Decision-making and analysis for intelligence systems

Elaborated By:

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1. Introduction:

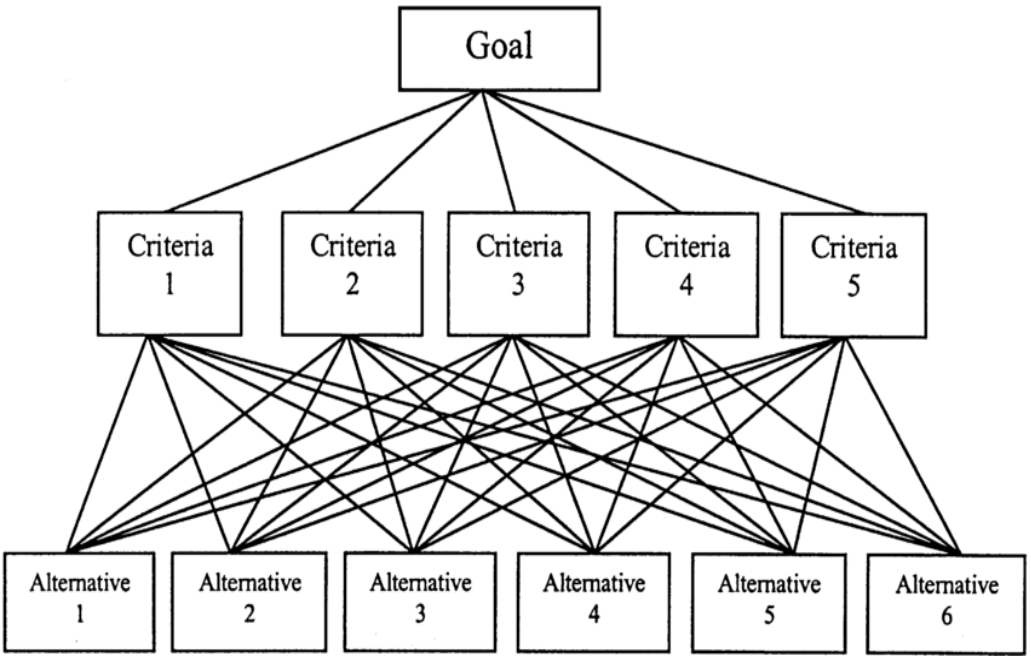
In the realm of intelligence systems, making smart decisions amidst vast data and uncertainties is crucial. Three powerful methods, Entropy, Analytic Hierarchy Process (AHP) and Promethee, simplify this task. Let's explore how they work:

Entropy: Think of it as a measure of chaos within data. The higher the entropy, the more disorder or unpredictability. By calculating entropy, we can identify where clarity is needed and prioritize data streams accordingly.

Analytic Hierarchy Process (AHP): This method helps break down complex decisions into smaller, manageable parts. It lets us compare criteria and alternatives systematically, making it easier to prioritize.

Promethee : is a method that helps intelligence systems rank options based on preferences and criteria, making it easier to make decisions in complicated situations.

Together, Entropy, AHP, Promethee revolutionize intelligence analysis, moving from guesswork to evidence-based decision-making. In our journey ahead, we'll dive into practical examples and demystify these methods for better understanding and application in intelligence systems.



2. Defining the Issue at Hand:

2.1 Propose:

Our project revolves around ranking a vast collection of 16k anime titles:

The initial step involves utilizing Multi-Criteria Decision Making (**MCDM**) techniques to systematically rank these diverse anime titles. Given the impracticality of manually ranking such a large dataset, computational methods are essential. Through the use of computer algorithms, we aim to provide a systematic approach to prioritize and rank anime based on various criteria. Ultimately, the goal is to assist individuals in selecting anime more effectively, whether they're interested in popular series like One Piece, Fullmetal Alchemist, or Naruto, or exploring other options based on the ranked decisions generated through this project.

2.2 Data Understanding:

First Step: We import our dataset which contains 16k entries. After selecting about 200 lines, it's sufficient, and we work with 4 quantitative criteria.

1) Members: This criterion refers to the number of members or users who have listed a particular anime on a platform such as MyAnimeList (MAL) or AniList. Essentially, it indicates the popularity or audience size of an anime within the community. A higher number of members typically suggests that the anime has a larger fan base or following.

2) Popularity: Popularity is a measure of how well-known or widely watched an anime is among viewers. It can be influenced by factors such as marketing, word-of-mouth recommendations, and cultural impact. Popularity can be assessed based on various metrics, including online search trends, social media discussions, and viewer ratings.

3) Ranked: This criterion refers to the position or ranking of an anime within a list or ranking system, such as the Top Anime list on MyAnimeList. Rankings are often determined by aggregating user ratings and reviews, taking into account factors such as overall rating score, number of votes, and recency of reviews. A higher ranked anime indicates that it is perceived favorably by viewers compared to other anime titles.

4) Score: The score of an anime represents its overall rating or quality as assessed by users or critics. Scores are typically given on a scale, such as 1 to 10 or 0 to 100, with higher scores indicating better reception or enjoyment. User scores are usually based on individual ratings submitted by viewers, while critic scores may be derived from professional reviews or aggregated ratings from trusted sources. The score provides an objective measure of the perceived merit or worthiness of an anime.

2.3 Visualization:

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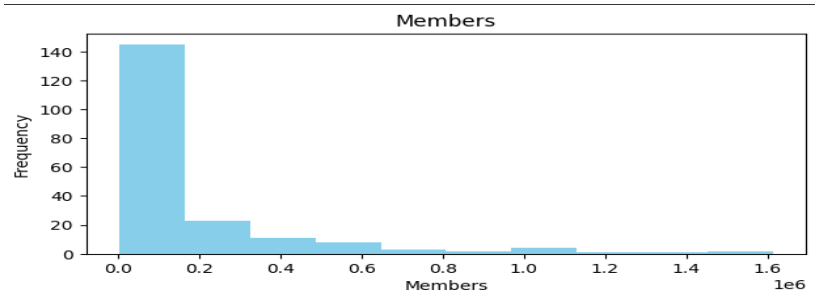
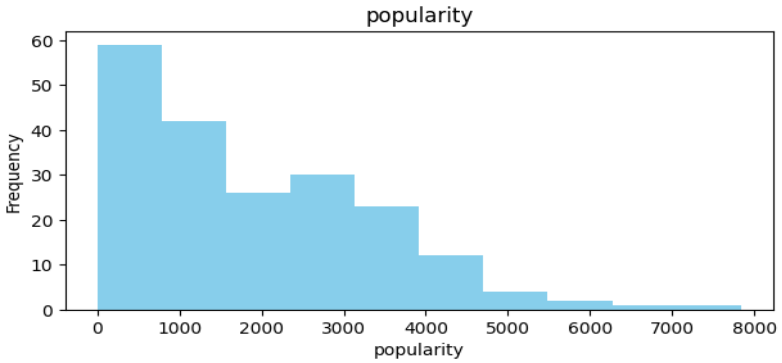
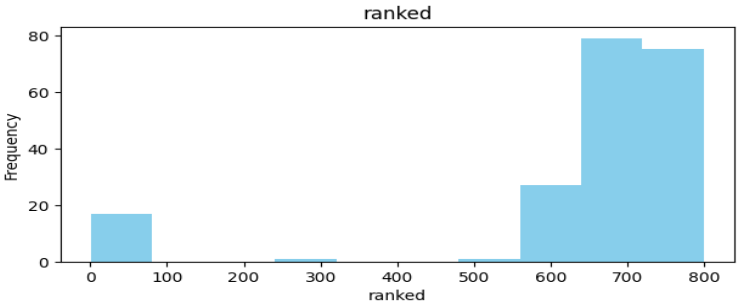
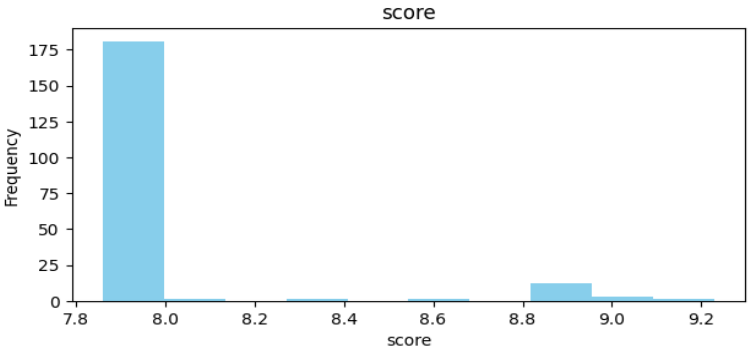








3. Interpreting The Result:

According to my result, Multi-Criteria Decision Making (MCDM) methods like Entropy and AHP, we found differents results :

1) Entropy:

We have completed several steps in our analysis. Beginning with data normalization, we then calculated entropy and determined weights. As a result, we have obtained weights using both the Entropy WSM (Weight Sum Model) and Entropy WPM (Weighted Product Model) methodologies. Now, we are ready to present our findings.

- Entropy WSM:

	title	Weight_Total
3	Fullmetal Alchemist: Brotherhood	1.566289
175	Xiao Lu He Xiao Lan	1.349472
76	Yao Shen Ji 3rd Season	1.300996
140	Tokyo Ghoul	1.244674
42	Yaoguai Mingdan 2nd Season	1.221523
...	...	...
180	Durarara!! Specials	0.763098
186	Sekaiichi Hatsukoi	0.762323
4	Kizumonogatari III: Reiketsu-hen	0.760289
18	Koukaku Kidoutai 2.0	0.735921
17	Kaguya-hime no Monogatari	0.627997

200 rows × 2 columns

- Entropy WPM:

	title	WPM
17	Kaguya-hime no Monogatari	0.005207
18	Koukaku Kidoutai 2.0	0.004398
199	Sakigake!! Cromartie Koukou	0.003396
197	Tanaka-kun wa Itsumo Kedaruge	0.003327
185	Tennis no Ouji-sama	0.003286
...	...	...
30	Haikyuu!! Movie 2: Shousha to Haisha	0.000000
31	Gochuumon wa Usagi Desu ka??: Dear My Sister	0.000000
35	Doukyonin wa Hiza, Tokidoki, Atama no Ue.	0.000000
32	Ginga Eiyuu Densetsu: Die Neue These - Seiran 1	0.000000
21	Saint Seiya: Meiou Hades Meikai-hen	0.000000

From the comparison table between WSM and WPM, we observe differences in ranking depending on the method used for entropy calculation. For instance, in WSM, Fullmetal Alchemist ranks highest, whereas in WPM, the ranking shifts to Kaguya-hime. This demonstrates that while both methods employ entropy for weighting decision criteria, they diverge in how these weights influence the ranking. WSM simply sums the weights, assuming equal importance for all criteria, while WPM multiplicatively combines the weights with criterion values, allowing for a more nuanced consideration of criteria interactions.

2) AHP:

- **First Step:** We begin by utilizing a matrix to assess scores for each criterion. Subsequently, we normalize these scores to establish a standard scale. Finally, we generate a confusion matrix to represent the outcomes.

- **Second Step:** We compute weights based on the four criteria dimensions, deriving an average weight. This process yields a tabular representation as follows:

	members	popularity	ranked	score
members	0.125000	0.027778	0.008333	0.000000
popularity	0.416667	0.125000	0.027778	0.008333
ranked	0.708333	0.416667	0.125000	0.027778
score	1.000000	0.708333	0.416667	0.125000

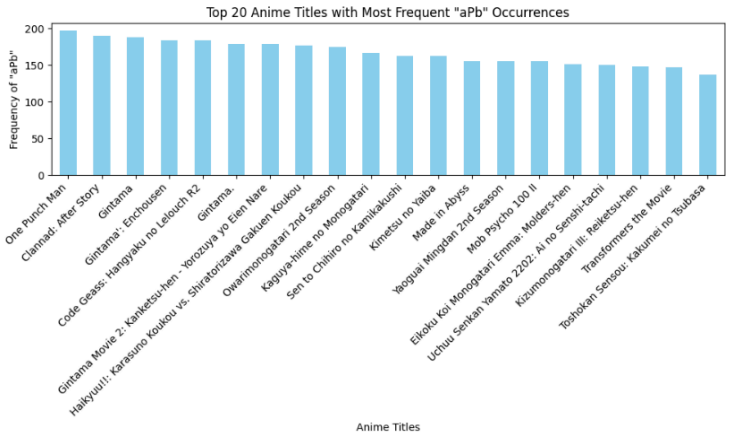
Finally, we calculate lambda, consistency index (CI), and use them to obtain the Consistency Ratio (CR)==0.1.

A CR of about 10% suggests that the pairwise comparisons are reasonably consistent. This indicates that the decision-maker has made reliable judgments.

According to the rankings obtained from the Entropy (WSM), the highest-ranked anime is "Xiao," while according to (WPM), the highest-ranked anime is "Yaoguai." This discrepancy in rankings highlights the influence of the specific decision-making model used on the final outcome.

3) Promethee:

In this approach, we performed six steps, including normalization, summing, obtaining matrices (Pi, Pj), and subsequently ranking our anime dataset based on phi- and phi+ values. Additionally, we have a graphic representing this process.
The graphic illustrates that 'One Punch Man' is ranked higher compared to 'Entropy' and AHP



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4. Discussion:

The use of Multi-Criteria Decision Making (MCDM) methods like Entropy, Analytic Hierarchy Process (AHP), and Promethee has offered valuable rankings for anime titles. However, the differing outcomes from each method underscore the importance of comprehending their principles and implications.

Entropy employs a systematic approach to prioritize anime based on factors such as popularity, ranking, score, and member count. It calculates entropy and determines weights through methods like Weight Sum Model (WSM) and Weighted Product Model (WPM), yielding diverse perspectives on criteria importance.

AHP simplifies complex decisions by breaking them into smaller parts, facilitating a structured comparison of criteria and alternatives. The Consistency Ratio (CR) ensures reliable judgments, but rankings may vary depending on the model used.

Promethee considers preferences and outranking relationships, providing graphical representations of rankings. The higher ranking of 'One Punch Man' suggests differing criteria importance.

In conclusion, understanding MCDM methods is crucial for meaningful intelligence analysis. Flexibility in approach is essential to account for decision-making complexities.