Node Replacement in DOTA 2 Team Networks

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DOTA 2 is without question one of the most popular online games worldwide. At peak hours everyday, you can find close to 1M unique users concurrently playing.[1] Professional DOTA 2 tournaments have also been the most lucrative to date, paying out a total of over $175M of prize money; an amount that exceeds the combined total historical payouts of Counter-Strike:Global Offensive ($70.9M) and League of Legends ($64M), the second and third highest paying professional esports respectively.[2]

A game of DOTA 2 starts with two teams, made up of 5 players each, placed on opposite corners of a square map. The goal of each team is to traverse the map and destroy a unique structure on the opposite side called the 'Ancient,' while also making sure that their own 'Ancient' does not get destroyed. It's similar to Chess where each side has different units trying to capture the opposing side's King, while making sure their own King does not get captured. But unlike Chess where each team is completely symmetrical, both having the same types of pieces at their disposal, each player in DOTA 2 can choose one out of 115 possible characters or heroes to use. The act of choosing heroes is actually a game in itself; team's pick them in alternating order and once a hero has been picked it cannot be picked again. On top of this, each team must arbitrarily ban a set number (varies between tournaments) of heroes from being picked each game. Since these constraints can prevent a team from realizing an ideal preconceived combination of characters, this paper aims to explore how network science, specifically methods for node replacement, can be used to find the best substitute for a character that's been removed from selection.

Here, we present three options to answer the problem of character substitution in DOTA 2. Firstly, we consider the team configurations in a given tournament and map out the co-occurrences of characters to create a representative network. Secondly, we apply network science methods to find the most similar characters (represented as nodes) given a sub-network of five characters within the network. We supplement this method by scraping character roles based on map positions over tournament matches and using these as a measure of similarity also. Lastly, we combine both methods together for the third option.

We test our recommender system using matches scraped from *www.dotabuff.com*. For every match, given the first four heroes of a team, we recommend the top *N* number of heroes for each hero blocked by the opposing team. As a measure of the accuracy of the system, we calculate the percentage of instances where the true fifth hero of the team is in the recommended heroes of the system. This is then benchmarked with recommending random heroes. Using the top five recommendations, we have an increase of *7.84%* using only the adjacency matrix, *5.80%* using both the adjacency and the hero roles, and *0.82%* using only the hero roles with respect to the random recommendations. The results here can be applied not just in the context of DOTA 2 but in other situations where parts of a whole need to be replaced. Examples are athletes in traditional team sports, employees in a workplace, ingredients in a recipe, just to name a few. Analysis on the applications in DOTA 2 remains of high interest, especially given the growing popularity of the game and its increasing push towards mainstream visibility and relevance.

[1] https://steamcharts.com/app/570
[2] https://www.esportsearnings.com/games