Toxic Game:

Predicting a DOTA 2 Match Result using Player Data

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Defense of the Ancient 2

DOTA 2 Free-to-Play Multiplayer Online Battle Arena (MOBA) video game developed by Valve Software for Windows and Mac (PC) in 2013.

- Currently owns the top 5 largest prize pool in e-sports (The International 2021 - $40,018,400.00)

- 14,520,350 active players worldwide as of October 2022

How to Play DOTA 2

Hero Selection

Two teams of 5 players each select a hero from a pool of 123 heroes

Destroy the Enemy Ancient

Win the game by destroying the enemy ancient (Only acessible by destroying towers)

Traverse the Map

Kill creeps (NPC), enemy heroes, destroy towers to earn gold for buying items and experience for leveling up

DIRE

RADIANT

https://www.researchgate.net/figure/Map-of-Dota-2-from-Dota-2-wiki-7_fig1_262207818

DOTA 2 Dataset

Contains 50,000 ranked matches of DOTA 2 as of 2019 stored in 11 Datasets
https://www.kaggle.com/datasets/devinanzelmo/dota-2-matches

	match_id	account_id	hero_id	player_slot	gold	gold_spent	gold_per_min	xp_per_min	kills	deaths	...	unit_order_eject_item_from_stash	unit_order_d
0	0	0	86	0	3261	10960	347	362	9	3	...	NaN	
1	0	1	51	1	2954	17760	494	659	13	3	...	NaN	
2	0	0	83	2	110	12195	350	385	0	4	...	NaN	
3	0	2	11	3	1179	22505	599	605	8	4	...	NaN	
4	0	3	67	4	3307	23825	613	762	20	3	...	NaN	

5 rows × 74 columns

	match_id	start_time	duration	tower_status_radiant	tower_status_dire	barracks_status_dire	barracks_status_radiant	first_blood_time	game_mode	rad
0	0	1446750112	2375	1982	4	3	63	1	22	
1	1	1446753078	2582	0	1846	63	0	221	22	
2	2	1446764586	2716	256	1972	63	48	190	22	
3	3	1446765723	3085	4	1924	51	3	40	22	
4	4	1446796385	1887	2047	0	63	58	22		

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

	cluster	region
0	111	NORTH AMERICA
1	112	NORTH AMERICA
2	113	NORTH AMERICA
3	121	NORTH AMERICA
4	122	NORTH AMERICA
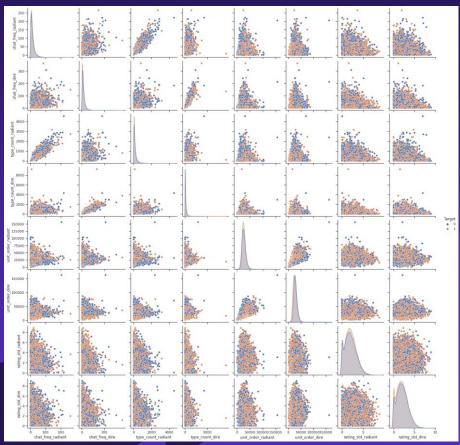
	account_id	trueskill_mu
0	236579	27.868035
1	-343	26.544163
2	-1217	26.521103
3	-1227	27.248025
4	-1284	22.931016

DOTA 2 Dataset

Goal: Create a ML model to predict a DOTA 2 match result using player data (actions, behavior, location)
Target column: 1 if Radiant wins, 0 if Dire wins

| chat_freq_radiant	chat_freq_dire	type_count_radiant	type_count_dire	unit_order_radiant	unit_order_dire	rating_std_radiant	rating_std_dire	region	Target
23.0	28.0	161.0	352.0	34577	39155	2.490819	4.004111	SOUTHEAST ASIA	1
11.0	5.0	100.0	34.0	22431	44294	3.775828	2.790705	SOUTHEAST ASIA	0
24.0	21.0	238.0	197.0	33147	33560	1.541538	0.000000	EUROPE	0
11.0	14.0	49.0	145.0	25208	27743	2.453707	2.409592	EUROPE	0
3.0	4.0	13.0	36.0	20707	34781	2.008455	2.571840	SOUTHEAST ASIA	1
...	...	...	...	...	...	...	...	...	...
19.0	6.0	185.0	66.0	29704	44788	0.108362	1.091523	NORTH AMERICA	1
1.0	4.0	5.0	45.0	18080	15315	3.752688	1.017042	SOUTH AMERICA	1
3.0	4.0	23.0	26.0	30102	34876	1.445037	1.374177	NORTH AMERICA	1
14.0	11.0	140.0	166.0	24904	23854	1.864004	2.054487	SOUTHEAST ASIA	1
10.0	24.0	116.0	105.0	49912	24655	1.512429	0.014440	SOUTHEAST ASIA	0
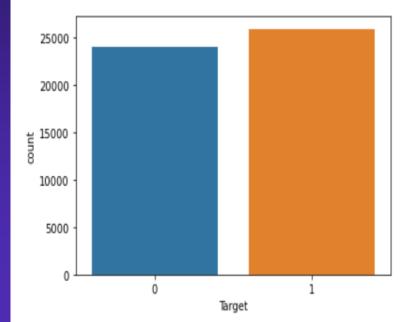
DOTA 2 Dataset

Population per class: 0
1   25943
0   24057
Proportion Chance Criterion: 50.07%
1.25 * Proportion Chance Criterion: 62.59%

Features

All Chat Metrics

1. Total frequency of all chat per team.
2. Total characters of the team's all chat

key	chat_freq	type_count
[fuck my ass, ka bu tooooooooooooo, 6k slayer,...	4.0	44.0
[space created, hah, hah, wtf, TA?, u srsly?, ...	16.0	98.0
[lol, really ?]	2.0	11.0
NaN	0.0	0.0
[mvp ulti]	1.0	8.0
...	...	...
[G, 1 punch man]	2.0	12.0
[ggwp]	1.0	4.0
[hahaha, we end, no time, noob, booo, Hahahaha]	6.0	35.0
[go nc, furion nc, noob, happu def noob, ez, e...	15.0	54.0
NaN	0.0	0.0

IG.Emo: ?

https://twitter.com/invgaming/status/1378701641982042115/photo/1

GAME IS PAUSED

Phoenix can use items and cast abilities during Icarus Dive.

TNC (Phoenix) paused the game.

TNC: wait I'm gonna greet my mother a happy mother's day brb

https://www.facebook.com/TNCProTeamDota2/photos/a.840519056030409/4064255780323371/?type=3

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[go nc, furion nc, noob, happu def noob, ez, e...	15.0	54.0
NaN	0.0	0.0

Features

unit_order_radiant	unit_order_dire
34577	39155
22431	44294
33147	33560
25208	27743
20707	34781
...	...
29704	44788
18080	15315
30102	34876
24904	23854
49912	24655

Unit Order

Total commands issued to the hero per team. Includes movements, attacks, item usages, taunts, pings, etc.

Attack

Item Usage

Skill Usage

Ping

Taunt

Features

https://stratz.com/leaderboards/olaplus

rating_std_radiant	rating_std_dire	region
2.490819	4.004111	SOUTHEAST ASIA
3.775828	2.790705	SOUTHEAST ASIA
1.541538	0.000000	EUROPE
2.453707	2.409592	EUROPE
2.008455	2.571840	SOUTHEAST ASIA
...	...	...
0.108362	1.091523	NORTH AMERICA
3.752688	1.017042	SOUTH AMERICA
1.445037	1.374177	NORTH AMERICA
1.864004	2.054487	SOUTHEAST ASIA
1.512429	0.014440	SOUTHEAST ASIA

Player Skill Level

Standard deviation of the skill level of the players per team.
*Ranked Match assumes similar average player skill level.

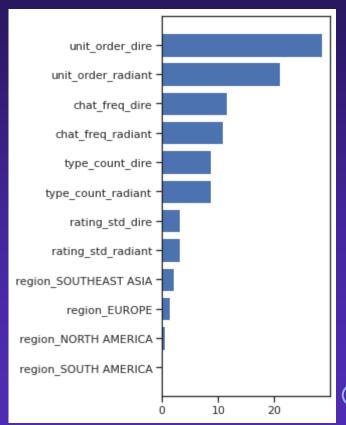## Region

Location of server that hosts the match.

Results: Auto ML

	Machine Learning Method	Test Accuracy	Best Parameter	Top Predictor Variable	Run Time
0	kNN	0.622155	N_Neighbor = 19	NA	1270.392044
1	Logistic (l2)	0.678918	C = 100	type_count_dire	392.016868
2	Logistic (l1)	0.679390	C = 5	type_count_dire	154.871302
3	Linear SVM (l2)	0.678510	C = 20	type_count_dire	289.821018
4	Linear SVM (l1)	0.678558	C = 3	type_count_dire	181.178500
5	Random Forest	0.692228	Max_features = 0.3	unit_order_dire	886.388162
6	Gradient Boosting Method	0.696830	Max_features = 0.8	unit_order_dire	253.603862
7	CATBoost Method	0.707668	Max_depth = 4	unit_order_dire	607.436897
8	LightGBM Method	0.705379	Max_depth = 10	type_count_radiant	942.903859
9	XGBoost Method	0.706595	Max_depth = 3	unit_order_dire	4372.107266
10	AdaBoost Method	0.689859	Learning_rate = 0.9	unit_order_dire	328.960214

Results: Feature Importance

	Feature	Avg. Importance	Std. Importance
5	unit_order_dire	23.020793	0.661431
4	unit_order_radiant	18.333316	0.473218
1	chat_freq_dire	12.403833	0.423855
0	chat_freq_radiant	11.774728	0.348871
2	type_count_radiant	10.799228	0.299124
3	type_count_dire	10.590838	0.328895
7	rating_std_dire	4.164862	0.291324
6	rating_std_radiant	3.920361	0.278750
11	region_SOUTHEAST ASIA	2.641226	0.207012
8	region_EUROPE	1.547586	0.203695
9	region_NORTH AMERICA	0.550063	0.136660
10	region_SOUTH AMERICA	0.253167	0.087253

Conclusion

- This case examines an <u>alternative</u> approach to predicting a Dota 2 match result via feature engineering.

- Current top accuracy 0.709 (CATBoost) exceeds the dataset's 1.25*Pcc of 0.6259

- Creating/Modifying features gives you a deeper understanding of your data and results in more valuable insights.

Recommendations:

➢ Better Feature Engineering related to the player
  ○ Player Behavior Score in game
  ○ Explore other metrics for all chats
  ○ Automated All Chat/Voice Lines Count

Thank You!