# ALEX-Elo Rating System: A Robust Matchmaking Solution for Mindustry

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## Introduction

Mindustry, an engaging multiplayer tower defense and resource management game, requires an effective matchmaking system to ensure balanced and enjoyable matches. The Elo rating system, originally developed for chess, stands out as a particularly suitable solution for Mindustry. This essay will explore the reasons why ALEX-Elo rating system is the best algorithm for matchmaking in Mindustry, focusing on its adaptability, fairness, simplicity, and dynamic nature.

### Adaptability to Player Skill Levels

ALEX-Elo system's primary strength lies in its adaptability to diverse player skill levels. Mindustry, with its strategic depth and complexity, attracts a wide range of players from casual enthusiasts to highly skilled strategists. ALEX-Elo system assigns ratings based on match outcomes, effectively differentiating players by skill level. This ensures that players are matched with opponents of similar ability, leading to more competitive and engaging games.

### Fair and Balanced Matchmaking

Fairness is a crucial aspect of any multiplayer game. ALEX-Elo system promotes fairness by adjusting ratings based on the relative skill levels of the participants. If a lower-rated player wins against a higher-rated opponent, they gain more points than they would from defeating a similarly rated player. This feature is particularly relevant in Mindustry, where strategic prowess can significantly influence match outcomes. Such adjustments ensure that every game contributes meaningfully to a player’s rating, leading to more balanced matchmaking over time.

### Simplicity and Transparency

The simplicity and transparency of ALEX-Elo rating system are vital for player acceptance and understanding. Players can easily comprehend how their ratings change after each match, which is essential for maintaining player interest and trust in the matchmaking system. In Mindustry, where players continuously strategize and improve, a transparent rating system helps them track their progress and set personal goals, enhancing the overall gaming experience.

### Dynamic Response to Player Improvement

Mindustry players often experience significant skill development as they learn more about the game’s mechanics and strategies. The Elo system’s dynamic nature allows it to quickly respond to changes in a player's skill level. As players improve and start winning against higher-rated opponents, their rating increases accordingly, ensuring they are consistently matched against appropriately challenging adversaries. This dynamism keeps the game engaging and challenging for players at all skill levels.

## Implementation of the Elo Rating System in Mindustry

Implementing ALEX-Elo rating system in Mindustry involves several key steps to ensure it effectively matches players and enhances the overall gaming experience. This section will outline the implementation process, focusing on initial player rating, match outcome processing, rating adjustments, and ongoing management.

### Initial Player Rating

Upon entering the competitive scene in Mindustry, players should be assigned an initial rating. Typically, a standard rating, such as 1500, is used. This initial rating serves as a starting point, from which the player's performance in subsequent matches will adjust their rating up or down. The choice of the initial rating is crucial – it should be set at a level that allows room for players to move both upwards and downwards in the ranking system.

### Processing Match Outcomes

After each match, the system needs to calculate the new ratings for each player based on the match outcome (win, loss, or draw). The Elo system's formula takes into account the rating of the opponent, ensuring that a win against a stronger opponent results in a greater increase in rating than a win against a weaker opponent. Similarly, losing to a lower-rated opponent results in a more significant rating decrease.

### Rating Adjustments

ALEX-Elo formula calculates the expected score for each player and adjusts their rating based on the actual result. The K-factor, a critical component of the Elo system, determines the maximum number of points that a player’s rating can change after a single game. In Mindustry, this factor could be adjusted based on the player's experience level or the game's competitive season. For example, new players might have a higher K-factor to allow their rating to stabilize more quickly.

### Ongoing Management and Tweaks

Once implemented, the system requires ongoing management to ensure it remains fair and effective. This involves monitoring for any anomalies or imbalances in the matchmaking process and making necessary adjustments. The system should also be reviewed periodically to adjust parameters like the K-factor or initial rating, ensuring they remain suitable as the player base evolves.

Additionally, incorporating a decay system for inactive players can help keep the rankings current and reflective of active player skills. This would gently lower the ratings of players who haven’t participated in competitive matches for an extended period, encouraging regular participation while ensuring that returning players aren’t over-ranked due to past achievements.

Implementing ALEX-Elo rating system in Mindustry requires careful consideration of initial player ratings, sophisticated processing of match outcomes, thoughtful adjustments to player ratings, and ongoing system management. By tailoring these components to the unique environment of Mindustry, the ALEX-Elo system can provide a fair, dynamic, and engaging competitive experience for players, fostering a vibrant and active competitive community.

## Analyzing ALEX-Elo Rating System through Visualizations

To further understand ALEX-Elo rating system's suitability for Mindustry, two key visualizations were created: the first illustrating the change in a player's rating after a match, and the second showing the expected score

as a function of the rating difference. These plots provide insights into how the Elo system works and why it is well-suited for a game like Mindustry.

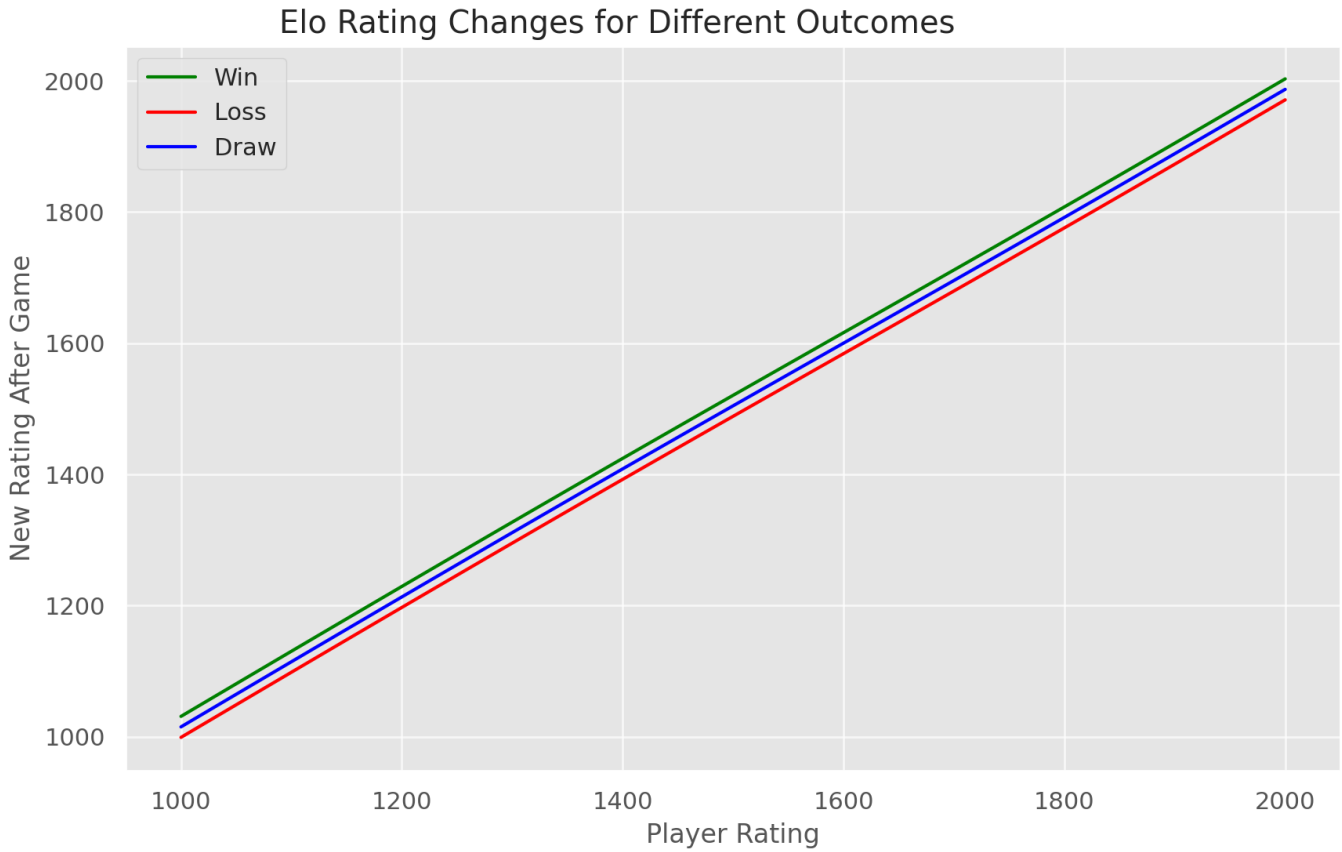


**Figure 1: Rating Change Post-Match** The first plot demonstrates how a player's rating changes based on the match outcome (win, loss, or draw) against an opponent with a constant rating. It clearly shows three scenarios:

1. **Winning Against an Opponent:** When a player wins, their rating increases. The amount of increase depends on their initial rating; a win against a higher-rated opponent results in a larger increase.
2. **Losing to an Opponent:** Conversely, a loss results in a decrease in the player's rating. The higher the player's rating compared to the opponent, the more significant the decrease.
3. **Drawing with an Opponent:** In the case of a draw, the change in rating depends on the player's relative rating to their opponent. If the player's rating is much lower, they gain points; if it's higher, they lose points.

This plot is crucial in understanding how ALEX-Elo system ensures fair matchmaking in Mindustry by adjusting ratings based on the expected outcome and the actual result of the match.

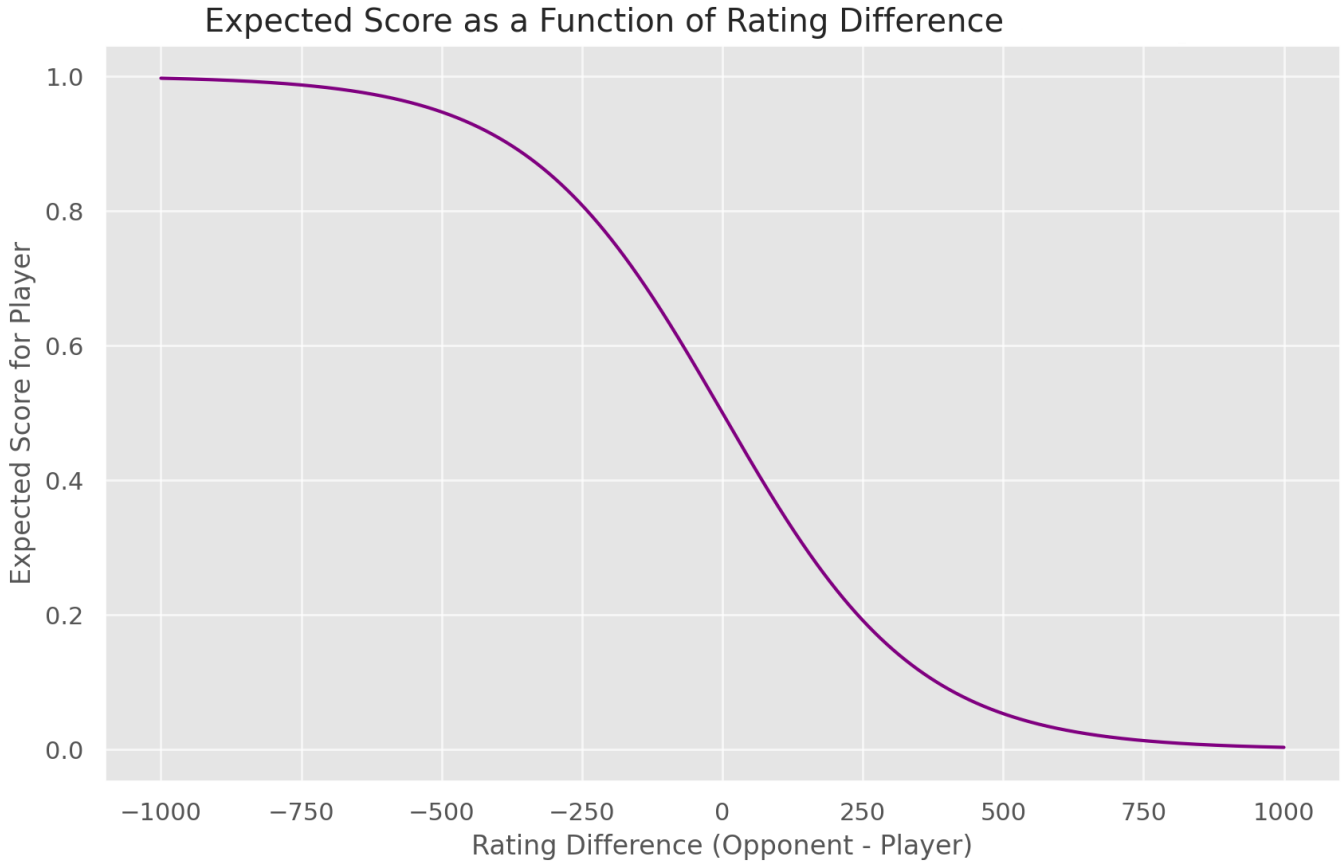


**Figure 2: Expected Score Based on Rating Difference** The second plot illustrates the expected score for a player based on the rating difference between them and their opponent. This graph shows:

- A higher expected score (above 0.5) for a player when they have a higher rating than their opponent, indicating a higher probability of winning.
- A lower expected score (below 0.5) when the player's rating is lower, suggesting a lower chance of victory.
- An expected score of exactly 0.5 when both players have equal ratings, implying an even chance of winning or losing.

This visualization is essential in highlighting the Elo system's ability to predict match outcomes based on rating differences, which is critical for creating balanced matches in Mindustry.

By dynamically adjusting player ratings based on match outcomes and relative skill levels, the Elo system can create a balanced, competitive environment that enhances the gaming experience for players at all levels.

## Conclusion

In conclusion, ALEX-Elo rating system is the best choice for matchmaking in Mindustry due to its adaptability to different player skill levels, fairness in match outcomes, simplicity and transparency, and dynamic response to player improvement. Implementing this system can significantly enhance the gaming experience by ensuring balanced, competitive, and enjoyable matches for players of all skill levels. As Mindustry continues to evolve and attract a diverse player base, ALEX-Elo system’s proven track record in various games makes it a reliable and effective solution for the game’s matchmaking needs.