

Mærstánas Rating System

Overview

The Elo rating system was invented in the 1960s by Arpad Elo, a Hungarian-American physics professor and chess master, and was officially adopted by the U.S. Chess Federation in 1960 and by FIDE (the international chess federation) in 1970. ([Wikipedia](#))

In historical terms, it's a very modern invention, and it definitely did not exist in the Anglo-Saxon period. However, when adapting Mærstánas to an online, multiplayer platform, I wanted to implement a rating system that could be used to compare players' skill level. Therefore, I adapted the Elo system to my game. What follows is a written explanation of the Python code included in the app I wrote. ([Source code on Codeberg](#))

It should be noted that the calculations express ratings with decimals. My online system tracks this internally but presents rounded ratings in the user interface. So, someone with a rating of 1191.7 would see this value as 1192. Personally, I like the whole number approach, but as this system is neither formal nor widely used, use whatever makes you happy.

Player Ratings

- **Starting Rating:** Every new player begins with a rating of **1000**.
- **How Ratings Change:** After each game, both players' ratings are adjusted based on the result and the relative strength of their opponents.
- **The K-Factor:** The maximum adjustment from a single game is **32 points**.

Wins and Losses

- If you win, your rating goes up.
- If you lose, your rating goes down.
- The exact number of points gained or lost depends on how strong your opponent was compared to you:
 - Beating a higher-rated opponent gives you more points.
 - Beating a much lower-rated opponent gives you only a few points.
 - Losing to a much lower-rated opponent costs you more points.
 - Losing to a much higher-rated opponent costs you only a few points.

Ties

- If the game ends in a tie, both players' ratings move toward each other:
 - The lower-rated player gains points.
 - The higher-rated player loses points.
- The closer the ratings already are, the smaller the adjustment.

This system ensures that ratings reflect not just wins and losses, but also the strength of the opponents you face.

Detailed Explanation

Rating overview

Players can calculate their own ratings after each match using a simple Elo-style method. New players start at 1000. Each result changes ratings by up to 32 points, scaled by how likely the result was based on both players' current ratings.

What you need

- **Current ratings:** Each player's rating before the match.
 - **Result:** Win, loss, or tie.
 - **K-factor:** Use $K = 32$ for every match.
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Core formulas

- **Rating difference**

$$\text{diff} = R_{\text{opponent}} - R_{\text{you}}$$

- **Expected score (your chance of a point)**

$$E = \frac{1}{1 + 10^{\left(\frac{\text{diff}}{400}\right)}}$$

- **Score by result**

$$S = \begin{cases} 1 & \text{if you win} \\ 0.5 & \text{if you tie} \\ 0 & \text{if you lose} \end{cases}$$

- **Rating update**

$$R_{\text{new}} = R_{\text{old}} + K \cdot (S - E)$$

Step-by-step for a win or loss

1. **Compute diff**

$$\text{diff} = R_{\text{opponent}} - R_{\text{you}}$$

2. **Compute your expected score**

$$E = \frac{1}{1 + 10^{\left(\frac{\text{diff}}{400}\right)}}$$

3. **Set your actual score S**

- **Win:** $S = 1$
- **Loss:** $S = 0$

4. **Update your rating**

$$R_{\text{new}} = R_{\text{old}} + 32 \cdot (S - E)$$

5. Update your opponent's rating

- Your opponent's expected score is $1 - E$.
- Their actual score is the opposite of yours (win = 0 for them, loss = 1).

$$R_{\text{new, opp}} = R_{\text{old, opp}} + 32 \cdot ((1 - S) - (1 - E))$$

Step-by-step for a tie

1. Compute absolute difference

$$\text{diff} = |R_{\text{you}} - R_{\text{opponent}}|$$

2. Compute expected score for the higher-rated player

$$E_{\text{higher}} = \frac{1}{1 + 10^{\left(\frac{\text{diff}}{400}\right)}}$$

3. Both players use $S = 0.5$

$$R_{\text{new}} = R_{\text{old}} + 32 \cdot (0.5 - E)$$

- For the higher-rated player, use $E = E_{\text{higher}}$.
 - For the lower-rated player, use $E = 1 - E_{\text{higher}}$.
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Examples

Win example (1200 vs. 1000, higher-rated player wins)

- **You:** $R_{\text{you}} = 1200$, **Opponent:** $R_{\text{opp}} = 1000$
- **diff:** $1000 - 1200 = -200$

$$E = \frac{1}{1 + 10^{\left(\frac{-200}{400}\right)}} \approx \frac{1}{1 + 10^{-0.5}} \approx 0.76$$

- **Win $S = 1$:**

$$\Delta R \approx 32 \cdot (1 - 0.76) \approx 7.7$$

- **Winner new rating:** $1200 + 7.7 \approx 1207.7$
- **Loser new rating:** Opponent's expected score = $1 - 0.76 = 0.24$

$$\Delta R_{\text{opp}} = 32 \cdot (0 - 0.24) \approx -7.7$$

$$\text{New rating } 1000 - 7.7 \approx 992.3$$

Upset win example (1000 vs. 1200, lower-rated player wins)

- **diff:** $1200 - 1000 = 200$

$$E = \frac{1}{1 + 10^{\left(\frac{200}{400}\right)}} \approx 0.24$$

- **Win $S = 1$:**

$$\Delta R \approx 32 \cdot (1 - 0.24) \approx 24.3$$

- **Winner new rating:** $1000 + 24.3 \approx 1024.3$
- **Loser new rating:** $1200 + 32 \cdot (0 - 0.76) \approx 1200 - 24.3 = 1175.7$

Tie example (1200 vs. 1000)

- **diff (absolute):** $|1200 - 1000| = 200$

$$E_{\text{higher}} \approx 0.76, \quad E_{\text{lower}} \approx 0.24$$

- **Both use $S = 0.5$:**
 - **Higher-rated new rating:** $1200 + 32 \cdot (0.5 - 0.76) \approx 1200 - 8.3 = 1191.7$
 - **Lower-rated new rating:** $1000 + 32 \cdot (0.5 - 0.24) \approx 1000 + 8.3 = 1008.3$
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Quick reference

- **Start:** Everyone begins at 1000.
- **K-factor:** Always 32.
- **Expected score:**

$$E = \frac{1}{1 + 10^{\left(\frac{R_{\text{opp}} - R_{\text{you}}}{400}\right)}}$$

- **Update:**

$$R_{\text{new}} = R_{\text{old}} + 32 \cdot (S - E)$$

- **Scores:** Win = 1, Tie = 0.5, Loss = 0.
- **Direction:** Upsets cause big swings; predictable results cause small swings.