Ağ Trafiği Sınıflandırması

1. Veri Toplama:

Analiz yapmak için gerekli verileri ağ trafiği, paket yakalama aracı olan WİRESHARK wifi interface çalıştırılarak sağlanmıştır.

2. Veri Keşfi (Exploratory Data Analysis - EDA)

2.a.) Veri Seti Yapısının İncelenmesi

In [22]:
```
import pandas as pd
import numpy as np
import seaborn as sns
```

In [24]:
```
wireshark= pd.read_csv("time.csv")
```

In [26]:
```
wireshark.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 62016 entries, 0 to 62015
Data columns (total 9 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   No.               62016 non-null  int64  
 1   Time              62016 non-null  int64  
 2   Source            62016 non-null  object 
 3   Destination       62016 non-null  object 
 4   Protocol          62016 non-null  object 
 5   Length            62016 non-null  int64  
 6   Destination Port  40889 non-null  float64
 7   Stream index      40889 non-null  float64
 8   Info              62016 non-null  object 
dtypes: float64(2), int64(3), object(4)
memory usage: 4.3+ MB
```

In [28]:
```
wireshark.describe()
```

Out[28]:

	No.	Time	Length	Destination Port	Stream index
count	62016.000000	62016.000000	62016.000000	40889.000000	40889.000000
mean	31008.500000	86.391189	963.091863	36707.616376	114.703514
std	17902.621484	37.106657	549.782212	21378.896337	19.381774
min	1.000000	0.000000	42.000000	80.000000	0.000000
25%	15504.750000	49.000000	148.000000	443.000000	109.000000
50%	31008.500000	81.000000	1292.000000	49215.000000	126.000000
75%	46512.250000	127.000000	1294.000000	49229.000000	126.000000
max	62016.000000	170.000000	1474.000000	63125.000000	141.000000

In [30]:
```
wireshark.head()
```

Out[30]:

	No.	Time	Source	Destination	Protocol	Length	Destination Port	Stream index	Info
0	1	0	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	wr-in-f207.1e100.net	TLSv1.2	110	443.0	0.0	Application Data
1	2	0	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	wr-in-f207.1e100.net	TCP	86	443.0	0.0	51528 > 443 [FIN, ACK] Seq=25 Ack=1 Win=2048...
2	3	0	wr-in-f207.1e100.net	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	TCP	86	51528.0	0.0	443 > 51528 [ACK] Seq=1 Ack=25 Win=311 Len=0...
3	4	0	wr-in-f207.1e100.net	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	TCP	86	51528.0	0.0	443 > 51528 [FIN, ACK] Seq=1 Ack=26 Win=311 ...
4	5	0	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	wr-in-f207.1e100.net	TCP	86	443.0	0.0	51528 > 443 [ACK] Seq=26 Ack=2 Win=2048 Len=...

In [32]:
```
wireshark.groupby(["Protocol"]).describe()
```

Out[32]:

	No.								Time		...	Destination Port					
	count	mean	std	min	25%	50%	75%	max	count	mean	...	75%	max	count	mean	std	min
Protocol																	
ARP	10.0	28480.800000	23643.022733	35.0	5750.50	29657.0	39300.75	61976.0	10.0	79.400000	...	NaN	NaN	0.0	NaN	NaN	NaN
BROWSER	2.0	107.500000	0.707107	107.0	107.25	107.5	107.75	108.0	2.0	19.000000	...	NaN	NaN	0.0	NaN	NaN	NaN
DNS	652.0	17496.242331	16277.609162	18.0	4025.75	15426.0	25599.50	61895.0	652.0	59.312883	...	NaN	NaN	0.0	NaN	NaN	NaN
HTTP	6.0	32745.166667	287.376698	32478.0	32519.50	32670.0	32900.75	33206.0	6.0	90.000000	...	49232.0	49232.0	6.0	130.000000	0.000000	130.0
ICMP	49.0	19941.081633	19086.578733	241.0	4101.00	14579.0	28219.00	61896.0	49.0	66.081633	...	NaN	NaN	0.0	NaN	NaN	NaN
ICMPv6	28.0	32774.392857	22369.155923	86.0	12400.75	38991.5	51917.50	62002.0	28.0	91.821429	...	NaN	NaN	0.0	NaN	NaN	NaN
MDNS	12.0	15890.500000	22957.013606	165.0	435.75	5098.5	22827.25	61718.0	12.0	58.333333	...	NaN	NaN	0.0	NaN	NaN	NaN
NBNS	6.0	5947.833333	9055.553642	95.0	99.25	109.5	13256.00	17639.0	6.0	29.000000	...	NaN	NaN	0.0	NaN	NaN	NaN
QUIC	20360.0	12604.967485	8697.542733	238.0	6049.75	11330.5	17220.25	61972.0	20360.0	48.904519	...	NaN	NaN	0.0	NaN	NaN	NaN
SSDP	8.0	31182.625000	32676.057539	203.0	663.75	31381.0	61756.50	61761.0	8.0	90.500000	...	NaN	NaN	0.0	NaN	NaN	NaN
TCP	35168.0	41115.388393	13303.265712	2.0	31576.75	42367.0	52160.25	62016.0	35168.0	107.039752	...	49229.0	63125.0	35168.0	115.412563	18.578734	0.0
TLSv1.2	702.0	37308.676638	14772.139032	1.0	29277.00	39609.0	48846.00	58377.0	702.0	101.772080	...	49215.0	63124.0	702.0	105.668091	24.926988	0.0
TLSv1.3	5013.0	35904.578895	13891.973649	126.0	27143.00	34324.0	45729.00	62006.0	5013.0	95.485937	...	49229.0	63125.0	5013.0	110.976262	22.948675	12.0

13 rows × 40 columns

2.b) Veri seti dönüşümleri

In [35]:
```
wireshark.dtypes
```

Out[35]:
```
No.                 int64
Time                int64
Source             object
Destination        object
Protocol           object
Length              int64
Destination Port  float64
Stream index      float64
Info               object
dtype: object
```

In [37]:
```
wireshark.Protocol =pd.Categorical(wireshark.Protocol)
```

In [39]:
```
wireshark.dtypes
```

Out[39]:
```
No.                  int64
Time                 int64
Source              object
Destination         object
Protocol          category
Length               int64
Destination Port   float64
Stream index       float64
Info                object
dtype: object
```

Veri Setinin Betimlenmesi

In [42]:
```
wireshark.shape
```

Out[42]:
```
(62016, 9)
```

In [44]:
```
wireshark.columns
```

Out[44]:
```
Index(['No.', 'Time', 'Source', 'Destination', 'Protocol', 'Length',
       'Destination Port', 'Stream index', 'Info'],
      dtype='object')
```

In [46]:
```
wireshark.describe().T
```

Out[46]:

	count	mean	std	min	25%	50%	75%	max
No.	62016.0	31008.500000	17902.621484	1.0	15504.75	31008.5	46512.25	62016.0
Time	62016.0	86.391189	37.106657	0.0	49.00	81.0	127.00	170.0
Length	62016.0	963.091863	549.782212	42.0	148.00	1292.0	1294.00	1474.0
Destination Port	40889.0	36707.616376	21378.896337	80.0	443.00	49215.0	49229.00	63125.0
Stream index	40889.0	114.703514	19.381774	0.0	109.00	126.0	126.00	141.0

In [48]:
```
wireshark.describe(include ="all").T
```

Out[48]:

	count	unique	top	freq	mean	std	min	25%	50%	75%	max
No.	62016.0	NaN	NaN	NaN	31008.5	17902.621484	1.0	15504.75	31008.5	46512.25	62016.0
Time	62016.0	NaN	NaN	NaN	86.391189	37.106657	0.0	49.0	81.0	127.0	170.0
Source	62016	90	cs531.wpc.edgecastcdn.net	18835	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Destination	62016	95	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	43419	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Protocol	62016	13	TCP	35168	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Length	62016.0	NaN	NaN	NaN	963.091863	549.782212	42.0	148.0	1292.0	1294.0	1474.0
Destination Port	40889.0	NaN	NaN	NaN	36707.616376	21378.896337	80.0	443.0	49215.0	49229.0	63125.0
Stream index	40889.0	NaN	NaN	NaN	114.703514	19.381774	0.0	109.0	126.0	126.0	141.0
Info	62016	36206	Protected Payload (KP0)	16168	NaN	NaN	NaN	NaN	NaN	NaN	NaN

2.c) Eksik değerlerin İncelenmesi

In [51]:
```
# Hiç eksik gözlem var mı
wireshark.isnull().values.any()
```

Out[51]:
```
True
```

Hangi değişkende kaçar tane var?

In [54]:
```
wireshark.isnull().sum()
```

Out[54]:
```
No.                    0
Time                   0
Source                 0
Destination            0
Protocol               0
Length                 0
Destination Port   21127
Stream index       21127
Info                   0
dtype: int64
```

In [56]:
```
wireshark.loc[wireshark['Protocol'] == 'DNS', 'Destination Port'] = 53
```

In [58]:
```
wireshark.isnull().sum()
```

Out[58]:
```
No.                    0
Time                   0
Source                 0
Destination            0
Protocol               0
Length                 0
Destination Port   20475
Stream index       21127
Info                   0
dtype: int64
```

In [60]:
```
filtered_df = wireshark[wireshark['Destination Port'].isnull()]
filtered_df['Protocol'].value_counts()
```

Out[60]:
```
Protocol
QUIC       20360
ICMP          49
ICMPv6        28
MDNS          12
ARP           10
SSDP           8
NBNS           6
BROWSER        2
DNS            0
HTTP           0
TCP            0
TLSv1.2        0
TLSv1.3        0
Name: count, dtype: int64
```

In [62]:
```
wireshark.drop(columns=['Stream index'], inplace=True)
```

In [64]:
```
wireshark.isnull().sum()
```

Out[64]:
```
No.                    0
Time                   0
Source                 0
Destination            0
Protocol               0
Length                 0
Destination Port    20475
Info                   0
dtype: int64
```

Kategorik değişkenlerin sınıflarına ve sınıf sayısına Erişmek

Object ve Kategorik Değişkenler ve Özetleri

In [68]:
```
kat_df = wireshark.select_dtypes(include =["object"])
kat_df.head()
```

Out[68]:

	Source	Destination	Info
0	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	wr-in-f207.1e100.net	Application Data
1	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	wr-in-f207.1e100.net	51528 > 443 [FIN, ACK] Seq=25 Ack=1 Win=2048...
2	wr-in-f207.1e100.net	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	443 > 51528 [ACK] Seq=1 Ack=25 Win=311 Len=0...
3	wr-in-f207.1e100.net	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	443 > 51528 [FIN, ACK] Seq=1 Ack=26 Win=311 ...
4	2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9	wr-in-f207.1e100.net	51528 > 443 [ACK] Seq=26 Ack=2 Win=2048 Len=...

In [70]:
```
kat_df.Source.unique()
```

Out[70]:
```
array(['2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9', 'wr-in-f207.1e100.net',
       'www.gstatic.com', 'gateway.fe2.apple-dns.net', '192.168.1.190',
       '192.168.1.1', 'zte_3c:85:10', '17.8.155.5',
       '2a01:b740:a41:632::4:1', '17.8.155.58',
       'fe80::10f7:a10d:fcf4:1cba', 'fe80::d672:26ff:fe3c:8510',
       'Apple_c3:68:53', '2a01:b740:a26:f000::5',
       'ec2-15-161-248-77.eu-south-1.compute.amazonaws.com',
       'clientservices.googleapis.com', 'accounts.google.com',
       'www.google.com', '2a06:98c1:3121::3', 'lh2.l.google.com',
       'googlehosted.l.googleusercontent.com', 'www.udemy.com',
       'mmx-ds.cdn.whatsapp.net',
       'media-router-apple71.prod.media.vip.ir2.yahoo.com',
       'google-ohttp-relay-safebrowsing.fastly-edge.com',
       '192.229.221.95', 'www3.l.google.com', 'update.googleapis.com',
       'mobile-gtalk.l.google.com', '2a01:b740:a26:f000::1',
       '2a01:b740:a1a:f000::3', 'ssl.gstatic.com',
       'a2-20-148-21.deploy.static.akamaitechnologies.com',
       'ec2-3-66-160-189.eu-central-1.compute.amazonaws.com',
       'i.ytimg.com',
       'g2a02-26f0-fa00-01b9-0000-0000-0000-02a1.deploy.static.akamaite',
       '188.114.96.3', 'www.googleapis.com', 'pancake.g.aaplimg.com',
       'googleads.g.doubleclick.net', 'fonts.gstatic.com',
       'www.google.com.tr', 'photos-ugc.l.googleusercontent.com',
       'content-autofill.googleapis.com', 'jnn-pa.googleapis.com',
       'static.doubleclick.net', '2a02:e0:3200::d4fc:7e4a',
       'clients.l.google.com', 'rr1.sn-u0g3jxaa-5qcl.googlevideo.com',
       'g2a02-26f0-fa00-01b0-0000-0000-0000-02a1.deploy.static.akamaite',
       'rr5.sn-u0g3jxaa-5qcs.googlevideo.com',
       'rr3.sn-nv47lns6.googlevideo.com',
       'rr2.sn-u0g3jxaa-5qcl.googlevideo.com',
       'e5977.dsce9.akamaiedge.net', 'play.google.com',
       'rr3.sn-u0g3jxaa-5qce.googlevideo.com',
       'g2a02-26f0-fa00-028e-0000-0000-0000-441d.deploy.static.akamaite',
       'g2a02-26f0-fa00-01ae-0000-0000-0000-1759.deploy.static.akamaite',
       'a2-20-149-82.deploy.static.akamaitechnologies.com',
       'rr4.sn-u0g3jxaa-5qcs.googlevideo.com',
       'rr1.sn-nv47lnly.googlevideo.com',
       'rr1.sn-nv47zne7.googlevideo.com',
       'doh.dns.apple.com.v.aaplimg.com', 'apple.com',
       'suggestqueries-clients6.youtube.com',
       'encrypted-tbn0.gstatic.com', 'www.tdk.gov.tr',
       'sakarya.ayk.gov.tr', 'www.google-analytics.com',
       'www.googletagmanager.com', 'www.googleadservices.com',
       'id.google.com', 'twitter.com', 'adservice.google.com',
       'cs510.wpc.edgecastcdn.net', 'tpop-api.twitter.com',
       'dualstack.twimg.twitter.map.fastly.net',
       'cs531.wpc.edgecastcdn.net', 't.co', 's.twitter.com',
       'platform.twitter.map.fastly.net', 'cm.g.doubleclick.net',
       'abs-zero.twimg.com', 'edgedl.me.gvt1.com', '2a06:98c1:3120::3',
       'beacons-handoff.gcp.gvt2.com', 'e2c62.gcp.gvt2.com',
       'beacons.gvt2.com', 'google.com', 'beacons2.gvt2.com'],
      dtype=object)
```

In [72]:
```
kat_df["Source"].value_counts().count()
```

Out[72]:
```
90
```

In [74]:
```
kat_df["Source"].value_counts()
```

Out[74]:
```
Source
cs531.wpc.edgecastcdn.net                                    18835
2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9                        12749
dualstack.twimg.twitter.map.fastly.net                        3499
lh2.l.google.com                                              3481
cs510.wpc.edgecastcdn.net                                     3124
                                                             ...
188.114.96.3                                                     4
2a02:e0:3200::d4fc:7e4a                                          3
g2a02-26f0-fa00-01b9-0000-0000-0000-02a1.deploy.static.akamaite  3
wr-in-f207.1e100.net                                             2
192.229.221.95                                                   1
Name: count, Length: 90, dtype: int64
```

In [76]:
```
kat_df["Destination"].value_counts()
```

Out[76]:
```
Destination
2a02:4e0:2d7c:9b49:3c3c:2374:f9de:bc9               43419
cs531.wpc.edgecastcdn.net                            4976
192.168.1.190                                        3681
dualstack.twimg.twitter.map.fastly.net               1314
cs510.wpc.edgecastcdn.net                            1305
                                                    ...
media-router-apple71.prod.media.vip.ir2.yahoo.com       3
192.168.1.255                                           3
wr-in-f207.1e100.net                                    3
192.229.221.95                                          2
ff02::1                                                 2
Name: count, Length: 95, dtype: int64
```

In [78]:
```
kat_df["Destination"].value_counts().count()
```

Out[78]:
```
95
```

In [80]:
```
kat_df["Info"].value_counts().count()
```

Out[80]:
```
36206
```

In [82]:
```
kat_df["Info"].value_counts()
```

Out[82]:
```
Info
Protected Payload (KP0)                                                                                  16168
Application Data                                                                                          3242
Application Data, Application Data, Application Data                                                      1121
Application Data, Application Data                                                                        1029
Protected Payload (KP0), DCID=e218f64b957d52d2                                                             785
                                                                                                         ...
443  >  49205 [ACK] Seq=226721 Ack=61590 Win=254208 Len=0                                                    1
443  >  49205 [ACK] Seq=226721 Ack=58750 Win=248576 Len=0                                                    1
443  >  49205 [ACK] Seq=226721 Ack=55910 Win=242944 Len=0                                                    1
49229  >  443 [ACK] Seq=9959 Ack=2222015 Win=2238976 Len=0 TSval=226082114 TSecr=751445223                    1
[TCP Keep-Alive ACK] 443  >  49208 [ACK] Seq=61914 Ack=2056 Win=69632 Len=0 TSval=1900718205 TSecr=4120035601    1
Name: count, Length: 36206, dtype: int64
```

In [84]:
```
kat_df = wireshark.select_dtypes(include =["category"])
```

In [86]:
```
kat_df.head()
```

Out[86]:

	Protocol
0	TLSv1.2
1	TCP
2	TCP
3	TCP
4	TCP

Kategorik Değişkenin Sınıflarına ve Sınıf Sayısına Erişmek

In [89]:
```
kat_df.Protocol.unique()
```

Out[89]:
```
['TLSv1.2', 'TCP', 'DNS', 'ARP', 'ICMPv6', ..., 'MDNS', 'SSDP', 'QUIC', 'ICMP', 'HTTP']
Length: 13
Categories (13, object): ['ARP', 'BROWSER', 'DNS', 'HTTP', ..., 'SSDP', 'TCP', 'TLSv1.2', 'TLSv1.3']
```

In [91]:
```
kat_df["Protocol"].value_counts().count()
```

Out[91]:
```
13
```

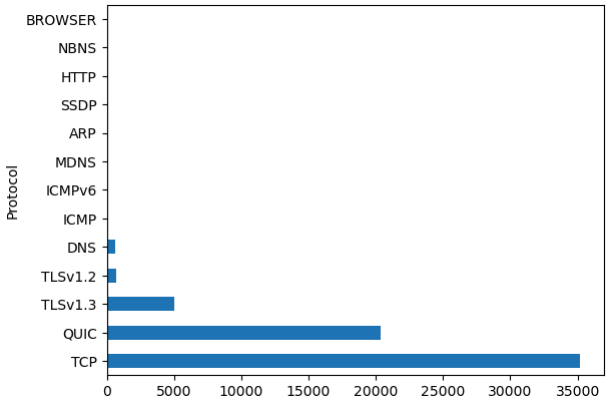
Kategorik Değişkenin Sınıflarına ve Frekanslarına Erişmek

In [94]:
```
kat_df["Protocol"].value_counts()
```

Out[94]:
```
Protocol
TCP        35168
QUIC       20360
TLSv1.3     5013
TLSv1.2      702
DNS          652
ICMP          49
ICMPv6        28
MDNS          12
ARP           10
SSDP           8
HTTP           6
NBNS           6
BROWSER        2
Name: count, dtype: int64
```

In [96]:
```
wireshark["Protocol"].value_counts().plot.barh()
```

Out[96]:
```
<Axes: ylabel='Protocol'>
```



Sürekli Değişken Özetleri

In [99]:
```
df_num = wireshark.select_dtypes(include = ["float64","int64"])
df_num.head()
```

Out[99]:

	No.	Time	Length	Destination Port
0	1	0	110	443.0
1	2	0	86	443.0
2	3	0	86	51528.0
3	4	0	86	51528.0
4	5	0	86	443.0

In [101…
```
df_num.describe().T
```

Out[101…

	count	mean	std	min	25%	50%	75%	max
No.	62016.0	31008.500000	17902.621484	1.0	15504.75	31008.5	46512.25	62016.0
Time	62016.0	86.391189	37.106657	0.0	49.00	81.0	127.00	170.0
Length	62016.0	963.091863	549.782212	42.0	148.00	1292.0	1294.00	1474.0
Destination Port	41541.0	36132.309814	21694.251135	53.0	443.00	49215.0	49229.00	63125.0

In [103…
```
df_num["Time"].describe().T
```

Out[103…
```
count    62016.000000
mean        86.391189
std         37.106657
min          0.000000
25%         49.000000
50%         81.000000
75%        127.000000
max        170.000000
Name: Time, dtype: float64
```

In [105…
```
print("Length Ortalama :"+ str(df_num["Length"].mean()))
print("Length Dolu Gözlem Sayısı :"+ str(df_num["Length"].count()))
print("Length Maksimum Değer :"+ str(df_num["Length"].max()))
print("Length Minimum Değer :"+ str(df_num["Length"].min()))
print("Length Medyan :"+ str(df_num["Length"].median()))
print("Length Standart sapma :"+ str(df_num["Length"].std()))
```

```
Length Ortalama :963.0918633900928
Length Dolu Gözlem Sayısı :62016
Length Maksimum Değer :1474
Length Minimum Değer :42
Length Medyan :1292.0
Length Standart sapma :549.7822115200838
```

Dağılım Grafikleri

Barplot

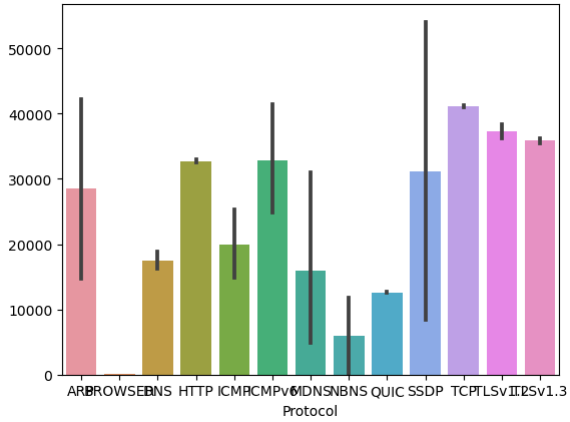
In [109…
```
wireshark.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 62016 entries, 0 to 62015
Data columns (total 8 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   No.               62016 non-null  int64
 1   Time              62016 non-null  int64
 2   Source            62016 non-null  object
 3   Destination       62016 non-null  object
 4   Protocol          62016 non-null  category
 5   Length            62016 non-null  int64
 6   Destination Port  41541 non-null  float64
 7   Info              62016 non-null  object
dtypes: category(1), float64(1), int64(3), object(3)
memory usage: 3.4+ MB
```

In [111…
```
sns.barplot(x = "Protocol", y= wireshark.Protocol.index, data=wireshark)
```

```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/categorical.py:641: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  grouped_vals = vals.groupby(grouper)
```

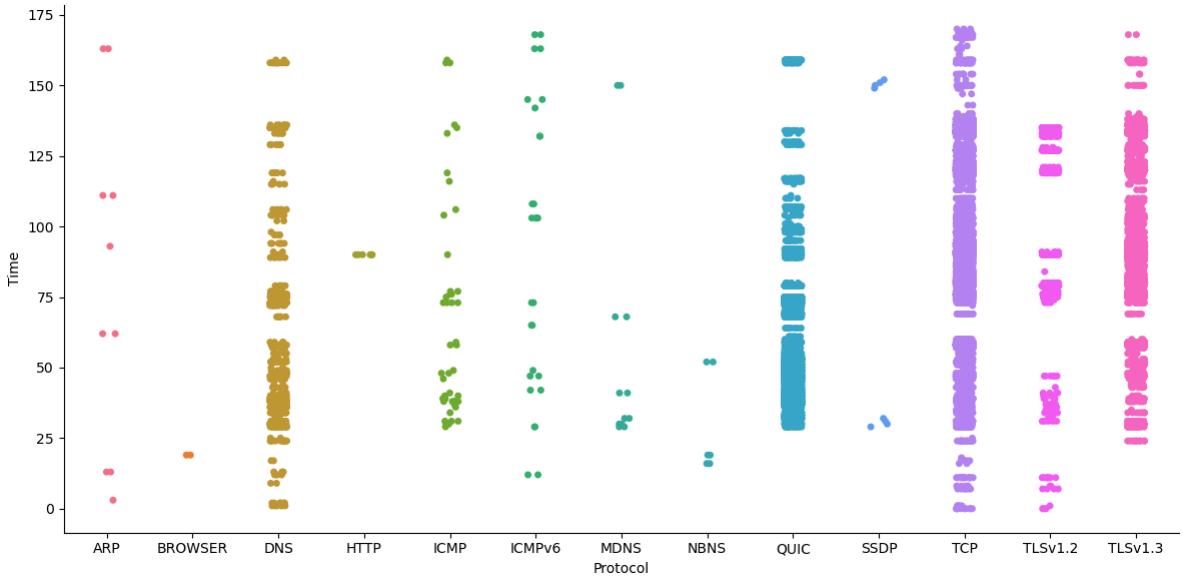
Out[111… <Axes: xlabel='Protocol'>



In [113…
```
sns.catplot(x ="Protocol", y = "Time", data = wireshark,height=6, aspect=2,hue="Protocol" )
```

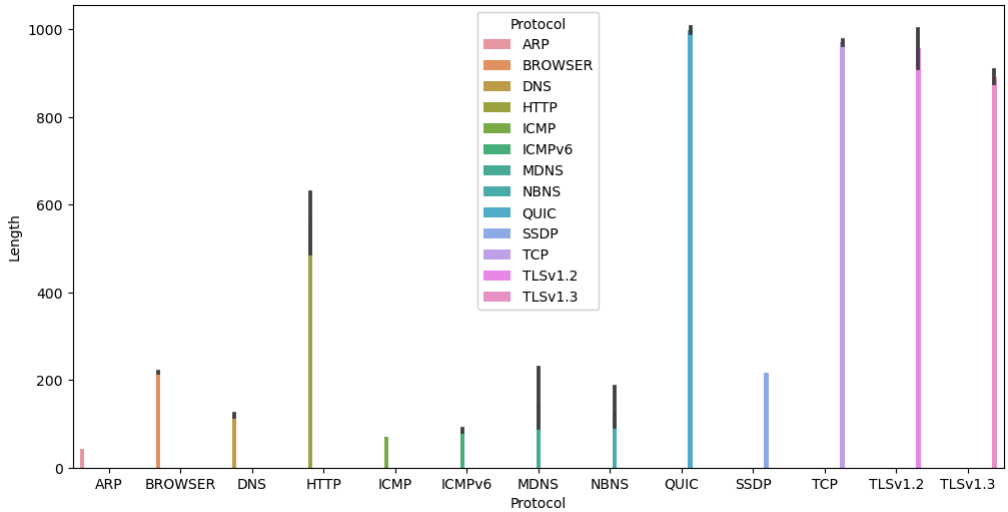
```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

Out[113… <seaborn.axisgrid.FacetGrid at 0x175ac6850>



In [115…
```
import seaborn as sns
import matplotlib.pyplot as plt
plt.figure(figsize=(12, 6))  # 12 birim genişlik, 6 birim yükseklik

# Bar plot çizdir
sns.barplot(x="Protocol", y="Length", data=wireshark, hue="Protocol")

# Grafiği göster
plt.show()
```

```
/opt/anaconda3/lib/python3.11/site-packages/seaborn/categorical.py:641: FutureWarning: The default of observed=False is deprecated and will be changed to True in a future version of pandas. Pass observed=False to retain current behavior or observed=True to adopt the future default and silence this warning.
  grouped_vals = vals.groupby(grouper)
```

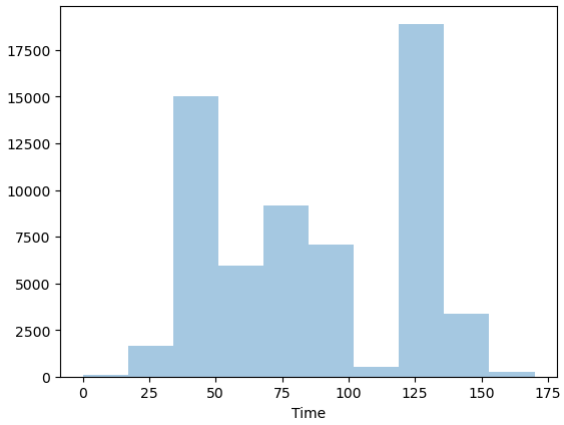


Histogram ve Yoğunluk

In [118…
```
sns.distplot(wireshark.Time,bins=10, kde=False)
```

```
/var/folders/9f/3_v_spgn6tqdx3krk10vsrlm0000gn/T/ipykernel_34728/3072574426.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(wireshark.Time,bins=10, kde=False)
```

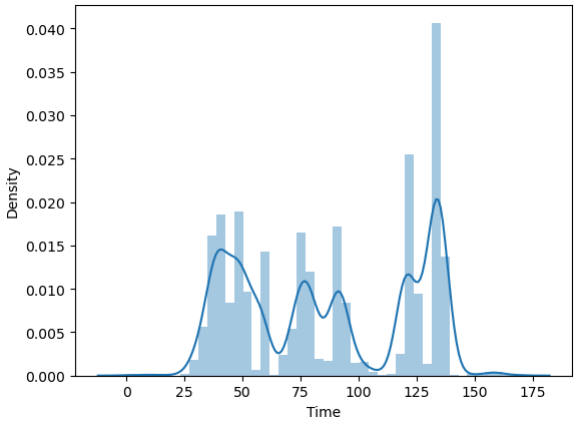
Out[118… <Axes: xlabel='Time'>



In [120…
```
sns.distplot(wireshark.Time)
```

```
/var/folders/9f/3_v_spgn6tqdx3krk10vsrlm0000gn/T/ipykernel_34728/3516642977.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(wireshark.Time)
/opt/anaconda3/lib/python3.11/site-packages/seaborn/_oldcore.py:1119: FutureWarning: use_inf_as_na option is deprecated and will be removed in a future version. Co
nvert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

Out[120… <Axes: xlabel='Time', ylabel='Density'>



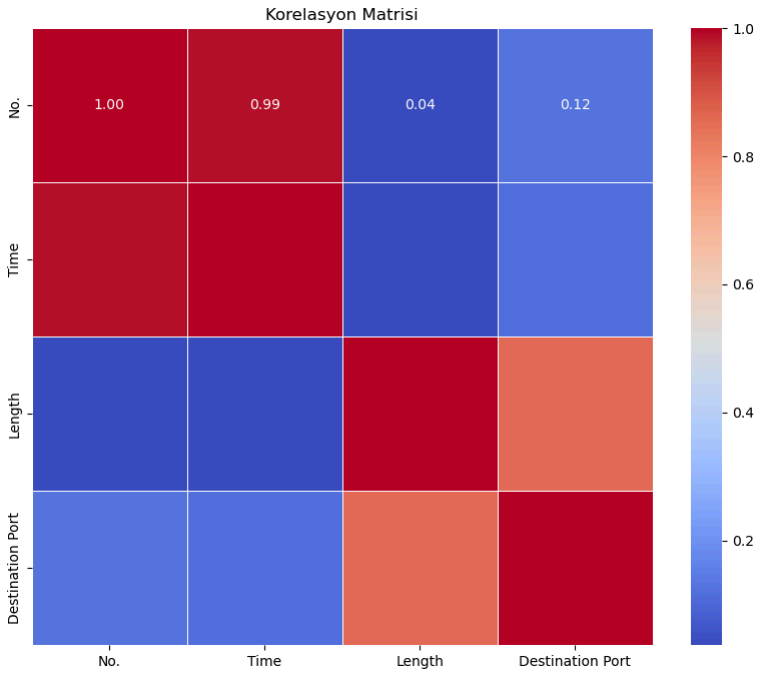
Korelasyon Matrisi

In [123…
```
numeric_df = wireshark.select_dtypes(include=['int64', 'float64'])
```

sns.distplot(wireshark.Time, hist=False)

In [126…
```
corr_matrix = numeric_df.corr()
```

In [128…
```
plt.figure(figsize=(10, 8))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', fmt=".2f", linewidths=0.5)
plt.title('Korelasyon Matrisi')
plt.show()
```



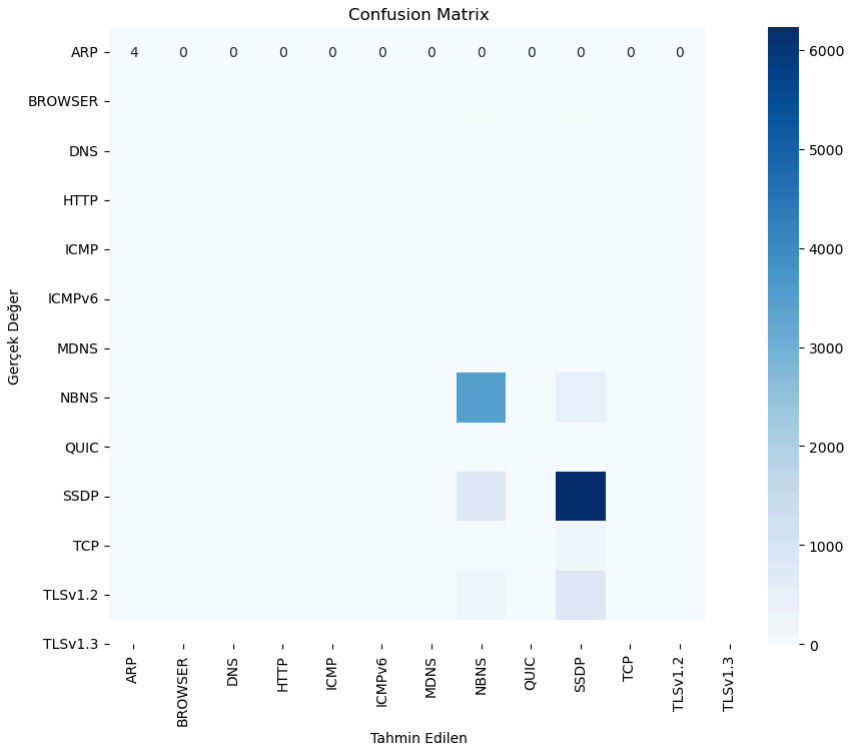
Naive Bayes ile Sınıflandırma

In [152…

```
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt

# Bağımsız değişkenler ve hedef değişkeni seçme
X = wireshark[['Time', 'Length']]
y = wireshark['Protocol']

# Veri setini eğitim ve test alt kümelerine bölmek
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Naive Bayes modelini eğitme
model = GaussianNB()
model.fit(X_train, y_train)

# Test seti üzerinde tahminler yapma
y_pred_naive_bayes = model.predict(X_test)

# Modelin performansını değerlendirme
accuracy_naive_bayes = accuracy_score(y_test, y_pred_naive_bayes)
print("Accuracy:", accuracy_naive_bayes)

# Performans ölçütlerini hesaplama
precision_naive_bayes = precision_score(y_test, y_pred_naive_bayes, average='weighted')
recall_naive_bayes = recall_score(y_test, y_pred_naive_bayes, average='weighted')
f1_naive_bayes = f1_score(y_test, y_pred_naive_bayes, average='weighted')

print("Precision:", precision_naive_bayes)
print("Recall:", recall_naive_bayes)
print("F1 Score:", f1_naive_bayes)

# Confusion matrix'i oluşturma
cm_naive_bayes = confusion_matrix(y_test, y_pred_naive_bayes)

# Sınıf etiketlerini al
classes_naive_bayes = model.classes_

# Sınıf etiketlerini kullanarak confusion matrix'i yazdır
print("Confusion Matrix:")
print("\t", end="")
for cls in classes_naive_bayes:
    print(cls, end="\t")
print()  # Yeni satır

for i, row in enumerate(cm_naive_bayes):
    print(classes_naive_bayes[i], end="\t")
    for cell in row:
        print(cell, end="\t")
    print()  # Yeni satır

# Görselleştirme
plt.figure(figsize=(10, 8))
sns.heatmap(cm_naive_bayes, annot=True, fmt="d", cmap="Blues", xticklabels=model.classes_, yticklabels=model.classes_)
plt.xlabel('Tahmin Edilen')
plt.ylabel('Gerçek Değer')
plt.title('Confusion Matrix')
plt.show()

plt.show()
```

```
Accuracy: 0.785149951628507
Precision: 0.708371494998986
Recall: 0.785149951628507
F1 Score: 0.744670135305346
Confusion Matrix:
        ARP     BROWSER DNS     HTTP    ICMP    ICMPv6  MDNS    NBNS    QUIC    SSDP    TCP     TLSv1.2 TLSv1.3
ARP     4       0       0       0       0       0       0       0       0       0       0       0
BROWSER 0       5       0       0       0       0       0       69      0       49      0       0
DNS     0       0       0       0       0       0       0       0       0       1       0       0
HTTP    0       0       0       13      0       0       0       0       0       0       0       0
ICMP    0       2       0       0       0       0       0       2       0       4       0       0
ICMPv6  0       1       0       0       0       0       0       2       0       2       0       0
MDNS    0       1       0       0       0       0       1       2       0       0       0       0
NBNS    0       40      0       0       0       0       4       3492    2       489     0       0
QUIC    0       0       0       0       0       0       0       0       1       0       0       0
SSDP    0       17      0       0       0       0       0       825     0       6223    0       0
TCP     0       3       0       0       0       0       0       13      0       143     0       0
TLSv1.2 0       2       2       0       0       0       0       157     0       833     0       0
```

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```



Karar Ağacı(Decision Tree) ile Sınıflandırma

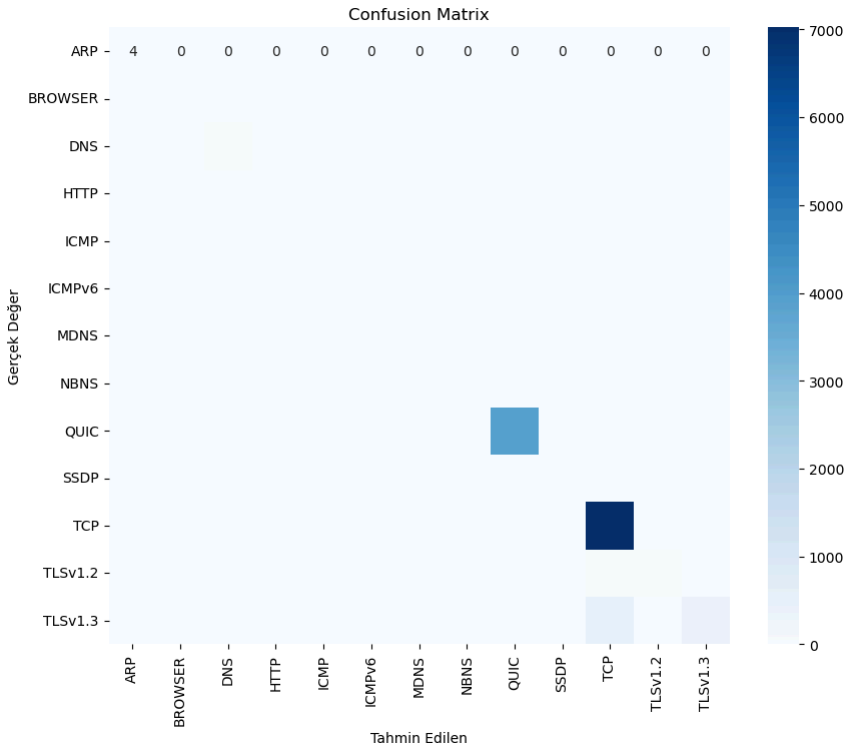
In [134…

```
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt

# Bağımsız değişkenler ve hedef değişkeni seçme
X = wireshark[['Time', 'Length']]
y = wireshark['Protocol']

# Veri setini eğitim ve test alt kümelerine bölmek
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Decision Tree modelini eğitme
model = DecisionTreeClassifier(random_state=42)
model.fit(X_train, y_train)

# Test seti üzerinde tahminler yapma
y_pred_decision_tree = model.predict(X_test)

# Modelin performansını değerlendirme
accuracy_decision_tree = accuracy_score(y_test, y_pred_decision_tree)
print("Accuracy:", accuracy_decision_tree)

# Performans ölçütlerini hesaplama
precision_decision_tree = precision_score(y_test, y_pred_decision_tree, average='weighted')
recall_decision_tree = recall_score(y_test, y_pred_decision_tree, average='weighted')
f1_decision_tree = f1_score(y_test, y_pred_decision_tree, average='weighted')

print("Precision:", precision_decision_tree)
print("Recall:", recall_decision_tree)
print("F1 Score:", f1_decision_tree)

# Confusion matrix'i oluşturma
cm_decision_tree = confusion_matrix(y_test, y_pred_decision_tree)

# Sınıf etiketlerini al
classes_decision_tree = model.classes_

# Sınıf etiketlerini kullanarak confusion matrix'i yazdır
print("Confusion Matrix:")
print("\t", end="")
for cls in classes_decision_tree:
    print(cls, end="\t")
print()  # Yeni satır

for i, row in enumerate(cm_decision_tree):
    print(classes_decision_tree[i], end="\t")
    for cell in row:
```

```
        print(cell, end="\t")
    print()  # Yeni satır

# Görselleştirme
plt.figure(figsize=(10, 8))
sns.heatmap(cm_decision_tree, annot=True, fmt="d", cmap="Blues", xticklabels=model.classes_, yticklabels=model.classes_)
plt.xlabel('Tahmin Edilen')
plt.ylabel('Gerçek Değer')
plt.title('Confusion Matrix')
plt.show()
```

```
Accuracy: 0.9291357626572073
Precision: 0.9239887672426934
Recall: 0.9291357626572073
F1 Score: 0.9196277668603088
Confusion Matrix:
        ARP     BROWSER DNS     HTTP    ICMP    ICMPv6  MDNS    NBNS    QUIC    SSDP    TCP     TLSv1.2 TLSv1.3
ARP     4       0       0       0       0       0       0       0       0       0       0       0       0
BROWSER 0       0       0       0       0       0       0       0       0       0       0       0       0
DNS     0       0       68      0       0       1       0       0       29      1       10      2       12
HTTP    0       0       0       0       0       0       0       0       0       0       0       0       1
ICMP    0       0       2       0       10      0       0       0       0       0       1       0       0
ICMPv6  0       0       0       0       0       1       0       0       1       0       5       1       0
MDNS    0       0       2       0       0       0       0       0       3       0       0       0       0
NBNS    0       1       1       0       0       0       0       1       1       0       0       0       0
QUIC    0       0       25      0       0       0       0       0       3934    0       31      3       34
SSDP    0       0       0       0       0       0       0       0       0       1       0       0       0
TCP     0       0       3       0       0       0       0       0       18      0       7022    9       13
TLSv1.2 0       0       3       0       0       0       0       0       9       0       60      67      20
TLSv1.3 0       0       13      0       0       0       0       0       41      0       504     19      417
```

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in label
s with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Recall is ill-defined and being set to 0.0 in labels w
ith no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```



Rastgele Ormanlar (Random Forests)ile Sınıflandırma

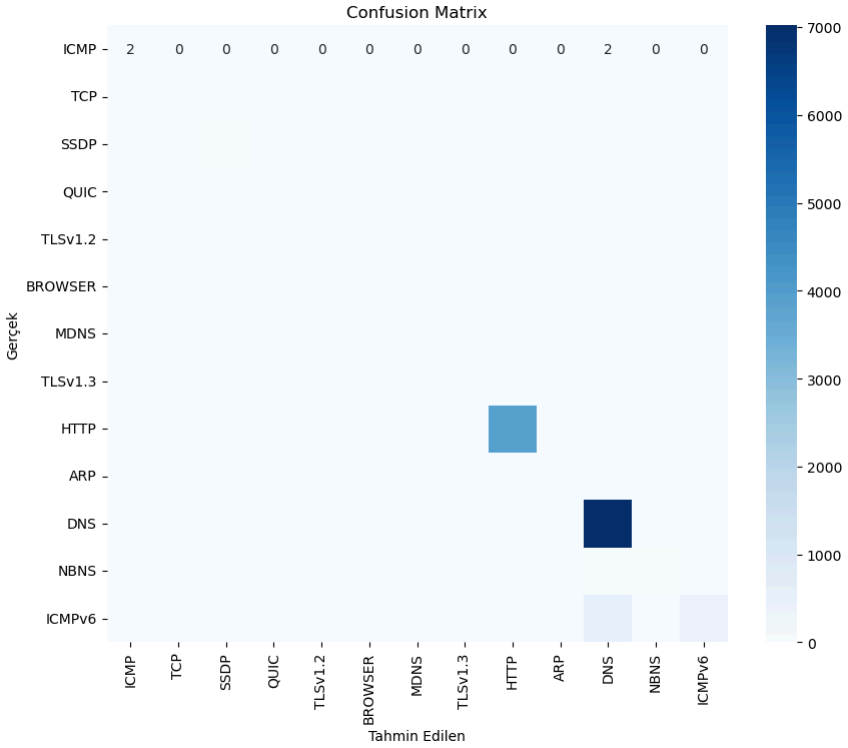
In [137…

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt

# Veri setini eğitim ve test setlerine bölelim
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Rastgele Ormanlar modelini oluşturalım
model = RandomForestClassifier(n_estimators=100, random_state=42)

# Modeli eğitelim
model.fit(X_train, y_train)

# Test seti üzerinde tahmin yapalım
y_pred_random_forest = model.predict(X_test)

# Modelin doğruluğunu değerlendirelim
random_forest_accuracy = accuracy_score(y_test, y_pred_random_forest)
print("Rastgele Ormanlar modelinin doğruluk payı:", random_forest_accuracy)

# Confusion matrix'i hesaplayalım
cm_random_forest = confusion_matrix(y_test, y_pred_random_forest)

# Precision, recall ve F1 score değerlerini hesaplayalım
random_forest_precision = precision_score(y_test, y_pred_random_forest, average='weighted')
random_forest_recall = recall_score(y_test, y_pred_random_forest, average='weighted')
random_forest_f1 = f1_score(y_test, y_pred_random_forest, average='weighted')

print("Precision:", random_forest_precision)
print("Recall:", random_forest_recall)
print("F1 Score:", random_forest_f1)

# Tahminleri ve gerçek değerleri bağımlı değişkene göre tabloda gösterme
```

```
classes_random_forest = model.classes_

print("\nTahminler ve Gerçek Değerler:")
print("\t\t", end="")
for cls in classes_random_forest:
    print(cls, end="\t")
print()  # Yeni satır

for i, row in enumerate(cm_random_forest):
    print(classes_random_forest[i], end="\t\t")
    for cell in row:
        print(cell, end="\t")
    print()  # Yeni satır

plt.figure(figsize=(10, 8))
sns.heatmap(cm_random_forest, annot=True, fmt="d", cmap="Blues", xticklabels=set(y), yticklabels=set(y))
plt.xlabel('Tahmin Edilen')
plt.ylabel('Gerçek')
plt.title('Confusion Matrix')
plt.show()
```

```
Rastgele Ormanlar modelinin doğruluk payı: 0.9291357626572073
Precision: 0.924155190731413
Recall: 0.9291357626572073
F1 Score: 0.9195701832247489

Tahminler ve Gerçek Değerler:
                ARP     BROWSER DNS     HTTP    ICMP    ICMPv6  MDNS    NBNS    QUIC    SSDP    TCP     TLSv1.2 TLSv1.3
ARP             2       0       0       0       0       0       0       0       0       0       2       0       0
BROWSER         0       0       0       0       0       0       0       0       0       0       0       0       0
DNS             0       0       66      0       0       1       0       0       32      1       11      2       10
HTTP            0       0       0       0       0       0       0       0       0       0       0       0       1
ICMP            0       0       2       0       8       0       0       0       0       0       3       0       0
ICMPv6          0       0       1       0       0       1       0       0       1       0       4       1       0
MDNS            0       0       1       0       0       0       0       0       3       0       1       0       0
NBNS            0       1       1       0       0       0       0       1       1       0       0       0       0
QUIC            0       0       21      0       0       0       0       0       3939    0       31      2       34
SSDP            0       0       0       0       0       0       0       0       0       1       0       0       0
TCP             0       0       4       0       0       0       0       0       18      0       7018    9       16
TLSv1.2         0       0       5       0       0       0       0       0       10      0       61      67      16
TLSv1.3         0       0       9       0       0       0       0       0       44      0       503     16      422
```

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in label
s with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Recall is ill-defined and being set to 0.0 in labels w
ith no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```



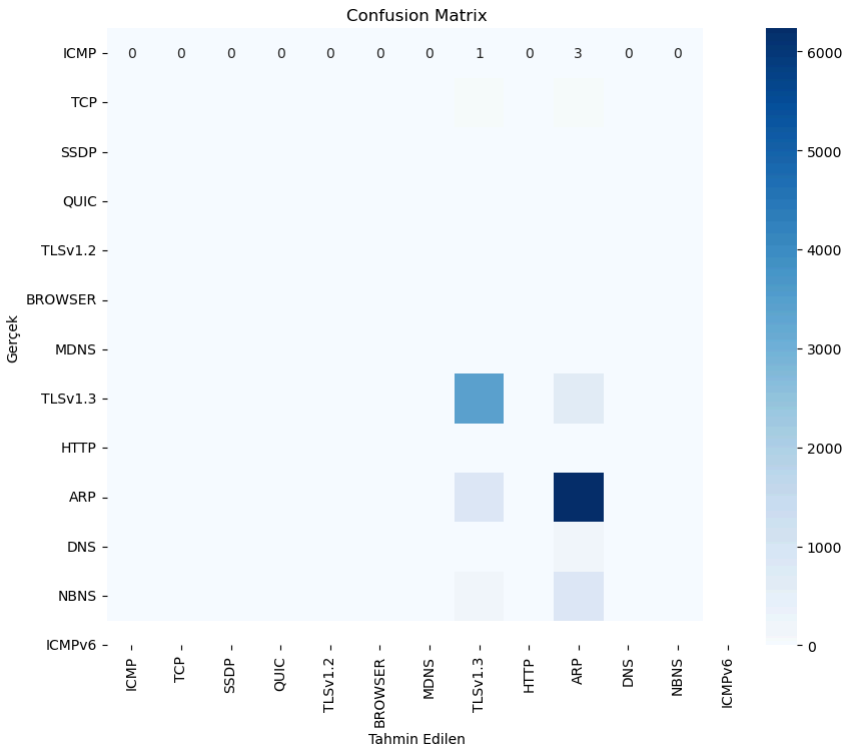
Lojistik Regresyon (Logistic Regression)ile Sınıflandırma

In [140…

```
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt

# Veri setini eğitim ve test setlerine bölelim
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Lojistik Regresyon modelini oluşturalım
model = LogisticRegression(max_iter=1000, random_state=42)

# Modeli eğitelim
model.fit(X_train, y_train)

# Test seti üzerinde tahmin yapalım
y_pred_logistic_regression = model.predict(X_test)

# Modelin doğruluğunu değerlendirelim
logistic_regression_accuracy = accuracy_score(y_test, y_pred_logistic_regression)
print("Accuracy:", logistic_regression_accuracy)

# Confusion matrix'i hesaplayalım
cm_logistic_regression = confusion_matrix(y_test, y_pred_logistic_regression)
```

```
# Precision, recall ve F1 score değerlerini hesaplayalım
logistic_regression_precision = precision_score(y_test, y_pred_logistic_regression, average='weighted')
logistic_regression_recall = recall_score(y_test, y_pred_logistic_regression, average='weighted')
logistic_regression_f1 = f1_score(y_test, y_pred_logistic_regression, average='weighted')

print("Precision:", logistic_regression_precision)
print("Recall:", logistic_regression_recall)
print("F1 Score:", logistic_regression_f1)

# Tahminleri ve gerçek değerleri bağımlı değişkene göre tabloda gösterme
classes_logistic_regression = model.classes_

print("\nTahminler ve Gerçek Değerler:")
print("\t\t", end="")
for cls in classes_logistic_regression:
    print(cls, end="\t")
print()  # Yeni satır

for i, row in enumerate(cm_logistic_regression):
    print(classes_logistic_regression[i], end="\t\t")
    for cell in row:
        print(cell, end="\t")
    print()  # Yeni satır

# Confusion matrix grafiğini oluşturalım
plt.figure(figsize=(10, 8))
sns.heatmap(cm_logistic_regression, annot=True, fmt="d", cmap="Blues", xticklabels=set(y), yticklabels=set(y))
plt.xlabel('Tahmin Edilen')
plt.ylabel('Gerçek')
plt.title('Confusion Matrix')
plt.show()
```

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in label
s with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
Accuracy: 0.7789422766849403
Precision: 0.6966026775180888
Recall: 0.7789422766849403
F1 Score: 0.7354726967309102

Tahminler ve Gerçek Değerler:
                ARP     BROWSER DNS     HTTP    ICMP    ICMPv6  MDNS    NBNS    QUIC    SSDP    TCP     TLSv1.2 TLSv1.3
ARP             0       0       0       0       0       0       0       1       0       3       0       0
BROWSER         0       0       0       0       0       0       0       72      0       51      0       0
DNS             0       0       0       0       0       0       0       0       0       1       0       0
HTTP            0       0       0       0       0       0       0       7       0       6       0       0
ICMP            0       0       0       0       0       0       0       2       0       6       0       0
ICMPv6          0       0       0       0       0       0       0       2       0       3       0       0
MDNS            0       0       0       0       0       0       0       4       0       0       0       0
NBNS            0       0       0       0       0       0       0       3431    0       596     0       0
QUIC            0       0       0       0       0       0       0       0       0       1       0       0
SSDP            0       0       0       0       0       0       0       834     0       6231    0       0
TCP             0       0       0       0       0       0       0       16      0       143     0       0
TLSv1.2         0       0       0       0       0       0       0       156     0       838     0       0
```



Gradient Boosting Classifier ile Sınıflandırma

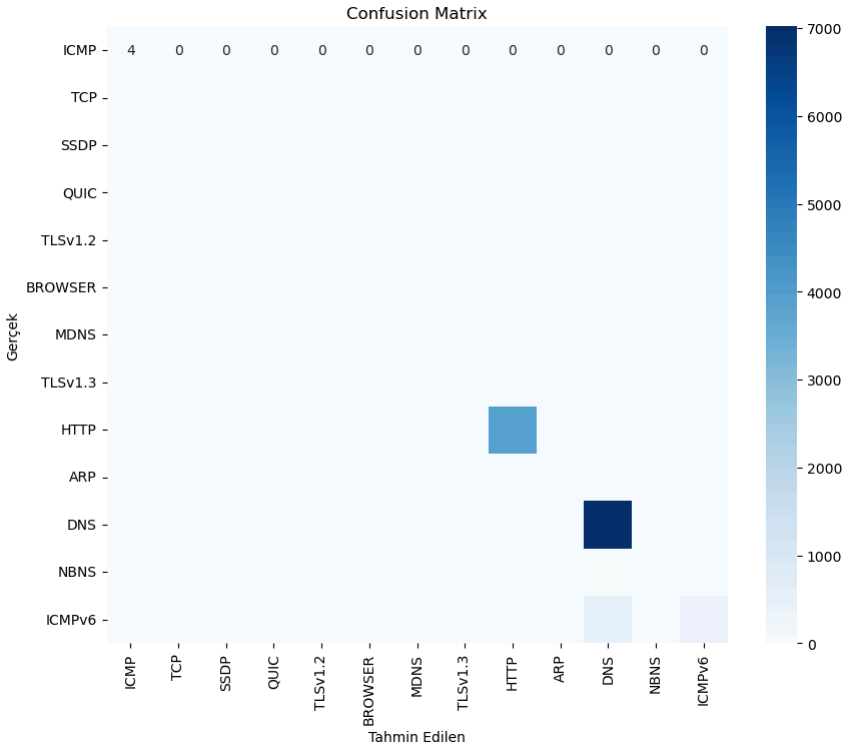
In [143…

```
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, accuracy_score, precision_score, recall_score, f1_score
import seaborn as sns
import matplotlib.pyplot as plt

# Veri setini eğitim ve test setlerine bölelim
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

```
# Gradient Boosting Classifier modelini oluşturalım
model = GradientBoostingClassifier(random_state=42)

# Modeli eğitelim
model.fit(X_train, y_train)

# Test seti üzerinde tahmin yapalım
y_pred = model.predict(X_test)

# Modelin doğruluğunu hesaplayalım
accuracy_gradient_boosting = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy_gradient_boosting)

# Precision, recall ve F1 score değerlerini hesaplayalım
precision_gradient_boosting = precision_score(y_test, y_pred, average='weighted')
recall_gradient_boosting = recall_score(y_test, y_pred, average='weighted')
f1_gradient_boosting = f1_score(y_test, y_pred, average='weighted')

print("Precision:", precision_gradient_boosting)
print("Recall:", recall_gradient_boosting)
print("F1 Score:", f1_gradient_boosting)

# Confusion matrix'i oluşturalım
cm_gradient_boosting = confusion_matrix(y_test, y_pred)

# Confusion matrix grafiğini oluşturalım
plt.figure(figsize=(10, 8))
sns.heatmap(cm_gradient_boosting, annot=True, fmt="d", cmap="Blues", xticklabels=set(y), yticklabels=set(y))
plt.xlabel('Tahmin Edilen')
plt.ylabel('Gerçek')
plt.title('Confusion Matrix')
plt.show()
```

```
Accuracy: 0.9272009029345373
Precision: 0.9198190575507177
Recall: 0.9272009029345373
F1 Score: 0.9160965127985726
```

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in label
s with no predicted samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
/opt/anaconda3/lib/python3.11/site-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Recall is ill-defined and being set to 0.0 in labels w
ith no true samples. Use `zero_division` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```



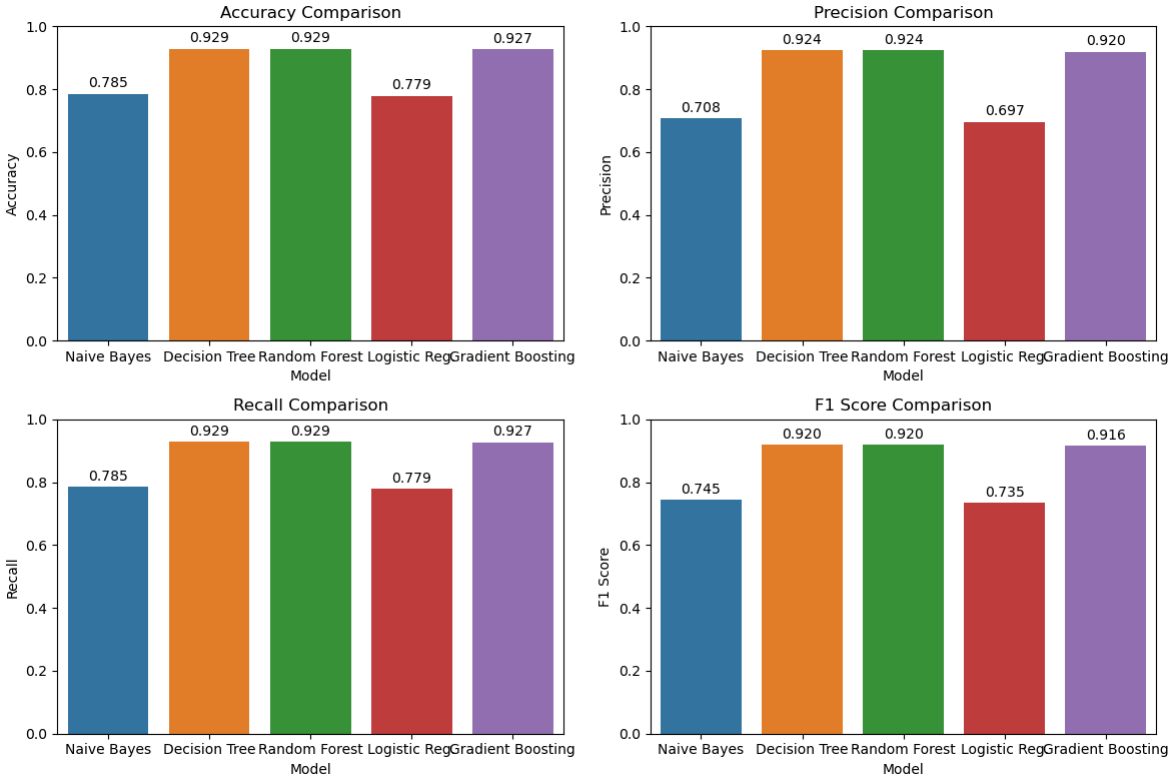
Modelleri karşılaştırma - Seçme - Değerlendirme

In [165…

```
models = ['Naive Bayes', 'Decision Tree', 'Random Forest', 'Logistic Reg.','Gradient Boosting']
accuracies = [accuracy_naive_bayes, accuracy_decision_tree, random_forest_accuracy, logistic_regression_accuracy,accuracy_gradient_boosting]
precisions = [precision_naive_bayes, precision_decision_tree, random_forest_precision, logistic_regression_precision, precision_gradient_boosting]
recalls = [recall_naive_bayes, recall_decision_tree, random_forest_recall, logistic_regression_recall,recall_gradient_boosting]
f1_scores = [f1_naive_bayes, f1_decision_tree, random_forest_f1, logistic_regression_f1, f1_gradient_boosting]

performance_df = pd.DataFrame({
    'Model': models,
    'Accuracy': accuracies,
    'Precision': precisions,
    'Recall': recalls,
    'F1 Score': f1_scores
})

# Tabloyu yazdıralım
print(performance_df)# Performans metriklerini görselleştirelim
plt.figure(figsize=(12, 8))

plt.subplot(2, 2, 1)
sns.barplot(x='Model', y='Accuracy', data=performance_df)
plt.title('Accuracy Comparison')
plt.ylim(0, 1)  # Y eksenini 0 ile 1 arasında sınırlayalım
for index, value in enumerate(performance_df['Accuracy']):
    plt.text(index, value + 0.02, '{:.3f}'.format(value), ha='center')  # Her barın üzerine değerleri yazalım

plt.subplot(2, 2, 2)
sns.barplot(x='Model', y='Precision', data=performance_df)
```

```
plt.title('Precision Comparison')
plt.ylim(0, 1)
for index, value in enumerate(performance_df['Precision']):
    plt.text(index, value + 0.02, '{:.3f}'.format(value), ha='center')

plt.subplot(2, 2, 3)
sns.barplot(x='Model', y='Recall', data=performance_df)
plt.title('Recall Comparison')
plt.ylim(0, 1)
for index, value in enumerate(performance_df['Recall']):
    plt.text(index, value + 0.02, '{:.3f}'.format(value), ha='center')

plt.subplot(2, 2, 4)
sns.barplot(x='Model', y='F1 Score', data=performance_df)
plt.title('F1 Score Comparison')
plt.ylim(0, 1)
for index, value in enumerate(performance_df['F1 Score']):
    plt.text(index, value + 0.02, '{:.3f}'.format(value), ha='center')

plt.tight_layout()
plt.show()
```

```
                Model  Accuracy  Precision    Recall  F1 Score
0         Naive Bayes  0.785150   0.708371  0.785150  0.744670
1       Decision Tree  0.929136   0.923989  0.929136  0.919628
2       Random Forest  0.929136   0.924155  0.929136  0.919570
3       Logistic Reg.  0.778942   0.696603  0.778942  0.735473
4   Gradient Boosting  0.927201   0.919819  0.927201  0.916097
```



Veri seti performans ölçütlerine göre, Decision Tree ve Random Forest modelleri oldukça benzer sonuçlar vermektedir. Her iki model de yüksek doğruluk, hassasiyet, geri çağırma ve F1 skoru sağlamaktadır.

Decision Tree modeli daha basit bir yapıya sahip olduğu için daha hızlı eğitilebilir ve daha kolay yorumlanabilir. Ancak, Random Forest, birden fazla karar ağacını bir araya getirerek daha güçlü bir model oluşturur ve genellikle daha iyi genelleme performansı sağlar.

Daha karmaşık ilişkileri yakalamak ve daha yüksek bir genelleme performansı elde etmek için Random Forest modelini tercih edilmiştir.

Seçilen Method Random Forest ile Kullanıcı Etkileşimli Protokol Sınıfı Tahmini

In [174…

```
from IPython.display import display, Markdown
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

model = RandomForestClassifier(n_estimators=100, random_state=42)

model.fit(X_train, y_train)

while True:

    length = input("Paket uzunluğunu girin (Çıkmak için 'x' tuşuna basın): ")
    if length.lower() == 'x':
        print("Çıkış yapılıyor...")
        break

    # Uzunluk değerini kontrol et
    if not length.isdigit():
        print("Lütfen sayısal bir değer girin.")
        continue

    time = input("Paket süresini girin: ")

    # Zaman değerini kontrol et
    if not time.isdigit():
        print("Lütfen sayısal bir değer girin.")
        continue
```

```
    length = float(length)
    time = float(time)
    X_new = [[time, length]]

    predicted_protocol = model.predict(X_new)
    display(Markdown(f"**Protokol:** <font color='red'>{predicted_protocol[0]}</font>"))
```

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but RandomForestClassifier was fitted with featu
re names
  warnings.warn(
```

Protokol: TCP

```
/opt/anaconda3/lib/python3.11/site-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but RandomForestClassifier was fitted with featu
re names
  warnings.warn(
```

Protokol: TLSv1.2

```
Çıkış yapılıyor...
```