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ISC 4220C Spring 2020
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Final Project

Course topics covered: Numerical Approximation and Numerical Integration

1. The popular Nintendo fighting game *Super Smash Brothers Ultimate* pits two fighters against each other in a 'one-versus-one' battle arena with the objective being to knock the opposing fighter off the battle arena to win the match. With 77 fighters, many have debated over which fighters are the best to consistently win matches. At the highest levels of play, professional players are often asked for their 'matchup chart' or 'spread' for their preferred character. One of these charts for the character R.O.B is depicted below in figure 1.

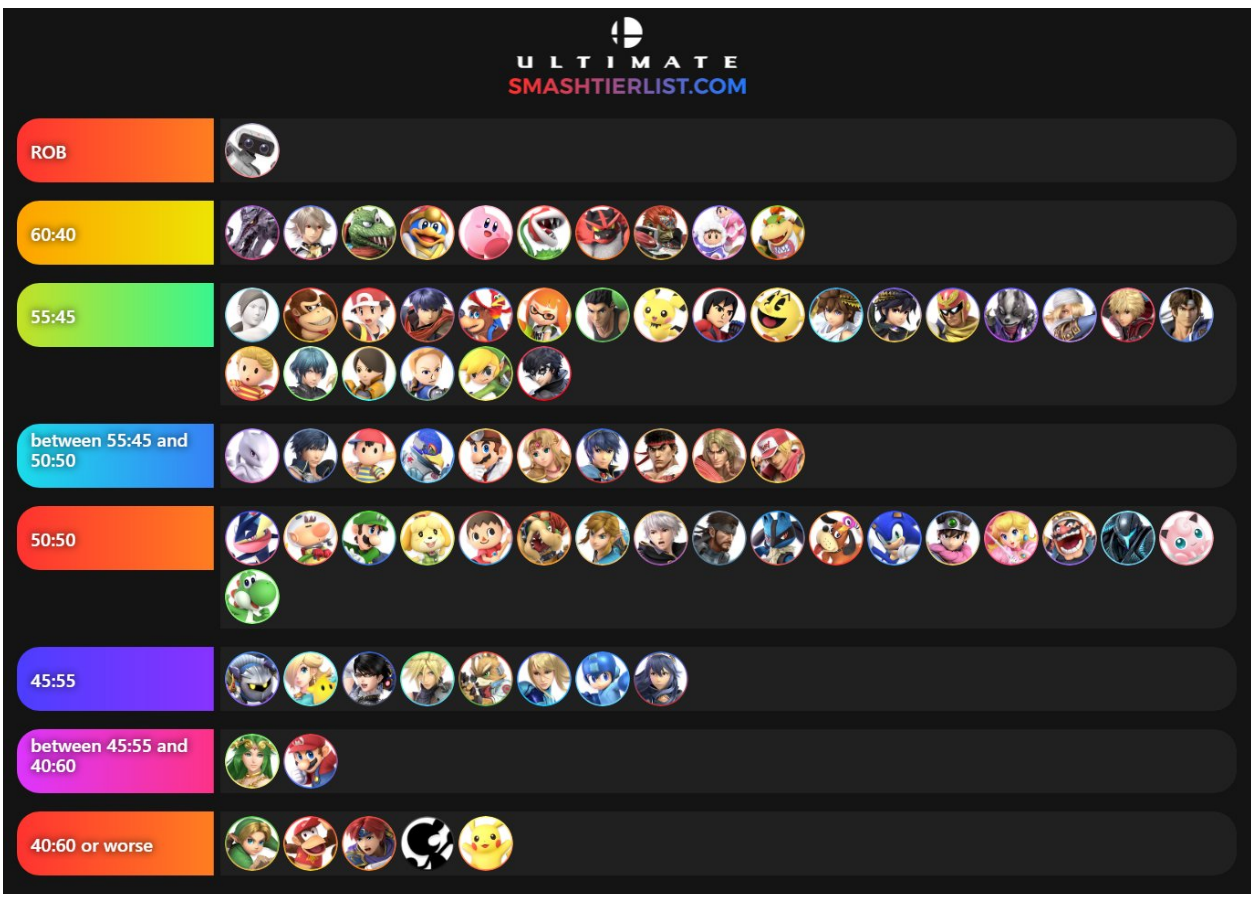

Figure 1.

Matchups are modeled in a xx:yy format. For example, R.O.B's 60:40 matchup against the fighter Ridley would indicate that between R.O.B and Ridley players of equal skill, the R.O.B player should expect to win 60 out of 100 matches. Many of these fighters have rock-paper-scissors-like relationships. While R.O.B might be good against Ridley, Ridley has a 70:30 matchup against R.O.B's counterpick, Mario.

Using a compilation of matchup spreads from *shorturl.at/dqwO2*, and a list of fighters ranked by their popularity from https://ssbworld.com/characters/usage/. Construct a linear system of matchups along with a final equation that incorporates the popularity of the fighters, and use a linear least squares approximation to rank the fighters in terms of their matchups against popular fighters.

Between two fighters we can construct a linear system by assigning ranking points to Each one by the equation

$$f_x - f_y = M_i$$

Where f_x is fighter X and f_y is fighter Y and M_i is the difference of their matchup. The final equation can be a sum of all the fighters ranking points with their popularity as the coefficient.

2. The probability mass function (p.m.f) for a Gaussian random variable with mean μand variance σ^2 is given by

$$f(x; \mu, \sigma^2) = \frac{1}{\sigma\sqrt{2\pi}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

Cumulative distribution functions of a Gaussian random variable can be found by taking the integral of the above equation. Integrals of this form are hard to solve analytically, but we can apply different integral techniques to solve them easily.

If the average height of NBA players is 79 inches with a standard deviation of 3.25 inches, use Simpson's 1/3rd rule (100 equally spaced intervals) and a 4-point Gaussian Quadrature rule to find the probability that a randomly selected NBA player is taller than Lebron James (81 inches). Which method came the closest?