SWE2026 Problem Solving Techniques, 2021 Spring

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PA 3 (Mid-term Exam): Scholarship Officer - APPENDIX

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1. Reference

1-A. About Reference

- The references below could be hard to apply to this problem. However, we can still learn some lessons from them. After reading them carefully, write down the lessons or key points obtained from those two references on your report.
- You can research further on these references or this problem. If you did, write them on the report as well.

1-B. Reference List

- **Cuckoo hashing**(https://en.wikipedia.org/wiki/Cuckoo_hashing) algorithm is often used in database system. However, this algorithm is hard to apply to this problem.
- **Twitter use different method**(http://highscalability.com/blog/2013/7/8/the-architecture-twitter-uses-to-deal-with-150m-active-users.html) according to different circumstances. However, their solution is hard to apply to this problem.

2. Report Example – Question 4

2-A. Example Problem

Exactly same problem with PA1 – 1. FC PST and PA2 – 1. FC PST 2 as subproblem 1 and subproblem 2, respectively.

2-B. Example Question

Time complexity calculation (<= 9 lines)

Calculate your time complexity by calculating your actual number of operations with worst N, M, and some Does your big-O notation seem correct? Is calculated value small enough for this problem?

2-C. Example Report 1

My time complexity is O(N + C) for both subproblem 1 and 2. For subproblem 1, when N = 500000 my solution loops through N data for input(500000). Next, check the value and update max ASGD throughout all month, date(365). Total number of operations is about 500365, and it's enough to work in 1 second, which also fits into O(N + C).For subproblem 2, when N = 500000 my solution loops through N data for input(500000). Check wining and losing scores to update max ASGD throughout all year, month, date(2 * 219365). Total operation is about 938730, and it's enough to work in 1 second, which also fits into O(N + C).

2-D. Example Report 2

I will use #OP for the number of operations, N for 5000000(worst case). For subproblem 1, input takes N. Loop through hash array takes month*day=12*31=372. Each should be compared and changed, which would be about 5. Printing task takes about 100. #OP = 501960 which takes very short time, thus time complexity is O(N). For subproblem 2, Input takes N, and each calculations take about 5. Merge sort takes N log N, and multiply it by 5 because merge sort is slow among n log n sorting algorithms. Then loop through N items. Each should compare date to previous one to refresh max value, which takes about 10. Printing takes about 50. #OP is 54828971 which takes about 0.55 seconds, thus time complexity is O(N log N).

3. Detailed Description – Question 6

3-A. Example Input and Output of A

Input	Output
8 S 1 1 3 2 100000 Q 3 0 0 0 0 25000000 S 5 1 18 4 3000000 S 1 6 12 2 25000000 S 1 6 12 5 28000000 Q 2 0 6 12 0 26000000 S 4 6 16 1 32000000 Q 3 0 1 0 2 200000	1 1 1

Description

- (Ignore the very first line) 2nd, 6th, 8th lines are queries, so they include the query type.
- TSAs of data are sorted but TSAs of queries are not sorted.
- There is a student whose TSA is lower than or equal to 25 000 000 at the time that the first query is requested.
    - 1st student.
- There is a student who takes 12 credits in the 6th semester and whose TSA is higher than or equal to 26 000 000 at the time that the second query is requested.
    - 4th student.
- There is only 1 student who is in the first semester and did not satisfy graduation requirements and whose TSA is lower than or equal to 200 000.
    - 1st student.

3-B. Example Input and Output of B

Input	Output
8 S 1 1 3 2 3000000 Q 3 0 0 0 0 2500000 S 5 1 18 4 2000000 S 1 6 12 2 1000000 S 1 6 12 5 15000000 Q 2 0 6 12 0 2600000 S 4 6 16 1 32000000 Q 3 0 1 0 2 200000	0 2 0

Description

- (Ignore the very first line) Second, 6th, 8th lines are queries, so they have the query type.
- All TSAs are not sorted.
- There is no student whose TSA is lower than or equal to 25 000 000 at the time that the first query is requested.
- There are two student who take 12 credits in 6th semester and whose TSA is higher than or equal to 26 000 000 at the time that the second query is requested.
    - 4th, 5th student.
- There is no student in his or her first semester who did not satisfy graduation requirements and whose TSA is lower than 200 000.

3-C. Description of C

Description

- In this case, subproblem1 and subproblem2 are combined.
- In some test cases, either one of query or data is dominating.
- In other test cases, query and data are given in equal proportions.