C++ STL (Part 1)

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Goal

- To learn about containers
  - pair
  - vector
  - set, unordered_set
  - map, unordered_map

About STL

Standard Template Library (STL) is a set of C++ functions/classes to perform various tasks.

There is a wide variety of functions and classes for different applications.

STL objects are more efficient, bug-free, and easier to use than custom implementations.

Pair

Pairs are very useful when dealing with two related values. For example, storing a range [L, R].

Pairs have inbuilt comparators such as <, >, etc.

Usage:

```
pair<int, int> p = {1, 7};
cout << p.first << endl; // outputs 1
cout << p.second << endl; // outputs 7
```

Vector

Vectors store an ordered collection of data. Unlike arrays, vectors can be resized. They also have far more features than arrays.

Useful vector functions:

```
v.begin(), v.end();
v.push_back(val), v.pop_back();
v.empty(), v.size();
v.insert(it, val), v.erase(it);
v.clear();
```

Sort Function

Syntax: `sort(begin, end, comparator);`

Sorts elements from [begin_iterator, end_iterator)

It is possible to write our own sort criteria instead of ascending/descending. It is called a "comparator".

Set / Map

Sets store unique values in a sorted order.
Search, removal, insertion of an element is O(logN).

For sets to work for some datatype, the datatype must have “<” function implemented.

Maps store a value for a unique key (sorted by the key).
Search, removal, insertion of an element is O(logN).

In other words, maps are similar to vectors, but they can have any value as an index. Also, they are sorted by index.

Unordered Set

Unordered Sets store unique values, in any order. Search, removal, insertion of an element is O(1).

For unordered sets to work for some datatype, the datatype must have a hash function implemented.

Therefore, unordered set can’t store pairs, or vectors, or other datatypes without a hash function.

Unordered Map

Unordered Map is similar to maps, but the keys are not ordered. Search, removal, insertion of an element is O(1).

For unordered maps to work for some datatype for the key, the datatype must have a hash function implemented.

Similar to unordered set, unordered map does not work for pair, vector, etc.

Example Problems:

- https://codeforces.com/group/c3FDl9EUi9/contest/262795/problem/B
- https://codeforces.com/group/c3FDl9EUi9/contest/262795/problem/C
- https://codeforces.com/group/c3FDl9EUi9/contest/262795/problem/D

Resources:

https://www.cppreference.com/Cpp_STL_ReferenceManual.pdf

https://devdocs.io/cpp/container (for STL containers)

https://devdocs.io/cpp/algorithm (for STL algorithms)

Using the above resources, try to learn about multiset, multimap.