

# Magic: The Gathering Card Recommender

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# Brief intro to Magic: the Gathering

- You're a wizard, Harry!
  - Two or more players cast spells at each other in order to reduce opponent's life total to 0 (most of the time).
- Most complicated game
  - Turing complete
    - [Magic: the Gathering is Turing Complete](#)
- Tournaments
  - Professional players
- Deck building
  - 60 card deck (usually)
  - Nearly 20,000 unique cards
  - Over a dozen formats

# Problem Statement

Building a deck in Magic can be difficult. There have been nearly 20,000 different tournament-legal cards printed throughout the history of the game. The goal of this project is to use data on Magic: the Gathering cards to build a content-based recommender system that suggests similar cards based on cosine similarity in order to improve card selection during the deck building process.



# Data

- Scryfall
  - Search engine for Magic: the Gathering
  - Open API
- MTG wiki
  - Any and all information about the game and mechanics
  - Research



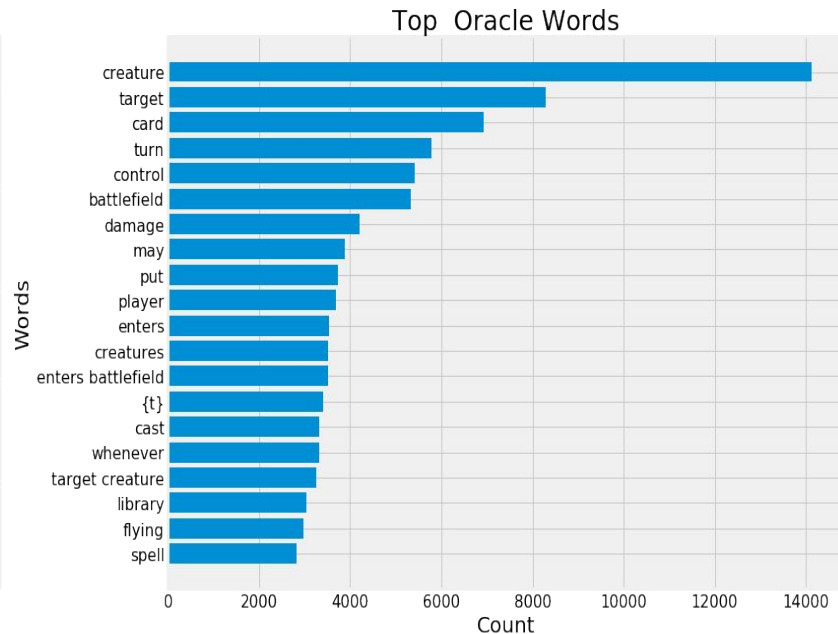
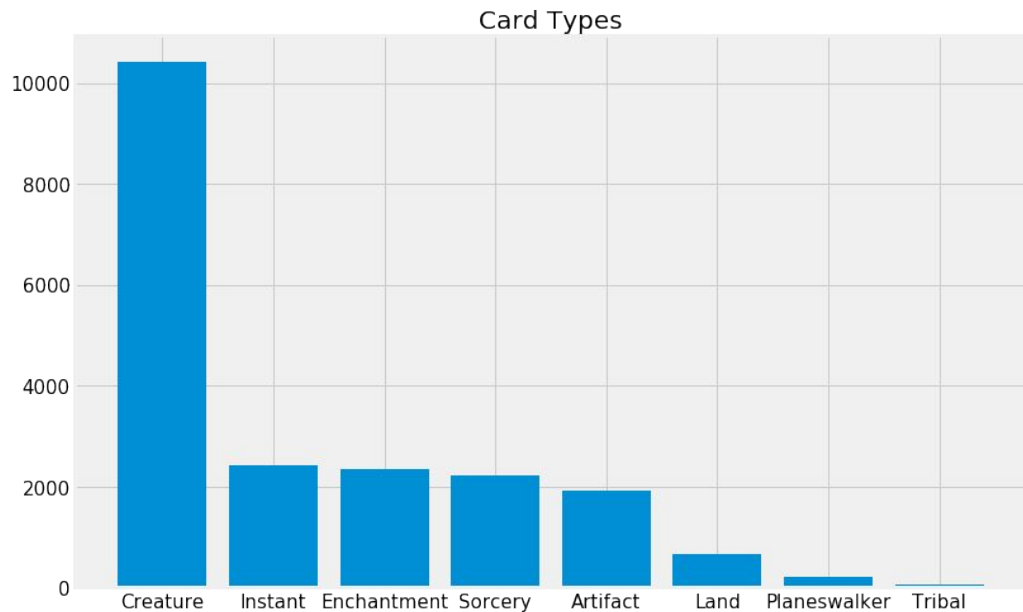
# Scryfall

# Process - Cleaning

- Nested JSON objects
  - Several cells have data that needs to be extracted
- Unnecessary data
  - Attributes like artist, collector number, set number, etc.
- Extraneous non-legal cards
  - Joke sets, archenemy, planechase, etc.
- Dual-sided cards
  - Extract data from nested JSON object
  - Created extra columns for back half
- Final table
  - Each row refers to a unique card
  - Each column is an attribute about that card

# Process - EDA

- Mostly focused on Oracle text of a card
- Helped guide number of nGrams to consider for recommender system



# Process - Recommender System

- Converted Oracle text to numerical attributes
- Eliminated non-impactful data
- First pass model using cosine similarity
- One by one added more numerical features
  - Cmc, power, toughness, loyalty
- Converted certain attributes to numerical data
  - activated/triggered abilities, type of card, color, etc.
- Scaled numerical data while keeping booleans unscaled
- Final model
  - Every row and column is a unique magic card
  - Each cell is the cosine similarity value between each card

# Demo

The screenshot displays the Magic Online interface. On the left, a card titled "Bonecrusher Giant" is shown. The card is a red-bordered creature card with the text "Creature — Giant" and "4/3". It features a large illustration of a giant. Below the illustration, the card's abilities are listed: "Whenever Bonecrusher Giant becomes the target of a spell, Bonecrusher Giant deals 2 damage to that spell's controller." and "Not every rule ends in glory." The card's mana cost is 4 red mana. The card is currently in play, as indicated by the "4/3" power/toughness in the bottom right corner.

On the right side of the interface, the details for the "Bonecrusher Giant" card are displayed. The card is identified as "Bonecrusher Giant" with a red-bordered icon. The type is "Creature — Giant". The abilities are listed: "Whenever Bonecrusher Giant becomes the target of a spell, Bonecrusher Giant deals 2 damage to that spell's controller." and "Not every rule ends in glory." The power/toughness is "4/3". The card is currently in play, as indicated by the "4/3" power/toughness in the bottom right corner.

Below the card details, there are two columns of buttons. The left column contains buttons for "Utopia", "Eldraine", "Mok", "Eldraine", and "Mok". The right column contains buttons for "Utopia", "Eldraine", "Mok", "Eldraine", and "Mok".

On the far right, there is a sidebar for the "Throne of Eldraine (ELD)" set. It shows a progress bar with 10 segments, 9 of which are filled. Below the progress bar, there are several empty slots for cards.



# Next Steps

- User collected data for a collaborative recommender system
  - Host and publish app somewhere
- Cosmetic updates to the app
- Improve upon the app to recommend *better* cards
  - How do you teach a computer what “better” means
- Increase filtering functionality
  - Filter by card type, color, mana cost, etc.

# Sources

- ScryFall Card Data (<https://scryfall.com/docs/api/bulk-data>)
- Scryfall Oracle Cards (<https://archive.scryfall.com/json/scryfall-oracle-cards.json>)
- MTG Wiki ([https://mtg.gamepedia.com/Main\\_Page](https://mtg.gamepedia.com/Main_Page))
- Magic: The Gathering is Turing Complete (<https://arxiv.org/pdf/1904.09828.pdf>)