Dotabase: a Dota 2 Database Visualizer

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Abstract

Our project, "Dotabase" serves to be a tool for new and veteran players of the game, "Dota 2." Multiple vises are used in tandem to provide a visual aid for the purposes of learning the game. A player can enter queried matches in order to observe an informative and educational representation of their statistics. This paper will describe our methodology and usage to display statistics in javascript.

1. Introduction/Motivation for Dotabase

Dota, better known as: "Defense of the Ancients," is a game with a legacy spanning over the course of a decade. The earliest known concept of Dota was coined in 2003 by an anonymous individual named "Eul."[1] It began as a player-made custom map for the popular RTS (real time strategy) game, "Warcraft III." Thus, successively newer and improved versions of the map were released since its conception. The current version, which is the sequel known as Dota 2, began development in 2009. The game underwent beta testing in 2011, and was released just last year, July 9, 2013.

Games are played 5 versus 5, with each player picking a hero out of a pool of over 100 possible heroes. There are many important variables that can be used as statistics, such as kills, deaths, GPM, (gold earned per minute) XPM, (experience earned per minute) etc. This makes Dota 2 a great source of variables to display visually. Players then compete on 2 teams, named the "Radiant" and "Dire." The goal of the game is to destroy the other team's main base, which is known as an "ancient."

On the day of 3/17/2014, there have been 663,760 concurrent players online playing Dota 2, as taken from the game distribution platform, Steam.[2] Clearly, a game with more than half a million players must have some sort of learning tool. There do exist many sites with guides to playing each of the many heroes in the game, as well as websites that keep track of player statistics. However, our goal of Dotabase is to devise something new and unique.

[1] http://en.wikipedia.org/wiki/Dota_2
[2] http://store.steampowered.com/

DIRE VICTORY

THE RADIANT

Hero	Player	Level	K	D	A	Gold	LH	DN	XPM	GPM	HD	HH	TD	Items
	o0soul	16	7	9	4	15k	142	1	377	383	6.4k	54	36	
	KoNcEpTzOfLiFe	18	4	6	6	12.2k	90	1	465	313	9.9k	0	152	
	BaNaNa	16	5	7	10	12.9k	129	1	350	329	5.2k	0	717	
	Anonymous	16	7	10	10	9.7k	33	1	367	247	12.2k	0	0	
	Anonymous	15	5	9	9	9.3k	30	0	310	238	7k	0	129	
		81	28	41	39	59.1k	424	4	1.9k	1.5k	40.6k	54	1k	

THE DIRE

Hero	Player	Level	K	D	A	Gold	LH	DN	XPM	GPM	HD	HH	TD	Items
	阵容 心态 havefun	16	4	7	18	12.8k	55	3	379	327	7.3k	0	736	
	你只活一次	22	12	4	20	20.4k	148	3	664	522	17.6k	0	1.4k	
	I want to k...	17	3	6	20	14.5k	60	3	411	371	7.3k	0	157	
	Life's a st...	20	15	9	12	19.4k	122	14	549	496	15.1k	0	3.7k	
	CNM	19	5	3	21	17.5k	121	13	492	447	9.3k	1.6k	2.5k	
		94	39	29	91	84.6k	506	36	2.5k	2.2k	56.6k	1.6k	8.5k	

An example of match statistics fetched from dotabuff.com, showing heroes picked, player names, hero levels, kills, deaths, assists, gold earned, last hits, denies, XPM, GPM, hero damage, hero healing, tower damage, and items.

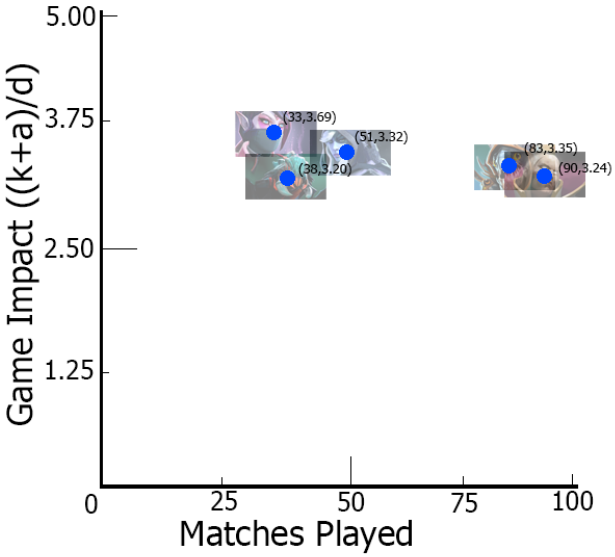
2. Background/Related Work

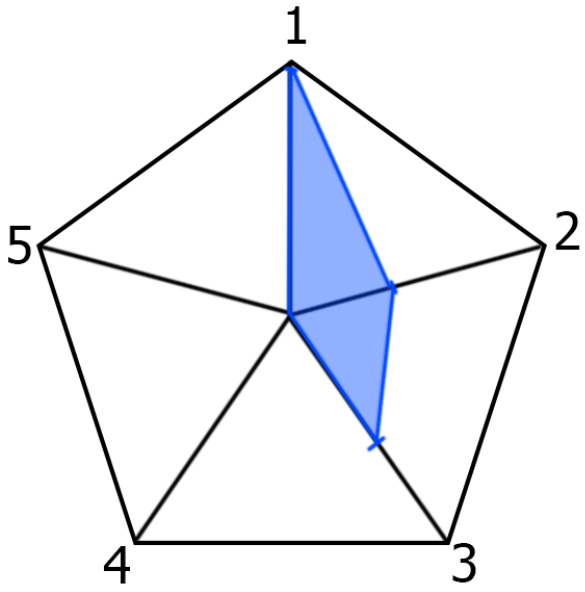
In order to begin our research, we looked at existing Dota statistic websites. The most prominent website is http://dotabuff.com/, a resource that can query the statistics of any given player. From there, we figured out how the website fetches player data; match history can be queried from the official Dota 2 API, hosted by steam.[3] The documentation was rather difficult to discern, but we were able to write code that makes PHP requests to the server. Similarly to program 2, a MySQL/Apache server was set up in XAMPP to run PHP files.

After obtaining the raw data, there were many methods as to how to go about visualizing player statistics. The most convenient method was to use visualization techniques provided by d3.[4] Our original methods listed in our proposal were possible to reproduce in d3's example vises. These were 3 vises:

1. **A 3D scatter plot**: displaying multiple heros' performance for a player.
2. **A star plot**: show the roles of a player, and their performance for each respective role.
3. **A globe**: this would show tournament win rate and matches of certain heroes.

[3] http://dev.dota2.com/showthread.php?t=47115
[4] http://d3js.org/





Load in player

JSON or XML file

Search by Hero

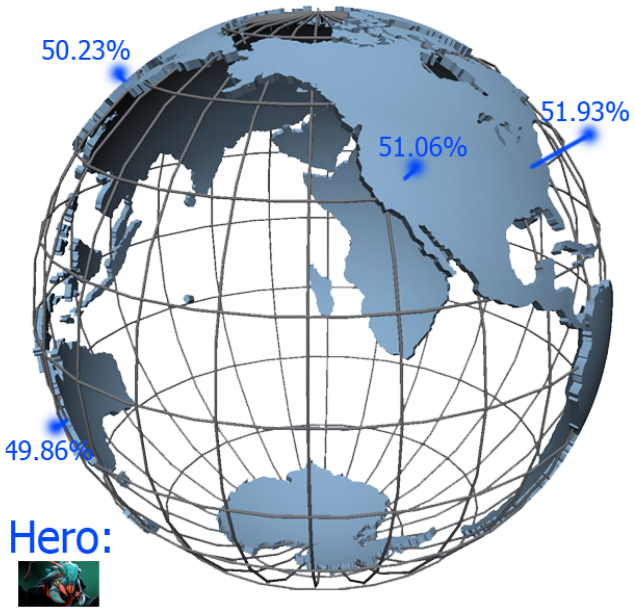
Filters:

Allegiance

Attribute

Role

Select Hero Dropdown



The choice to use multiple vises would enable the feature of brush linking. As shown in the image above, (data which is taken from my profile) the hero displayed in the globe would be chosen in the first and second vises. More specifically, the hero in the example image was Weaver. The scatter plot's advantage is that most played heroes are readily visible. This is related to the second vis, which is a star plot based on hero role. It follows logically that consecutive games with one hero will be linked to one role. (or 2 in special cases) Yet, each role must be explained first. There are 5 roles, which are the numbers 1 through 5. This represents allocation of gold on the team, role 1 having the most gold and role 5 having the least. In this case, Weaver is a hero of role 3, which is why my proficiency is shown in

the star plot for 3. Notice how proficiency for 4 and 5 are absent; I mostly play roles 1-3, and all heroes shown in the first vis are 1-3 as well. The code for the star plot was provided from two d3 sources.[5][6]

Lastly, the third vis will show a hero's win percentage in global tournaments, and return match IDs as well. This allows players to view replays of high level games in order to possibly improve their skill. By the use of all 3 vises in tandem, a player can enter their data, (taken from the Dota 2 API) view their success with various heroes, observe their role proficiency, and query any professional matches for a given hero they have played. The way that this vis helps players is by providing match IDs that they can download onto their Dota 2 client and view for themselves.

Unfortunately, we decided against using the globe visualization. We intended to use cesium.js[7], a javascript library for making 3D globes and 2D maps. The justification for not using this vis will be explained in our results. With that in mind, we instead developed upon our existing 2 vises and improved their functionality greatly.

3. Approach

Unlike our previous projects, fetched data was not conveniently formatted in advance. Thus, we had to write a script in PHP to record values that were formatted our own desired way. This was both advantageous and advantageous for our purposes, as we could write any file format desired, at the expense of time that could be used towards actual vis design. Ultimately, we settled upon using .CSV file format because we had previously used this file format in program 2. Thus, our intention of using JSON and XML files was redacted.

Code Snippet:

```
echo $heroRoles[$heroes_data[$match->get_slot($playerSlot)->get('hero_id')]['localized_name']];
        echo ",";
        $text .= $heroRoles[$heroes_data[$match->get_slot($playerSlot)->get('hero_id')]['localized_name']].",";

        echo $match->get_slot($playerSlot)->get('kills');
        echo ",";
        $text .= $match->get_slot($playerSlot)->get('kills').",";

        echo $match->get_slot($playerSlot)->get('deaths');
        echo ",";
        $text .= $match->get_slot($playerSlot)->get('deaths').",";
```

In terms of what variables we needed to query, we decided in the end to query:

1. Match ID
2. Hero name
3. Kills

[5] https://gist.github.com/nbremer/6506614
[6] https://github.com/alangrafu/radar-chart-d3
[7] http://cesiumjs.org/

4. Deaths
5. Assists
6. Gold per minute
7. Experience per minute
8. Creep kills (last hits)

As shown in our proposal, our final project would consist of three different vis's displaying multiple representations of player data and proficiency. The first vis was the most basic, displaying an array of three variables per hero played; each hero's kills, games played, and win ratio. These variables can already be displayed from dotabuff.com, but our vis aims to make visual differences readily apparent to viewers. Moreover, our vis can accept any arbitrary number of matches. For this vis, we ended up using d3 and x3dom.[8]

The second vis was simple in complexity, but advanced in terms of finding relevant data needed for calculations. A star plot plot was used to display a player's skill within the five categories of roles in Dota 2. The calculations done were professional player averages, which would serve as thresholds for player skill. Research was first done on concurrent professional team's players. Once the profiles were retrieved, we returned average stats for their respective roles. In essence, the professional players served as a benchmark for "outstanding" players with a maximum possible score for their indicated role. With this in mind, all other players could be compared to this benchmark, returning a value from 1 to 5, with 1 being poor and 5 being outstanding.

The players used as benchmarks for each respective role were:

Role 1: BurNIng (Team DK, China; http://dotabuff.com/players/90892734)
Role 2: Dendi (Team Natus Vincere, Ukraine; http://dotabuff.com/players/70388657)
Role 3: Funn1k (Team Natus Vincere, Ukraine; http://dotabuff.com/players/86723143)
Role 4: Aui_2000 (Team Cloud 9, USA; http://dotabuff.com/players/40547474)
Role 5: Akke (Team Alliance, Sweden; http://dotabuff.com/players/41288955)

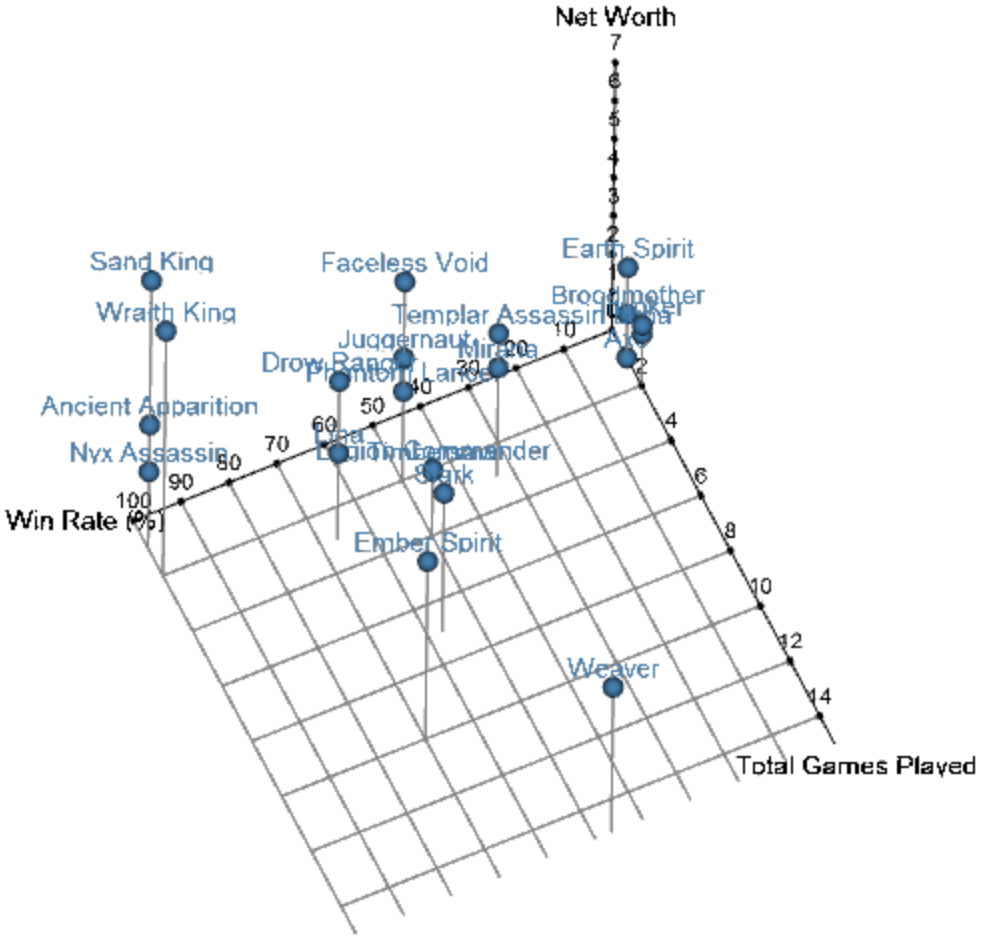
**Team Alliance and Natus Vincere won first and second place in The International 2013, a $2,874,381 prize pool tournament.*

4. Results

A large bulk of the project consisted of fetching data sets, most of which is not visible to users. This is helpful for practical purposes, as Dotabase runs offline without any issues. Additionally, making direct calls to the Dota API server directly can become taxing on the server if excessive calls are made. The current Dotabase folder will contain two player's data sets, as well as professional player sets: the latter of which are used for comparisons in the second vis, the star plot. Our project takes in a primary

[8] http://bl.ocks.org/hlvoorhees/5986172

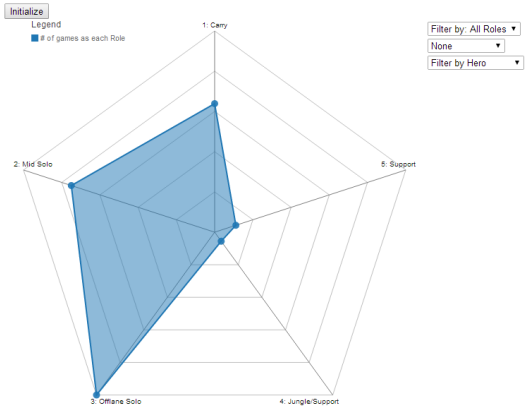
and secondary data set, which can be compared together in the star plot.

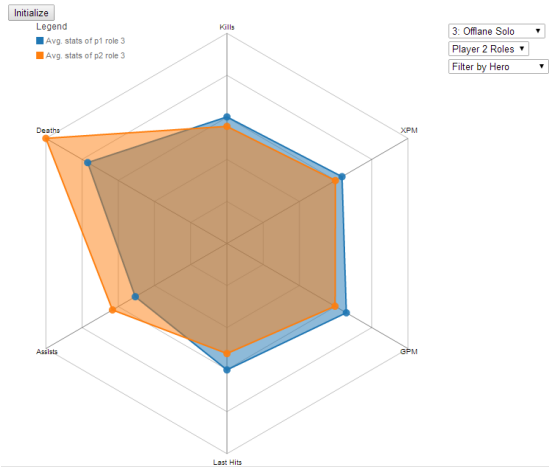


By the resulting graph generated by inputting data of the last 100 matches, many conclusions can be drawn. The data may be difficult to discern to those unfamiliar with Dota 2, but as an experienced player there are noticeable correlations. Dota 2 is a game that has undergone many iterations, and the current version is 6.80 which was released on January 29th. That being said, many heroes undergo balance changes every patch. Disregarding heroes that have very low games played, Templar Assassin, Ember Spirit, and Weaver have significant data values. Consider the tier list for version 6.80[9], in which Templar Assassin is one of the lowest tier heroes. (41-46% win rate) This corresponds with my very low win rate for Templar Assassin, which is between 30-40%. On the other hand, Weaver remains an average hero, with 49-52% win rate. This is displayed correctly as well, as the win percent correlates at 40-50%. The final significant statistic I would like to delineate is Ember Spirit, with 70% win rate. This hero is in fact one of the newest heroes, being introduced in patch 6.79. The general population of Dota 2 players have yet to see his potential and counters, meaning that there

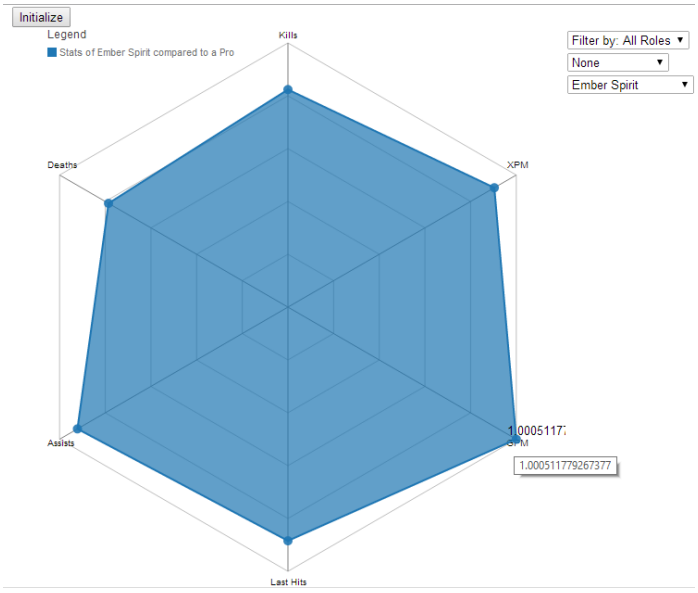
[9] http://dotabuff.com/blog/2014-02-13-pub-tier-list-680

are no conventional methods towards combating Ember Spirit. All in all, my performance correlates to current trending dota tier lists, which means that they are indeed accurate in gauging an average player's win percentage.





The previous two images are of my games played of each role, and my specific "3" role's performance. Previously in the hypothesis, a similar distribution of roles played was shown. The expectations were met; based on the heroes played in the last 100 games, the most prominent are roles 1 through 3. A feature was added to compare the roles of two players. Thus, the blue star plot indicates my performance as the 3 role, whereas the orange star plot is Eric Anderson's performance. As Eric does not play as much Dota 2 as I do, my performance should be higher on average. This can be observed easily, with me surpassing him in every aspect. His deaths are still higher than mine, which is actually a detriment. It can be concluded that the performance of two players can be accurately compared.



In this image I have chosen to filter by heros, specifically ember spirit. As observed in the first vis, my success with this new hero is very evident; my gold per minute average is equal to that of a

professional player. It is important to note that my deaths are still rather high, which shows additional room for improvement. Once ember spirit becomes an "old" hero by the standards of average Dota 2 players, they will have developed necessary builds and counters towards him. It is expected that the statistics should lower over time, provided that I play against more competent players in the future whilst picking ember spirit.

The added inclusion of role and hero filters allows in-depth analysis of players. For the purposes of categorization, an additional job of ours was to list the possible role(s) over every single hero in Dota 2. This was a tedious, yet rewarding process. For matches read in, each game with a hero is categorized by roles 1 through 5. Therefore, in our star plot we were able to sort not only by role, but by hero. Players can already see their performance for each role, but now exact heroes for respective roles can be pinpointed.

The probable usefulness of the globe vis was very dubious from the start. As stated above, tier lists do exist. In fact, many heroes see little to no competitive gameplay, despite being picked in public games. For example, at The International 2013, one third of the heroes were either picked 2 or less times, with one hero never being picked.[10] Moreover, by the time new patches come out and heroes are changed, their play styles may change as a result. Formerly viable strategies are lost, due to the constantly changing metagame of Dota 2. The second reason for removing the vis was for the sake of presentation. The globe itself is in fact the least useful resource, but takes up the most space on the screen. We want to bring the viewer's attention to the more important aspects of Dotabase, specifically the star plot. All the vises produced did not show any unexpected results, but rather correlated with our hypothesis and other related Dota 2 specific trends. As long as a sufficiently large data set is provided, useful statistics are readily observable.

5. Conclusion

There was little to hypothesize, but rather it was more important to show that our results were correctly reflected in Dotabase. It is safe to say that results were produced as expected, considering the clear role distribution for my matches in the star plot. As a player of 4000 matchmaking rating, my above average skill in the 3 role was accurately depicted. Yet, my weakest point that I need to work on is to not die as much as right now. It follows logically that I play to aggressively, and should be more defensive as the 3 role.

One stretch goal we wish we could have performed was the ability to factor MMR (matchmaking rating) into skill.[11] Dotabase fails to determine if a player is truly "good" if they have very few games played. For example, for a person with only a single game played which resulted in an absolutely one sided victory, they would have an "outstanding" rating. Yet, the first few games played in Dota 2 will always be in a low skill bracket; experienced players can always make new accounts that will have grossly skewed stats that do not reflect their true skill. For now, this miscalculation is

[10] http://www.gosugamers.net/dota2/features/3406-heroes-of-the-international-3
[11] http://dota2toplist.com/statistics

acceptable, as many other Dota 2 statistic websites (such as Dotabuff) fail in this aspect as well.

In terms of the success of this project, it has exceeded our expectations. It is important to note that not only is it useful to compare data to pro players, comparisons to players of the same skill level are also rewarding. This is to say, 5 players of nearly the same skill level could form a team together. Presently, teams recruit other players by asking for their MMR. This is slightly flawed, as it is possible to play and win due to your team, not by your own performance. Hence, by using both MMR and Dotabase, a player's full potential can be realized. Unfortunately, this cannot fully be implemented as of now, since MMR is a hidden stat that is viewable only by a single player and their friends. If this feature becomes public, there is yet hope for an online version of Dotabase.

6. References

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