

What is game matchmaking?

In multiplayer video games, matchmaking is the process of connecting players together for online play sessions. The design of matchmaking has significant impact on playing experience of players



Rule of matchmaking

To match players of roughly equal ability together, **Matchmaking Rating (MMR)** is introduced as a value that determines the skill level of each player.

It also offers a special internal rating system used for matchmaking, in which system would choose players with similar MMRs to compose a match.

The MMR score is calculated by the **Elo rating system**, which is widely used in master-level chess game and many video games such as Hearthstone. Below is the basic formula:

$$\text{Performance rating} = \frac{\text{Total of opponents' rating} + 400 * (\text{Wins} - \text{Losses})}{\text{Games}}$$

After a match, this formula would generate the new MMRs.

The background of the slide features stylized artwork from the game Apex Legends. At the top, a character with brown hair and a white visor is shown in a dynamic pose. Below them, the word 'APEX' is written in large, white, blocky letters, with '— LEGENDS —' in smaller text underneath. At the bottom, two more characters are depicted: one on the left wearing a green helmet and holding a gun, and one on the right in a grey suit holding a large weapon. The entire scene is set against a light, textured background with a red border on the left and right sides.

Monte Carlo Simulation on Game Matchmaking

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Assumption and Hypothesis

If the difference of MMRs in a match is too large, there is a significant probability that players on both sides would have a terrible or boring **playing experience**.

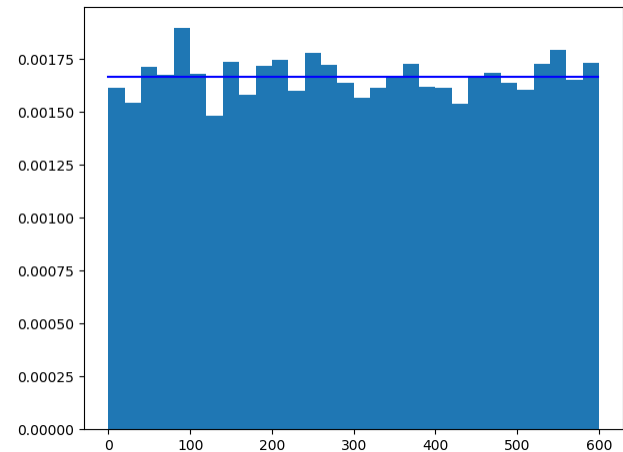
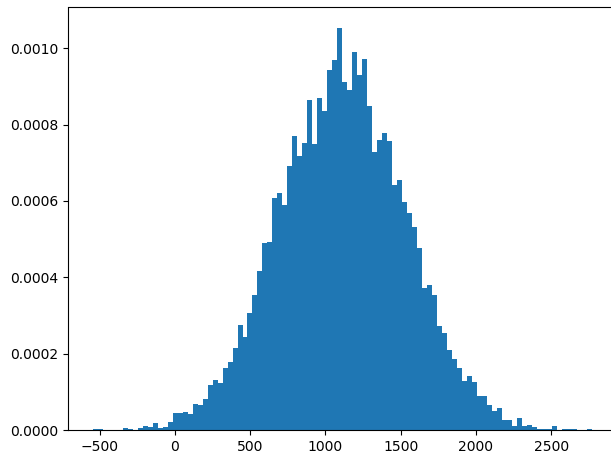
If the difference is too small, the **waiting time** of matchmaking would be too long, which also negatively affect the **playing experience**.

In this project

- **we would focus on finding an appropriate MMR range rule for matchmaking to allow players to have optimal playing experience.**
- **The changes of MMR distribution under different rules would be analyzed.**

Method

- We would simulate the matchmaking process in an amount of players. Each player would be represented by the MMR score, which is supposed to follow normal distribution.
- players will enter the waiting pool separately and the waiting time would begin to be calculated.
- Matchmaking would be processed every t_1 seconds.
- The result of each match would be estimated by **Elo rating system**, which is also used to adjust and generate player's new MMR based on the result.



Uncertainty elements:

- Rule for choosing MMR during the matchmaking
- If waiting time is more than t_2 seconds, there is P_1 probability that players would leave the game
- If players are not content with matches (difference of MMRs is too large, there is P_2 probability that they would leave the game.
- There is P_3 probability that one side would get a buff which is able to make players perform well extraordinarily in a match.

Limitation:

- Our code only simulates 1 vs 1 scenario like Hearthstone. More elements would be considered in other scenarios.
- We simplified the scenario compared to real video games, which are much more complicated when computing MMR