Ranking Factors of Team Success

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Agenda

- Background and Motivation
- The Game and Its Community
- The Dataset
- Factors of Team Success
- Ranking Factors of Team Success
- Conclusion and Future Work
Vast amount of data on the Web allow for observing social interactions on a large scale.

We want to study cooperation within teams and factors of team success.

For this we use the multiplayer online game Dota 2.

Here players are always assigned to a team with common goals and interest.
The Game and Its Community

- Multiplayer Online Battle Arena game by Valve
- Two teams of five players
- Each player controls a “hero” that evolves through destruction of enemy forces
- One match: on average 45 minutes
- Steam platform: social network around Dota 2

http://www.dota2wiki.com/wiki/Dota_2_Wiki, 01/13
Heroes are unique characters:
- 66 distinct heroes
- Through combination of initial attributes heroes are suited for different strategies (“roles”)

Crucial: Strategies should be chosen based on all heroes in the team

Lina

Class: Intelligence
Strength: 18
Agility: 16
Intelligence: 27
Role: Nuker, Disabler, Support

http://www.dota2wiki.com/wiki/Dota_2_Wiki, 01/13
The Dataset

Steam Web API

Dota2 Web API

For our analysis: 87,204 matches played by 138,101 individuals
Factor 1: Players’ Experience

<table>
<thead>
<tr>
<th>Win?</th>
<th>#Previous Played Matches</th>
<th>#Previous Won Matches</th>
<th>Time Played (min)</th>
<th>...</th>
<th>#Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>7</td>
<td>320</td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

Logistic regression

Experience score for each player in a team

Average of experience scores of team members

Team’s experience score

Result: Team’s experience score has a high impact on team success ($p<0.007$)
Factor 2: Selected Heroes

<table>
<thead>
<tr>
<th>Win?</th>
<th>Strength</th>
<th>Agility</th>
<th>Intelligence</th>
<th>...</th>
<th>Attack Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>16</td>
<td>27</td>
<td></td>
<td>625</td>
</tr>
</tbody>
</table>

Logistic regression

Score for each hero

Average of scores of heroes in a team

Team’s hero score

→ Result: Team hero score has a high impact on team success ($p < 1.8 \times 10^{-6}$)
For each player: number of friends (on Steam platform) within the team

\[ \text{Team’s score: 3} \quad (\text{maximum of team members’ friends}) \]

\[ \Rightarrow \text{Result: Number of friends within the team has a high impact on team success} \quad (p < 2.2 \times 10^{-16}) \]
Factor 4: National Diversity

- Number of distinct countries in a team

- Not all countries know $\rightarrow$ filter dataset

- **Result**: Teams with *one or two* countries are more likely to win than teams with *three or more* countries ($p<0.04$)
Factor 4: National Diversity (2)

- Next step: subdivision of matches according to their difficulty, i.e., low, normal, high.

Results:

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-value</td>
<td>&lt;0.004</td>
<td>0.184</td>
<td>0.421</td>
</tr>
</tbody>
</table>

Teams perform better if members are only from one or two countries; in particular if players are not so advanced.
Ranking Factors

- Quantification of influence of different factors
  - We exclude Factor 4 (smaller dataset, low significance level)

<table>
<thead>
<tr>
<th>Win?</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/0</td>
<td>Team Experience Score</td>
<td>Team Hero Score</td>
<td>Maximum # of Friends</td>
</tr>
</tbody>
</table>

Logistic regression

Fitted Model

Goodness-of-Fit Tests

Ranking of Factors
## Ranking Factors (2)

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Factor Description</th>
<th>$\chi^2$</th>
<th>Df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 3</td>
<td>Maximum number of friends: measures the social ties inside the team</td>
<td>210.6</td>
<td>4</td>
<td>$&lt;2.0 \times 10^{-44}$</td>
</tr>
<tr>
<td>Factor 2</td>
<td>Team hero score: is related to the chosen characters</td>
<td>89.8</td>
<td>1</td>
<td>$&lt;2.7 \times 10^{-21}$</td>
</tr>
<tr>
<td>Factor 1</td>
<td>Team experience score: aggregates the experience of the team members</td>
<td>72.7</td>
<td>1</td>
<td>$&lt;1.5 \times 10^{-17}$</td>
</tr>
</tbody>
</table>

(Analysis of variance, Type III test with likelihood-ratio $\chi^2$ statistics)
### Model Summary:

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>constant</strong></td>
<td>-0.067***</td>
<td>0.01</td>
</tr>
<tr>
<td><code>max # friends = 4</code></td>
<td>0.283***</td>
<td>0.026</td>
</tr>
<tr>
<td><code>max # friends = 3</code></td>
<td>0.191***</td>
<td>0.019</td>
</tr>
<tr>
<td><code>max # friends = 2</code></td>
<td>0.108***</td>
<td>0.014</td>
</tr>
<tr>
<td><code>max # friends = 1</code></td>
<td>0.038***</td>
<td>0.012</td>
</tr>
<tr>
<td><code>team hero score</code></td>
<td>0.16***</td>
<td>0.017</td>
</tr>
<tr>
<td><code>team experiences score</code></td>
<td>-0.144***</td>
<td>0.017</td>
</tr>
</tbody>
</table>

Number of Observations: 174,404

***p<0.01
Conclusion and Future Work

- Data from online games can be used to infer social behavior pattern
- Results imply that friendship ties and strategy of the entire team are more crucial than experience of players

Future work:
- Extend the model to account also for other factors
- Introduce more sophisticated measures of team experience and role distribution
- Apply network analysis to study friendship ties
- Take into account cultural distance