The Path to DotA Master

An intelligent model to predict and visualize match result in DotA 2

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THE PATH TO DotA MASTER

Introduction

DotA 2, the online video game, is widely accepted as a kind of electronic sport program. Hero selection is an essential part of it.

Based on tremendous data from DotA 2, we build our system to predict the winning possibility of different matches and recommend team bases. With the help of our system, a rookie is able to test different team bases online and finally gain experience from doing comparisons.

Dataset

Hero attributes

There are 112 heroes in our analysis, each of them has two set of attributes.

Advantage indices

We create two matrices anti-advantage-index-matrix and combo-advantage-index-matrix in size 112x112 for hero pairs.

Historical match data

We collected 100 thousand matches for model training among 2.7 billion historical matches data available.

Among these data, both Hero attributes and Historical match data are raw data acquiring from DotA 2 API. Advantage indices are processed and calculated based on Hero attributes.

System Architecture

A. Training Subsystem

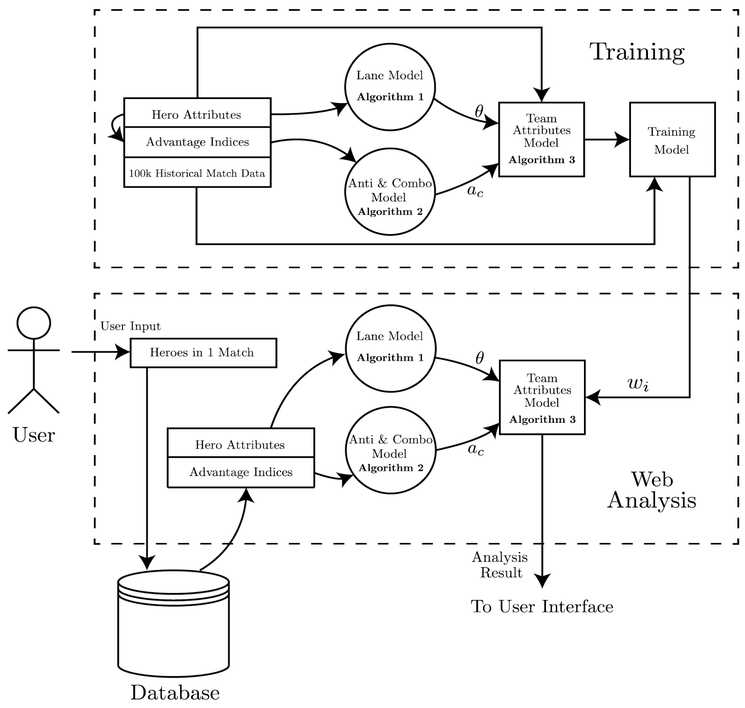
In Training subsystem, dataset Hero attributes and Advantage indices are sent to ***Lane Model*** and ***Anti & Combo Model***, respectively. The output of these two models are Resource-Adjustment-Index and Advantage-Adjustment-Index. These two parameters, along with dataset Hero attributes itself, are sent to ***Team Attributes Model***.

The subsystem is then trained based on the output of Algorithm 3 and 100k Historical match data. Finally, we obtain weighted parameters for each model attributes. These weighted parameters are used to calculate analysis results (winning rate, etc.) in Web-Analysis subsystem.

B. Web-Analysis Subsystem

The Web-Analysis subsystem is an interface between website users and our proposed prediction model.

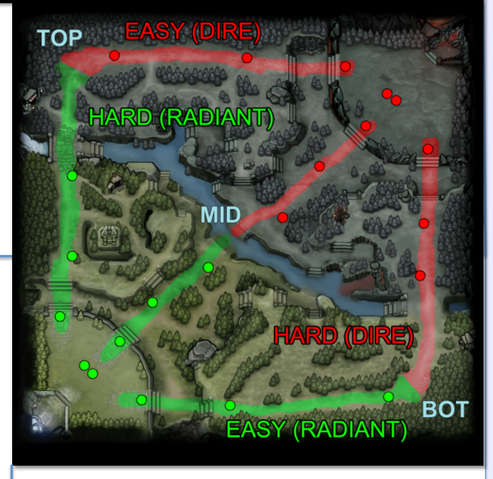
Datasets Hero attributes and Advantage indices are stored in a database . Whenever a website user enters the 10 hero names of both teams, subsystem searches in the database and selects all the attributes related to these 10 heroes. These attributes are sent to ***Lane Model*** and ***Anti & Combo Model*** which are fast enough to be implemented in the web analysis. Combined with the pre-trained weighted parameters, we are able to calculate all the results needed from ***Team Attributes Model***. Later, Web-Analysis subsystem performs a data visualization on the user interface and users can read it directly from the website.



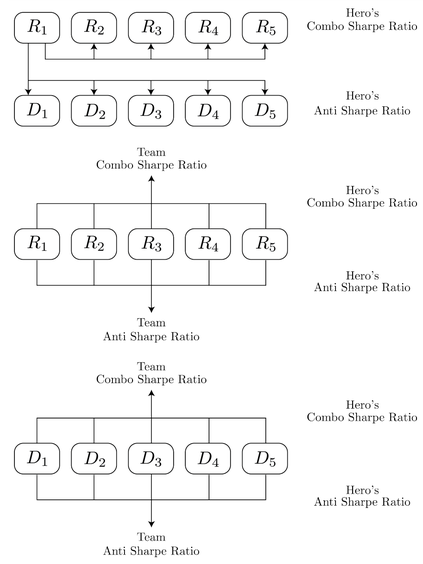
Model & Algorithm

I. Lane model & algorithm

To show the level of resource by a Resource-Adjustment-Index θ, we get the base performance data for heroes in both teams first. After training the weight α, we perform an optimization and calculate θ we need. The higher the θ, we higher the adjustment for team 1. On the contrary, the performance of team 2 is weaken because the lack of resource limits their abilities.



II. Anti & Combo Model



$$R_1's \text{ Combo Sharpe Ratio} = \frac{E\{R_2, R_3, R_4, R_5\}}{\sigma\{R_2, R_3, R_4, R_5\}}$$

Take the influence of teammates and enemies into consideration.

The idea comes from ”Sharpe Ratio” which is a terminology widely used in finance analysis. It is a way to examine the performance of an investment by adjusting for its risk. In our model, we use the same idea to calculate the ”Sharpe Ratio” for anti and combo advantage-index.

In the second part of our dataset, we have Advantage indices in two 112 x 112 matrices. Element[i][j] in them represents *the anti-advantage-index* and the *combo-advantage-index* of a hero pair *{Hero i, Hero j}* respectively.

Then we use the following equation to calculate Sharpe Ratios.

$$R_1's \text{ Anti Sharpe Ratio} = \frac{E\{D_1, D_2, D_3, D_4, D_5\}}{\sigma\{D_1, D_2, D_3, D_4, D_5\}}$$

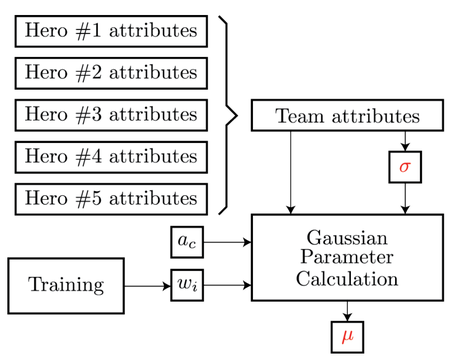
$$\text{Team R Combo Sharpe Ratio} = \frac{E\{CSR_{R_1}, CSR_{R_2}, CSR_{R_3}, CSR_{R_4}, CSR_{R_5}\}}{\sigma\{CSR_{R_1}, CSR_{R_2}, CSR_{R_3}, CSR_{R_4}, CSR_{R_5}\}}$$

III. Team Attributes Model

Among the 5 heroes in a team, different hero plays different roles. Some of them are good at dealing damage, while some are specialized in healing their teammates.

From this perspective, to optimize the performance of a team, we can just take a weighted average of the 5 members to calculate the team attributes.

We are able to obtain μ and σ for the Gaussian Distribution of each team. The winning rate of any combination of heroes can be computed then.



IV. Training

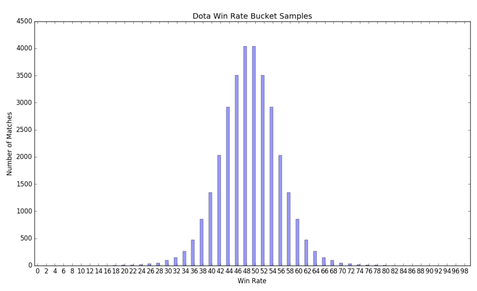
We know the μ and σ from Team Attributes Model, advantage adjustment parameters a_c from Anti & Combo Model, and resource adjustment index θ from Lane Model. We also have 100k historical match data.

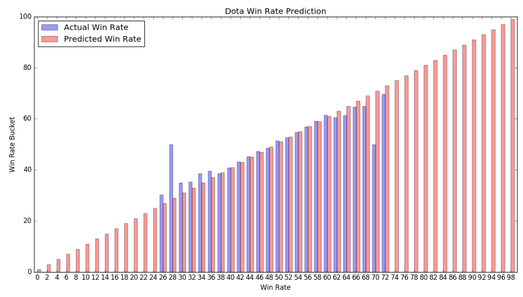
The training of the weight w_i is basically a maximum likelihood estimation. Pandas toolkit is used here to train the weights. These weights are then sent to Web Analysis subsystem for online computing.

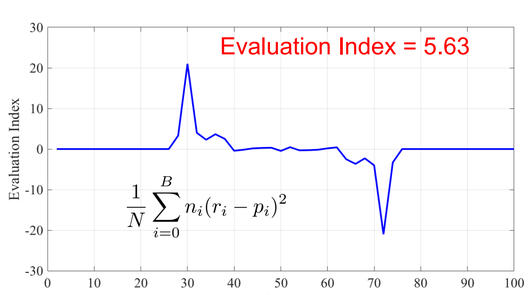
- Step 1: Set the initial value $w_i = 1$.
- Step 2: For every historical match, we calculate the predicted winning rate of each team based on Gaussian method mentioned at the beginning of this section. Parameters μ, σ can be calculated from *Team Attributes Model*.
- Step 3: Pick the higher one (denoted as Pj) among the two winning rates
- Step 4: Multiply w_{rj} for 100k matches and take log
- Step 5: Use gradient descent to find the optimal w_i for the following optimization problem

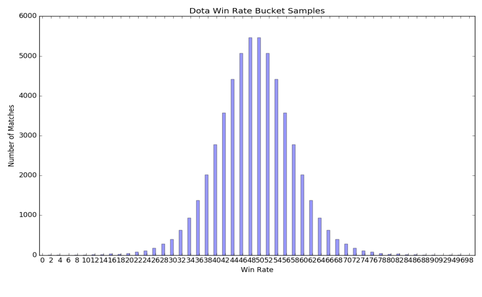
$$\min L = -\sum_{j=1}^{100k} log(P_j)$$

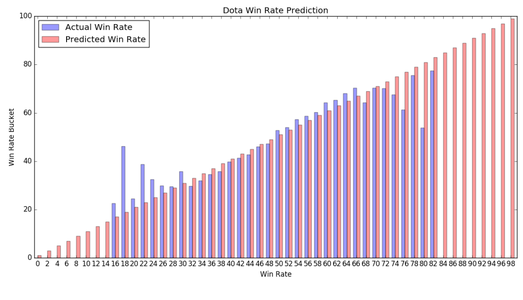
Result & Conclusion

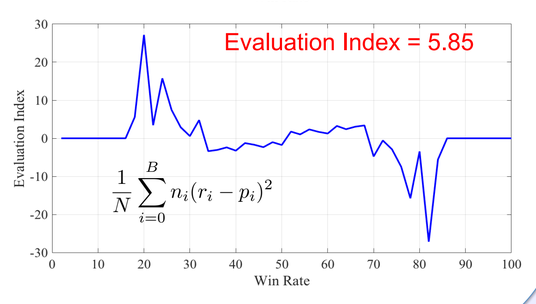


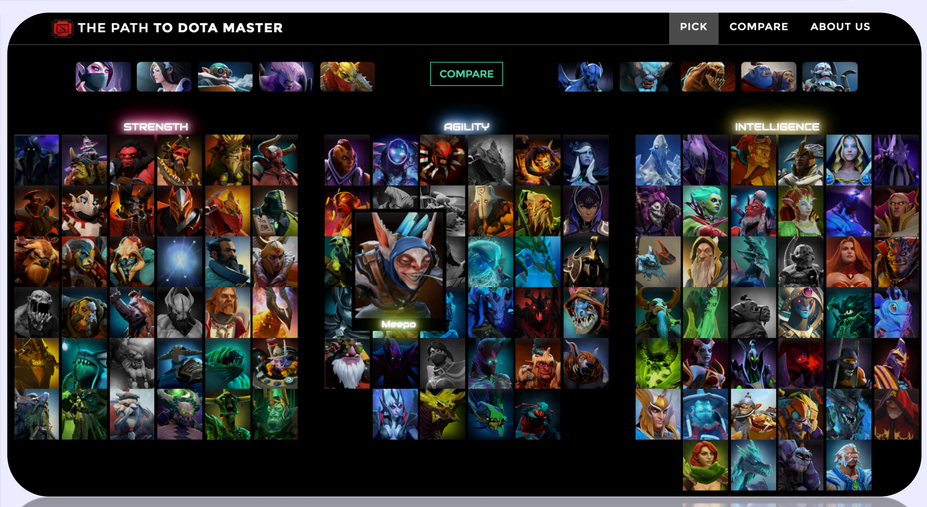












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USER INTERFACE!