Coding Set 6

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1. Basic Inheritance: Display Information

Topic: Single Inheritance
Problem:
Create a class Person with data members name and age. Derive a class Student from Person that adds a data member course.
Write a program to input and display details of a student.

Learning Outcome: Understanding of single inheritance and protected access specifier.

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2. Constructor and Inheritance

Topic: Constructor Calling Order
Problem:
Create two classes Base and Derived. Both have constructors and destructors that display messages when called.
Create an object of Derived and observe the order of constructor/destructor calls.

Learning Outcome: Understanding of constructor–destructor call hierarchy in inheritance.

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3. Using protected Members

Topic: Access specifiers
Problem:
Create a class Employee with protected data members id and salary.
Derive a class Manager that sets and displays these details through a member function.

Learning Outcome: Usage of protected members and inheritance for controlled data access.

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4. Multi-level Inheritance

Topic: Multi-level Inheritance
Problem:
Create three classes — Person, Employee, and Manager — where Employee inherits from Person, and Manager inherits from Employee.
Each class should add one extra data member and display all details.

Learning Outcome: Understanding of inheritance hierarchy and passing data through constructors.

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5. Hierarchical Inheritance

Topic: Multiple Derived Classes from One Base
Problem:
Create a base class Shape with a function area().
Derive two classes: Rectangle and Circle. Override the area() function to compute respective areas.

Learning Outcome: Function overriding in hierarchical inheritance.

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6. Function Overriding with virtual Keyword

Topic: Polymorphism via Inheritance
Problem:
Create a base class Animal with a speak() function.
Derive classes Dog and Cat that override this function.
Use a base class pointer to call the functions and observe behavior with and without virtual.

Learning Outcome: Role of virtual functions in runtime polymorphism.

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7. Multiple Inheritance (Moderate)

Topic: Combining Features of Multiple Classes
Problem:
Create class Teacher with member subject and class Researcher with member area_of_research.
Derive a class TeachingAssistant from both, and display details of a TA.

Learning Outcome: Handling data and ambiguity in multiple inheritance.

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8. The Diamond Problem (Moderate)

Topic: Virtual Base Classes
Problem:
Create a class Person, derive Teacher and Student from it, and then derive a class TA from both Teacher and Student.
Demonstrate the **diamond problem** and resolve it using **virtual inheritance**.

Learning Outcome: Understanding the diamond problem and how virtual inheritance eliminates duplication of base class members.

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9. Operator Overloading with Inheritance (Moderate)

Topic: Inheritance + Operator Overloading
Problem:
Create a class Vector2D with x and y coordinates and overload the + operator.
Derive a class Vector3D that adds z coordinate and overloads the + operator as well.
Show how the derived operator reuses base functionality.

Learning Outcome: Combining operator overloading with inheritance and reusing base class code.

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10. Abstract Class and Pure Virtual Function

Topic: Abstract Classes & Interfaces
Problem:
Create an abstract class Shape with pure virtual function area().
Derive classes Rectangle, Circle, and Triangle and override the function to calculate their areas.
Store objects in a base class pointer array and display the area of each shape.

Learning Outcome: Implementation of abstract classes and polymorphism in C++.