Contest Duration: 2025-04-27(Sun) 08:00 (http://www.timeanddate.com/worldclock/fixedtime.html?iso=20250427T2100&p1=248) - 2025-04-27(Sun) 09:40 (http://www.timeanddate.com/worldclock/fixedtime.html?iso=20250427T2240&p1=248) (local time) (100 minutes) Back to Home (/home)

Top (/contests/abc403) Tasks (/contests/abc403/tasks)

Clarifications (/contests/abc403/clarifications) Submit (/contests/abc403/submit)

Results Standings (/contests/abc403/standings)

Virtual Standings (/contests/abc403/standings/virtual)

Custom Test (/contests/abc403/custom_test) Editorial (/contests/abc403/editorial)

Discuss (https://codeforces.com/blog/entry/142272)

Official

E - Forbidden Prefix (/contests/abc403/tasks/abc403_e) Editorial by en_translator (/users/en_translator)

Prerequisite: Trie

This problem is an exercise of **trie**, which is a data structure that represents a list of strings as a rooted tree. Information stored on each vertex allows us efficient manipulations regarding prefixes.

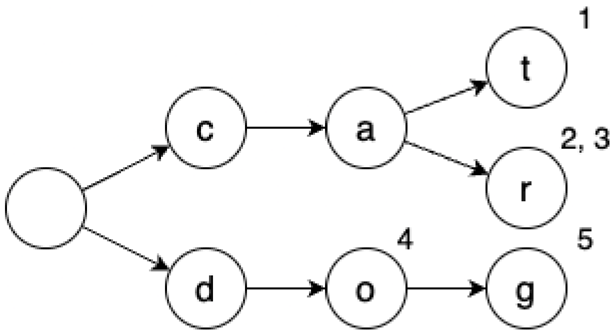
A trie is constructed so that each vertex represents a character, and a path from the root to another vertex corresponds to a string. Strings with common prefixes share a path from the root to some of their ancestor.

Each vertex of the trie maintain the following information:

- The character represented by the vertex
- The list of children of the vertex
- The list of strings that is **accepted** at the vertex; i.e. the list of indices of the original list, that coincides with the string represented by the path from the root to the vertex

For example, a list of strings $(S_1, S_2, S_3, S_4, S_5) = (\texttt{cat}, \texttt{car}, \texttt{car}, \texttt{do}, \texttt{dog})$ is represented by the following trie. The numbers on the top left of each vertex represent the indices of the string that is accepted by the vertex.

2025-04-27 (Sun) 22:18:49 -04:00



Solution of the problem

We describe how to solve the problem using a trie. We maintain all the given strings S_i in a single trie T, regardless of which of X and Y it will belong to. Also, maintain a set Z, which stores "the strings S_i contained in Y that has an element S_j in X as a prefix." The sought answer is $|Y| - |Z|$. If we can update Z fast enough every time S_i is given, then the problem can be solved.

There are two possible situations where an element is added to Z:

1. Query 1 asks to add S_i to X, causing $S_j \in Y\ (j < i)$ to have S_i as a prefix, resulting in S_j being added to Z.
2. Query 2 asks to add S_i to Y, causing S_i to have $S_j \in X\ (j < i)$ as a prefix, resulting in S_i being added to Z.

We explain how to handle each type of query.

Processing query 1

If the subtree rooted at the vertex accepting $S_i \in X$ contains a vertex that accepts $S_j \in Y$, then we add S_j to Z.

If we inspect all the vertices in the subtree, we cannot make it within the execution time limit. Instead, we will keep for each vertex v in T, the set of the elements $S_j \in Y$ to be added to Z when an $S_i \in X$ accepted by v is added for the next time. This can be updated by, every time adding $S_j \in Y$ to T, for all vertex v that accepts a prefix of S_j, adding S_j to Z_v. When adding $S_i \in X$, add all $j \in Z_v$ to Z and empty Z_v, where v is the vertex accepting S_i. Since Z_v can have up to Q elements, so it seems inefficient at a glance, but the total number of times that an S_j is taken out of any Z_v is at most S_j times. Therefore, the overall time complexity is $O(\sum_{i=1}^{Q} |S_i| \log Q)$.

Processing query 2

It is sufficient to check if there is a vertex v that accepts a prefix of $S_i \in X$ and also accepts an $S_j \in X$. To this end, we maintain a flag f_v for each vertex v in T signifying whether X contains a string that is accepted by that vertex. When adding a string of X to T, we set $f_v = \mathrm{true}$ for the vertex v accepting that string; when adding a string of Y, we check if there exists an ancestor v of the vertex that accepts its prefix such that $f_v = \mathrm{true}$.

Summary

To wrap up, each type of query can be processed as follows:

2025-04-27 (Sun)
22:18:49 -04:00

- When adding S_i to X:
  - Add S_i to T.
  - For the vertex v accepting S_i, perform the following:
    - Add each $S_j \in Z_v$ to Z, and empty Z_v.
    - Let $f_v = \mathrm{true}$.
- When adding S_i to Y:
  - Add S_i to T.
  - For each vertex v accepting a prefix of S_i, perform the following:
    - Add i to Z_v.
    - If $f_v = \mathrm{true}$, add i to Z.

The overall time complexity is $O(\sum_{i=1}^{Q} |S_i| \log Q)$.

Sample code (Python) (https://atcoder.jp/contests/abc403/submissions/65219576)

posted: about 3 hours ago
last update: about 3 hours ago

am)

ps%3A%2F%2Fatcoder.jp%2Fcontests%2Fabc403%2Feditorial%2F12832%3Flang%3Den&title=Editorial%20-
0403)

2025-04-27 (Sun)
22:18:49 -04:00