## Decode DSA with C++ ( DECODE 2.0)



| | | | | | Week No |
|---|---|---|---|---|---|
| **Introduction to C++** | | | | | |
| Fundamentals of C++ Programming | Introduction to C++ | 0 | Introduction to course and C++ | - Introduction to C++ as programming language<br>- Installation of VS Code and making it ready to get started<br>- Number Systems | Week 1 |
| | | 1 | Output and Variables | - Basic Printing<br>- Variables and Data types<br>- Arithmetic Operations<br>- Importance of inclusion of header file<br>- Compilation Process | |
| | | 2 | Input and Operators | | |
| | **Fundamentals of Programming - 1** | | | | |
| | Fundamentals of Programming - 1 | 3 | Conditional Statements \| Part 1 | - If, Else if and else<br>- Combining multiple conditions | Week 2 |
| | | 4 | Conditional Statements \| Part 2 | - Ternary and switch statement<br>- Problems on conditions | |
| | | 5 | Looping Constructs \| Part 1 | - For, while and do-while loops<br>- Problems on loops | |
| | **Fundamentals of Programing - 2** | | | | |
| | Fundamentals of Programming - 2 | 6 | Looping Constructs \| Part 2 | - Break and continue<br>- Problems on loops using operators | Week 3 |
| | | 7 | Pattern Printing \| Part 1 | - Pattern Printing Basic Problems | |
| | | 8 | Pattern Printing \| Part 2 | - Pattern Printing Advanced Problems | |
| | **Diving more into C++ Programming** | | | | |
| | Diving more into C++ Programming | 9 | Functions | - Need and importance of functions<br>- Function declaration and definition<br>- Global and local variables<br>- What is int main()<br>- Various inbuilt functions<br>- Incorrect swap function | week 4 |
| | | 10 | Pointers | - What is a variable in terms of memory?<br>- Address of a variable<br>- Introduction to Pointers<br>- Pointer Arithmetic<br>- Pass by reference and pass by value<br>- Functions and pointers (Correct swap function)<br>- Double pointers | |
| | | 11 | **Compilation Process | | |
| **One Dimensional Arrays** | | | | | |
| Headstart to Data Structures: Arrays and Strings | One Dimensional Arrays | 12 | One Dimensional Arrays \| Part 1 | - Array declaration<br>- Array elements accessing and modification<br>- Linear Search | Week 5 |
| | | 13 | One Dimensional Arrays \| Part 2 | - Arrays as argument to functions<br>- Arrays and pointers<br>- Problems on Arrays | |
| | | 14 | One Dimensional Arrays \| Part 3 | - Dynamic Allocation<br>- Implementation of Dynamic Array class<br>- Introduction to C++ STL and Vectors<br>- Problems on one dimensional arrays | |
| | **Two Dimensional Arrays** | | | | |
| | Two Dimensional Arrays | 15 | Two Dimensional Arrays \| Part 1 | - Two dimensional Array declaration<br>- 2D array elements accessing and modification<br>- Problems on 2D arrays | Week 6 |
| | | 16 | Two Dimensional Arrays \| Part 2 | - Problems on 2D arrays | |
| | | 17 | Two Dimensional Arrays \| Part 3 | - Matrix Multiplication<br>- Problems on 2D arrays | |
| | **Strings** | | | | |
| | Strings | 18 | Strings \| Part 1 | - Character Arrays<br>- C++ STL string class | Week 7 |
| | | 19 | Strings \| Part 2 | - Problems on Strings | |
| | **Revision Test - Friday** | | | | |
| **Analysis of Algorithms** | | | | | |
| Basic Algorithms<br>- Recursion<br>- Divide and Conquer | Analysis of Algorithms | 20 | Time and Space Complexity \| Part 1 | - Why asymptotic analysis<br>- Time Complexity<br>- Space Complexity | Week 8 |
| | | 21 | Time and Space Complexity \| Part 2 | - Problems to calculate time complexity | |
| | **Sorting** | | | | |
| | Basic Sorting Algorithms | 22 | Bubble Sorting | - Bubble Sort<br>- Time and space complexity | Week 9 |
| | | 23 | Selection Sort and Insertion Sort | - Selection Sort<br>- Insertion Sort | |
| | | 24 | Problems on Sorting | - Problems on Basic Sorting | |
| | **Searching** | | | | |
| | Searching | 25 | Searching \| Part 1 | - Analysis of linear search<br>- Binary Search<br>- Implementation of C++ lower_bound | Week 10 |
| | | 26 | Searching \| Part 2 | - Search Space of Binary Search<br>- Problems on Binary Search | |
| | **Recursion** | | | | |
| | Recursion | 27 | Recursion \| Part 1 | - Recursion<br>- Principle of Mathemtical Induction<br>- Problems on Recursion | Week 11 |
| | | 28 | Recursion \| Part 2 | - Calculating time complexity of Recursive codes<br>- Greatest Common Divisor<br>- Problems on Recursion | |
| | | 29 | Recursion \| Part 3 | - Efficient Power function<br>- Problems on Recursion | |
| | | 30 | Recursion \| Part 4 | - Problems on Recursion | |
| | **Advanced Sorting** | | | | |
| | Advanced Sorting | 31 | Merge Sort \| Part 1 | - Merge Sort<br>- Time and space complexity analysis of divide and conquer | Week 12 |
| | | 32 | Merge Sort \| Part 2 | - Inversion Count<br>- Problems on Merge sort | |
| | | 33 | Quick Sort | - Quick Sort<br>- Randomised Quick Sort<br>- Inbuilt sort functions<br>- Custom Comparators | |
| | | 34 | Cyclic Sort | - Cyclic Sort<br>- Problems on Cyclic Sort | |
| | **Diving into Mathematics** | | | | |
| | Diving into Mathematics | 35 | Mathematics Questions | - Sieve of Eratosthenes<br>- Questions on Prefix Sum | Week 13 |
| | | 36 | Mathematics Questions | - Sliding Window | |
| | | 37 | Bitwise Operations and Modulo Arithmetic | - Basic bitwise operations:  AND, OR, NOT, XOR<br>- Basic problems on XOR operator<br>- Modulo Operation<br>- Basic Modulo Properties<br>- Some basic problems using Modulo Arithmetic | |
| | **Revision Test - Sunday** | | | | |
| **Object Oriented Programming** | | | | | |

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| **Linear Data Structures** | **Object Oriented Programming** | 38 | The Very Basics of OOPS | - Importance of OOPS paradigm<br>- Class declaration and definition<br>- Data members and methods<br>- Creating objects<br>- Constructors<br>- Destructors | Week 14 |
| | | 39 | Diving into OOPS | - Friend Function<br>- Operator Overloading<br>- Pillars of OOPS | |
| | | | **Linked List** | | |
| | **Linked List** | 40 | Linked List \| Part 1 | - Implementation of Linked List class | Week 15 |
| | | 41 | Linked List \| Part 2 | - Two pointers (or multiple pointers) approach<br>- Problems on Linked List | |
| | | 42 | Linked List \| Part 3 | - Problems on Linked List | |
| | | 43 | Linked List \| Part 4 | - Implementation of Doubly Linked List<br>- Other kinds of Linked List (Just introduction and uses) | |
| | | | **Stack** | | |
| | **Stack** | 44 | Stacks \| Part 1 | - Inbuilt stack class<br>- Problems on stack | Week 16 |
| | | 45 | Stacks \| Part 2 | - Problems on Stack | |
| | | 46 | Stacks \| Part 3 | - Problems on Stack | |
| | | 47 | Stacks \| Part 4 | - Implementation of Stacks | |
| | | | **Queue** | | |
| | **Queue** | 48 | Queues \| Part 1 | - Inbuilt queue class<br>- Problems on queue | Week 17 |
| | | 49 | Queues \| Part 2 | - Problems on Queues | |
| | **Revision Test - Sunday** | | | | |
| **Non linear data structures** | | | **Binary Tree** | | |
| | **Introduction to Trees and Binary Trees** | 50 | Binary Trees \| Part 1 | - Linear vs Non-linear data structures<br>- Implementation of Binary Trees | Week 18 |
| | | 51 | Binary Trees \| Part 2 | - Tree traversals | |
| | | 52 | Binary Trees \| Part 3 | - Height and diameter of binary tree<br>- Some Mathematical observations and formulas for binary trees<br>- Problems on Binary Trees | |
| | | | **Binary Search Trees** | | |
| | **Binary Search Trees** | 53 | Binary Search Trees \| Part 1 | - Use of Binary Search Tree<br>- Implementation of BST (including searching) | Week 19 |
| | | 54 | Binary Search Trees \| Part 2 | - Deletion of Nodes in BST | |
| | | 55 | Binary Search Trees \| Part 3 | - Problems on BST<br>- Time complexity analysis and need for balanced BSTs | |
| | | | **Priority Queues** | | |
| | **Priority Queues** | 56 | Priority Queues \| Part 1 | - Introduction to Complete Binary Trees<br>- Introduction to Priority Queues<br>- Inbuilt Priority Queue | Week 20 |
| | | 57 | Priority Queues \| Part 2 | - Implementation of Heap Data Structure<br>- Heap Sort | |
| | | 58 | Priority Queues \| Part 3 | - Problems on Priority Queue | |
| | | | **Hashmaps and Sets** | | |
| | **Hashmaps and Sets** | 59 | Hashmaps \| Part 1 | - Need of hashmaps<br>- Introduction to hashmaps<br>- Use of inbuilt hashmaps<br>- Problems on hashmaps | Week 21 |
| | | 60 | Hashmaps \| Part 2 | - Problems on hashmaps | |
| | | 61 | Hashmaps and Sets | - Hash functions<br>- Collision Handling<br>- Implementation of Hashmaps<br>- Load Factor<br>- Use of inbuilt sets<br>- Problems on Sets | |
| **Backtracking, Dynamic Programming and Greedy** | | | **Backtracking** | | |
| | **Backtracking** | 62 | Backtracking \| Part 1 | - Backtracking<br>- Problems of Backtracking | Week 22 |
| | | 63 | Backtracking \| Part 2 | - Problems of Backtracking | |
| | | | **Greedy and Adhoc Problems** | | |
| | **Ad-hoc and Greedy** | 64 | Greedy and Ad-hoc Problems | - Various problems requiring simple observations<br>- Problems using Greedy Approach | Week 23 |
| | | | **Dynamic Programming and Bit Manipulation** | | |
| | **Dynamic Programming and Bit Manipulation** | 65 | Dynamic Programming \| Part 1 | - Dynamic Programming | Week 24 |
| | | 66 | Dynamic Programming \| Part 2 | - Bottom Up Thinking | |
| | | 67 | Dynamic Programming \| Part 3 | - Top Down Approach | |
| | | 68 | Dynamic Programming \| Part 4 | - Problems on Dynamic Programming | |
| | | 69 | Dynamic Programming \| Part 5 | - Problems on Dynamic Programming | |
| | | 70 | Bit Manipulation | - Setting and unsetting of bits<br>- Problems on Bit Manipulation and Dynamic Programming | |
| | **Revision Test - Sunday** | | | | |
| **Graphs and Miscellaneous** | | | **Graphs** | | |
| | **Graphs** | 71 | Graphs \| Part 1 | - Importance of understanding graphs<br>- Graph Terminology<br>- Various implementations | Week 25 |
| | | 72 | Graphs \| Part 2 | - Breadth First Search<br>- Depth First Search | |
| | | 73 | Graphs \| Part 3 | - Weighted Graphs<br>- Directed Graphs<br>- Bellman Ford Algorithm | |
| | | 74 | Graphs \| Part 4 | - Floyd Warshall Algorithm<br>- Dijkstra's Algorithm | |
| | | 75 | Graphs \| Part 5 | - Minimum Spanning Trees<br>- Prim's Algorithm | |
| | | 76 | Graphs \| Part 6 | - Union Set implementation<br>- Problems on Union Set<br>- Kruskal's Algorithm | |
| | | 77 | Graphs \| Part 7 | - Topological Sort and implementation<br>- Problems on Graph | |
| | | | **Tries** | | |
| | **Tries** | 78 | Tries | - Implementation of Tries<br>- Huffman Encoding Algorithm<br>- Problems on Tries (Maximum XOR and related questions) | |
| | **FINAL TEST** | | | | |