1   Background and problem description

Super Smash Bros. Melee (hereafter *SSBM*,) a fighting game originally released in 2001, has recently experienced a resurgence in competitive play. Major tournament series such as Genesis and Evolution regularly attract upwards of 1,000 entrants [1], a scale otherwise unheard of for decade-old games incapable of online play.

Melee It On Me (*MIOM*), the competitive community's primary governing body, produces annual ranking lists of the 100 most skilled players, established by panel vote. The accuracy of these lists and their methodology are highly debated within the community at large. There have been many attempts at using existing rating systems such as Elo and Glicko to generate comparable rankings, but few are still publicly maintained, partially due to the scattered nature of the available data. Further, these rankings (like their MIOM counterparts) are produced at infrequent intervals from aggregated resuls. Thus, since the scene lacks a formal competitive circuit, the task of ranking the top players attending an upcoming tournament (e.g., for seeding purposes) falls mainly on that tournament's organizers.

2   Objectives

I propose to

   i. consolidate the available tournament data, dating as far back as 2003-4, into a publicly maintained dataset;
  ii. use this dataset and a maximum-likelihood estimation method such as Whole- History Rating (*WHR*) [2] to reconstruct real-time ratings for the period comprising the earliest MLG tournaments in 2005-6 to the present day;
 iii. use D3.js [3] to visualize these time-series in a manner similar to [4].

3   Basic data model and project workflow

The data will consist primarily of match metadata from tournament brackets, as shown in the code snippet below. This data will be cleaned and reformatted into a format more appropriate for storage in a relational database, most likely JSON or CSV.

The baseline schema (omitting unnecessary attributes) has the following tables:

  i. TOURNAMENTS, having attribute `ID` and `date`;

 ii. MATCHES, having attributes `ID`, `bracket_ID`, `winner_ID`, `loser_ID`;

iii. PLAYERS, having attribute `ID`;

 iv. MATCHES_PLAYERS, join table.

At the basic level, within this database, tournaments are ordered temporally by their `date` attributes, while their brackets are ordered temporally by the match attributes `winner_ID` and `loser_ID`, which contain the IDs of the matches the winner and loser of that match play next. `loser_ID` is `NULL` only if the loser is eliminated from the tournament; `winner_ID` is `NULL` only if the winner of the match is the winner of the tournament.

The primary question of interest is to derive a stable measure of player skill from the sequence of match records. One method of doing so that has been adopted by other e-sports communities is TrueSkill [5], which assumes that player skill before any given match follows a Gaussian distribution. The probability of one player defeating another is then roughly approximated by the probability that a randomly sampled value from the former's distribution exceeds one from the latter's; this gives rise to the *Bradley-Terry model*

$$P_t(i > j) \approx \frac{\mu_{it}}{\mu_{it} + \mu_{jt}},$$

where μ_{it}, μ_{jt} are the means of players i and j's distributions at time t. The TrueSkill algorithm, like many others, performs maximum-likelihood estimation of these parameters using this assumption. One goal of this project is to adapt this algorithm slightly to model some of the peculiarities of *SSBM*'s competitive environment, as demonstrated, e.g., in [6].

4 Sample data format

Currently, the data is primarily stored on sites such as Liquipedia [7] in a markup format. The following snippet (sourced from [8]) contains the match data from three sets between top-level players at the tournament Shine 2017:

```
|l1m1p1=PewPewU |l1m1p1flag=us |l1m1p1score=3
|l1m1p2=Trif |l1m1p2flag=es |l1m1p2score=2
|l1m1win=1
|l1m1p1char1=marth |l1m1p2char1=peach |l1m1p1stock1= |l1m1p2stock1=0 |l1m1win1=1 |l1m1stage1=Unknown
|l1m1p1char2=marth |l1m1p2char2=peach |l1m1p1stock2= |l1m1p2stock2=0 |l1m1win2=1 |l1m1stage2=Unknown
|l1m1p1char3=marth |l1m1p2char3=peach |l1m1p1stock3=0 |l1m1p2stock3=1 |l1m1win3=2 |l1m1stage3=Dream Land
|l1m1p1char4=marth |l1m1p2char4=peach |l1m1p1stock4=0 |l1m1p2stock4=1 |l1m1win4=2 |l1m1stage4=Yoshi's Story
|l1m1p1char5=marth |l1m1p2char5=peach |l1m1p1stock5=1 |l1m1p2stock5=0 |l1m1win5=1 |l1m1stage5=Pokémon Stadium
|l1m1date=August 26, 2017
|l1m1details={{BracketMatchDetails|reddit=|comment=|vod=}}

|l1m2p1=Westballz |l1m2p1flag=us |l1m2p1score=3
|l1m2p2=Lucky |l1m2p2flag=us |l1m2p2score=0
|l1m2win=1
|l1m2p1char1=falco |l1m2p2char1=fox |l1m2p1stock1=1 |l1m2p2stock1=0 |l1m2win1=1 |l1m2stage1=Battlefield
|l1m2p1char2=falco |l1m2p2char2=fox |l1m2p1stock2=2 |l1m2p2stock2=0 |l1m2win2=1 |l1m2stage2=Dream Land
|l1m2p1char3=falco |l1m2p2char3=fox |l1m2p1stock3=1 |l1m2p2stock3=0 |l1m2win3=1 |l1m2stage3=Pokémon Stadium
|l1m2details={{BracketMatchDetails|vod=https://www.youtube.com/watch?v=4bMa_nRjC3E|comment=}}

|l1m3p1=S2J |l1m3p1flag=us |l1m3p1score=3
|l1m3p2=HugS |l1m3p2flag=us |l1m3p2score=1
|l1m3win=1
|l1m3p1char1=cf |l1m3p2char1=samus |l1m3p1stock1=0 |l1m3p2stock1=1 |l1m3win1=2 |l1m3stage1=Yoshi's Story
|l1m3p1char2=cf |l1m3p2char2=samus |l1m3p1stock2=1 |l1m3p2stock2=0 |l1m3win2=1 |l1m3stage2=Pokémon Stadium
|l1m3p1char3=cf |l1m3p2char3=samus |l1m3p1stock3=2 |l1m3p2stock3=0 |l1m3win3=1 |l1m3stage3=Yoshi's Story
|l1m3p1char4=cf |l1m3p2char4=samus |l1m3p1stock4=3 |l1m3p2stock4=0 |l1m3win4=1 |l1m3stage4=Yoshi's Story
|l1m3date=August 26, 2017
|l1m3details={{BracketMatchDetails|reddit=|comment=|vod=https://www.youtube.com/watch?v=7zTSvNM-E1c}}
```

References

[1] https://www.ssbwiki.com/List_of_largest_Smash_tournaments

[2] https://www.remi-coulom.fr/WHR/WHR.pdf

[3] https://d3js.org/

[4] https://www.youtube.com/watch?v=z2DHpW79w0Y

[5] https://papers.nips.cc/paper/3331-trueskill-through-time-revisiting-the-history-of-chess.pdf

[6] https://www.reddit.com/r/SSBM/comments/4pitia/an_objective_ranking_system_that_compensates_for/

[7] http://liquipedia.net/smash/Main_Page

[8] http://liquipedia.net/smash/index.php?title=Shine/2017/Melee/Singles_Bracket&action=edit&section=4