Board Game Recommendation System

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Introduction

- Games have been around since 3500 BC before written history, and have developed into a vast and diverse industry.
- Studies have shown an improvement in decision-making performance (Connors et al., 2011) and fluid intelligence (Bartolucci et al., 2019) from playing board games.
- Games are increasingly used in classrooms as educational tools (Hoy, 2018), and in reinforcement learning for AI.
- They have almost no environmental impact outside of production compared to video games.
- They are growing in popularity - Market value of $12 billion, with projected growth of 9% per year (Wordsrated, 2024).

Research Purpose

- Build a recommendation system to easily give you personalized game suggestions to play based on the games you like.
  - Recommender systems return a list of filtered items that might be relevant to a specific user.
  - Popular recommendation systems found on Amazon, Spotify, Netflix, etc.
- Eliminate the time spent finding good recommendations given the abundance of games on the market.
  - Research takes time.
  - Word of mouth recommendations can be unreliable.

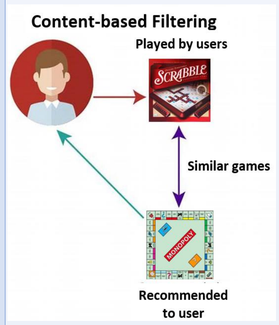
Data Collection

- Dataset was collected in February 2021 from BGG.com for a study on game mechanics (Samarasinghe et al., 2021).
- Includes all ranked games (reviewed by 30 users or more). 20,343 games were kept at the time of collection.
- Attributes included: Name, Year published, Min # of players, Max # of players, Playing time, Min age, Avg rating, Avg complexity, Mechanics used

Pre-processing

- The ‘mechanics’ column was One Hot Encoded due to high cardinality.
- Principal Component Analysis was conducted, successfully reducing the feature size from 190 to 8 PC, retaining 70% of the original variance.

Methodology



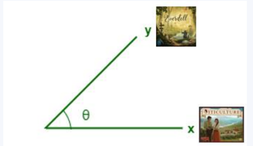
Content-based Filtering

- Doesn’t require user data to build the algorithm.
- Relies on the features of the items to filter.
- Gives individualized recommendations, especially for those with niche interests.
- No surprises in recommendations by aligning closely to user preferences.

Cosine similarity score

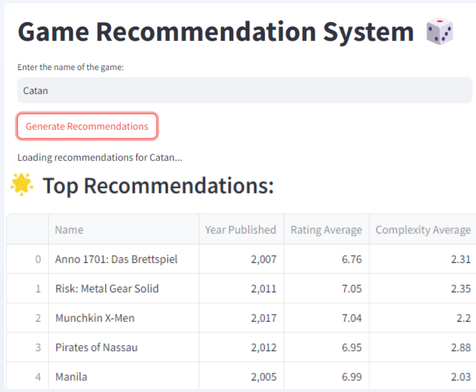
- Represents each item as vectors made up of the item features.
- Takes the dot product of two vectors divided by the magnitude of each vector.
- The smaller the angle, the bigger the item similarity.

$$CosSim(x,y) = \frac{x \cdot y}{|x||y|} = \frac{\sum_i^n x_i y_i}{\sqrt{\sum_i^n x_i^2}\sqrt{\sum_i^n y_i^2}}$$



Features	Everdell	Viticulture
Complexity	2.82	2.91
Hand Management	1	1
Average Rating	8.03	8.08
Year Published	2018	2015
Playing Time	80 min	90 min
Worker Placement	1	1

Recommender System



Content-Based Recommendation System			
k	5	10	15
# of relevant items @ k	2.61	5.41	8.67
Precision @ k (# of relevant items at k / k)	0.52	0.54	0.58
Recall @ k (# of relevant items at k / # of relevant items)	0.30	0.62	-
Hit Rate @ k (at least one relevant item in k)	0.87	0.96	0.98

- User feedback data shows the content-based recommendations out-perform the random ones by providing more relevant suggestions.

Random Recommendation System			
k	5	10	15
# of relevant items @ k	0.72	1.86	3.25
Precision @ k	0.14	0.19	0.22
Recall @ k	0.22	0.57	-
Hit Rate @ k	0.5	0.73	0.88

Conclusion

- The recommendation system successfully suggests similar games based on user preferences.
- Recommendations can align too closely to original user inputs, leaving no novelty.
- Difficult to know whether recommendations are good due to user bias and subjectivity.
- Sample size may not be representative of the actual population.
- Further research may continue with a hybrid model mixing content and collaborative filtering techniques to diversify recommendations.

References

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