C, C++ and DSA

Objective: To do hands-on practices on Fundamentals and Algorithms.

Pre-requisites: No Pre-requisites, but basic fundamental of languages.

Session 1 (Introduction to C Language)

- History of C Language
- Types of C Variables, The First C Program
- The C Character Set, Data Types and Ranges
- Type Declaration, Type Conversion
- Constant, Variables and Keywords
- Associativity of Operators
- Different Types of Operators with Examples

Session 2 (The Decision Control Structure)

- The If Statement, The If-Else Statement
- The Nested of If-Else Statement
- Switch Statement and its various Conditions
- Nesting of If Statements
- Break statement and its examples

Session 3 (The Loop Control Structure)

- Introduction to Loops and its Types
- Working with For Loop with Example
- Working with While Loop
- Continue, exit(0), goto statements
- Working with Do While Loop
- Nested of Looping (while, do-while, for)

Session 4 (Arrays and Pointers)

- Introduction to Arrays
- Types of Arrays with Examples
- Working with 1-D, 2-D and 3-D Arrays
- Pointers and 1-D, Pointers and 2-D Array
- Pointers and 3-D Arrays
- Pointers to an Arrays, Arrays of Pointers

Session 5 (Functions and Pointers)

- Introduction to Functions, Passing Values between Functions
- Function Declaration and Prototype
- Function Returning Pointers
- Call by Value and Call by Address
- Recursion, Passing Arrays to Function
- Pointer to Function
- Function with Variable Number of Arguments

Session 6 (Working with Structure)

- Why use structure, Declaring a structure
- Accessing Structure Elements
- Array of Structures, Uses of Structure, Typedef, BitFields
- Event Listeners Registration
- How Structure Elements are Stored
- Additional Features of Structure
- Enumerated Data Types
- Union and Union of Structures

Session 7 (Working with File Input/Output)

- Data Organization, File Operations (Opening, Reading, Writing)
- File Opening Modes, String I/O in Files
- Text Files and Binary Files
- Working with Command Line Arguments
- Counting Characters, Tabs and Space
- Writing and Reading to/from Files
- Working with Low Level Disk I/O
- Working with Files Library Functions
- Low Level File Interaction

Session 8 (The C Preprocessor Directives)

- Features of C Preprocessor, Macro Expansion, File Inclusion
- #if and #elif Directives, Macros with Arguments, Macros with Functions
- Conditional Compilation, #undef and #pragma Directives

Session 9 (Principles of Object Oriented Programming)

- Object Oriented Programming Paradigm, Basic Concepts of OOPS

- ➤ Benefits of OOP, Object Oriented Languages
- ➤ Application of OOP

Session 10 (Beginning with C++)

- ➤ What is C++, Application of C++
- ➤ A Simple C++ Program, Creating the Source File
- ➤ More C++ Statements, An Example of Class
- ➤ Structure of C++ Program, Compiling and Linking

Session 11 (Tokens, Expressions and Control Statements)

- ➤ Tokens, Keywords, Identifiers and Constant
- ➤ Basic Data Types, User Defined Data Types
- ➤ Derived Data Types, Declarations of Variables
- ➤ Dynamic Initialization of Variables, Reference Variables
- ➤ Operator Precedence, Operators in C++
- ➤ Scope Resolution Operator, Member De-referencing Operators
- ➤ Memory Management Operators, Manipulators, Type Cast Operators
- ➤ Expression and Their Types
- ➤ Implicit Conversion, Operator Overloading
- ➤ Control Statements and Looping

Session 12 (Functions in C++)

- ➤ The Main Function, Function Prototyping
- ➤ Return by Reference, Inline Function
- ➤ Friend and Virtual Functions
- ➤ Call by Reference, Function Overloading
- ➤ Default Arguments, Const Arguments
- ➤ Math Library Functions

Session 13 (Classes and Objects)

- ➤ Introduction to C++, A C++ Program with Class
- ➤ Defining Member Functions, Nesting of Member Functions
- ➤ Private Member Functions, Static Data Members, Static Member Functions
- ➤ Fried Functions, Returning Objects, Making an Outside Function Inline
- ➤ Arrays within a Class, Memory Allocation for Objects
- ➤ Arrays of Objects, Object as Function Arguments
- ➤ Constant Member Functions, Pointer to Members, Local Classes

Session 14 (Constructors and Destructors)

- Introduction to Constructors, Multiple Constructors in Class
- Dynamic Initialization of Objects
- Dynamic Constructor, Const Objects
- Parameterized Constructor
- Constructors with Default Arguments, Copy Constructor
- Constructing Two-Dimensional Arrays
- Destructors and its Properties

Session 15 (Operator Overloading and Type Conversion)

- Defining Operator Overloading
- Overloading Unary and Binary Operators
- Manipulation of Strings using Operators
- Overloading Binary Operators using Fried
- Examples of Overloading Operators
- Rules for Overloading Operators, Type Conversions

Session 16 (Inheritance: Extending Classes)

- Defining Derived Classes, Single Inheritance
- Making Private Member Inheritance, Multi-level Inheritance
- Constructors in Derived Classes, Multiple Inheritance
- Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes
- Abstract Classes, Member Classes: Nesting of Classes

Session 17 (Pointers, Virtual Functions and Polymorphism)

- Pointers, Pointers to Objects, this Pointers
- Pure Virtual Functions, Pointers to Derived Classes
- Virtual Functions

Session 18 (Managing Console I/O Operations)

- C++ Streams, C++ Stream Classes
- Unformatted I/O Operations, Formatted Console I/O Operations
- Managing Output with Manipulators

Session 19 (Working with Files)

- Classes for File Stream Operations, Opening and Closing a File
- Detecting end of the file, File Modes, More about open(), Command Line Args

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- ➢ File Pointers and Their Manipulators
- ➢ Sequential Input and Output Operations
- ➢ Updating a File: Random Access
- ➢ Error Handling During File Operations

Session 20 (Template Programming)

- ➢ Introduction to Template, Class Templates, Function Templates
- ➢ Class Templates with Multiple Parameters
- ➢ Function Templates with Multiple Parameters
- ➢ Overloading of Templates, Member Function Templates
- ➢ Non-Type Template Arguments

Session 21 (Exception Handling)

- ➢ Basic of Exception Handling
- ➢ Exception Handling Mechanism, Throwing Mechanism
- ➢ Caching and Re-throwing Exception

Session 22 (Manipulating Strings)

- ➢ Introduction to Strings, Creating Strings Objects
- ➢ Manipulating String Objects, Relational Operators, String Characteristics
- ➢ Accessing Characters in Strings, Comparing and Swapping of Strings

Session 23 (Introduction to Standard Template Library)

- ➢ Introduction to STL and its Components, Application of Container Classes
- ➢ Containers, Iterators, Algorithms, Function Objects
- ➢ Working with Namespaces
- ➢ Introduction to STL Classes

Session 24 (Introduction to Data Structures and Algorithms)

- ➢ Data Structure Introduction and Classification
- ➢ Algorithm Efficiency, Abstract Data Types and Algorithms
- ➢ Notation: (Big-O, Omega and Theta)
- ➢ Time and Space Complexity, Worst Case, Average Case and Best Case

Session 25 (Linked Lists)

- ➢ Introduction to Linked List Types of Linked List with its operations
- ➢ Linked List versus Arrays, Application of Linked List
- ➢ Memory Allocation and De-allocation

- ➢ Polynomial Representation

Session 26 & 27: Stacks and Queues

- ➢ Introduction to Stacks, Arrays Representation of Stacks
- ➢ Operation on a Stack: Push(), Pop() and Peek()
- ➢ Linked List Representation of Stack
- ➢ Push, Pop and Peek Operation with Linked List
- ➢ Multiple Stacks, Application of Stacks
- ➢ Evaluation of Arithmetic Expression, Infix to Postfix Conversion
- ➢ Introduction to Queues, Arrays and List Representation of Queue
- ➢ Types of Queues with Examples
- ➢ Application of Queues, Circular Queue
- ➢ Dequeue, Priority Queue, Multiple Queue Examples

Session 28 (Trees)

- ➢ Introduction to Trees, Types of Trees, Tree Traversal
- ➢ In-Order, Post-Order and Pre-Order
- ➢ Introduction to Binary Search Tree, Operations with Binary Search Tree
- ➢ Threaded Binary Tree, AVL Tree and Its Rotations
- ➢ B and B+ Trees

Session 29 (Graphs)

- ➢ Introduction to Graphs, Graph Terminology
- ➢ Directed Graphs and its Terminology, Representation of Graph
- ➢ Adjacency Matrix Representation, BFS and DFS Searching Algorithm
- ➢ Shortest Path Algorithms, Minimum Spanning Trees
- ➢ Prim's and Kruskal's Algorithm, Dijkstra's Algorithm and Application of Graphs

Session 30 (Heaps, Searching and Sorting)

- ➢ Introduction to Heaps and its Applications, Introduction to Sorting Algorithms
- ➢ Bubble Sorting, Selection Sorting, Insertion, Merge, Quick and Heap Sorting
- ➢ Linear Search and Binary Search
- ➢ Hash Table, Hash Function and Collisions in Hashing
- ➢ Type of Techniques for Collision Resolutions