```
[2]  import pandas as pd
     import numpy as np
```

```
[3]  match_file = pd.read_csv('data_raw/match.csv')
     match_file.head()
```

	match_id	start_time	duration	tower_status_radiant	tower_sta
0	0	1446750112	2375	1982	4
1	1	1446753078	2582	0	1846
2	2	1446764586	2716	256	1972
3	3	1446765723	3085	4	1924
4	4	1446796385	1887	2047	0

```
[4]  # details of bit string is in :
     #
     https://wiki.teamfortress.com/wiki/WebAPI/GetMatchDetails#Player_
     Slot
     def tower_status(ts_radiant, ts_dire):
         tsr = {}
         tsd = {}
         bit_tsr = '{0:016b}'.format(ts_radiant)
         bit_tsd = '{0:016b}'.format(ts_dire)
         tsr['top'] = bit_tsr.count('1', -3)
         tsd['top'] = bit_tsd.count('1', -3)
         tsr['mid'] = bit_tsr.count('1', 10, 13)
         tsd['mid'] = bit_tsd.count('1', 10, 13)
         tsd['bottom'] = bit_tsd.count('1', 7, 10)
         tsr['bottom'] = bit_tsr.count('1', 7, 10)
         tsd['ancient'] = bit_tsd.count('1', 5, 7)
         tsr['ancient'] = bit_tsr.count('1', 5, 7)
         return (tsr, tsd)

     def barracks_status(bs_radiant, bs_dire):
         bsr = {}
         bsd = {}
         bit_bsr = '{0:08b}'.format(bs_radiant)
         bit_bsd = '{0:08b}'.format(bs_dire)
         bsr['top'] = bit_bsr.count('1', -2)
         bsd['top'] = bit_bsd.count('1', -2)
         bsr['mid'] = bit_bsr.count('1', 2, 4)
         bsd['mid'] = bit_bsd.count('1', 2, 4)
         bsd['bottom'] = bit_bsd.count('1', 4, 6)
```

```
    bsr['bottom'] = bit_bsr.count('1', 4, 6)
    return (bsr, bsd)
```

```
[5]  df_players = pd.read_csv(
         'data_raw/players.csv',
         usecols=[
             'match_id',
             'player_slot',
             'gold',
             'gold_spent',
             'kills',
             'deaths',
             'assists',
             'denies',
             'last_hits',
             'hero_damage',
             'tower_damage',
             'level',
             'gold_buyback'
             ])
     # df_player_time = pd.read_csv('dota-2-matches/player_time.csv')
     # df_ability = pd.read_csv('dota-2-matches/ability_upgrades.csv')
     df_team_fights = pd.read_csv('data_raw/teamfights.csv')
     df_team_fights_players =
     pd.read_csv('data_raw/teamfights_players.csv')
```

Novel feature: negative chat

We tried a custom known list of reliably negative words in chat as a novel feature. We count the number of occurrences of each word in the dictionary in chat per team per match.

```
[6]  df_chat = pd.read_csv('data_raw/chat.csv')
     df_chat['key'].fillna('', inplace=True)

     naughty_words = [
         'stfu',
         'ez',
         'fuck',
         'wtf',
         'blame',
         'report',
         'reported',
         'shit',
         'ass',
         'asshole',
         'idiot',
         'stupid',
         'support',
         'blyat',
         'noob',
         'gg'
     ]

     def get_naughty_count(phrase):
         naughty_count = 0
         tokens = phrase.split()
         for token in tokens:
             naughty_count = naughty_count + (1 if token in
     naughty_words else 0)
         return naughty_count

     df_chat['is_radiant'] = df_chat['slot'] < 5
     df_chat['naughty_count'] =
     df_chat['key'].apply(get_naughty_count)
     df_chat.head()
```

	match_id	key	slot	time	unit	is_radiant	naughty
0	0	force it	6	-8	6k Slayer	False	0
1	0	space created	1	5	Monkey	True	0
2	0	hah	1	6	Monkey	True	0
3	0	ez 500	6	9	6k Slayer	False	1
4	0	mvp ulti	4	934	Kira	True	0

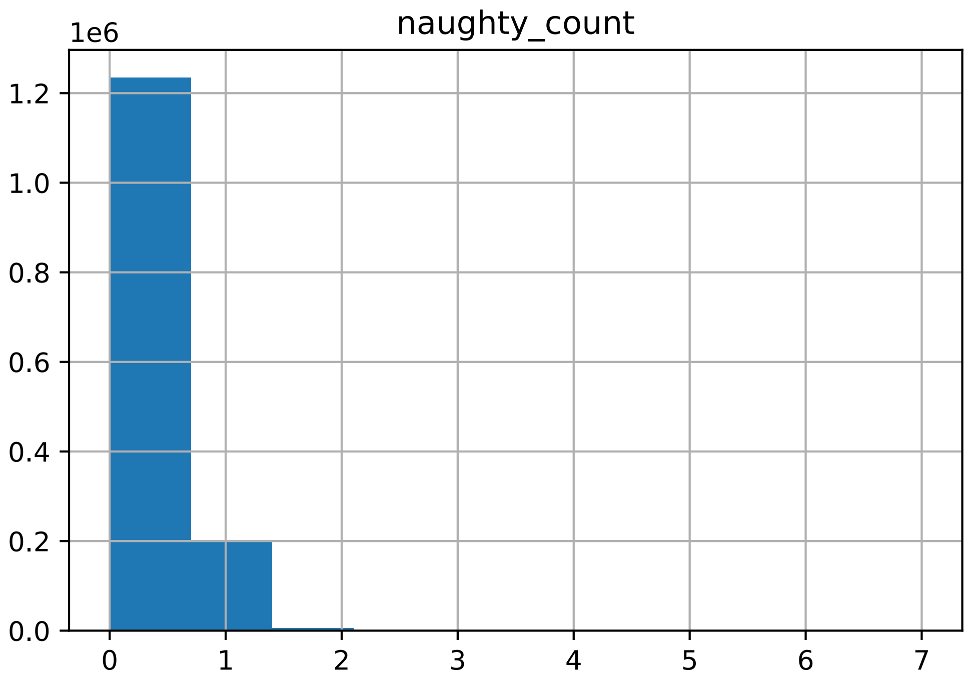
[48]
```
df_chat['naughty_count'].describe()
```

```
count    1.439488e+06
mean     1.467015e-01
std      3.670513e-01
min      0.000000e+00
25%      0.000000e+00
50%      0.000000e+00
75%      0.000000e+00
max      7.000000e+00
Name: naughty_count, dtype: float64
```

We can see that the median negative word count is 0, and the majority of games have 0 instances of negative words. Thus, later we convert it to a binary feature (present or not).

```
[17]  df_naughty_count_only = pd.DataFrame(df_chat['naughty_count'],
      columns=['naughty_count'])
      df_naughty_count_only.hist()
```

```
array([[<matplotlib.axes._subplots.AxesSubplot object at
0x000001380ED6C7C0>]],
      dtype=object)
```



```
[50]  df_match_grouped = df_chat.groupby(['match_id', 'is_radiant'],
      as_index=False).naughty_count.agg('sum')
      df_match_grouped['radiant_naughty_count'] =
      np.where(df_match_grouped['is_radiant'] == True,
      df_match_grouped['naughty_count'], 0)
      df_match_grouped['dire_naughty_count'] =
      np.where(df_match_grouped['is_radiant'] == False,
      df_match_grouped['naughty_count'], 0)
      df_match_grouped.head()
```

	match_id	is_radiant	naughty_count	radiant_naughty_count	di
0	0	False	2	0	2
1	0	True	3	3	0
2	1	False	1	0	1

	match_id	is_radiant	naughty_count	radiant_naughty_count	di
3	1	True	0	0	0
4	2	False	2	0	2

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[52]
```
df_match_naughty_counts =
df_match_grouped.groupby(['match_id']).agg({
    'radiant_naughty_count': 'sum',
    'dire_naughty_count': 'sum'
})

df_match_naughty_counts.head()
```

	radiant_naughty_count	dire_naughty_count
match_id		
0	3	2
1	0	1
2	1	2
3	1	2
4	1	3

[54]
```
match_data = []
match_file = match_file[match_file['game_mode'] == 22]
df_players.fillna(0, inplace=True)

radiant_pl = [0,1,2,3,4]
dire_pl = [128,129,130,131,132]
player_features = {
    'gold': 'full_total',
    'gold_spent': 'full_avg',
    'kills': 'only_total',
    'deaths': 'full_total',
    'assists': 'full_avg',
    'denies': 'full_avg',
    'last_hits': 'full_avg',
    'hero_damage': 'full_total',
    'tower_damage': 'full_total',
    'level': 'full_total',
    'gold_buyback': 'full_avg'
    }
```

```
[56]  df = df_players[(df_players.player_slot.isin(radiant_pl)) &
      (df_players.match_id == 0)]
      df
```

	match_id	player_slot	gold	gold_spent	kills	deaths	assi
0	0	0	3261	10960	9	3	18
1	0	1	2954	17760	13	3	18
2	0	2	110	12195	0	4	15
3	0	3	1179	22505	8	4	19
4	0	4	3307	23825	20	3	17

```
[58]  tf = df_team_fights_players[df_team_fights_players.match_id == 0]
      # for i in list(range(0,int(len(tf)/10))):
      #     print(i*10,(i+1)*10)
      a = tf[0:10]
      d = sum(a[a.player_slot.isin(dire_pl)]['deaths'])
      d
```

```
2
```

```
[60]  def teamfight_result(teamfights):
          loss_d = 0
          loss_r = 0
          for i in list(range(0,int(len(tf)/10))):
              tf_df = teamfights[i*10:(i+1)*10]
              rd = sum(tf_df[tf_df.player_slot.isin(radiant_pl)]
      ['deaths'])
              dd = sum(tf_df[tf_df.player_slot.isin(dire_pl)]
      ['deaths'])
              if dd < rd:
                  loss_r += 1
              elif rd < dd:
                  loss_d += 1
          return (loss_r, loss_d)
```

```
[62]  def stat_agg(types: str, feature_name: str, data_list: str,
      team_data: dict):
        if types == "only_total":
            team_data[f'{feature_name}_total'] = sum(data_list)
        elif types == "full_total":
            team_data[f'{feature_name}_total'] = sum(data_list)
            team_data[f'{feature_name}_max'] = max(data_list)
            team_data[f'{feature_name}_min'] = min(data_list)
            team_data[f'{feature_name}_std'] =
round(np.std(data_list), 4)
        elif types == "full_avg":
            team_data[f'{feature_name}_avg'] = np.average(data_list)
            team_data[f'{feature_name}_max'] = max(data_list)
            team_data[f'{feature_name}_min'] = min(data_list)
            team_data[f'{feature_name}_std'] =
round(np.std(data_list), 4)

        return team_data
```

```
[63]  # filter_players = df_players.player_slot.isin(radiant_pl) &
      df_players['match_id'] == 0
      df_players.dtypes
```

```
match_id          int64
player_slot       int64
gold              int64
gold_spent        int64
kills             int64
deaths            int64
assists           int64
denies            int64
last_hits         int64
hero_damage       int64
tower_damage      int64
level             int64
gold_buyback    float64
dtype: object
```

```
[64]  def aggregation_data(match_id, team, team_data: dict):
          # getting the player list
          player_ids = radiant_pl if team == 'radiant' else dire_pl

          filter_players = (df_players.player_slot.isin(player_ids)) &
      (df_players.match_id == match_id)
          df_team_players = df_players[filter_players]

          for feature in player_features:
              team_data = stat_agg(player_features[feature], feature,
      df_team_players[feature], team_data)

          return team_data
```

```
[65]  len(match_file)
```

```
48670
```

```
[67]  for idx, row in match_file.iterrows():
          match_id = row['match_id']
          duration = row['duration']

          # Tower, barracks, ancient status
          tower_radiant, tower_dire =
      tower_status(row['tower_status_radiant'],
      row['tower_status_dire'])
          barracks_radiant, barracks_dire =
      barracks_status(row['barracks_status_radiant'],
      row['barracks_status_dire'])

          # teamfights result
          loss_radiant, loss_dire =
      teamfight_result(df_team_fights_players[df_team_fights_players.ma
      tch_id == match_id])

          # naughty word count
          naughty_counts = None
          try:
              naughty_counts = df_match_naughty_counts.loc[match_id]
          except:
              pass

          radiant_naughty_count = 0
          dire_naughty_count = 0

          radiant_naughty_count =
      naughty_counts['radiant_naughty_count'] if naughty_counts is not
      None else 0
          dire_naughty_count = naughty_counts['radiant_naughty_count']
      if naughty_counts is not None else 0

          #-- radiant --#
          # init
          team_radiant = {'match_id': match_id, 'duration': duration}
          # result
          team_radiant['result'] = 1 if row['radiant_win'] else 0
          # tower, barrack, ancient comparison data
          team_radiant['top_towers'] = tower_radiant['top'] -
      tower_dire['top']
          team_radiant['mid_towers'] = tower_radiant['mid'] -
      tower_dire['mid']
```

```
    team_radiant['bottom_towers'] = tower_radiant['bottom'] -
tower_dire['bottom']
    team_radiant['ancient_status'] = tower_radiant['ancient'] -
tower_dire['ancient']
    team_radiant['top_barracks'] = barracks_radiant['top'] -
barracks_dire['top']
    team_radiant['mid_barracks'] = barracks_radiant['mid'] -
barracks_dire['mid']
    team_radiant['bottom_barracks'] = barracks_radiant['bottom']
- barracks_dire['bottom']
    # aggregating data from players, abilities
    team_radiant = aggregation_data(match_id, 'radiant',
team_radiant)
    # teamfight
    team_radiant['teamfight_loss'] = loss_radiant
    # naughty count
    team_radiant['has_negative_chat'] = True if
radiant_naughty_count > 0 else False

    #-- dire --#
    # init
    team_dire = {'match_id': match_id, 'duration': duration}
    # result
    team_dire['result'] = 0 if row['radiant_win'] else 1
    # tower, barrack, ancient comparison data
    team_dire['top_towers'] = - tower_radiant['top'] +
tower_dire['top']
    team_dire['mid_towers'] = - tower_radiant['mid'] +
tower_dire['mid']
    team_dire['bottom_towers'] = - tower_radiant['bottom'] +
tower_dire['bottom']
    team_dire['ancient_status'] = - tower_radiant['ancient'] +
tower_dire['ancient']
    team_dire['top_barracks'] = - barracks_radiant['top'] +
barracks_dire['top']
    team_dire['mid_barracks'] = - barracks_radiant['mid'] +
barracks_dire['mid']
    team_dire['bottom_barracks'] = - barracks_radiant['bottom'] +
barracks_dire['bottom']
    # aggregating data from players, abilities
    team_dire = aggregation_data(match_id, 'dire', team_dire)
    # teamfight
    team_dire['teamfight_loss'] = loss_dire
    # naughty word count
    team_dire['has_negative_chat'] = True if dire_naughty_count >
0 else False

    match_data.append(team_radiant)
    match_data.append(team_dire)
```

```
[33]  print('match data count: ', len(match_data))
```

```
match_data[0]
```

```
match data count:  6

{'match_id': 0,
 'duration': 2375,
 'result': 1,
 'top_towers': 1,
 'mid_towers': 3,
 'bottom_towers': 2,
 'ancient_status': 2,
 'top_barracks': 0,
 'mid_barracks': 2,
 'bottom_barracks': 2,
 'gold_total': 10811,
 'gold_max': 3307,
 'gold_min': 110,
 'gold_std': 1290.2002,
 'gold_spent_avg': 17449.0,
 'gold_spent_max': 23825,
 'gold_spent_min': 10960,
 'gold_spent_std': 5215.8388,
 'kills_total': 50,
 'deaths_total': 17,
 'deaths_max': 4,
 'deaths_min': 3,
 'deaths_std': 0.4899,
 'assists_avg': 17.4,
 'assists_max': 19,
 'assists_min': 15,
 'assists_std': 1.3565,
 'denies_avg': 6.0,
 'denies_max': 13,
 'denies_min': 1,
 'denies_std': 4.6476,
 'last_hits_avg': 142.6,
 'last_hits_max': 271,
 'last_hits_min': 30,
 'last_hits_std': 97.9155,
 'hero_damage_total': 85226,
 'hero_damage_max': 33740,
 'hero_damage_min': 4217,
 'hero_damage_std': 10610.3799,
 'tower_damage_total': 8853,
 'tower_damage_max': 6055,
 'tower_damage_min': 143,
 'tower_damage_std': 2222.8977,
 'level_total': 100,
 'level_max': 24,
 'level_min': 16,
 'level_std': 3.0332,
 'gold_buyback_avg': -414.2,
 'gold_buyback_max': 0.0,
 'gold_buyback_min': -1056.0,
 'gold_buyback_std': 507.455,
 'teamfight_loss': 1,
 'naughty_word_count': True}
```

```
[68]  df_match_data = pd.DataFrame(match_data)
      df_match_data.to_csv('data_clean/cleaned_match_data')
```