Raport

April 21, 2022

1 Przewidywanie zwycięzcy rundy w grze Counter Strike: Global Offensive

1.1 Dane

Zbiór danych składa się ze snapshotów rund z około 700 meczów z profesjonalnych turniejów rozgrywanych w 2019 i 2020 roku.

Snapshoty - czyli zestawienie pewnych stanów kluczowych elementów rozgrywki - były rejestrowane podczas gry co 20 sekund aż do rozstrzygnięcia danej rundy. Łączna liczba zapisanych snapshotów wynosi 122411. Część tych rekordów będzie traktowana jako zbiór danych uczących, a pozostała część jako część danych testów. Każdy rekord traktowany jest jako pojedynczy, niezależny element do analizy danych.

1.2 Czym jest klasyfikator MLP?

Perceptron wielowarstwowy (MLP) to model sztucznej sieci neuronowej ze sprzężeniem do przodu, który odwzorowuje zestawy danych wejściowych na zestaw odpowiednich danych wyjściowych.

MLP składa się z wielu warstw, a każda warstwa jest w pełni połączona z następną. Węzły warstw to neurony z nieliniowymi funkcjami aktywacji, z wyjątkiem węzłów warstwy wejściowej. Pomiędzy warstwą wejściową a wyjściową może znajdować się jedna lub więcej nieliniowych warstw ukrytych.

1.3 Import bibliotek i danych

[75]:
```
import numpy as np
import pandas as pd
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import RobustScaler
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.neural_network import MLPClassifier
from matplotlib import pyplot as plt
import seaborn as sns
```

[76]:
```
df = pd.read_csv('Data/csgo_round_snapshots.csv')
```

[77]:
```
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)
```

[78]:
```
df.head()
```

[78]:

	time_left	ct_score	t_score	map	bomb_planted	ct_health	t_health
0	175.00	0.0	0.0	de_dust2	False	500.0	500.0
1	156.03	0.0	0.0	de_dust2	False	500.0	500.0
2	96.03	0.0	0.0	de_dust2	False	391.0	400.0
3	76.03	0.0	0.0	de_dust2	False	391.0	400.0
4	174.97	1.0	0.0	de_dust2	False	500.0	500.0

	ct_armor	t_armor	ct_money	t_money	ct_helmets	t_helmets
0	0.0	0.0	4000.0	4000.0	0.0	0.0
1	400.0	300.0	600.0	650.0	0.0	0.0
2	294.0	200.0	750.0	500.0	0.0	0.0
3	294.0	200.0	750.0	500.0	0.0	0.0
4	192.0	0.0	18350.0	10750.0	0.0	0.0

	ct_defuse_kits	ct_players_alive	t_players_alive	ct_weapon_ak47
0	0.0	5.0	5.0	0.0
1	1.0	5.0	5.0	0.0
2	1.0	4.0	4.0	0.0
3	1.0	4.0	4.0	0.0
4	1.0	5.0	5.0	0.0

	t_weapon_ak47	ct_weapon_aug	t_weapon_aug	ct_weapon_awp	t_weapon_awp
0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0

	ct_weapon_bizon	t_weapon_bizon	ct_weapon_cz75auto	t_weapon_cz75auto
0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0

	ct_weapon_elite	t_weapon_elite	ct_weapon_famas	t_weapon_famas
0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0

	ct_weapon_g3sg1	t_weapon_g3sg1	ct_weapon_galilar	t_weapon_galilar
0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0

```
2              0.0             0.0                0.0              0.0
3              0.0             0.0                0.0              0.0
4              0.0             0.0                0.0              0.0

   ct_weapon_glock  t_weapon_glock  ct_weapon_m249  t_weapon_m249  \
0              0.0             5.0             0.0            0.0
1              0.0             5.0             0.0            0.0
2              0.0             4.0             0.0            0.0
3              0.0             3.0             0.0            0.0
4              0.0             5.0             0.0            0.0

   ct_weapon_m4a1s  t_weapon_m4a1s  ct_weapon_m4a4  t_weapon_m4a4  \
0              0.0             0.0             0.0            0.0
1              0.0             0.0             0.0            0.0
2              0.0             0.0             0.0            0.0
3              0.0             0.0             0.0            0.0
4              0.0             0.0             0.0            0.0

   ct_weapon_mac10  t_weapon_mac10  ct_weapon_mag7  t_weapon_mag7  \
0              0.0             0.0             0.0            0.0
1              0.0             0.0             0.0            0.0
2              0.0             0.0             0.0            0.0
3              0.0             0.0             0.0            0.0
4              0.0             0.0             0.0            0.0

   ct_weapon_mp5sd  t_weapon_mp5sd  ct_weapon_mp7  t_weapon_mp7  \
0              0.0             0.0            0.0           0.0
1              0.0             0.0            0.0           0.0
2              0.0             0.0            0.0           0.0
3              0.0             0.0            0.0           0.0
4              0.0             0.0            0.0           0.0

   ct_weapon_mp9  t_weapon_mp9  ct_weapon_negev  t_weapon_negev  \
0            0.0           0.0              0.0             0.0
1            0.0           0.0              0.0             0.0
2            0.0           0.0              0.0             0.0
3            0.0           0.0              0.0             0.0
4            0.0           0.0              0.0             0.0

   ct_weapon_nova  t_weapon_nova  ct_weapon_p90  t_weapon_p90  \
0             0.0            0.0            0.0           0.0
1             0.0            0.0            0.0           0.0
2             0.0            0.0            0.0           0.0
3             0.0            0.0            0.0           0.0
4             0.0            0.0            0.0           0.0

   ct_weapon_r8revolver  t_weapon_r8revolver  ct_weapon_sawedoff  \
```

```
0                  0.0                 0.0                 0.0
1                  0.0                 0.0                 0.0
2                  0.0                 0.0                 0.0
3                  0.0                 0.0                 0.0
4                  0.0                 0.0                 0.0

   t_weapon_sawedoff  ct_weapon_scar20  t_weapon_scar20  ct_weapon_sg553  \
0                0.0               0.0              0.0              0.0
1                0.0               0.0              0.0              0.0
2                0.0               0.0              0.0              0.0
3                0.0               0.0              0.0              0.0
4                0.0               0.0              0.0              0.0

   t_weapon_sg553  ct_weapon_ssg08  t_weapon_ssg08  ct_weapon_ump45  \
0             0.0              0.0             0.0              0.0
1             0.0              0.0             0.0              0.0
2             0.0              0.0             0.0              0.0
3             0.0              0.0             0.0              0.0
4             0.0              0.0             0.0              0.0

   t_weapon_ump45  ct_weapon_xm1014  t_weapon_xm1014  ct_weapon_deagle  \
0             0.0               0.0              0.0               0.0
1             0.0               0.0              0.0               0.0
2             0.0               0.0              0.0               0.0
3             0.0               0.0              0.0               0.0
4             0.0               0.0              0.0               0.0

   t_weapon_deagle  ct_weapon_fiveseven  t_weapon_fiveseven  ct_weapon_usps  \
0              0.0                  0.0                 0.0             4.0
1              0.0                  0.0                 0.0             4.0
2              0.0                  0.0                 0.0             4.0
3              0.0                  0.0                 0.0             4.0
4              0.0                  0.0                 0.0             4.0

   t_weapon_usps  ct_weapon_p250  t_weapon_p250  ct_weapon_p2000  \
0            0.0             0.0            0.0              1.0
1            0.0             0.0            0.0              1.0
2            0.0             0.0            0.0              0.0
3            0.0             0.0            0.0              0.0
4            0.0             0.0            0.0              1.0

   t_weapon_p2000  ct_weapon_tec9  t_weapon_tec9  ct_grenade_hegrenade  \
0             0.0             0.0            0.0                   0.0
1             0.0             0.0            0.0                   0.0
2             0.0             0.0            0.0                   0.0
3             1.0             0.0            0.0                   0.0
4             0.0             0.0            0.0                   0.0
```

```
   t_grenade_hegrenade  ct_grenade_flashbang  t_grenade_flashbang  \
0                  0.0                   0.0                  0.0
1                  0.0                   0.0                  0.0
2                  0.0                   0.0                  0.0
3                  0.0                   0.0                  0.0
4                  0.0                   0.0                  0.0

   ct_grenade_smokegrenade  t_grenade_smokegrenade  \
0                      0.0                     0.0
1                      0.0                     2.0
2                      0.0                     2.0
3                      0.0                     0.0
4                      0.0                     0.0

   ct_grenade_incendiarygrenade  t_grenade_incendiarygrenade  \
0                           0.0                          0.0
1                           0.0                          0.0
2                           0.0                          0.0
3                           0.0                          0.0
4                           0.0                          0.0

   ct_grenade_molotovgrenade  t_grenade_molotovgrenade  \
0                        0.0                       0.0
1                        0.0                       0.0
2                        0.0                       0.0
3                        0.0                       0.0
4                        0.0                       0.0

   ct_grenade_decoygrenade  t_grenade_decoygrenade round_winner
0                      0.0                     0.0           CT
1                      0.0                     0.0           CT
2                      0.0                     0.0           CT
3                      0.0                     0.0           CT
4                      0.0                     0.0           CT
```

[79]:
```
df.isnull().sum().sum()
```

[79]:
```
0
```

[80]:
```
df.shape
```

[80]:
```
(122410, 97)
```

1.4 Przeprocesowanie danych

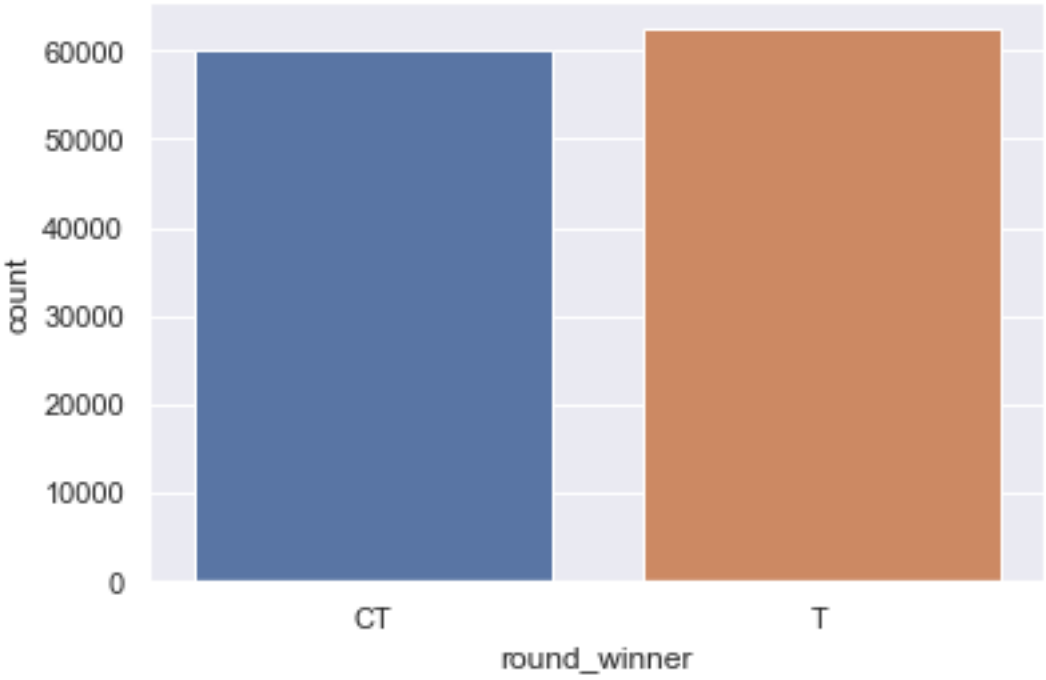
W pierwszej kolenności sprawdźmy liczność klas.

[81]:
```
df['round_winner'].value_counts()
```

[81]:
```
T     62406
CT    60004
Name: round_winner, dtype: int64
```

[82]:
```
sns.set_theme(style="darkgrid")
sns.countplot(x='round_winner', data=df)
```

[82]:
```
<AxesSubplot:xlabel='round_winner', ylabel='count'>
```



Następnie przekonwertujemy wszystkie kolumny na wartości liczbowe.

[83]:
```
col = df.drop(df.select_dtypes(np.number), axis = 1).columns
col
```

[83]:
```
Index(['map', 'bomb_planted', 'round_winner'], dtype='object')
```

[84]:
```
lbl = LabelEncoder()
for value in col:
    df[value] = lbl.fit_transform(df[value])
```

[85]:
```
df['bomb_planted'] = df['bomb_planted'].astype(np.int16)
```

[86]:
```
cols = [f for f in df.columns if f not in ['round_winner']]
```

Dodatkowo każda wartość zostanie znormalizowana.

[87]:
```
scaler = RobustScaler()

for value in cols:
    scaler = RobustScaler()
    df[value] = scaler.fit_transform(df[[value]])
```

Na koniec podzielimy dane na wektor danych oraz wektor wyników.

[88]:
```
x = df.drop(['round_winner'], axis = 1)
y = df['round_winner']
```

[89]:
```
len(cols)
```

[89]: 96

Finalnie każdy rekord zawiera 96 atrybutów, które prezentują się w sposób przedstawiony poniżej.

[90]:
```
x.head()
```

[90]:

	time_left	ct_score	t_score	map	bomb_planted	ct_health	t_health	\
0	0.715105	-0.857143	-0.857143	-0.666667	0.0	0.000000	0.000000	
1	0.545726	-0.857143	-0.857143	-0.666667	0.0	0.000000	0.000000	
2	0.010000	-0.857143	-0.857143	-0.666667	0.0	-0.726667	-0.561798	
3	-0.168575	-0.857143	-0.857143	-0.666667	0.0	-0.726667	-0.561798	
4	0.714837	-0.714286	-0.857143	-0.666667	0.0	0.000000	0.000000	

	ct_armor	t_armor	ct_money	t_money	ct_helmets	t_helmets	\
0	-1.291096	-1.136054	-0.112782	-0.191489	-0.5	-0.6	
1	0.078767	-0.115646	-0.368421	-0.395137	-0.5	-0.6	
2	-0.284247	-0.455782	-0.357143	-0.404255	-0.5	-0.6	
3	-0.284247	-0.455782	-0.357143	-0.404255	-0.5	-0.6	
4	-0.633562	-1.136054	0.966165	0.218845	-0.5	-0.6	

	ct_defuse_kits	ct_players_alive	t_players_alive	ct_weapon_ak47	\
0	-0.333333	0.0	0.0	0.0	
1	0.000000	0.0	0.0	0.0	
2	0.000000	-1.0	-1.0	0.0	
3	0.000000	-1.0	-1.0	0.0	
4	0.000000	0.0	0.0	0.0	

	t_weapon_ak47	ct_weapon_aug	t_weapon_aug	ct_weapon_awp	t_weapon_awp	\
0	-0.5	0.0	0.0	0.0	0.0	
1	-0.5	0.0	0.0	0.0	0.0	
2	-0.5	0.0	0.0	0.0	0.0	
3	-0.5	0.0	0.0	0.0	0.0	
4	-0.5	0.0	0.0	0.0	0.0	

	ct_weapon_bizon	t_weapon_bizon	ct_weapon_cz75auto	t_weapon_cz75auto	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	

	ct_weapon_elite	t_weapon_elite	ct_weapon_famas	t_weapon_famas	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	

	ct_weapon_g3sg1	t_weapon_g3sg1	ct_weapon_galilar	t_weapon_galilar	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	

	ct_weapon_glock	t_weapon_glock	ct_weapon_m249	t_weapon_m249	\
0	0.0	0.333333	0.0	0.0	
1	0.0	0.333333	0.0	0.0	
2	0.0	0.000000	0.0	0.0	
3	0.0	-0.333333	0.0	0.0	
4	0.0	0.333333	0.0	0.0	

	ct_weapon_m4a1s	t_weapon_m4a1s	ct_weapon_m4a4	t_weapon_m4a4	\
0	0.0	0.0	-0.5	0.0	
1	0.0	0.0	-0.5	0.0	
2	0.0	0.0	-0.5	0.0	
3	0.0	0.0	-0.5	0.0	
4	0.0	0.0	-0.5	0.0	

	ct_weapon_mac10	t_weapon_mac10	ct_weapon_mag7	t_weapon_mag7	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	

	ct_weapon_mp5sd	t_weapon_mp5sd	ct_weapon_mp7	t_weapon_mp7	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	

```
3              0.0             0.0            0.0           0.0
4              0.0             0.0            0.0           0.0

   ct_weapon_mp9  t_weapon_mp9  ct_weapon_negev  t_weapon_negev  \
0            0.0           0.0              0.0             0.0
1            0.0           0.0              0.0             0.0
2            0.0           0.0              0.0             0.0
3            0.0           0.0              0.0             0.0
4            0.0           0.0              0.0             0.0

   ct_weapon_nova  t_weapon_nova  ct_weapon_p90  t_weapon_p90  \
0             0.0            0.0            0.0           0.0
1             0.0            0.0            0.0           0.0
2             0.0            0.0            0.0           0.0
3             0.0            0.0            0.0           0.0
4             0.0            0.0            0.0           0.0

   ct_weapon_r8revolver  t_weapon_r8revolver  ct_weapon_sawedoff  \
0                   0.0                  0.0                 0.0
1                   0.0                  0.0                 0.0
2                   0.0                  0.0                 0.0
3                   0.0                  0.0                 0.0
4                   0.0                  0.0                 0.0

   t_weapon_sawedoff  ct_weapon_scar20  t_weapon_scar20  ct_weapon_sg553  \
0                0.0               0.0              0.0              0.0
1                0.0               0.0              0.0              0.0
2                0.0               0.0              0.0              0.0
3                0.0               0.0              0.0              0.0
4                0.0               0.0              0.0              0.0

   t_weapon_sg553  ct_weapon_ssg08  t_weapon_ssg08  ct_weapon_ump45  \
0             0.0              0.0             0.0              0.0
1             0.0              0.0             0.0              0.0
2             0.0              0.0             0.0              0.0
3             0.0              0.0             0.0              0.0
4             0.0              0.0             0.0              0.0

   t_weapon_ump45  ct_weapon_xm1014  t_weapon_xm1014  ct_weapon_deagle  \
0             0.0               0.0              0.0               0.0
1             0.0               0.0              0.0               0.0
2             0.0               0.0              0.0               0.0
3             0.0               0.0              0.0               0.0
4             0.0               0.0              0.0               0.0

   t_weapon_deagle  ct_weapon_fiveseven  t_weapon_fiveseven  ct_weapon_usps  \
0              0.0                  0.0                 0.0        0.333333
```

```
1              0.0                  0.0                 0.0        0.333333
2              0.0                  0.0                 0.0        0.333333
3              0.0                  0.0                 0.0        0.333333
4              0.0                  0.0                 0.0        0.333333

   t_weapon_usps  ct_weapon_p250  t_weapon_p250  ct_weapon_p2000  \
0            0.0             0.0            0.0              1.0
1            0.0             0.0            0.0              1.0
2            0.0             0.0            0.0              0.0
3            0.0             0.0            0.0              0.0
4            0.0             0.0            0.0              1.0

   t_weapon_p2000  ct_weapon_tec9  t_weapon_tec9  ct_grenade_hegrenade  \
0             0.0             0.0            0.0                   0.0
1             0.0             0.0            0.0                   0.0
2             0.0             0.0            0.0                   0.0
3             1.0             0.0            0.0                   0.0
4             0.0             0.0            0.0                   0.0

   t_grenade_hegrenade  ct_grenade_flashbang  t_grenade_flashbang  \
0                  0.0             -0.333333            -0.333333
1                  0.0             -0.333333            -0.333333
2                  0.0             -0.333333            -0.333333
3                  0.0             -0.333333            -0.333333
4                  0.0             -0.333333            -0.333333

   ct_grenade_smokegrenade  t_grenade_smokegrenade  \
0                -0.333333               -0.333333
1                -0.333333                0.333333
2                -0.333333                0.333333
3                -0.333333               -0.333333
4                -0.333333               -0.333333

   ct_grenade_incendiarygrenade  t_grenade_incendiarygrenade  \
0                           0.0                          0.0
1                           0.0                          0.0
2                           0.0                          0.0
3                           0.0                          0.0
4                           0.0                          0.0

   ct_grenade_molotovgrenade  t_grenade_molotovgrenade  \
0                        0.0                      -0.5
1                        0.0                      -0.5
2                        0.0                      -0.5
3                        0.0                      -0.5
4                        0.0                      -0.5
```

	ct_grenade_decoygrenade	t_grenade_decoygrenade
0	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0

1.4.1 Wybór atrybutów

W pierwszej kolejności sprawdzimy, które atrybuty mają największy wpływ na klasy.

W tym celu wykorzystamy model *Random Forest Regressor*, który dopasowuje szereg klasyfikujących drzew decyzyjnych do różnych podpróbek zbioru danych i wykorzystuje uśrednianie w celu poprawy dokładności predykcyjnej i kontroli nadmiernego dopasowania.

[91]:
```
rf = RandomForestRegressor(n_estimators=150)
rf.fit(x, y)
```

[91]:
```
RandomForestRegressor(n_estimators=150)
```

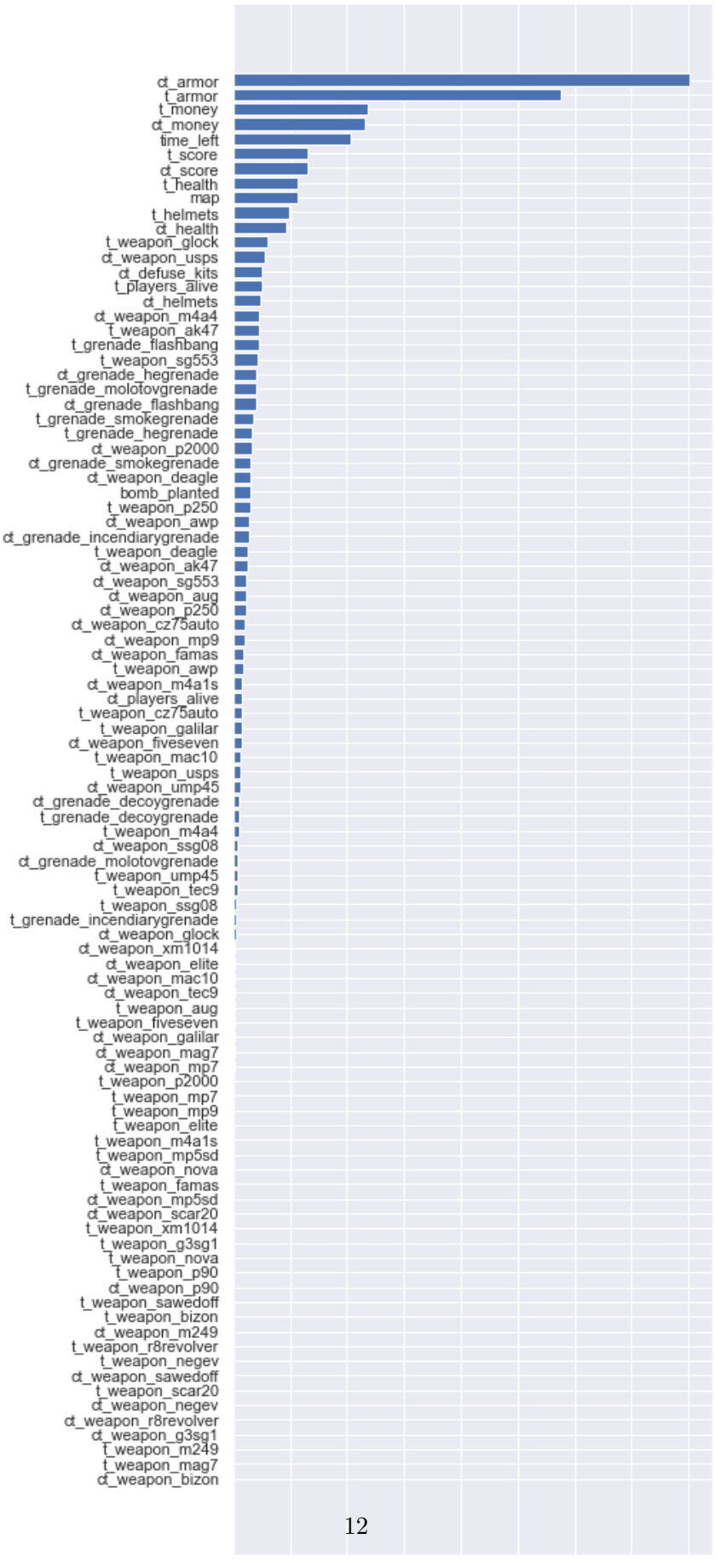
Po stworzeniu i wyuczeniu modelu sortujemy tablice zawierającą informacje o tym, jak duży wpływ mają konkretne atrybuty w podejmowaniu decyzji.

[92]:
```
indexes = rf.feature_importances_.argsort()
```

Wpływ poszczególnych atrybutów został przedstawiony na poniższym wykresie.

[93]:
```
plt.figure(figsize=(6,20))
plt.barh(x.columns[indexes], rf.feature_importances_[indexes])
plt.xlabel("Feature Importance")
```

[93]:
```
Text(0.5, 0, 'Feature Importance')
```


ct_armor
t_armor
t_money
ct_money
time_left
t_score
ct_score
t_health
map
t_helmets
ct_health
t_weapon_glock
ct_weapon_usps
ct_defuse_kits
t_players_alive
ct_helmets
ct_weapon_m4a4
t_weapon_ak47
t_grenade_flashbang
t_weapon_sg553
ct_grenade_hegrenade
t_grenade_molotovgrenade
ct_grenade_flashbang
t_grenade_smokegrenade
t_grenade_hegrenade
ct_weapon_p2000
ct_grenade_smokegrenade
ct_weapon_deagle
bomb_planted
t_weapon_p250
ct_weapon_awp
ct_grenade_incendiarygrenade
t_weapon_deagle
ct_weapon_ak47
ct_weapon_sg553
ct_weapon_aug
ct_weapon_p250
ct_weapon_cz75auto
ct_weapon_mp9
ct_weapon_famas
t_weapon_awp
ct_weapon_m4a1s
ct_players_alive
t_weapon_cz75auto
t_weapon_galilar
ct_weapon_fiveseven
t_weapon_mac10
t_weapon_usps
ct_weapon_ump45
ct_grenade_decoygrenade
t_grenade_decoygrenade
t_weapon_m4a4
ct_weapon_ssg08
ct_grenade_molotovgrenade
t_weapon_ump45
t_weapon_tec9
t_weapon_ssg08
t_grenade_incendiarygrenade
ct_weapon_glock
ct_weapon_xm1014
ct_weapon_elite
ct_weapon_mac10
ct_weapon_tec9
t_weapon_aug
t_weapon_fiveseven
ct_weapon_galilar
ct_weapon_mag7
ct_weapon_mp7
t_weapon_p2000
t_weapon_mp7
t_weapon_mp9
t_weapon_elite
t_weapon_m4a1s
t_weapon_mp5sd
ct_weapon_nova
t_weapon_famas
ct_weapon_mp5sd
ct_weapon_scar20
t_weapon_xm1014
t_weapon_g3sg1
t_weapon_nova
t_weapon_p90
ct_weapon_p90
t_weapon_sawedoff
t_weapon_bizon
ct_weapon_m249
t_weapon_r8revolver
t_weapon_negev
ct_weapon_sawedoff
t_weapon_scar20
ct_weapon_negev
ct_weapon_r8revolver
ct_weapon_g3sg1
t_weapon_m249
t_weapon_mag7
ct_weapon_bizon
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Feature Importance

Następnie możemy odrzucić te atrybuty, które mają niski wpływ na podejmowanie decyzji lub nie mają żadnego. W tym celu wybraliśmy te atrybuty, dla których wartość parametru *feature_importance* jest większa od wartości 0,005.

[94]:
```
importances = rf.feature_importances_[indexes]
indexes = indexes[np.argwhere(importances > 0.005)]
indexes = np.concatenate(indexes).ravel().tolist()
columns = x.columns[indexes]
x = x[columns]
```

W tym momencie możemy sprawdzić liczbę atrybutów pozostałych po selekcji.

[95]:
```
x.shape
```

[95]:
```
(122410, 39)
```

Mamy 38 atrybutów, które prezentują się jak w poniższej tabeli.

[96]:
```
x.head()
```

[96]:

	ct_weapon_mp9	ct_weapon_cz75auto	ct_weapon_p250	ct_weapon_aug	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	

	ct_weapon_sg553	ct_weapon_ak47	t_weapon_deagle	\
0	0.0	0.0	0.0	
1	0.0	0.0	0.0	
2	0.0	0.0	0.0	
3	0.0	0.0	0.0	
4	0.0	0.0	0.0	

	ct_grenade_incendiarygrenade	ct_weapon_awp	t_weapon_p250	bomb_planted	\
0	0.0	0.0	0.0	0.0	
1	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	

	ct_weapon_deagle	ct_grenade_smokegrenade	ct_weapon_p2000	\
0	0.0	-0.333333	1.0	
1	0.0	-0.333333	1.0	
2	0.0	-0.333333	0.0	
3	0.0	-0.333333	0.0	

```
4               0.0               -0.333333             1.0

   t_grenade_hegrenade  t_grenade_smokegrenade  ct_grenade_flashbang  \
0                  0.0               -0.333333             -0.333333
1                  0.0                0.333333             -0.333333
2                  0.0                0.333333             -0.333333
3                  0.0               -0.333333             -0.333333
4                  0.0               -0.333333             -0.333333

   t_grenade_molotovgrenade  ct_grenade_hegrenade  t_weapon_sg553  \
0                      -0.5                   0.0             0.0
1                      -0.5                   0.0             0.0
2                      -0.5                   0.0             0.0
3                      -0.5                   0.0             0.0
4                      -0.5                   0.0             0.0

   t_grenade_flashbang  t_weapon_ak47  ct_weapon_m4a4  ct_helmets  \
0            -0.333333           -0.5            -0.5        -0.5
1            -0.333333           -0.5            -0.5        -0.5
2            -0.333333           -0.5            -0.5        -0.5
3            -0.333333           -0.5            -0.5        -0.5
4            -0.333333           -0.5            -0.5        -0.5

   t_players_alive  ct_defuse_kits  ct_weapon_usps  t_weapon_glock  ct_health  \
0              0.0       -0.333333        0.333333        0.333333   0.000000
1              0.0        0.000000        0.333333        0.333333   0.000000
2             -1.0        0.000000        0.333333        0.000000  -0.726667
3             -1.0        0.000000        0.333333       -0.333333  -0.726667
4              0.0        0.000000        0.333333        0.333333   0.000000

   t_helmets       map  t_health  ct_score   t_score  time_left  ct_money  \
0       -0.6 -0.666667  0.000000 -0.857143 -0.857143   0.715105 -0.112782
1       -0.6 -0.666667  0.000000 -0.857143 -0.857143   0.545726 -0.368421
2       -0.6 -0.666667 -0.561798 -0.857143 -0.857143   0.010000 -0.357143
3       -0.6 -0.666667 -0.561798 -0.857143 -0.857143  -0.168575 -0.357143
4       -0.6 -0.666667  0.000000 -0.714286 -0.857143   0.714837  0.966165

    t_money   t_armor  ct_armor
0 -0.191489 -1.136054 -1.291096
1 -0.395137 -0.115646  0.078767
2 -0.404255 -0.455782 -0.284247
3 -0.404255 -0.455782 -0.284247
4  0.218845 -1.136054 -0.633562
```

Mając już przetworzone dane, możemy wydzielić z nich zbiór treningowy oraz testowy.

[97]:
```
x_train, x_test, y_train, y_test = train_test_split(x, y, stratify = y,␣
↪test_size = 0.1, random_state = 0)
```

[98]:
```
x_train.shape
```

[98]:
```
(110169, 39)
```

[99]:
```
x_test.shape
```

[99]:
```
(12241, 39)
```

Jak widać na podstawie powyższych wywołań, mamy 110169 rekordów w zbiorze treningowym oraz 12241 w zbiorze testowym. W tym momencie możemy rozpocząć inicjalizacje modelu.

1.4.2 Definicja i inicjalizacja modelu

W celu inicjalizacji modelu zostanie wykorzystany klasyfikator MLP, zaimplementowany w bibliotece *scikit-learn* jako *MLPClassifier*.

MLPClassifier określa wielowarstwowy perceptron. W przeciwieństwie do innych algorytmów klasyfikacji, takich jak klasyfikator wektorów wspierających lub naiwny klasyfikator Bayesa, *MLPClassifier* przy wykonaniu zadania klasyfikacji opiera się na podstawowej sieci neuronowej.

Istotne cechy wielowarstwowego perceptronu MLP w bibliotece *scikit-learn*: - w warstwie wyjściowej nie ma funkcji aktywacji, - w przypadku scenariuszy regresji błąd kwadratowy jest funkcją straty, a entropia krzyżowa jest funkcją straty klasyfikacji, - może pracować z regresją pojedynczych, jak i wielu wartości docelowych, - w przeciwieństwie do innych popularnych pakietów, implementacja MLP w *scikit* nie obsługuje GPU. - nie jest możliwe dostrojenie parametrów, takich jak różne funkcje aktywacji, inicjatory wagi itp. dla każdej warstwy.

[100]:
```
nn_clf = MLPClassifier(verbose = True)
```

Opcja *verbose=True* powoduje, że na standardowe wyjście będą drukowane wiadomości o postępach w kolejnych iteracjach.

Następnie przechodzimy do dopasowania modelu do macierzy danych *x_train* i wyniku *y_train*.

[101]:
```
nn_clf.fit(x_train, y_train)
```

```
Iteration 1, loss = 0.48001526
Iteration 2, loss = 0.45443920
Iteration 3, loss = 0.44855651
Iteration 4, loss = 0.44424559
Iteration 5, loss = 0.44119112
Iteration 6, loss = 0.43881870
Iteration 7, loss = 0.43602165
Iteration 8, loss = 0.43413346
Iteration 9, loss = 0.43238168
Iteration 10, loss = 0.43044811
Iteration 11, loss = 0.42913017
```

```
Iteration 12, loss = 0.42795988
Iteration 13, loss = 0.42631679
Iteration 14, loss = 0.42556749
Iteration 15, loss = 0.42417754
Iteration 16, loss = 0.42340622
Iteration 17, loss = 0.42236470
Iteration 18, loss = 0.42125027
Iteration 19, loss = 0.42059905
Iteration 20, loss = 0.41999418
Iteration 21, loss = 0.41908024
Iteration 22, loss = 0.41836787
Iteration 23, loss = 0.41730338
Iteration 24, loss = 0.41688252
Iteration 25, loss = 0.41585448
Iteration 26, loss = 0.41513754
Iteration 27, loss = 0.41442731
Iteration 28, loss = 0.41370405
Iteration 29, loss = 0.41292838
Iteration 30, loss = 0.41222901
Iteration 31, loss = 0.41179587
Iteration 32, loss = 0.41053177
Iteration 33, loss = 0.41051793
Iteration 34, loss = 0.40950201
Iteration 35, loss = 0.40865221
Iteration 36, loss = 0.40824867
Iteration 37, loss = 0.40808898
Iteration 38, loss = 0.40742771
Iteration 39, loss = 0.40700306
Iteration 40, loss = 0.40642847
Iteration 41, loss = 0.40590989
Iteration 42, loss = 0.40552802
Iteration 43, loss = 0.40446347
Iteration 44, loss = 0.40421381
Iteration 45, loss = 0.40373333
Iteration 46, loss = 0.40351673
Iteration 47, loss = 0.40262809
Iteration 48, loss = 0.40218768
Iteration 49, loss = 0.40213368
Iteration 50, loss = 0.40121764
Iteration 51, loss = 0.40075708
Iteration 52, loss = 0.40043096
Iteration 53, loss = 0.40009568
Iteration 54, loss = 0.39973165
Iteration 55, loss = 0.39895798
Iteration 56, loss = 0.39864603
Iteration 57, loss = 0.39861160
Iteration 58, loss = 0.39762831
Iteration 59, loss = 0.39733803
```

```
Iteration 60, loss = 0.39716891
Iteration 61, loss = 0.39704845
Iteration 62, loss = 0.39649278
Iteration 63, loss = 0.39578075
Iteration 64, loss = 0.39549061
Iteration 65, loss = 0.39521812
Iteration 66, loss = 0.39522164
Iteration 67, loss = 0.39524714
Iteration 68, loss = 0.39422611
Iteration 69, loss = 0.39430835
Iteration 70, loss = 0.39356381
Iteration 71, loss = 0.39346180
Iteration 72, loss = 0.39315167
Iteration 73, loss = 0.39303061
Iteration 74, loss = 0.39191398
Iteration 75, loss = 0.39239674
Iteration 76, loss = 0.39221024
Iteration 77, loss = 0.39189102
Iteration 78, loss = 0.39154758
Iteration 79, loss = 0.39088792
Iteration 80, loss = 0.39112278
Iteration 81, loss = 0.39100867
Iteration 82, loss = 0.39028134
Iteration 83, loss = 0.39076824
Iteration 84, loss = 0.39061000
Iteration 85, loss = 0.38938957
Iteration 86, loss = 0.38998950
Iteration 87, loss = 0.38922879
Iteration 88, loss = 0.38925665
Iteration 89, loss = 0.38904180
Iteration 90, loss = 0.38847561
Iteration 91, loss = 0.38872945
Iteration 92, loss = 0.38802789
Iteration 93, loss = 0.38779857
Iteration 94, loss = 0.38791565
Iteration 95, loss = 0.38757272
Iteration 96, loss = 0.38691663
Iteration 97, loss = 0.38706029
Iteration 98, loss = 0.38731323
Iteration 99, loss = 0.38713128
Iteration 100, loss = 0.38632400
Iteration 101, loss = 0.38625907
Iteration 102, loss = 0.38662615
Iteration 103, loss = 0.38597629
Iteration 104, loss = 0.38603507
Iteration 105, loss = 0.38558089
Iteration 106, loss = 0.38536262
Iteration 107, loss = 0.38530541
```

```
Iteration 108, loss = 0.38565438
Iteration 109, loss = 0.38476153
Iteration 110, loss = 0.38488125
Iteration 111, loss = 0.38453152
Iteration 112, loss = 0.38426963
Iteration 113, loss = 0.38432219
Iteration 114, loss = 0.38358462
Iteration 115, loss = 0.38421846
Iteration 116, loss = 0.38439748
Iteration 117, loss = 0.38364193
Iteration 118, loss = 0.38367817
Iteration 119, loss = 0.38379879
Iteration 120, loss = 0.38321187
Iteration 121, loss = 0.38320733
Iteration 122, loss = 0.38313328
Iteration 123, loss = 0.38307715
Iteration 124, loss = 0.38343239
Iteration 125, loss = 0.38256299
Iteration 126, loss = 0.38295389
Iteration 127, loss = 0.38204827
Iteration 128, loss = 0.38201784
Iteration 129, loss = 0.38197456
Iteration 130, loss = 0.38166846
Iteration 131, loss = 0.38219273
Iteration 132, loss = 0.38180104
Iteration 133, loss = 0.38191366
Iteration 134, loss = 0.38152079
Iteration 135, loss = 0.38189897
Iteration 136, loss = 0.38171513
Iteration 137, loss = 0.38111496
Iteration 138, loss = 0.38082634
Iteration 139, loss = 0.38107588
Iteration 140, loss = 0.38081955
Iteration 141, loss = 0.38068893
Iteration 142, loss = 0.38123919
Iteration 143, loss = 0.37999542
Iteration 144, loss = 0.38015388
Iteration 145, loss = 0.38021811
Iteration 146, loss = 0.38046293
Iteration 147, loss = 0.37932430
Iteration 148, loss = 0.37970658
Iteration 149, loss = 0.37992756
Iteration 150, loss = 0.37986059
Iteration 151, loss = 0.37991824
Iteration 152, loss = 0.37906741
Iteration 153, loss = 0.37931127
Iteration 154, loss = 0.37918259
Iteration 155, loss = 0.37899981
```

```
Iteration 156, loss = 0.37897268
Iteration 157, loss = 0.37822194
Iteration 158, loss = 0.37952528
Iteration 159, loss = 0.37870348
Iteration 160, loss = 0.37887201
Iteration 161, loss = 0.37843006
Iteration 162, loss = 0.37825528
Iteration 163, loss = 0.37847671
Iteration 164, loss = 0.37797510
Iteration 165, loss = 0.37796924
Iteration 166, loss = 0.37800517
Iteration 167, loss = 0.37818095
Iteration 168, loss = 0.37811403
Iteration 169, loss = 0.37720168
Iteration 170, loss = 0.37786452
Iteration 171, loss = 0.37786796
Iteration 172, loss = 0.37730313
Iteration 173, loss = 0.37780171
Iteration 174, loss = 0.37751012
Iteration 175, loss = 0.37790143
Iteration 176, loss = 0.37707576
Iteration 177, loss = 0.37698748
Iteration 178, loss = 0.37658086
Iteration 179, loss = 0.37602368
Iteration 180, loss = 0.37696320
Iteration 181, loss = 0.37700843
Iteration 182, loss = 0.37714355
Iteration 183, loss = 0.37715894
Iteration 184, loss = 0.37655213
Iteration 185, loss = 0.37635376
Iteration 186, loss = 0.37616180
Iteration 187, loss = 0.37584692
Iteration 188, loss = 0.37625805
Iteration 189, loss = 0.37534958
Iteration 190, loss = 0.37631373
Iteration 191, loss = 0.37611275
Iteration 192, loss = 0.37556852
Iteration 193, loss = 0.37672967
Iteration 194, loss = 0.37621180
Iteration 195, loss = 0.37603356
Iteration 196, loss = 0.37572429
Iteration 197, loss = 0.37596753
Iteration 198, loss = 0.37518520
Iteration 199, loss = 0.37554752
Iteration 200, loss = 0.37548067

C:\Users\adasi\AppData\Local\pypoetry\Cache\virtualenvs\csgo-round-prediction-
GhoYBn2B-py3.10\lib\site-
```

```
packages\sklearn\neural_network\_multilayer_perceptron.py:692:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
```

[101]:
```
MLPClassifier(verbose=True)
```

W tym momencie możemy sprawdzić średnią trafność modelu na rozważanych danych testowych.

[102]:
```
print(f'Model sieci neuronowej: {nn_clf.score(x_test, y_test)}')
```

```
Model sieci neuronowej: 0.7863736622824933
```

1.5 Podział prac

1. ~~Wybór niezbędnych bibliotek - Jakub Michalak~~
2. ~~Walidacja i wydzielenie danych treningowych - Damian Opoka~~
3. ~~Analiza i przygotowanie danych - Damian Opoka~~
4. ~~Definicja modelu - Adam Ryl~~
5. Weryfikacja krzyżowa - Adam Ryl
6. Dostosowanie hiperparametrów - Jakub Michalak
7. Wygenerowanie wyników - Piotr Kryczka
8. Analiza wyników - Piotr Kryczka