**Description:**

Model 3 is another interesting variation of the original model with another team of 5 heroes. As we can find the lineup with the highest win rate against arbitrary team using the original model, we are now trying to find two teams, each of which contains 5 heroes, so that the win rate of each team is maximized, and the win rate difference between these two teams is minimized under certain constraints. In other words, we want to find the match in which the best two teams of heroes will fight with each other.

**The LP Model:**

**Variables:**

Let binary variables represent the hero for team 1, and represent the hero for team 2.

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**Objective Function:**

Suppose we want team 1 to finally win, then the objective function is to maximize the win rate of team 1 plus that of team 2 minus the win rate difference between two teams, i.e.

whereis the average win rate of hero against all other 114 heroes, i.e. where is the win rate of hero on hero.

Notice:

1. since one hero can only appear on one team in a match, .
2. this objective function can be simplified as

**Constraints:**

1. win rate for team 1 is greater than that for team 2, i.e.
2. any hero can appear at most once in a match, i.e. for all *i,*
3. each team must have 5 heroes, i.e.
4. each team’s total gold income per minute must under the resource limit, which is the constant named *gpm.* i.e. *gpm*, and *gpm* whereis the average gold income per minute for hero.
5. each team’s total experience income per minute must under the resource limit, which is the constant named *epm.* i.e. *epm*, and *epm* whereis the average experience income per minute for hero.
6. all , are binary variables.

**Code and Data:**

The code to generate this LP model as input to lpsolve is “model3.py”. Here we gained and used the data about the win rate of each hero to other heroes with the file “hero\_matchup\_grid.npy”, and the data about the average gold and experience income per minute for each hero with the file “hero\_gpm\_xpm.npy”. Each row in these files represents the data for one hero, and the rows are in alphabetical order of hero’s name.

**Solution:**

The solution of this model, i.e. the maximum win rate for team 2 is 2.766, and the win rate difference between team 1 and team 2 is **0.0012**:

Team 1 (winner team):

**Chaos Knight, Omni Knight, Shadow Shaman, Underlord, Zeus**

Team 2 (loser team):

**Centaur Warrunner, Crystal Maiden, Spectre, Vengeful Spirit, Wraith King**

**Verification:**

We can approximately verify the solution by picking 1000 random choices of 2 teams that confirms to the constraint, and then confirm that our solution indeed has the smallest win rate difference. As shown in the figure “Model3\_verification.png”, our solution has the smallest win rate difference.

This is a realistic solution based on empirical experience. (Todo: Dino)

The binding constraints were the resources limitation of gold/exp per minute for each team. (Todo: Dino)

This solution is again different from the result of model 1 for some reason. (ToDo: Dino)