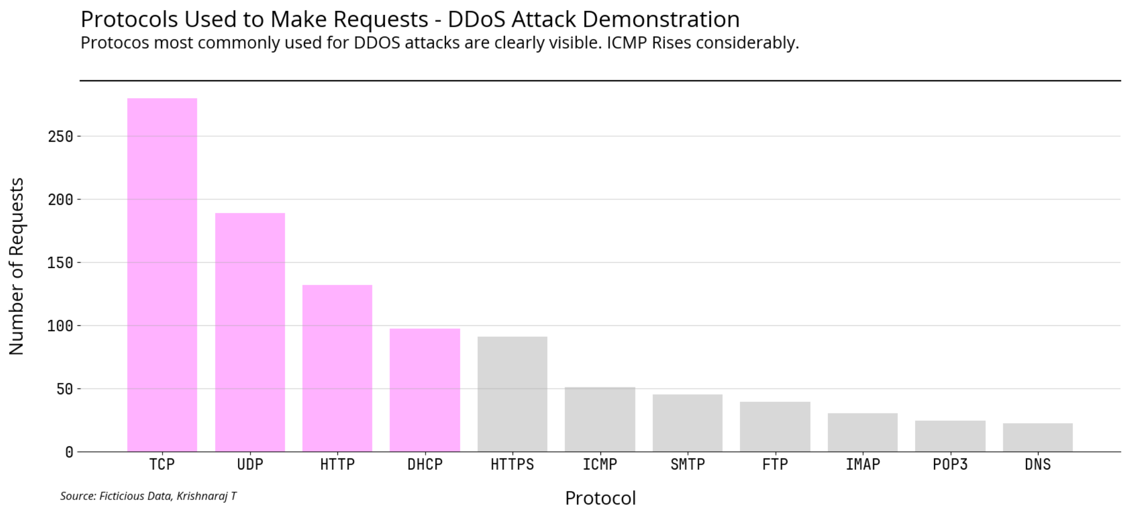
[17]:

```
# let us now plot what protocols were used to make requests
# count the number of requests for each protocol
```

```
protocol_counts = ddos_log_db['Protocol'].value_counts()

# set the color of the first rectangle to pink and the color of the other rectangles to gray
colors = ['magenta'] * 4 + ['gray'] * (len(protocol_counts) - 4)

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Protocols Used to Make Requests - DDoS Attack Demonstration'
subtitle = 'Protocos most commonly used for DDOS attacks are clearly visible. ICMP Rises considerably. '

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
```

```
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
 ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

plt.bar(protocol_counts.index, protocol_counts.values, color=colors, alpha=0.3)

# set the title and axis labels
# ax.set_title('Protocols Used to Make Requests')
ax.set_xlabel('Protocol')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)


# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)
```

```
[17]: Text(0.11, 0.02, 'Source: Ficticious Data, Krishnaraj T')
```



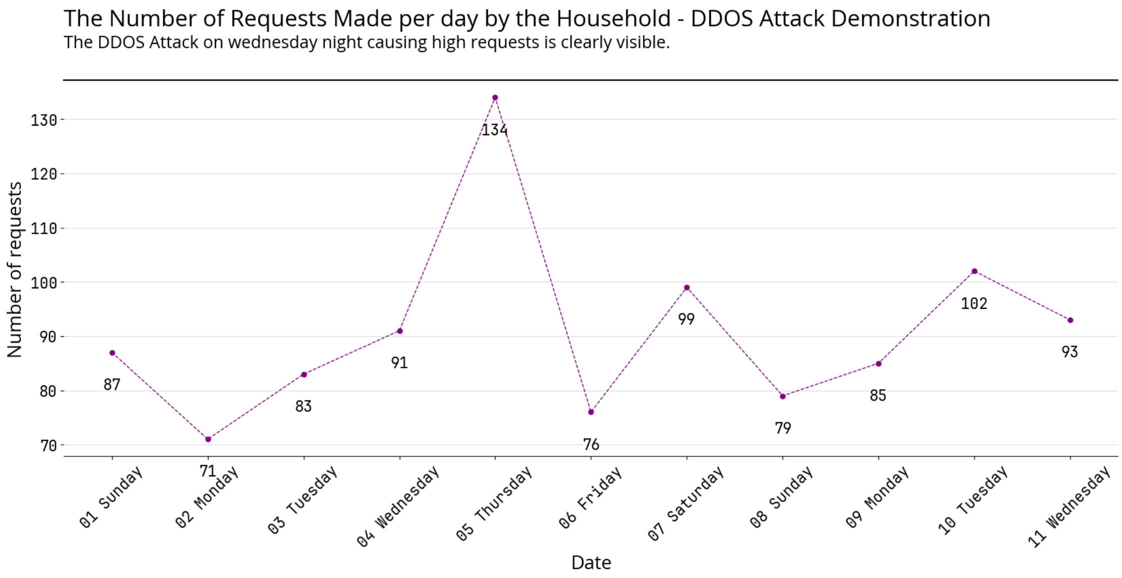
[18]:

```python
# let us plot the number of requests per day
ddos_log_db['Time'] = pd.to_datetime(ddos_log_db['Time'])
ddos_log_db['Date'] = ddos_log_db['Time'].dt.date

# sort data by date
ddos_log_db = ddos_log_db.sort_values(by=['Date'])

ddos_log_db.head()

# now let us plot the number of requests per day
dates = ddos_log_db['Date'].value_counts()

# sorting dates
dates = dates.sort_index()

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'The Number of Requests Made per day by the Household - DDOS Attack␣
  ↪Demonstration'
subtitle = 'The DDOS Attack on wednesday night causing high requests is clearly␣
  ↪visible. '

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
```

```python
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# plotting as a time series
plt.plot_date(dates.index, dates.values, color='purple', marker='o',␣
 ↪linestyle='dashed', linewidth=1, markersize=5)

# also put labels on the markers a little over the markers for visibility
for i in range(len(dates)):
    plt.text(dates.index[i], dates.values[i]-6, dates.values[i], ha='center',␣
 ↪va='center', color='black', fontsize=16)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Date', fontsize=20, fontname="Open Sans")
plt.ylabel('Number of requests', fontsize=20, fontname="Open Sans")

# change space on top of chart we are actually adjusting the scale of the plot␣
 ↪as well.
plt.subplots_adjust(top=0.8, wspace=0.3)

# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# tilt the x-axis labels by 45 degrees
for tick in ax.get_xticklabels():
    tick.set_rotation(45)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.4)
```

```
# plt.grid(axis='x', alpha=0.2)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# customize the tick labels
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %A'))

plt.show()
```

```
/tmp/ipykernel_1371293/392571808.py:45: UserWarning: marker is redundantly
defined by the 'marker' keyword argument and the fmt string "o" (-> marker='o').
The keyword argument will take precedence.
  plt.plot_date(dates.index, dates.values, color='purple', marker='o',
linestyle='dashed', linewidth=1, markersize=5)
```



The Number of Requests Made per day by the Household - DDOS Attack Demonstration

The DDOS Attack on wednesday night causing high requests is clearly visible.

[19]:

```
# let us now plot the number of requests per device

devices = ddos_log_db['IP Address'].value_counts()
devices
```

[19]:

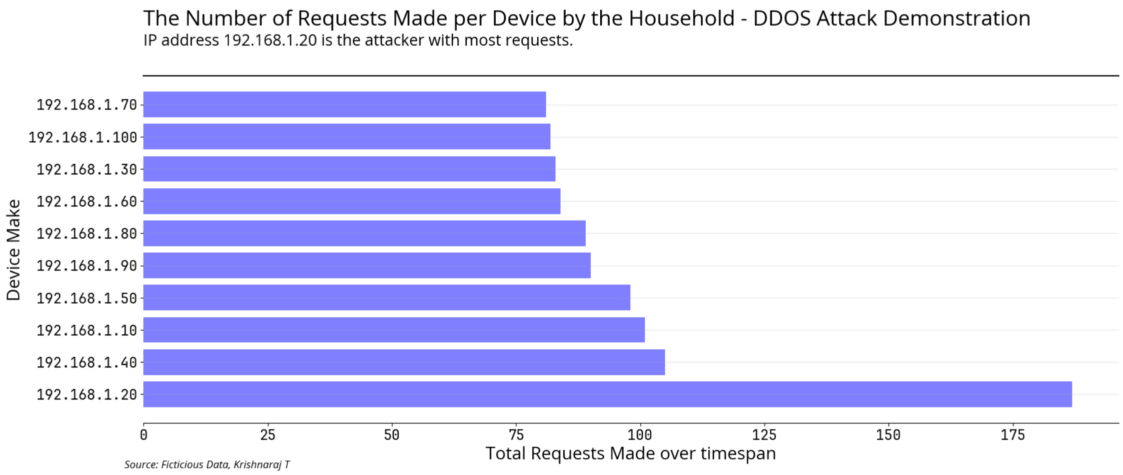
```
IP Address
192.168.1.20    187
192.168.1.40    105
192.168.1.10    101
192.168.1.50     98
192.168.1.90     90
```

```
192.168.1.80      89
192.168.1.60      84
192.168.1.30      83
192.168.1.100     82
192.168.1.70      81
Name: count, dtype: int64
```

[20]:

```
# sorting devices in descending order
devices = devices.sort_values(ascending=False)

# plotting

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'The Number of Requests Made per Device by the Household - DDOS Attack␣
 ↪Demonstration'
subtitle = 'IP address 192.168.1.20 is the attacker with most requests. '

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.3)
# plt.grid(axis='x', alpha=0.2)
# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)


# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open Sans")
plt.ylabel('Device Make', fontsize=20, fontname="Open Sans")


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

plt.barh(devices.index, devices.values, color='blue', alpha=0.5)
```

```
[20]: <BarContainer object of 10 artists>
```



3.2 Instagram Account Compromised

[21]:

```
# Writing functions for columns that we wanna generate randomly
def generate_attacker_mac_address():
    return '1c:8c:f5:0d:d2:53'

def generate_attacker_dest_ip_address():
    # define the weights for each website
    website_weights = {'Youtube': 15, 'Instagram': 100, 'Facebook': 8,␣
 ↪'Twitter': 5, 'Other': 2}

    # create a list of websites based on their weights
    websites = []
    for website, weight in website_weights.items():
        websites.extend([website] * weight)

    # randomly select a website from the list
    website = random.choice(websites)

    # generate a random IP address for the website
    if website == 'Youtube':
        return ('216.58.194.45' , website)
    elif website == 'Instagram':
        return ('3.213.31.34' , website)
    elif website == 'Facebook':
        return ('69.63.176.22' , website)
    elif website == 'Twitter':
        return ('104.244.42.12' , website)
    else:
        return ('192.168.1.53' , website)
```

```python
def generate_dest_ip_address():
    # define the weights for each website
    website_weights = {'Youtube': 8, 'Instagram': 10, 'Facebook': 8, 'Twitter': 5, 'Other': 2}

    # create a list of websites based on their weights
    websites = []
    for website, weight in website_weights.items():
        websites.extend([website] * weight)

    # randomly select a website from the list
    website = random.choice(websites)

    # generate a random IP address for the website
    if website == 'Youtube':
        return ('216.58.194.45' , website)
    elif website == 'Instagram':
        return ('3.213.31.34' , website)
    elif website == 'Facebook':
        return ('69.63.176.22' , website)
    elif website == 'Twitter':
        return ('104.244.42.12' , website)
    else:
        return ('192.168.1.53' , website)

def generate_attacker_ip_address():
    ip = '192.168.1.20'
    return ip

def generate_device_name():
    device_names = ['iPhone', 'Samsung', 'OnePlus', 'Nokia', 'Xiaomi', 'Oppo', 'Vivo', 'Realme', 'Micromax', 'Lenovo']
    return random.choice(device_names)

def generate__attacker_interface():
    interfaces = ['5gz', '2.4gz']
    return random.choice(interfaces)

def generate_date_time():
    # generate random date and time, but only in the range of a few days
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = random.randint(0, 10)
    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
 ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = end_date.hour
    if hour < 6:
        # almost no traffic between 2am and 6am
        hour = random.randint(6, 23)
    elif hour < 9:
        # more traffic during the morning hours
        hour = random.randint(6, 10)
    elif hour < 18:
        # most traffic during the daytime
        hour = random.randint(9, 17)
    else:
        # less traffic during the evening hours
        hour = random.randint(17, 23)

    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)

    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')

def generate_attacker_date_time():
    # generate random date and time, but only on 4th day
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = 7

    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
 ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = 19

    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)
    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')

def gen_attacker_protocols():
    protocols = ['TCP', 'UDP', 'DHCP', 'HTTP', 'HTTPS', 'FTP', 'SMTP', 'POP3',␣
 ↪'IMAP', 'DNS', 'ICMP']
    weights = [0.4, 0.5, 0.3, 0.15, 0.1, 0.05, 0.05, 0.025, 0.025, 0.025, 0.35]
    return random.choices(protocols, weights=weights)[0]
```

[22]:

```
# Generate insta brute force attack data, consider a home environment. with 10␣
 ↪users. across a span of 10 days. Visiting 100 websites per device per day.

insta_brute_force_db = pd.DataFrame(columns=['MAC', 'IP Address', 'Device␣
 ↪Name', 'Interface', 'Requested IP', 'Time'])

for i in range(10):
    # check if time columns is on 4th jan
    if i == 7:
        temp_df = pd.DataFrame({
            'MAC' : [generate_attacker_mac_address() for j in range(100)],
            'IP Address': [generate_attacker_ip_address() for j in range(100)],
            'Device Name': [generate_device_name() if j > 50 else 'Vivo' for j␣
 ↪in range(100)],
            'Interface': [generate_interface() for j in range(100)],
            'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
            'Requested Website': [generate_attacker_dest_ip_address()[1] for j␣
 ↪in range(100)],
            'Protocol': [gen_attacker_protocols() if j < 50 else␣
 ↪gen_protocols() for j in range(100)],
            'Time': [generate_attacker_date_time() if j < 50 else␣
 ↪generate_date_time() for j in range(100)]
        })

    else:
        temp_df = pd.DataFrame({
            'MAC' : [generate_mac_address() for j in range(100)],
            'IP Address': [generate_device_ip_address() for j in range(100)],
            'Device Name': [generate_device_name() for j in range(100)],
            'Interface': [generate_interface() for j in range(100)],
            'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
            'Requested Website': [generate_dest_ip_address()[1] for j in␣
 ↪range(100)],
            'Protocol': [gen_attacker_protocols() for j in range(100)],
            'Time': [generate_date_time() for j in range(100)]
    })
    insta_brute_force_db = pd.concat([insta_brute_force_db, temp_df],␣
 ↪ignore_index=True)

insta_brute_force_db
```

[22]:

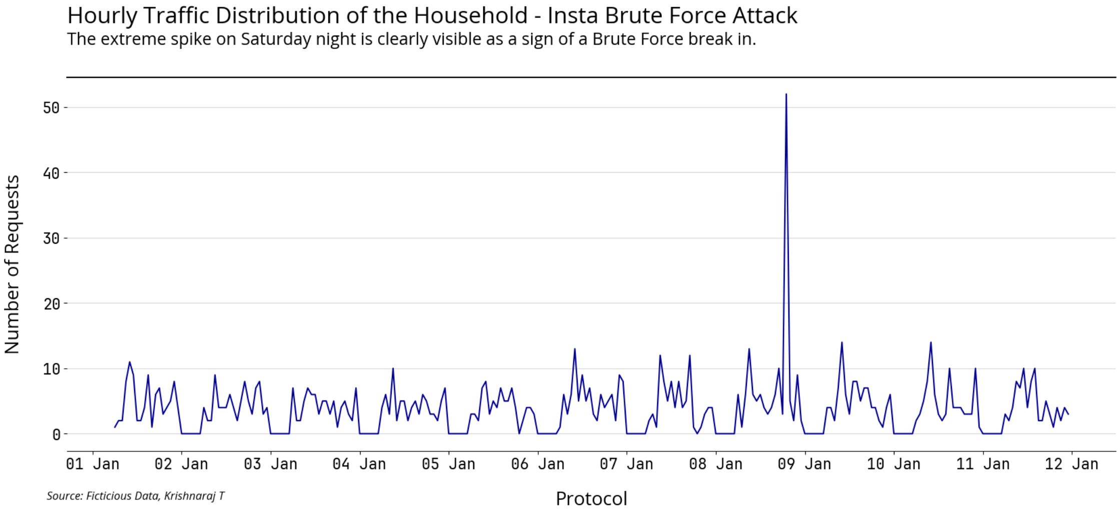
```
                   MAC    IP Address Device Name Interface   Requested IP  \
0    2c:a2:6d:d7:4d:95  192.168.1.30      Xiaomi      2.4gz   69.63.176.22
1    4d:28:71:f8:33:42  192.168.1.40     OnePlus      2.4gz  216.58.194.45
2    50:47:ca:97:8b:ef  192.168.1.80     OnePlus        5gz   69.63.176.22
3    e4:fb:ab:37:11:e3  192.168.1.40        Oppo      2.4gz   69.63.176.22
4    94:e8:1a:89:bf:a1  192.168.1.20      iPhone        5gz  216.58.194.45
..                 …           …         …       …              …
995  7b:ee:0a:0f:fa:46  192.168.1.20      Xiaomi        5gz   69.63.176.22
996  b3:70:45:97:7f:8f  192.168.1.90      Xiaomi      2.4gz   69.63.176.22
997  01:ab:22:5a:15:8f  192.168.1.60       Nokia      2.4gz    3.213.31.34
998  35:82:e7:e0:2b:ef  192.168.1.10       Nokia      2.4gz   192.168.1.53
999  da:4a:75:f6:fd:d3  192.168.1.20      Realme        5gz   69.63.176.22

                    Time Requested Website Protocol
0    2023-01-07 13:15:56           Youtube     SMTP
1    2023-01-10 15:25:23         Instagram     DHCP
2    2023-01-03 15:44:14           Twitter      TCP
3    2023-01-06 20:00:19           Youtube    HTTPS
4    2023-01-11 12:35:29           Youtube      UDP
..                   …                …       …
995  2023-01-08 17:14:18         Instagram      TCP
996  2023-01-09 10:54:10          Facebook      TCP
997  2023-01-01 17:40:04          Facebook    HTTPS
998  2023-01-08 20:08:56           Youtube      TCP
999  2023-01-07 17:01:59         Instagram     IMAP

[1000 rows x 8 columns]
```

[23]:

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

temp_df = insta_brute_force_db.copy()
# convert the 'Time' column to a datetime object
temp_df['Time'] = pd.to_datetime(temp_df['Time'])

# set the 'Time' column as the index
temp_df.set_index('Time', inplace=True)

# resample the data by hour and count the number of requests
hourly_counts = temp_df.resample('H').count()['MAC']
```

```python
# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Hourly Traffic Distribution of the Household - Insta Brute Force Attack'
subtitle = 'The extreme spike on Saturday night is clearly visible as a sign of a Brute Force break in. '

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)
```

```
# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# ax.set_title('Protocols Used to Make Requests')
ax.set_xlabel('Protocol')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)

plt.plot(hourly_counts.index, hourly_counts.values, color='darkblue')

# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

# customize the tick labels
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %b'))
```



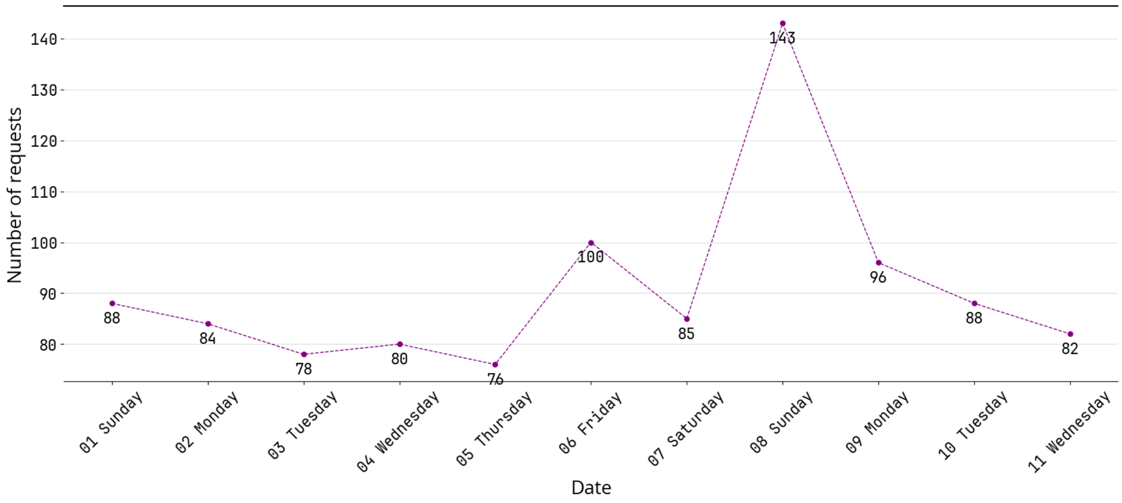
Source: Ficticious Data, Krishnaraj T

[24]:

```
# let us plot the number of requests per day
insta_brute_force_db['Time'] = pd.to_datetime(insta_brute_force_db['Time'])
insta_brute_force_db['Date'] = insta_brute_force_db['Time'].dt.date

# sort data by date
insta_brute_force_db = insta_brute_force_db.sort_values(by=['Date'])

insta_brute_force_db.head()

# now let us plot the number of requests per day
dates = insta_brute_force_db['Date'].value_counts()

# sorting dates
dates = dates.sort_index()

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'The Number of Requests Made per day by the Household - Insta Brute␣
 ↪Force Attack'
subtitle = 'The extreme spike on Saturday night is clearly visible as a sign of␣
 ↪a Brute Force break in.'

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)

plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)
```

```python
# plotting as a time series
plt.plot_date(dates.index, dates.values, color='purple', marker='o', linestyle='dashed', linewidth=1, markersize=5)

# also put labels on the markers a little over the markers for visibility
for i in range(len(dates)):
    plt.text(dates.index[i], dates.values[i]-3, dates.values[i], ha='center', va='center', color='black', fontsize=16)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Date', fontsize=20, fontname="Open Sans")
plt.ylabel('Number of requests', fontsize=20, fontname="Open Sans")

# change space on top of chart we are actually adjusting the scale of the plot as well.
plt.subplots_adjust(top=0.8, wspace=0.3)

# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# tilt the x-axis labels by 45 degrees
for tick in ax.get_xticklabels():
    tick.set_rotation(45)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.4)
# plt.grid(axis='x', alpha=0.2)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# customize the tick labels
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %A'))

plt.show()
```

```
/tmp/ipykernel_1371293/3146978229.py:45: UserWarning: marker is redundantly
defined by the 'marker' keyword argument and the fmt string "o" (-> marker='o').
The keyword argument will take precedence.
  plt.plot_date(dates.index, dates.values, color='purple', marker='o',
linestyle='dashed', linewidth=1, markersize=5)
```



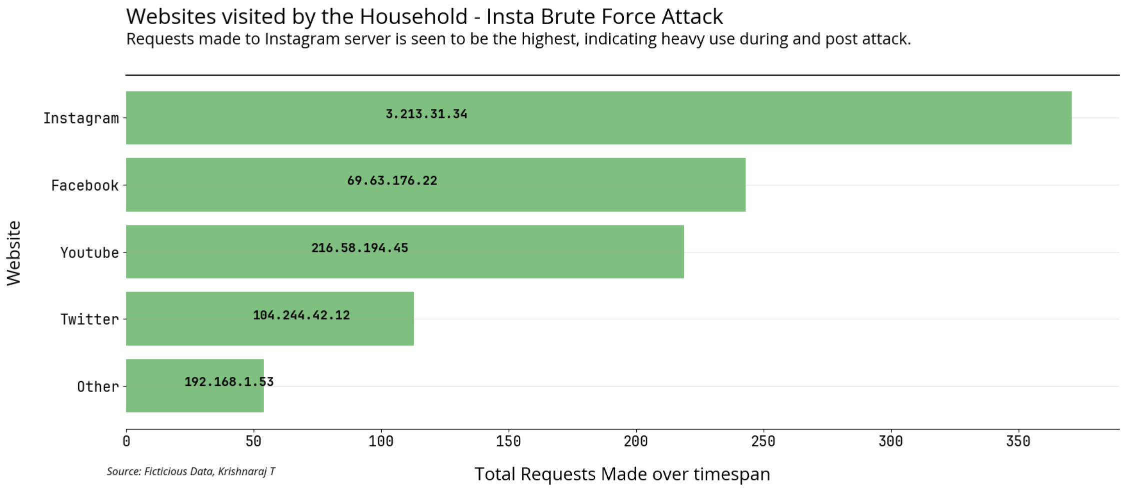
The Number of Requests Made per day by the Household - Insta Brute Force Attack

The extreme spike on Saturday night is clearly visible as a sign of a Brute Force break in.

```
[25]: import matplotlib.pyplot as plt

      # assuming you have a DataFrame called `normal_log_db` with columns called␣
        ↪'Requested IP' and 'Requested Website'
      destination_ips = insta_brute_force_db['Requested IP'].value_counts()
      destination_ips = destination_ips.sort_values(ascending=False)

      destination_websites = insta_brute_force_db['Requested Website'].value_counts()
      destination_websites = destination_websites.sort_values(ascending=False)

      destination_ips = destination_ips.iloc[::-1]
      destination_websites = destination_websites.iloc[::-1]

      # creating the plot.
      fig, ax = plt.subplots(figsize=(20, 8))

      # informative title + subtitle
      title = 'Websites visited by the Household - Insta Brute Force Attack'
      subtitle = 'Requests made to Instagram server is seen to be the highest,␣
        ↪indicating heavy use during and post attack. '

      # add title + subtitle to plot
      plt.text(
          x = 0.125,y = 0.90,s = title, fontname="Open Sans",
          fontsize = 24,ha='left',transform = fig.transFigure
      )
```

```
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.3)
# plt.grid(axis='x', alpha=0.2)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)


# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
 ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# set the y-axis tick labels to the website names
plt.yticks(range(len(destination_websites)), destination_websites.index)

# invert the y-axis so that the website names are displayed from top to bottom
# plt.gca().invert_yaxis()

# add the names of the websites inside their individual bars
```

```
for i, v in enumerate(destination_ips.index):
    plt.text(x=destination_ips.values[i] / 3, y=i, s=v, color='black',␣
 ↪fontweight='bold', fontsize=14)


# foot note
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)

plt.barh(range(len(destination_websites)), destination_websites.values,␣
 ↪color='green', alpha=0.5)


plt.show()
```



Websites visited by the Household - Insta Brute Force Attack

Requests made to Instagram server is seen to be the highest, indicating heavy use during and post attack.

Source: Ficticious Data, Krishnaraj T

3.3 Port Scanning

This is a surveillance technique that is used to identify open ports on a system. This is used by hackers to identify vulnerable ports on a system.

[26]:
```
# Writing functions for columns that we wanna generate randomly
def generate_attacker_mac_address():
    return '1c:8c:f5:0d:d2:53'

def generate_attacker_dest_ip_address():
    # define the weights for each website
    website_weights = {'Youtube': 15, 'Instagram': 100, 'Facebook': 8,␣
 ↪'Twitter': 5, 'Other': 2}

    # create a list of websites based on their weights
    websites = []
    for website, weight in website_weights.items():
        websites.extend([website] * weight)

    # randomly select a website from the list
    website = random.choice(websites)

    # generate a random IP address for the website
    if website == 'Youtube':
        return ('216.58.194.45' , website)
    elif website == 'Instagram':
        return ('3.213.31.34' , website)
    elif website == 'Facebook':
        return ('69.63.176.22' , website)
    elif website == 'Twitter':
        return ('104.244.42.12' , website)
    else:
        return ('192.168.1.53' , website)


def generate_dest_ip_address():
    # define the weights for each website
    website_weights = {'Youtube': 8, 'Instagram': 10, 'Facebook': 8, 'Twitter':␣
 ↪5, 'Other': 2}

    # create a list of websites based on their weights
    websites = []
    for website, weight in website_weights.items():
        websites.extend([website] * weight)

    # randomly select a website from the list
    website = random.choice(websites)

    # generate a random IP address for the website
    if website == 'Youtube':
        return ('216.58.194.45' , website)
    elif website == 'Instagram':
        return ('3.213.31.34' , website)
    elif website == 'Facebook':
        return ('69.63.176.22' , website)
    elif website == 'Twitter':
        return ('104.244.42.12' , website)
    else:
        return ('192.168.1.53' , website)

def generate_attacker_ip_address():
    ip = '192.168.1.20'
    return ip

def generate_device_name():
    device_names = ['iPhone', 'Samsung', 'OnePlus', 'Nokia', 'Xiaomi', 'Oppo',␣
 ↪'Vivo', 'Realme', 'Micromax', 'Lenovo']
    return random.choice(device_names)

def generate__attacker_interface():
    interfaces = ['5gz', '2.4gz']
    return random.choice(interfaces)

def generate_date_time():
    # generate random date and time, but only in the range of a few days
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = random.randint(0, 10)

    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
 ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = end_date.hour
    if hour < 6:
        # almost no traffic between 2am and 6am
        hour = random.randint(6, 23)
    elif hour < 9:
        # more traffic during the morning hours
        hour = random.randint(6, 10)
    elif hour < 18:
        # most traffic during the daytime
        hour = random.randint(9, 17)
    else:
        # less traffic during the evening hours
        hour = random.randint(17, 23)

    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)

    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')

def generate_attacker_date_time():
    # generate random date and time, but only on 4th day
    start_date = pd.to_datetime('2023-01-01')

    # generate random number of days
    days_to_add = random.choice([3, 4, 5, 6, 7])

    # generate random number of seconds
    seconds_to_add = random.randint(0, 86400)

    # add random days and seconds to start date
    end_date = start_date + pd.Timedelta(days=days_to_add,␣
 ↪seconds=seconds_to_add)

    # set the hour of the timestamp based on the time of day
    hour = 19

    # set the hour of the timestamp
    end_date = end_date.replace(hour=hour)

    # return timestamp as string
    return end_date.strftime('%Y-%m-%d %H:%M:%S')

def gen_attacker_protocols():
    protocols = ['TCP', 'UDP', 'DHCP', 'HTTP', 'HTTPS', 'FTP', 'SMTP', 'POP3',␣
 ↪'IMAP', 'DNS', 'ICMP']
    ports = {
        'TCP': 21,          # HTTP
        'UDP': 53,          # DNS
        'DHCP': 67,         # DHCP Server
        'HTTP': 80,         # Hypertext Transfer Protocol
        'HTTPS': 443,       # HTTP Secure (TLS/SSL)
        'FTP': 21,          # File Transfer Protocol (Control)
        'SMTP': 25,         # Simple Mail Transfer Protocol
        'POP3': 110,        # Post Office Protocol v3
        'IMAP': 143,        # Internet Message Access Protocol
        'DNS': 53,          # Domain Name System
        'ICMP': None        # Internet Control Message Protocol (does not use␣
↪ports)
    }
    # A more evenly distributed weight list that adds up to 1.
    weights = [0.15, 0.1, 0.1, 0.2, 0.2, 0.05, 0.05, 0.025, 0.025, 0.025, 0.05]
    selection = random.choices(protocols, weights=weights)[0]
    return (selection, ports[selection])
```

[27]:

```
# Generate insta brute force attack data, consider a home environment. with 10␣
↪users. across a span of 10 days. Visiting 100 websites per device per day.

port_scanning_db = pd.DataFrame(columns=['MAC', 'IP Address', 'Device Name',␣
↪'Interface', 'Requested IP', 'Time'])

for i in range(10):
    # check if time columns is on 4th jan
    if i in [3, 4, 5, 6, 7]:
        temp_df = pd.DataFrame({
            'MAC' : [generate_attacker_mac_address() for j in range(100)],
            'IP Address': [generate_attacker_ip_address() for j in range(100)],
            'Device Name': [generate_device_name() if j > 50 else 'Vivo' for j␣
↪in range(100)],
            'Interface': [generate_interface() for j in range(100)],
            'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
            'Requested Website': [generate_attacker_dest_ip_address()[1] for j␣
↪in range(100)],
            'Protocol': [gen_attacker_protocols()[0] for j in range(100)],
            'Port': [gen_attacker_protocols()[1]  for j in range(100)],
            'Time': [generate_attacker_date_time() if j < 50 else␣
↪generate_date_time() for j in range(100)]
        })

    else:
        temp_df = pd.DataFrame({
            'MAC' : [generate_mac_address() for j in range(100)],
            'IP Address': [generate_device_ip_address() for j in range(100)],
            'Device Name': [generate_device_name() for j in range(100)],
            'Interface': [generate_interface() for j in range(100)],
            'Requested IP': [generate_dest_ip_address()[0] for j in range(100)],
            'Requested Website': [generate_dest_ip_address()[1] for j in␣
↪range(100)],
            'Protocol': [gen_protocols()[0] for j in range(100)],
            'Port': [gen_protocols()[1] for j in range(100)],
            'Time': [generate_date_time() for j in range(100)]
    })
    port_scanning_db = pd.concat([port_scanning_db, temp_df], ignore_index=True)

port_scanning_db
```

[27]:

```
                   MAC    IP Address Device Name Interface   Requested IP  \
0    c8:7e:39:8f:88:0e  192.168.1.90      iPhone       5gz    3.213.31.34
1    a4:40:77:9c:a1:20  192.168.1.40       Nokia       5gz   192.168.1.53
2    3d:4c:d1:cb:77:fe  192.168.1.20      Realme       5gz    3.213.31.34
3    d8:76:ce:51:e6:a6  192.168.1.90     OnePlus       5gz   69.63.176.22
4    38:0d:88:f0:32:60  192.168.1.90      Xiaomi       5gz   69.63.176.22
..                  …           …         …       …             …
995  21:c2:3c:0e:7b:fb  192.168.1.70      Lenovo       5gz    3.213.31.34
996  09:7a:bb:6b:8e:65  192.168.1.60       Nokia       5gz   69.63.176.22
997  42:fd:10:ff:30:9a  192.168.1.20     OnePlus     2.4gz  104.244.42.12
998  19:eb:68:62:86:85  192.168.1.10        Oppo     2.4gz    3.213.31.34
999  27:20:42:cc:90:b1  192.168.1.30      Xiaomi       5gz    3.213.31.34

                    Time Requested Website Protocol   Port
0    2023-01-02 09:36:12          Facebook     HTTP  143.0
1    2023-01-03 07:15:50         Instagram    HTTPS   21.0
2    2023-01-11 10:34:36           Youtube    HTTPS   21.0
3    2023-01-08 17:18:27         Instagram      TCP    NaN
4    2023-01-11 10:13:45         Instagram      UDP  443.0
..                    …                …      …    …
995  2023-01-05 15:54:49           Youtube     HTTP   80.0
996  2023-01-04 22:39:57         Instagram      UDP   21.0
997  2023-01-06 06:40:58           Twitter     POP3   21.0
998  2023-01-04 23:53:19         Instagram     ICMP   80.0
999  2023-01-03 18:24:33           Youtube     DHCP   53.0

[1000 rows x 9 columns]
```

[28]:

```
# let us now plot what protocols were used to make requests
# count the number of requests for each protocol

port_counts = port_scanning_db['Port'].value_counts()

# change indices from float to int
port_counts.index = port_counts.index.astype(int)
port_counts.index = port_counts.index.astype(str)

port_counts.index
```

[28]:

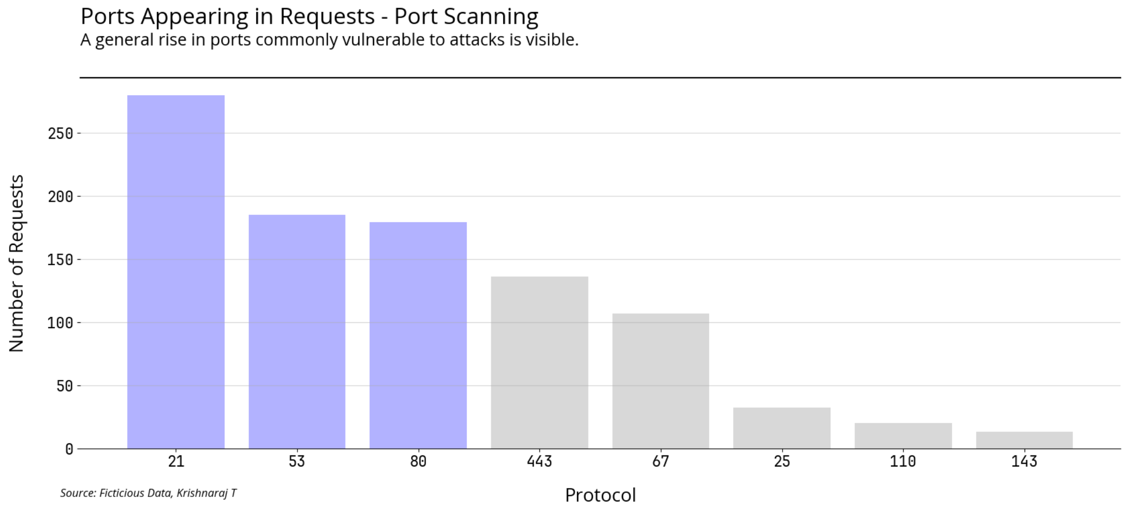
```
Index(['21', '53', '80', '443', '67', '25', '110', '143'], dtype='object',
name='Port')
```

[29]:

```
# set the color of the first rectangle to pink and the color of the other␣
 ↪rectangles to gray
colors = ['blue'] * 3 + ['gray'] * (len(port_counts) - 3)

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'Ports Appearing in Requests - Port Scanning'
subtitle ='A general rise in ports commonly vulnerable to attacks is visible.'

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)
plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# changing space
plt.subplots_adjust(top=0.8, wspace=0.3)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.5)
# plt.grid(axis='x', alpha=0.5)

# turn off spines
plt.gca().spines[['left','right', 'top']].set_visible(False)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Total Requests Made over timespan', fontsize=20, fontname="Open␣
 ↪Sans", labelpad=20)
plt.ylabel('Website', fontsize=20, fontname="Open Sans", labelpad=20)
```

```python


# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

plt.bar(port_counts.index, port_counts.values, color=colors, alpha=0.3)

# set the title and axis labels
# ax.set_title('Protocols Used to Make Requests')
ax.set_xlabel('Protocol')
ax.set_ylabel('Number of Requests')

# set the x-axis tick labels to be rotated for better readability
# plt.xticks(rotation=45)


# footnote
footnote = "Source: Ficticious Data, Krishnaraj T"
plt.text(
    x = 0.11,
    y = 0.02,
    s = footnote,
    fontname = 'Open Sans',
    fontstyle = 'italic',
    fontsize = 12,
    ha = 'left',
    transform = fig.transFigure
)
```

```
[29]: Text(0.11, 0.02, 'Source: Ficticious Data, Krishnaraj T')
```



Ports Appearing in Requests - Port Scanning

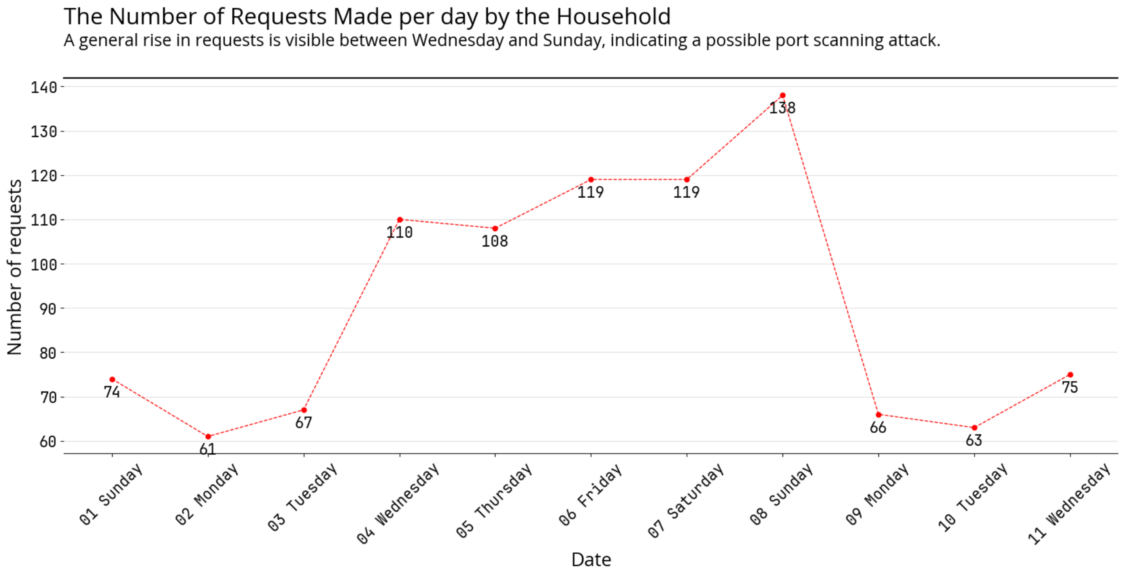
A general rise in ports commonly vulnerable to attacks is visible.

Source: Ficticious Data, Krishnaraj T

[30]:
```
# let us plot the number of requests per day
port_scanning_db['Time'] = pd.to_datetime(port_scanning_db['Time'])
port_scanning_db['Date'] = port_scanning_db['Time'].dt.date

# sort data by date
port_scanning_db = port_scanning_db.sort_values(by=['Date'])

# now let us plot the number of requests per day
dates = port_scanning_db['Date'].value_counts()

# sorting dates
dates = dates.sort_index()

# creating the plot.
fig, ax = plt.subplots(figsize=(20, 8))

# informative title + subtitle
title = 'The Number of Requests Made per day by the Household'
subtitle = 'A general rise in requests is visible between Wednesday and Sunday,␣
  ↪indicating a possible port scanning attack.'

# add title + subtitle to plot
plt.text(
    x = 0.125,y = 0.90,s = title, fontname="Open Sans",
    fontsize = 24,ha='left',transform = fig.transFigure
)

plt.text(
    x = 0.125,y = 0.86,s = subtitle, fontname="Open Sans",
    fontsize = 18,ha = 'left',transform = fig.transFigure
)

# line between titles and chart
plt.gca().plot(
    [0.125, .9], # x co-ords
    [.80, .80], # y co-ords
    transform = fig.transFigure,
    clip_on = False,
    color = 'k',
    linewidth = 1.5
)

# plotting as a time series
plt.plot_date(dates.index, dates.values, color='red', marker='o',␣
 ↪linestyle='dashed', linewidth=1, markersize=5)

# also put labels on the markers a little over the markers for visibility
for i in range(len(dates)):
    plt.text(dates.index[i], dates.values[i]-3, dates.values[i], ha='center',␣
 ↪va='center', color='black', fontsize=16)

# set the size of the tick labels and axis labels
ax.tick_params(axis='both', which='major', labelsize=16)
plt.xlabel('Date', fontsize=20, fontname="Open Sans")
plt.ylabel('Number of requests', fontsize=20, fontname="Open Sans")

# change space on top of chart we are actually adjusting the scale of the plot␣
 ↪as well.
plt.subplots_adjust(top=0.8, wspace=0.3)

# set the font size of the tick labels
for tick in ax.xaxis.get_major_ticks():
    tick.label1.set_fontsize(16)
for tick in ax.yaxis.get_major_ticks():
    tick.label1.set_fontsize(16)

# tilt the x-axis labels by 45 degrees
for tick in ax.get_xticklabels():
    tick.set_rotation(45)

# grid lines
# keep only toned down vertical lines
plt.grid(axis = 'y',alpha = 0.4)
# plt.grid(axis='x', alpha=0.2)

# turn off spines
```

```
plt.gca().spines[['left','right', 'top']].set_visible(False)

# customize the tick labels
ax.xaxis.set_major_locator(mdates.DayLocator())
ax.xaxis.set_major_formatter(mdates.DateFormatter('%d %A'))

plt.show()
```

```
/tmp/ipykernel_1371293/3533643962.py:43: UserWarning: marker is redundantly
defined by the 'marker' keyword argument and the fmt string "o" (-> marker='o').
The keyword argument will take precedence.
  plt.plot_date(dates.index, dates.values, color='red', marker='o',
linestyle='dashed', linewidth=1, markersize=5)
```



[ ]:

[ ]: