Hacker Cup 2017 Qualification Round Solutions

FACEBOOK HACKER CUP · TUESDAY, JANUARY 10, 2017

Here are the solutions to the Hacker Cup 2017 Qualification Round problems. If you had a rejected solution and want to find out where you went wrong, read on and download the official input and output!

Input / Output / Solutions: https://www.dropbox.com/sh/rzyhrzol...

The problems for this round were written by Wesley May.

Progress Pie

For each point, we need to check two things:

1) Is the point close enough to the center that it could be within the circle at all?

This is as simple as computing the distance between the point and the center of the circle: `sqrt((X - 50)^2 + (Y - 50)^2)`. This distance must be no greater than 50, the radius of the circle.

2) Is the point between the two lines that define the bounds of the current circle sector?

We'd like to know the angle of the given point in the reference frame where 0 degrees is up and 90 degrees is to the right, since that's the way the boundary of the circle sector moves as the progress increases.

Most languages have an `atan2()` function which can give you the angle from (0, 0) to a given point. However, this function puts 0 degrees to the right and 90 degrees upwards, so it's necessary to translate the output to the desired reference frame.

And of course, if P = 0%, all points are white.

Lazy Loading

Consider the heaviest item that hasn't yet been moved. When this item is moved, it should certainly be on the top of the stack to make the current bag appear as heavy as possible. To move this item we'll need to add as many other items as necessary to make the bag appear to weigh at least 50 pounds.

(with weight `W`) in the bag, along with the `K` lightest available items, where `K` is the lowest integer that satisfies `(K + 1) * W >= 50`. If there aren't enough remaining items to fake a 50-pound bag, then you can't complete another trip. Pretend that you put those items in the last bag moved.

To efficiently find the heaviest and lightest items, we should first sort the input. This takes `O(N log N)` time, and the rest of the algorithm takes `O(N)` time. (Given the small bound on the weights of the items, a more efficient sorting method is possible, but unnecessary.)

Fighting the Zombie

For each attack, we need to compute the probability that it rolls at least `H` damage. We can compute this using dynamic programming.

Let `f(D, K)` be the probability of dealing at least `K` damage with `D` dice. For a given input `X Y Z` we want to compute `f(X, H - Z)`. We can use the following recursive definition:

- `f(D, K) = 1` for `K <= 0` (We can always do at least 0 damage)
- `f(0, K) = 0` for `K > 0` (We can't do a positive amount of damage with 0 dice)
- `f(D, K) = (1 / Y) * ( f(D - 1, K - 1) + f(D - 1, K - 2) + ... + f(D - 1, K - Y) )`

This last formula combines the outcomes of all possible die rolls for a single die, and weights them evenly by `1 / Y`.

In this way, we can compute the probability of success for each attack in `O(X * Y * (H - Z))` time.

Since the most damage we can do is `X * Y`, we can trivially reject any case where `H - Z > X * Y`. That means we can also consider the time complexity to be `O(X * Y * X * Y) = O(X^2 * Y^2)`.

many of the last cases.
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Siddhesh Patil I had my solution and code correct for the progress pie and yet it wasn't selected?
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Facebook Hacker Cup A number of the answers in your submitted output file for Progress Pie were indeed incorrect.
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Rafael Sofi-Zadeh Am i the ONLY one who got a "Progress Pie" input file with 1000 test cases instead of 2005?!?
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Facebook Hacker Cup During the contest, each competitor receives a randomized set of 1000 cases out of our 2005 total cases.
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Suyash Srivastava Facebook Hacker Cup There is surely a problem with progress pie question. When I downloaded the input file it had 1000 test cases only and now in the solution it has 2005. How is it possible?
The code I submitted is just the same as your Solution code.... See More
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Facebook Hacker Cup During the contest, each competitor receives a randomized set of 1000 cases out of our 2005 total cases.

A number of the answers in your submitted output file were incorrect.
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Tanmay Maheshwari Does the green tick means the output is correct? i.e. the green tick suggests that I have qualified the round?
Like · Reply · January 10 at 6:41pm

Facebook Hacker Cup That's right. We'll also send out official advancement emails within a couple of days.
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पंकज जहागिरदार Facebook Hacker Cup When I downloaded the input file of the Progress Pie it had only 1000 test cases and now its showing 2005 .. strange..
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Nir Shalmon It seems like I downloaded a different input for Progress Pie... I only had 1000 cases which were different from the 2005 in the Dropbox. I still have that file. What should I do? Can they check the code I submitted with the correct input?
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We'll be sending out official advancement emails within a couple of days.
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Amr Ramadan So how do we know about the next round and who passed the qualifications?
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Facebook Hacker Cup Everyone who got at least one problem correct according to the final scoreboard will advance. We'll also be sending out official advancement emails within a couple of days.
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Prabhakaran Mani Facebook Hacker Cup My Lazy loading solution been invalidated despite producing the expected output.Not sure why??
Like · Reply · January 10 at 3:18pm

Facebook Hacker Cup Nearly all of the answers in your submitted output file were incorrect.
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