Background reading document

**Research into Android Studio**

I have performed reading and research into various topics involving creating a mobile game including the development of a native android app created using java classes and xml. Some of the research papers that I investigated involved the development and uses of a matchmaking system to connect players together without the need for players to have to share unique identifying codes. I also performed some research into the use of an Elo ranking system created originally for chess as a way of identifying the skill of the individual players.

Android development involves using software created by JetBrains (creators of IntelliJ) and google called android studio. This program makes the development of basic applications straight forward. The developer must use XML and a language that can be used to interact with it, some common choices are java, Kotlin and C++.

In the XML layouts you can add different items, these are all called views. You can create your own layouts to create the design of the app you would like. These layouts can be static, i.e. created just using the XML design, or they can be dynamic, created programmatically using the chosen programming language. You can add views to the layout that you created. These views could range from the most basic Text View, which allows the programmer to show the user some text. To complex such as Recycler Views, A type of scrolling view that requires an adapter.

**Research into ELO**

From the reading of the document “A Comprehensive Guide to Chess Ratings [1]” I have learnt that there are multiple different types of available ranking system. Some are more specialised for the type of play where a player’s skill will decrease with time and others remain the players skill the same no matter if they have not played for a while. All current models use formulas to determine outcomes. There are the formulas that describe the expected score of a game given two players ratings and the formula that describes how a player rating changes over time. The article that I read discussed the assumptions that are required to apply these formulas and that changing the assumptions may result in the need to change the formulas. In order to successfully implement an Elo system for players each player will need to have a record stored that the matchmaking system can use to determine if the players that are in the queue should be matched together or not.

Elo based system use bell curves to show a player’s skill level. There are two different models for determining the type of graph. The Bradley-Terry model uses the logistic distribution assumption and the Thurstone-Mosteller mode uses the normal distribution.

The Bradley-Terry model assumes that a player will play with an ability that changes from game to game. However, “the individual’s ability will rarely be substantially lower than the average. [1]” This model “assumes that if we consider all possible combinations of values from one players strength distribution with all possible combinations” of values from an opponent’s strength distribution the difference between the two numbers over all these combinations follow a logistic distribution.[1]” “From the Bradley-Terry model we can determine that the probability that the first player will outperform the other is the fraction under the logistic curve that is to the right of 0. [1]”

However, there may be outlier games where said player would play at a higher or lower ranking than is their main one. Players may also be expected to perform at a higher rate than their standard more often than they would at a lower rate.

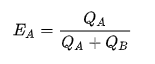
Some of the current organizations that make use of an Elo based ranking system in real life is the USCF, which uses computational power to perform its rating calculations and other such membership operations for its more than 30000 members.

This paper also discusses the use of ranking system in tennis where a player’s skill may decline over time. The ATP tennis ranking system awards points “based on the type of tournament, total prize money in the tournament and the highest round a player attained before being eliminated. [1]” These players are then “ranked by the sum of their points corresponding to their best 14 results from the previous 52 weeks. [1]” If the player has been competing for less than 14 tournaments, then all their points are summed. The ATP system’s rankings can change suddenly, for example if a player won a grand slam title then went on to have a year of poor results then when the player will come to compete a year later their ranking will have seen significant reduction from the previous year.

Some of the forumlas that are related to the discussion of elo ranking are as follows:









Where and 

If a player’s actual scores exceeded their expected scores the system views this as evidence that the players rank needs to change. This could be adjusted up or down based on the performance of the recent tournament. The maximum adjustment per game for the player is called the K-factor. In chess the K-Factor is set at “K=16 for masters and K=32 for weaker players. [1]”

If a player was expected to score points but actually scored points then the formula for updating that players rating is 

Scoring is based on whether the player won lost or drew (1 for a win, 0.5 for a draw and 0 for a loss).

**Research into Matchmaking Systems**

Matchmaking is used to determine the best way of grouping players for them to player a game. Additionally, the matchmaking system would try to create a game where the players taking part have a fair chance of winning. Matchmaking system can use the above described system (ELO ranking) or any other developed ranking system such as TrueSkill and Glicko/Glicko-2

If every player has “played enough games to estimate their skill and if enough players of each skill are available [2]”, “it would be possible to compose matches where both teams have on average the same chance of winning. [2]”

How much rating information is available for a single game?

“Suppose you wanted to store an integer with each of the players reflecting their position in the ranking. You would need N integers each of which with a range of at least 0 to N-1, requiring log2(N) bits per integer for a total of N \* log2(N) bits [2]”

If there is a displayed ranking ladder, then people may look to abuse the system to make as many gains as they can, so they are displayed high on the leader board.

Players may wish to have a higher skilled player use their account

Playing with friends or playing against friends that have a higher or lower rank and are willing to help manipulate the system.

Players may also wish to de level, which would involve them either creating a new account, or lose multiple matching on purpose as a means of losing ELO.

Using the formula that the paper discusses you are about to calculate the average time a player must wait before a game start.

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Where

is the number of different game modes in your game, where gamers can only ever get matched if they choose the same game mode.

 is the average duration of a match in minutes.

 is the average number of players in a single match.

 is the number of buckets required to divide the gamer population into buckets of roughly equal skill.

is the average time in minutes a gamer must wait until the match starts/.



is the average number of players online in the title at any given time.”

[2]

This paper talks about how you want to try and keep the average waiting time as low as possible

References

[1] Prof. Mark E. Glickman, “A Comprehensive Guide to Chess Ratings”, [Online], Date unknown. Available: <http://www.glicko.net/research/acjpaper.pdf>

[2] Thore Graepel and Ralf Herbrich, “Ranking and Matchmaking How to rate players’ skills for fun and competitive gaming”, [Online], Date Unknown. Available: <https://www.microsoft.com/en-us/research/wp-content/uploads/2006/10/Game-Developer-Feature-Article-Graepel-Herbrich.pdf>