SoC 2022 : Competitive Coding

Contents

1. Week-1

C++ basics and STL, start on codeforces, build a template, string, vector, map, unordered_map, queue, priority_queue, stack, deque and their methods, operators (~, ^, ...) and applications.

Mostly C++ is used, and sometimes Python or Java. (One application is when very large integers are involved).

- Competitive Programmer's Handbook, by Antti Laaksonen.
- DSA books: CLRS, Kleinberg-Tardos (more theoretical)
- Problems on Codeforces, Codechef, other online platforms, CSES (https://cses.fi/problemset/)

Template: 1_basic.cpp
Can start with Chapters 1 and 4 of the CP book.

- Get VSCode to identify the path to bits/stdc++.h (or include individual paths) https://www.youtube.com/watch?v=pyn0TjUnf18
- VSCode user snippets, terminal
- "\n" vs endl (endl flushes the output, so have to use flush() in case of "\n" (Interactive Questions))
- ios_base::sync_with_stdio(false); cin.tie(0);
- shorthand for vectors, 'for' loops, typedefs, etc.
- rng (https://codeforces.com/blog/entry/61587)
- file read and write
- **use ll/ull instead of int if ranges are such

- Big O notation
  ~ just remove the smaller parts…
  n^2 + 2n + 5 = O(n^2)
  log n = O(n)

  Constraints (would be mentioned in the question): ~10^6 operations/second.
  So if n≤10^5 and time limit ≤1 second, then O(n^2) probably won't work (TLE).
  For example, if n≤20, then can probably brute force (2^n would work).

- **C++ STL Data Structures and their methods**

  i) vector
  - 2_vector.cpp (methods discussed)
  - Can think as dynamic length array.
  - https://www.geeksforgeeks.org/vector-in-cpp-stl/

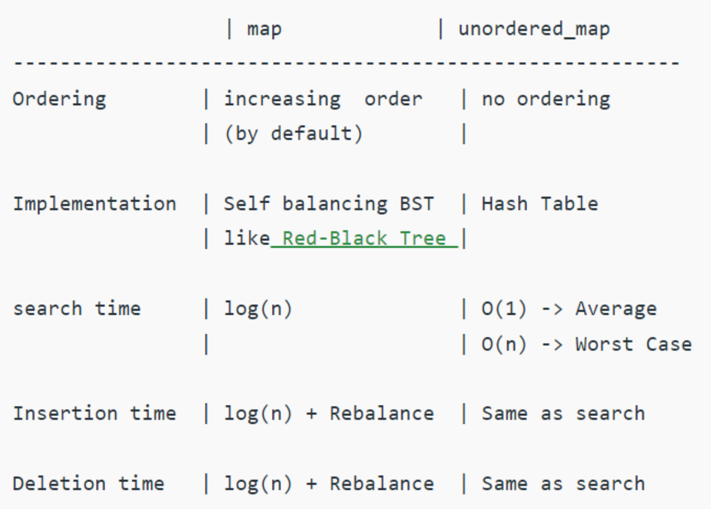
  ii) string
  - 3_string.cpp
  - More functions than a char array, and much more convenient (it's an object, not a pointer)
  - https://www.geeksforgeeks.org/stdstring-class-in-c/

  iii) stack, queue, deque, priority_queue
  - 4_stack.cpp
  - Stack: LIFO, queue: FIFO

- Priority_queue: first element is greatest/least/(according to given criterion)
- https://www.geeksforgeeks.org/stack-in-cpp-stl/
- https://www.geeksforgeeks.org/queue-cpp-stl/
- https://www.geeksforgeeks.org/deque-cpp-stl/
- https://www.geeksforgeeks.org/list-cpp-stl/
- https://www.geeksforgeeks.org/priority-queue-in-cpp-stl/

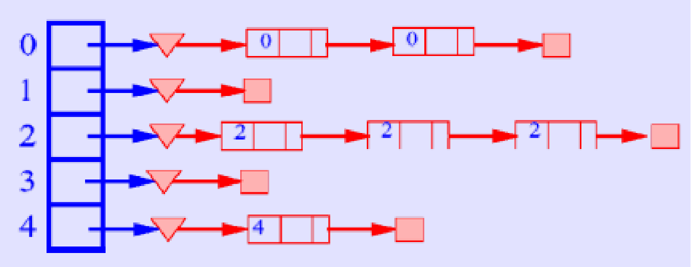
iv) Pair, map, set, (multimap)

- 5_map-set.cpp
- https://www.geeksforgeeks.org/map-associative-containers-the-c-standard-template-library-stl/
- https://www.geeksforgeeks.org/unordered_map-in-cpp-stl/



```
                  | map               | unordered_map
---------------------------------------------------------
Ordering        | increasing  order   | no ordering
                | (by default)        |

Implementation  | Self balancing BST  | Hash Table
                | like Red-Black Tree |

search time     | log(n)              | O(1) -> Average
                |                     | O(n) -> Worst Case

Insertion time  | log(n) + Rebalance  | Same as search

Deletion time   | log(n) + Rebalance  | Same as search
```

-
- https://www.geeksforgeeks.org/map-vs-unordered_map-c/
- https://www.geeksforgeeks.org/set-in-cpp-stl/
- Hash table ~ to



- Question: given an array and a target sum, is there a pair of integers that add up to the target sum?
  O(n^2), O(n.log(n)), O(n)
  See code.

v) Operators

- https://www.geeksforgeeks.org/operators-c-c/
- XOR properties:
  → exclusive OR, $1\oplus1=0$, $0\oplus0=0$, $1\oplus0=1$
  → $p\oplus0000...0=p$, $p\oplus1....1=\sim p$, associative, commutative
  → bool p1,...,pn, then $p1\oplus p2...\oplus pn$ is 1 iff an odd number of pi's are 1.
  e.g. $1\oplus1\oplus0\oplus1 = 1$

- https://www.geeksforgeeks.org/c-bitset-and-its-application/
- Bitset

- CSES introductory problems
  - Will cover "Two Sets" in dp too.
  - Discuss Two Sets (recursive solution)