Developing a Regression Algorithm for Predicting Magic: The Gathering Card Efficiency in Draft Format

Jonathan Tuck – jonathantuck@stanford.edu
Department of Electrical Engineering, Stanford University

Motivation

- Magic: the Gathering (Magic) is a trading card game that has controlled the genre with over 20,000,000 players.
- Draft Format: Open a pack, pick a card, and pass remaining cards. Repeat this process for three packs.
- In Draft, one of the most important factors in building a winning deck is drafting “efficient” cards, or cards that are relatively cheap (in terms of its mana cost) for the cumulative effect of the card on the game.

Card Efficiency = \frac{\text{Overall Positive Effect of Card}}{\text{Mana Cost}}

Problem Formulation

- Develop regression algorithm for determining card efficiency
- Determine which base algorithm performs best
- Alter base algorithm to fit Magic card rating framework
- Incorporate unique Magic features
- Use Draftsim ratings as true values of card efficiency
- Ratings used by professional Magic players in order to help card prioritization decisions
- Ratings range from 0.0 to 5.0, in 0.1 increments
- Inherent subjectivity in Draftsim ratings, but there does exist purely objective comparisons between cards
- Only features to be used are features derived from the Magic cards themselves

Features of a Magic Card

- Card Name
- Card Type and Subtype
- Mana
- Artwork
- Expansion Symbol
- Unique On-Card Effects
- Power/Toughness (running, static)
- Flavor Text
- Card Number
- Rarity
- Collector Information
- Cost
- Mana costs
- Inherent subjectivity in the rating scheme
- Ratings range from 0.0 to 5.0, in 0.1 increments
- Ratings used by professional Magic players in order to help card prioritization decisions
- Ratings range from 0.0 to 5.0, in 0.1 increments
- Inherent subjectivity in Draftsim ratings, but there does exist purely objective comparisons between cards
- Only features to be used are features derived from the Magic cards themselves

Experimental Results

- Best results came from using Multivariate Adaptive Regression Splines (MARS) with thresholding to values between 0.0 and 5.0 in 0.1 increments.

\hat{y}(x(i)) = \sum_{i=1}^{\eta} a_i B_i(x(i))

- \chi is the numerical mapping of the card features, a, are constants, and B_i are basis functions that are in general taken to be a combination of either hinge functions or the product of two or more hinge functions. Recall that a hinge function h(x) = max(0, x).
- MARS with thresholding classified ~60% of cards perfectly, and 88% to within 1.0 rating units.
- Some lack of accuracy is to be expected: there exists subjectivity in the rating scheme.

Future Work

- Predict Based on past draft choices:
  - This would lead to predicting the most efficient, synergized deck.
  - Many more formats to explore:
    - “Sealed” – Construct decks from 6 packs opened immediately prior to gameplay
    - “Standard” – Construct decks from most recent expansions
    - “Modern” – Construct decks from expansions from the last 10 years
    - “Vintage” – Construct decks using any card ever made

References

- Some lack of accuracy is to be expected: there exists subjectivity in the rating scheme.