

AtCoder Rating System ver. 1.00

Summary of the rating system

This rating system depends on Logistic Distribution (or Sigmoid Function) like Elo Rating, but with a lot of modifications.

In each contest, you get a *performance*. This value represents how well you performed in the contest. You can check your performances of old contests in <https://atcoder.jp/user/USERNAME/history>.

Then, roughly speaking, your rating is computed as the weighted average (recent contests have more weights) of performances minus f (the number of participation in rated contests), where $f(1) = 1200$ and f gradually decreases and converges to zero.

This means that if you keep getting the performance of X , your rating starts from $X - 1200$ and converges to X . Please don't worry if you get very low rating in the first contest - your rating is very likely to increase quickly if you participate in more contests. After 10 contests, you can assume that your rating is close to your real strength.

Computing Performances

Internally, there are two types of performances: *Perf* and *RPerf* (rounded perf). The numbers shown in <https://atcoder.jp/user/USERNAME/history> are actually *RPerf*.

First, for each participant, we compute *APerf* (average perf). Let $Perf_1, \dots, Perf_k$ be the history of *Perf* (not *RPerf*) of one particular user. $Perf_1$ is the newest and $Perf_k$ is the oldest. Then, *APerf* of this participant is defined as

$$APerf = \frac{\sum_{i=1}^k Perf_i \times 0.9^i}{\sum_{i=1}^k 0.9^i} \quad (1)$$

$APerf$ of newcomers are set to $Center$, where $Center = 1200$ for AGC, $Center = 1000$ for ARC and $Center = 800$ for ABC.

Let n be the number of participants, and let $APerf_i$ be $APerf$ of the i -th participant. Then, $Perf$ of the r -th ranked user in this contest is defined as the unique X that satisfies

$$\sum \frac{1}{1 + 6.0^{(X-APerf_i)/400.0}} = r - 0.5 \quad (2)$$

This X can be computed using binary search.

Note that the rank is the average of all tied places - for example, if four people are tied from the 3rd place to the 6th place, the rank of these people is 4.5.

As an exception, in order to avoid too small variance of performances in the first contest, the performances in the first contest is exaggerated as follows:

$$Perf = (Perf - Center) * 1.5 + Center \quad (3)$$

Finally, $RPerf$ of each user is computed as

$$RPerf = \min \{Perf, RATEDBOUND + 400\} \quad (4)$$

where $RATEDBOUND$ is 2800 for ARC, 2000 for ABC, and ∞ for AGC.

This means that the performances of several top people in ARC are all 3200.

Computing Ratings

The rating is the average of performances.

Let f be the following function:

$$F(n) = \frac{\sqrt{\sum_{i=1}^n 0.81^i}}{\sum_{i=1}^n 0.9^i} \quad (5)$$

$$f(n) = \frac{F(n) - F(\infty)}{F(1) - F(\infty)} \times 1200 \quad (6)$$

Let g be the following function:

$$g(X) = 2.0 \frac{X}{800} \quad (7)$$

This function is used to assign more weights to better performances. Thus, there is a big difference between very good performance and moderately good performance, while the difference between big failure and moderate failure is not so big.

Let $RPerf_1, \dots, RPerf_k$ be the history of $RPerf$ of one particular user. Then, the rating for this user is defined as

$$Rating = g^{-1} \left(\frac{\sum_1^k g(RPerf_i) \times 0.9^i}{\sum_1^k 0.9^i} \right) \quad (8)$$

Colors

To be written.

Dan and Kyu

To be written. For now, we just say that it depends on the maximum rating you achieved.

History of this document

- 08/13/2016 Ver. 1.00: First version.