Kick Start 2018 - Round E

Analysis: Yogurt

Yogurt: Analysis

Intuitively, if Lucy wants to maximize the amount of yogurt she consumes, she should consume as many cups as possible each day, and always choose a cup that is closest to expiring.

Small dataset

We can directly implement the above strategy to solve the Small dataset, in which Lucy can only consume one cup per day. On each day, we scan the list for the smallest unselected cup that has not expired, consume it, and remove it from the list. Since we make up to **N** passes through a list with up to **N** items, the time complexity is O($\mathbf{N}^2$).

Large dataset

To improve the above strategy to solve the Large dataset, we can first sort the cups in non-decreasing order of time until expiration. Then, on each day, we remove all expired cups from the beginning of the list and then consume the next **K**. Since we only handle each cup in the sorted list once, the initial sorting step determines the overall time complexity, which is O(**N** log **N**).

But we can do even better! Notice that there are only **N** cups, and since **K** ≥ 1, Lucy could consume or discard all of them in at most **N** days. So any $\mathbf{A_j} \geq \mathbf{N}$ can be replaced with **N**. Then, we can count how may cups will expire on each day, and then proceed backwards from the **N**th day to the first day. On each day, Lucy consumes at most **K** cups, and moves any remaining cups from that day to the previous day, since it is safe to consume them earlier. (Any extra cups left over on day 1 must be discarded.) We make one forward pass through the data to count the cups and one reverse pass to answer the question, so this strategy is O(**N**).