1. Introduction to the judge environment

2. Prefix sum/precomputation technique

Sample Problem: Even Pairs

Input:

- first line: a positive integer n
- second line: a sequence $x_0, \ldots, x_{n-1} \in \{0, 1\}$

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- first line: a positive integer n
- second line: a sequence $x_0, \ldots, x_{n-1} \in \{0, 1\}$

Output: a single line containing the number of pairs $0 \leq i \leq j < n$ such that

$$x_i + \cdots + x_j$$

is even.

Example

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Input: $n = 4$

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$$A: \quad 0 \quad 1 \quad 1 \quad 1$$

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$$A: \quad 0 \quad 1 \quad 1 \quad 1$$

Output: # of ‘even pairs’: 0

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Input: $n = 4$

$$A: \quad 0 \quad 1 \quad 1 \quad 1$$

Interval (red) sum $= 0$

Output: # of 'even pairs': 1

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Input: $n = 4$

$$A: \quad 0 \quad 1 \quad 1 \quad 1$$

Interval (red) sum $= 2$

Output: # of 'even pairs': 2

Example

Input: $n = 4$

$$A: \quad 0 \quad 1 \quad 1 \quad 1$$

Interval (red) sum $= 2$

Output: # of 'even pairs': 3

Example

Input: $n = 4$

$$A: \quad 0 \quad 1 \quad 1 \quad 1$$

Interval (red) sum $= 2$

Output: # of 'even pairs': 4

First Approach

(1) for all pairs $i \leq j$, compute the sum $x_i + \cdots + x_j$

(2) if it is even, increment a counting variable

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- this type of analysis is **very important** in this course

Second Approach

Observation:

$$x_i + \cdots + x_j = \sum_{a=0}^{j} x_a - \sum_{b=0}^{i-1} x_b$$
$$= S_j - S_{i-1}$$

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Running time: $O(n^2)$

Third Approach

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Running time: $O(n)$

Even Pairs - Conclusion

Technique: Partial sums/Precomputing

- Precomputing partial sums allows computing the sum of the elements in an interval in constant time.
- More generally, precomputing certain values can speed up the running time of an algorithm.

Judge Feedback

Besides CORRECT, TIMELIMIT, and WRONG-ANSWER, the judge can give the following feedback:

ASSERTION-FAILURE SIGABRT: memory screw-up or assertion failure

SEGMENTATION-FAULT SIGSEGV: memory screw-up (e.g. out-of-bounds)

RUN-ERROR nonzero exit status

FORBIDDEN bad syscall or other safety

Forum

The forum is your main tool for discussing ideas and getting help. Use it.

Of course, you will only learn if you first try to solve the problems on your own.

Forum: How To Ask Questions

1. Apply spoiler warnings

Example

SPOILER<<<

Set this text to have a white foreground. It will then be invisible unless marked. The <<< ... >>> exploit a bug in the email plugin to also remove the text in plain-text email.

>>>

Forum: How To Ask Questions

1. Apply spoiler warnings
2. Describe the problem, not your guesses or summaries

Example

Bad When I compile, it tells me it cannot find it.

Good When I run `g++ -o foo foo.cpp`, I get

```
bash: $'g++\302\240-o': command not found
```

Forum: How To Ask Questions

1. Apply spoiler warnings
2. Describe the problem, not your guesses or summaries
3. Code: describe what fails and what you expect instead

Example

Bad The code below doesn't work. Help?

Good I am trying to solve Problem 1. I tried strategy **something**. My code is below. For some reason, when running it on the provided test case it emits `no solution` instead of `1`. What am I doing wrong?

Forum: How To Ask Questions

1. Apply spoiler warnings
2. Describe the problem, not your guesses or summaries
3. Code: describe what fails and what you expect instead
4. Code: post **minimal** examples

Example

Bad When I call `.foo()` on a `vector`, it segfaults. Bug!

Good I am trying to **something**. The code is below. I get a segfault in the line that calls `.foo()`, but if I remove that line the program continues. What am I doing wrong?

Forum: How To Ask Questions

1. Apply spoiler warnings
2. Describe the problem, not your guesses or summaries
3. Code: describe what fails and what you expect instead
4. Code: post **minimal** examples
5. Do not rush to claim that you have found a bug

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It is important that you know certain parts of the C++ standard library, such as:

- how to do I/O using `<iostream>`,
- how and when to use which container: `vector`, `set`, `map`, `stack`, `queue`, and `priority_queue`,
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IMPORTANT! Read the 'A Short Introduction to C++ for the Algorithms Lab' document and familiarise yourselves with the concepts within.

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