X Junior Balkan Olympiad in Informatics

Skopje, 2016

Day 1: Donations

Analysis:

The hardest part in this problem is figuring out a combination of expressions that help you answer the following question: "Does a person named X have more, less, or equal amount of money to Y?" Once you know how to get the answer to that question, the problem becomes a classic binary search. Start by asking for 1.000.000.000 and then depending on the answer, remove at least half of the possible amounts of money. Keep doing this until you figure out the exact number.

In order to perform the query above, you need to find an expression that matches no less than 2k and no more than N-2k records. The key observation for that is that the ages of all people are evenly distributed. Which means that something like "age > 50" probably works for that purpose, and if it doesn't, you need to find a number X such that the query "age > X" returns as many matches as we want.

Short description: Let's call the expression we found T. Let C be the question we care about ("name == X && money > y" for example). Now we know that:

count(C) = count(T || C) + count(not T || C) - N

Note that all of the expressions on the right hand side match between k and n-k records, so they are all legal expressions for which we can get a result back. Using them, we can do the binary search. To better understand why both sides are equal in the above equation, draw the Venn Diagrams, or google "Tracker Attack" as it uses the same idea.