

Data Structures & Algorithms

Prepared by: Mohamed Ayman

Algorithm Engineer at Valeo

Deep Learning Researcher and Teaching Assistant
at The American University in Cairo (AUC)

spring 2020

Valeo



THE AMERICAN
UNIVERSITY IN CAIRO



sw.eng.MohamedAyman@gmail.com



facebook.com/cs.MohamedAyman




linkedin.com/in/cs-MohamedAyman



github.com/cs-MohamedAyman




codeforces.com/profile/Mohamed_Ayman



Lecture 14

STL in C++ (Non-Linear Data Structures)



Course Roadmap



Part 2: Non-Linear Data Structures

Lecture 8: Binary Tree

Lecture 9: Binary Search Tree

Lecture 10: Self Balancing Binary Search Tree

Lecture 11: Binary Heap Tree

Lecture 12: Hash Tables

Lecture 13: Graphs

Lecture 14: STL in C++ (Non-Linear Data Structures)

Lecture Agenda

We will discuss in this lecture
the following topics

1- STL in C++ (Non-Linear Data Structures)

2- Set

3- Multi-set

4- Map

5- Multi-map

6- Priority Queue

A top-down view of a white desk. On the left, a person's hands are typing on a white Apple keyboard. Above the keyboard is a white Apple mouse. To the right of the mouse is a bright yellow wristwatch with a black face. In the bottom right corner, the top of a white smartphone is visible. The text "Let's STARTUP" is centered on the desk. "Let's" is in a small, grey, sans-serif font. "STARTUP" is in a large, bold, sans-serif font. "START" is black with a white speckled texture, and "UP" is solid red with a white speckled texture.

Let's
STARTUP

Lecture Agenda



Section 1: STL in C++ (Non-Linear Data Structures)

Section 2: Set

Section 3: Multi-set

Section 4: Map

Section 5: Multi-map

Section 6: Priority Queue



Lecture Agenda



✓ Section 1: STL in C++ (Non-Linear Data Structures)

Section 2: Set

Section 3: Multi-set

Section 4: Map

Section 5: Multi-map

Section 6: Priority Queue



Practice



HackerRank - Trees & Balanced Trees



- [01] <https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>
- [02] <https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>
- [03] <https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>
- [04] <https://www.hackerrank.com/challenges/tree-height-of-a-binary-tree/problem>
- [05] <https://www.hackerrank.com/challenges/tree-top-view/problem>
- [06] <https://www.hackerrank.com/challenges/tree-level-order-traversal/problem>
- [07] <https://www.hackerrank.com/challenges/binary-search-tree-insertion/problem>
- [08] <https://www.hackerrank.com/challenges/binary-search-tree-lowest-common-ancestor/problem>
- [09] <https://www.hackerrank.com/challenges/tree-huffman-decoding/problem>
- [10] <https://www.hackerrank.com/challenges/swap-nodes-algo/problem>
- [11] <https://www.hackerrank.com/challenges/is-binary-search-tree/problem>
- [12] <https://www.hackerrank.com/challenges/self-balancing-tree/problem>
- [13] <https://www.hackerrank.com/challenges/square-ten-tree/problem>
- [14] <https://www.hackerrank.com/challenges/balanced-forest/problem>
- [15] <https://www.hackerrank.com/challenges/jenny-subtrees/problem>
- [16] <https://www.hackerrank.com/challenges/array-and-simple-queries/problem>
- [17] <https://www.hackerrank.com/challenges/median/problem>

HackerEarth - Binary Tree



- [01] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/mirror-image-2/>
- [02] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/magical-tree-1-e7f8cabd/>
- [03] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/mancunian-and-colored-tree/>
- [04] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/directory-deletion-71e793b8/>
- [05] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/approximate/largest-cycle-in-a-tree-9113b3ab/>
- [06] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/tree-counting-3/>
- [07] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/population-outburst-7db5d39a/>
- [08] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/gandhi-tree-march/>
- [09] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/count-the-tree/>

HackerEarth - Binary Search Tree



- [01] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-watching-fight/>
- [02] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-his-friends/>
- [03] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/distinct-count/>
- [04] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/b-sequence-f919fc86/>
- [05] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-cursed-tree/>
- [06] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-bst/>
- [07] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/dummy3-4/>
- [08] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/suarez/>
- [09] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/little-monk-and-swaps/>
- [10] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/mst-revisited-3f9d614c/>

Lecture Agenda



✓ Section 1: STL in C++ (Non-Linear Data Structures)

✓ Section 2: Set

Section 3: Multi-set

Section 4: Map

Section 5: Multi-map

Section 6: Priority Queue



Practice



HackerRank - Trees & Balanced Trees



- [01] <https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>
- [02] <https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>
- [03] <https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>
- [04] <https://www.hackerrank.com/challenges/tree-height-of-a-binary-tree/problem>
- [05] <https://www.hackerrank.com/challenges/tree-top-view/problem>
- [06] <https://www.hackerrank.com/challenges/tree-level-order-traversal/problem>
- [07] <https://www.hackerrank.com/challenges/binary-search-tree-insertion/problem>
- [08] <https://www.hackerrank.com/challenges/binary-search-tree-lowest-common-ancestor/problem>
- [09] <https://www.hackerrank.com/challenges/tree-huffman-decoding/problem>
- [10] <https://www.hackerrank.com/challenges/swap-nodes-algo/problem>
- [11] <https://www.hackerrank.com/challenges/is-binary-search-tree/problem>
- [12] <https://www.hackerrank.com/challenges/self-balancing-tree/problem>
- [13] <https://www.hackerrank.com/challenges/square-ten-tree/problem>
- [14] <https://www.hackerrank.com/challenges/balanced-forest/problem>
- [15] <https://www.hackerrank.com/challenges/jenny-subtrees/problem>
- [16] <https://www.hackerrank.com/challenges/array-and-simple-queries/problem>
- [17] <https://www.hackerrank.com/challenges/median/problem>

HackerEarth - Binary Tree



- [01] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/mirror-image-2/>
- [02] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/magical-tree-1-e7f8cabd/>
- [03] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/mancunian-and-colored-tree/>
- [04] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/directory-deletion-71e793b8/>
- [05] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/approximate/largest-cycle-in-a-tree-9113b3ab/>
- [06] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/tree-counting-3/>
- [07] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/population-outburst-7db5d39a/>
- [08] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/gandhi-tree-march/>
- [09] <https://www.hackerearth.com/practice/data-structures/trees/binary-and-nary-trees/practice-problems/algorithm/count-the-tree/>

HackerEarth - Binary Search Tree



- [01] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-watching-fight/>
- [02] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-his-friends/>
- [03] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/distinct-count/>
- [04] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/b-sequence-f919fc86/>
- [05] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-cursed-tree/>
- [06] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/monk-and-bst/>
- [07] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/dummy3-4/>
- [08] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/suarez/>
- [09] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/little-monk-and-swaps/>
- [10] <https://www.hackerearth.com/practice/data-structures/trees/binary-search-tree/practice-problems/algorithm/mst-revisited-3f9d614c/>

Lecture Agenda



✓ Section 1: STL in C++ (Non-Linear Data Structures)

✓ Section 2: Set

✓ Section 3: Multi-set

Section 4: Map

Section 5: Multi-map

Section 6: Priority Queue



Practice



HackerRank - Advanced



- [01] <https://www.hackerrank.com/challenges/kindergarten-adventures/problem>
- [02] <https://www.hackerrank.com/challenges/x-and-his-shots/problem>
- [03] <https://www.hackerrank.com/challenges/jim-and-the-skyscrapers/problem>
- [04] <https://www.hackerrank.com/challenges/find-maximum-index-product/problem>
- [05] <https://www.hackerrank.com/challenges/cube-summation/problem>
- [06] <https://www.hackerrank.com/challenges/direct-connections/problem>
- [07] <https://www.hackerrank.com/challenges/palindromic-subsets/problem>
- [08] <https://www.hackerrank.com/challenges/polynomial-division/problem>
- [09] <https://www.hackerrank.com/challenges/costly-intervals/problem>
- [10] <https://www.hackerrank.com/challenges/the-strange-function/problem>
- [11] <https://www.hackerrank.com/challenges/lazy-white-falcon/problem>
- [12] <https://www.hackerrank.com/challenges/heavy-light-white-falcon/problem>
- [13] <https://www.hackerrank.com/challenges/heavy-light-2-white-falcon/problem>
- [14] <https://www.hackerrank.com/challenges/burger-happiness/problem>
- [15] <https://www.hackerrank.com/challenges/roy-and-alpha-beta-trees/problem>
- [16] <https://www.hackerrank.com/challenges/coloring-tree/problem>

HackerRank - Advanced



- [17] <https://www.hackerrank.com/challenges/recalling-early-days-gp-with-trees/problem>
- [18] <https://www.hackerrank.com/challenges/white-falcon-and-tree/problem>
- [19] <https://www.hackerrank.com/challenges/jagia-playing-with-numbers/problem>
- [20] <https://www.hackerrank.com/challenges/weird-queries/problem>
- [21] <https://www.hackerrank.com/challenges/rooted-tree/problem>
- [22] <https://www.hackerrank.com/challenges/net-admin/problem>
- [23] <https://www.hackerrank.com/challenges/net-admin/problem>
- [24] <https://www.hackerrank.com/challenges/subsequence-weighting/problem>
- [25] <https://www.hackerrank.com/challenges/self-driving-bus/problem>
- [26] <https://www.hackerrank.com/challenges/unique-colors/problem>
- [27] <https://www.hackerrank.com/challenges/functional-palindromes/problem>
- [28] <https://www.hackerrank.com/challenges/little-alexey-and-sum-of-maximums/problem>
- [29] <https://www.hackerrank.com/challenges/heavy-light-2-white-falcon/problem>
- [30] <https://www.hackerrank.com/challenges/starfleet/problem>
- [31] <https://www.hackerrank.com/challenges/swaps-and-sum/problem>
- [32] <https://www.hackerrank.com/challenges/arithmetic-progressions/problem>

HackerRank - Advanced



- [33] <https://www.hackerrank.com/challenges/coolguy-and-two-subsequences/problem>
- [34] <https://www.hackerrank.com/challenges/subtrees-and-paths/problem>
- [35] <https://www.hackerrank.com/challenges/triplets/problem>
- [36] <https://www.hackerrank.com/challenges/beautiful-segments/problem>
- [37] <https://www.hackerrank.com/challenges/taxicab-drivers-problem/problem>
- [38] <https://www.hackerrank.com/challenges/jagia-playing-with-numbers/problem>
- [39] <https://www.hackerrank.com/challenges/helix/problem>
- [40] <https://www.hackerrank.com/challenges/company-retreat/problem>
- [41] <https://www.hackerrank.com/challenges/counting-on-a-tree/problem>
- [42] <https://www.hackerrank.com/challenges/fibonacci-numbers-tree/problem>
- [43] <https://www.hackerrank.com/challenges/pair-sums/problem>
- [44] <https://www.hackerrank.com/challenges/ticket-to-ride/problem>
- [45] <https://www.hackerrank.com/challenges/number-game-on-a-tree/problem>
- [46] <https://www.hackerrank.com/challenges/almost-equal-advanced/problem>
- [47] <https://www.hackerrank.com/challenges/almost-sorted-interval/problem>
- [48] <https://www.hackerrank.com/challenges/beautiful-segments/problem>

HackerRank - Advanced



- [49] <https://www.hackerrank.com/challenges/ab0/problem>
- [50] <https://www.hackerrank.com/challenges/easy-addition/problem>
- [51] <https://www.hackerrank.com/challenges/find-the-permutation/problem>
- [52] <https://www.hackerrank.com/challenges/box-operations/problem>
- [53] <https://www.hackerrank.com/challenges/max-transform/problem>

HackerEarth - Hash Tables



- [01] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/perfect-pair-df920e90/>
- [02] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/kth-character-2/>
- [03] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/bob-and-string-easy/>
- [04] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/will-rick-survive-or-not-2/>
- [05] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/maximum-occurrence-9/>
- [06] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/lets-plot-this-47a575ed/>
- [07] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/thanos-and-the-infinity-stones/>
- [08] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/statistics-2/>
- [09] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/star-studded-lockdown/>
- [10] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/alien-language/>
- [11] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/xsquare-and-palindromes-insertion/>
- [12] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/riyaz-dhruv-the-friendship/>
- [13] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/xsquare-and-double-strings-1/>
- [14] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/n-co-ordinates-map-practice/>
- [15] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/all-vowels-2/>
- [16] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/pair-sums/>
- [17] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/cricket-balls/>
- [18] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/frequency-of-students/>

HackerEarth - Hash Tables



- [19] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/n-co-ordinates-pair-practice/>
- [20] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/bob-an-idiot-11/>
- [21] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/mind-palaces-3/>
- [22] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/the-monk-and-kundan/>
- [23] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/exists/>
- [24] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/maximum-subarray-sum-of-subarrays-7f33aefa/>
- [25] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/easy-one-8/>
- [26] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/notebook-pages-dbad75a5/>
- [27] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/aman-and-lab-file-work-8cd1d24c/>
- [28] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/difficult-characters/>
- [29] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/crushing-violence/>
- [30] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/factorial-game-1/>
- [31] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/suzakus-festivals-14dacd7c/>
- [32] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/little-jhool-and-the-magical-jewels/>
- [33] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/icpc-team-management/>
- [34] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/e-16/>
- [35] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/little-monk-and-the-matchmaker/>
- [36] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/the-monk-and-prateek/>

HackerEarth - Hash Tables



- [37] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/the-electric-type/>
- [38] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/highest-rating-f8ead57a/>
- [39] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/chetan-vs-fauji/>
- [40] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/a-needle-in-the-haystack-1/>
- [41] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/ishans-dilemma/>
- [42] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/yet-another-valentines-proposal/>
- [43] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/mathison-and-the-divisible-trio-a0a169b0/>
- [44] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/shantam-and-richness-1/>
- [45] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/longlong/>
- [46] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/mandee-and-his-girlfriend-9a96aabd/>
- [47] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/shubham-and-subarrays-325b1e73/>
- [48] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/scrambled-letters-00e18912-6cb9f33c/>
- [49] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/chandu-and-chandni/>

Lecture Agenda



✓ Section 1: STL in C++ (Non-Linear Data Structures)

✓ Section 2: Set

✓ Section 3: Multi-set

✓ Section 4: Map

Section 5: Multi-map

Section 6: Priority Queue



Practice



HackerRank - Advanced



- [01] <https://www.hackerrank.com/challenges/kindergarten-adventures/problem>
- [02] <https://www.hackerrank.com/challenges/x-and-his-shots/problem>
- [03] <https://www.hackerrank.com/challenges/jim-and-the-skyscrapers/problem>
- [04] <https://www.hackerrank.com/challenges/find-maximum-index-product/problem>
- [05] <https://www.hackerrank.com/challenges/cube-summation/problem>
- [06] <https://www.hackerrank.com/challenges/direct-connections/problem>
- [07] <https://www.hackerrank.com/challenges/palindromic-subsets/problem>
- [08] <https://www.hackerrank.com/challenges/polynomial-division/problem>
- [09] <https://www.hackerrank.com/challenges/costly-intervals/problem>
- [10] <https://www.hackerrank.com/challenges/the-strange-function/problem>
- [11] <https://www.hackerrank.com/challenges/lazy-white-falcon/problem>
- [12] <https://www.hackerrank.com/challenges/heavy-light-white-falcon/problem>
- [13] <https://www.hackerrank.com/challenges/heavy-light-2-white-falcon/problem>
- [14] <https://www.hackerrank.com/challenges/burger-happiness/problem>
- [15] <https://www.hackerrank.com/challenges/roy-and-alpha-beta-trees/problem>
- [16] <https://www.hackerrank.com/challenges/coloring-tree/problem>

HackerRank - Advanced



- [17] <https://www.hackerrank.com/challenges/recalling-early-days-gp-with-trees/problem>
- [18] <https://www.hackerrank.com/challenges/white-falcon-and-tree/problem>
- [19] <https://www.hackerrank.com/challenges/jagia-playing-with-numbers/problem>
- [20] <https://www.hackerrank.com/challenges/weird-queries/problem>
- [21] <https://www.hackerrank.com/challenges/rooted-tree/problem>
- [22] <https://www.hackerrank.com/challenges/net-admin/problem>
- [23] <https://www.hackerrank.com/challenges/net-admin/problem>
- [24] <https://www.hackerrank.com/challenges/subsequence-weighting/problem>
- [25] <https://www.hackerrank.com/challenges/self-driving-bus/problem>
- [26] <https://www.hackerrank.com/challenges/unique-colors/problem>
- [27] <https://www.hackerrank.com/challenges/functional-palindromes/problem>
- [28] <https://www.hackerrank.com/challenges/little-alexey-and-sum-of-maximums/problem>
- [29] <https://www.hackerrank.com/challenges/heavy-light-2-white-falcon/problem>
- [30] <https://www.hackerrank.com/challenges/starfleet/problem>
- [31] <https://www.hackerrank.com/challenges/swaps-and-sum/problem>
- [32] <https://www.hackerrank.com/challenges/arithmetic-progressions/problem>

HackerRank - Advanced



- [33] <https://www.hackerrank.com/challenges/coolguy-and-two-subsequences/problem>
- [34] <https://www.hackerrank.com/challenges/subtrees-and-paths/problem>
- [35] <https://www.hackerrank.com/challenges/triplets/problem>
- [36] <https://www.hackerrank.com/challenges/beautiful-segments/problem>
- [37] <https://www.hackerrank.com/challenges/taxicab-drivers-problem/problem>
- [38] <https://www.hackerrank.com/challenges/jagia-playing-with-numbers/problem>
- [39] <https://www.hackerrank.com/challenges/helix/problem>
- [40] <https://www.hackerrank.com/challenges/company-retreat/problem>
- [41] <https://www.hackerrank.com/challenges/counting-on-a-tree/problem>
- [42] <https://www.hackerrank.com/challenges/fibonacci-numbers-tree/problem>
- [43] <https://www.hackerrank.com/challenges/pair-sums/problem>
- [44] <https://www.hackerrank.com/challenges/ticket-to-ride/problem>
- [45] <https://www.hackerrank.com/challenges/number-game-on-a-tree/problem>
- [46] <https://www.hackerrank.com/challenges/almost-equal-advanced/problem>
- [47] <https://www.hackerrank.com/challenges/almost-sorted-interval/problem>
- [48] <https://www.hackerrank.com/challenges/beautiful-segments/problem>

HackerRank - Advanced



- [49] <https://www.hackerrank.com/challenges/ab0/problem>
- [50] <https://www.hackerrank.com/challenges/easy-addition/problem>
- [51] <https://www.hackerrank.com/challenges/find-the-permutation/problem>
- [52] <https://www.hackerrank.com/challenges/box-operations/problem>
- [53] <https://www.hackerrank.com/challenges/max-transform/problem>

HackerEarth - Hash Tables



- [01] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/perfect-pair-df920e90/>
- [02] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/kth-character-2/>
- [03] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/bob-and-string-easy/>
- [04] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/will-rick-survive-or-not-2/>
- [05] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/maximum-occurrence-9/>
- [06] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/lets-plot-this-47a575ed/>
- [07] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/thanos-and-the-infinity-stones/>
- [08] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/statistics-2/>
- [09] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/star-studded-lockdown/>
- [10] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/alien-language/>
- [11] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/xsquare-and-palindromes-insertion/>
- [12] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/riyaz-dhruv-the-friendship/>
- [13] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/xsquare-and-double-strings-1/>
- [14] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/n-co-ordinates-map-practice/>
- [15] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/all-vowels-2/>
- [16] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/pair-sums/>
- [17] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/cricket-balls/>
- [18] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/frequency-of-students/>

HackerEarth - Hash Tables



- [19] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/n-co-ordinates-pair-practice/>
- [20] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/bob-an-idiot-11/>
- [21] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/mind-palaces-3/>
- [22] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/the-monk-and-kundan/>
- [23] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/exists/>
- [24] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/maximum-subarray-sum-of-subarrays-7f33aefa/>
- [25] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/easy-one-8/>
- [26] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/notebook-pages-dbad75a5/>
- [27] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/aman-and-lab-file-work-8cd1d24c/>
- [28] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/difficult-characters/>
- [29] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/crushing-violence/>
- [30] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/factorial-game-1/>
- [31] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/suzakus-festivals-14dadc7c/>
- [32] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/little-jhool-and-the-magical-jewels/>
- [33] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/icpc-team-management/>
- [34] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/e-16/>
- [35] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/little-monk-and-the-matchmaker/>
- [36] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/the-monk-and-prateek/>

HackerEarth - Hash Tables



- [37] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/the-electric-type/>
- [38] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/highest-rating-f8ead57a/>
- [39] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/chetan-vs-fauji/>
- [40] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/a-needle-in-the-haystack-1/>
- [41] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/ishans-dilemma/>
- [42] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/yet-another-valentines-proposal/>
- [43] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/mathison-and-the-divisible-trio-a0a169b0/>
- [44] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/shantam-and-richness-1/>
- [45] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/longlong/>
- [46] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/mandee-and-his-girlfriend-9a96aabd/>
- [47] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/shubham-and-subarrays-325b1e73/>
- [48] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/scrambled-letters-00e18912-6cb9f33c/>
- [49] <https://www.hackerearth.com/practice/data-structures/hash-tables/basics-of-hash-tables/practice-problems/algorithm/chandu-and-chandni/>

Lecture Agenda



✓ Section 1: STL in C++ (Non-Linear Data Structures)

✓ Section 2: Set

✓ Section 3: Multi-set

✓ Section 4: Map

✓ Section 5: Multi-map

Section 6: Priority Queue



Practice



HackerEarth - Heaps / Priority Queues



- [01] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/little-monk-and-abd/>
- [02] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/seating-arrangement-6b8562ad/>
- [03] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/monk-and-multiplication/>
- [04] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/monk-and-champions-league/>
- [05] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/roy-and-trending-topics-1/>
- [06] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/hostel-visit/>
- [07] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/haunted/>
- [08] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/pk-and-special-array-operation-1-7bd52ad1/>
- [09] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/approximate/little-monk-and-root/>
- [10] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/little-monk-and-williamson/>
- [11] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/little-monk-and-virat/>
- [12] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/little-monk-and-steve-smith/>
- [13] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/guptas-escape-b71099d5/>
- [14] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/monk-and-some-queries/>
- [15] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/monk-and-iq/>
- [16] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/power-up-2/>
- [17] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/2nd/>

HackerEarth - Heaps / Priority Queues



- [18] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/monk-and-the-magical-candy-bags/>
- [19] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/maximiser-le-score-64285dcd/>
- [20] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/break-the-door/>
- [21] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/booble-the-search-engine/>
- [22] <https://www.hackerearth.com/practice/data-structures/trees/heapspriority-queues/practice-problems/algorithm/theatre-830bdbff/>

Lecture Agenda



- ✓ Section 1: STL in C++ (Non-Linear Data Structures)
- ✓ Section 2: Set
- ✓ Section 3: Multi-set
- ✓ Section 4: Map
- ✓ Section 5: Multi-map
- ✓ Section 6: Priority Queue





DO
MORE.