Day 3 – C# & OOP Basics

Date: 11-10-2025

Topic: Inheritance, Polymorphism, Abstraction, Encapsulation, Access Modifiers, Constructors, Destructors, Static & Sealed Classes, Namespaces

1. WHAT IS OOP (OBJECT-ORIENTED PROGRAMMING)?

Object-Oriented Programming is a paradigm that organizes software design around **objects**, rather than functions and logic.
Objects are instances of classes that contain **data (fields)** and **behaviors (methods)**.

C# is a fully OOP-based language and supports all four main principles:

Principle	Description
Encapsulation	Hiding internal details of objects and exposing only necessary parts.
Abstraction	Showing only essential features and hiding background details.
Inheritance	Acquiring the properties and behavior of another class.
Polymorphism	One name, many forms — allows method overloading and overriding.

2. INHERITANCE

Definition:

Inheritance is a mechanism that allows one class (child) to acquire the properties and behaviors of another class (parent).

Syntax:

```
class Parent
{
   // base class code
}
class Child : Parent
{
   // derived class code
}
```

Types of Inheritance in C#:

Type	Example	Description
Single	A → B	One parent, one child

Multilevel	A → B → C	Chain of inheritance
Hierarchical	A → B, A → C	One parent, multiple children
Multiple	Not supported directly (use interfaces)	

Keywords:

- base → Used to call parent class constructors or methods.
- protected → Members accessible in derived classes.

Example:

```
class Employee
{
   public void Work() => Console.WriteLine("Working...");
}
class Developer : Employee
{
   public void Code() => Console.WriteLine("Coding in C#...");
}
```

3. POLYMORPHISM

Definition:

Polymorphism means *"many forms"*. It allows methods to have the same name but behave differently depending on the context.

Types:

Type	Description	Keyword
Compile-Time (Static)	Method Overloading	Same method name, different parameters
Runtime (Dynamic)	Method Overriding	Redefined method in child class

Example 1 – Method Overloading:

```
class Calculator
{
   public int Add(int a, int b) => a + b;
   public double Add(double a, double b) => a + b;
```

```
}
```

Example 2 – Method Overriding:

```
class Shape
{
   public virtual void Draw() => Console.WriteLine("Drawing a shape...");
}
class Circle : Shape
{
   public override void Draw() => Console.WriteLine("Drawing a circle...");
}
```

💬 **Keyword Summary:**

- virtual → Marks method in base class that can be overridden.
- override → Redefines base class method in child class.
- new → Hides base class method without overriding it.

4. ABSTRACTION

Definition:

Abstraction is the process of hiding internal implementation details and showing only the necessary features.

In C#, abstraction can be achieved using:

- **Abstract classes**
- **Interfaces**

Abstract Class Example:

```
abstract class Vehicle
{
   public abstract void Start(); // abstract method
   public void Stop() => Console.WriteLine("Vehicle stopped");
}
class Car : Vehicle
```

```
{
   public override void Start() => Console.WriteLine("Car started ");
}
```

Interface Example:

```
interface IShape
{
   double GetArea();
}
class Circle : IShape
{
   public double radius = 5;
   public double GetArea() => Math.PI * radius * radius;
}
```

Key Points:

Aspect	Abstract Class	Interface
Implementation	Partial	None
Multiple Inheritance	Not	yes
Access Modifiers	Allowed	Not allowed in methods

5. ENCAPSULATION

Definition:

Encapsulation is the process of **binding data and methods together** and protecting data from outside access.

Example:

```
class BankAccount
{
   private double balance;

   public void Deposit(double amount)
   {
```

```
        if (amount > 0) balance += amount;
    }

    public double GetBalance() => balance;
}
```

Why Encapsulation?

- Prevents unauthorized data access.
- Makes code maintainable and secure.
- Encourages modular structure.

6. ACCESS MODIFIERS

Access modifiers define the **scope** or **visibility** of members.

Modifier	Description	Scope
public	Accessible anywhere	Global
private	Accessible only within class	Class
protected	Accessible in derived classes	Class + Child
internal	Accessible within same assembly	Project-level
protected internal	Protected + Internal	Class + Assembly

7. CONSTRUCTORS AND DESTRUCTORS

Constructor

- Used to initialize objects.
- Automatically called when object is created.
- Has **same name** as class and **no return type**.

Types:

1. **Default Constructor** – No parameters.
2. **Parameterized Constructor** – With parameters.
3. **Static Constructor** – Used to initialize static data.
4. **Copy Constructor** – Copies data from one object to another.

Example:

```
class Student
{
   public string Name;
   public int Age;

   public Student(string n, int a)
   {
      Name = n; Age = a;
   }

   public void Display() => Console.WriteLine($"{Name}, {Age}");
}
```

Destructor

- Used to clean up resources.
- Called automatically by Garbage Collector.

```
~Student()
{
   Console.WriteLine("Destructor called");
}
```

8. STATIC CLASSES AND MEMBERS

Static Class:

A class declared with the keyword static cannot be instantiated and contains only static members.

Example:

```
static class MathHelper
{
   public static int Square(int x) => x * x;
}
```

Notes:

- Access directly using ClassName.MethodName.
- Commonly used for utility/helper functions.

9. SEALED CLASS

Definition:

A **sealed** class cannot be inherited.
Used when you want to prevent further derivation for security or performance reasons.

Example:

```
sealed class Logger
{
   public void Log(string msg) => Console.WriteLine("Log: " + msg);
}
```

10. NAMESPACES

Definition:

A **namespace** is a container that organizes classes and avoids name conflicts.

Example:

```
namespace DhruvTraining.Day3
{
   class Demo
   {
      public void Show() => Console.WriteLine("Inside DhruvTraining namespace");
   }
}
```

Use using DhruvTraining.Day3; to access it in another file.

11. GARBAGE COLLECTOR (CLR CONCEPT RECAP)

- CLR (Common Language Runtime) manages memory automatically.
- **Garbage Collector (GC)** removes unreferenced objects.

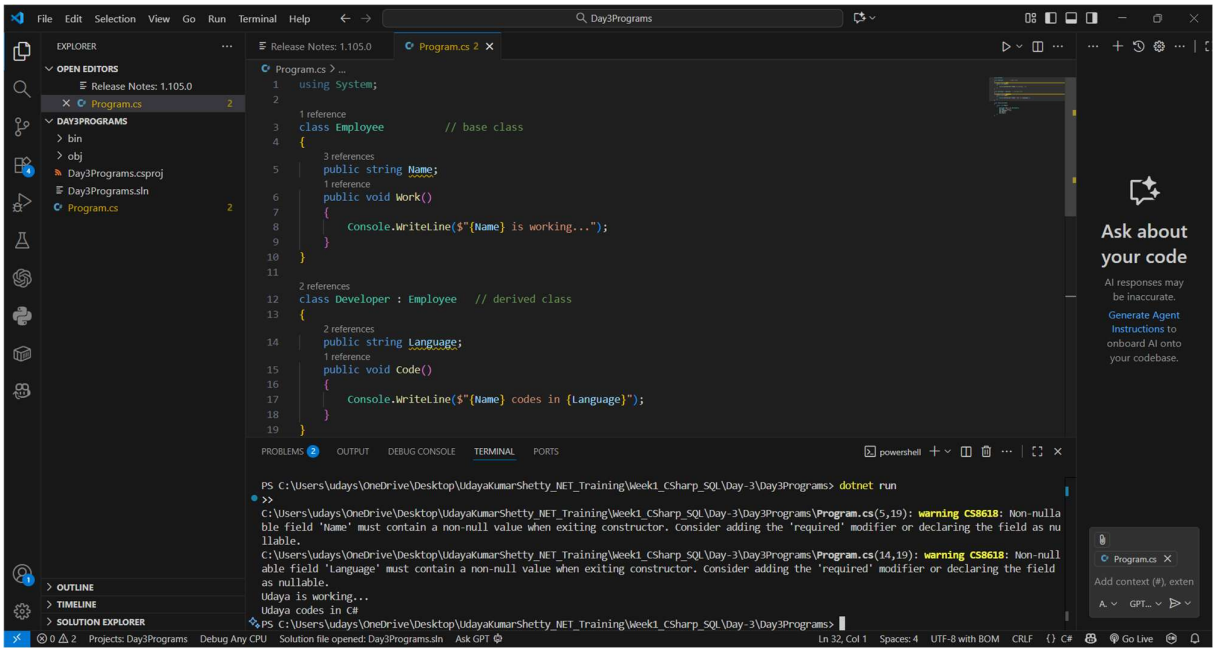
- You can force GC using:
- GC.Collect();
- GC.WaitForPendingFinalizers();
- But normally, it's handled automatically by the runtime.

SUMMARY TABLE

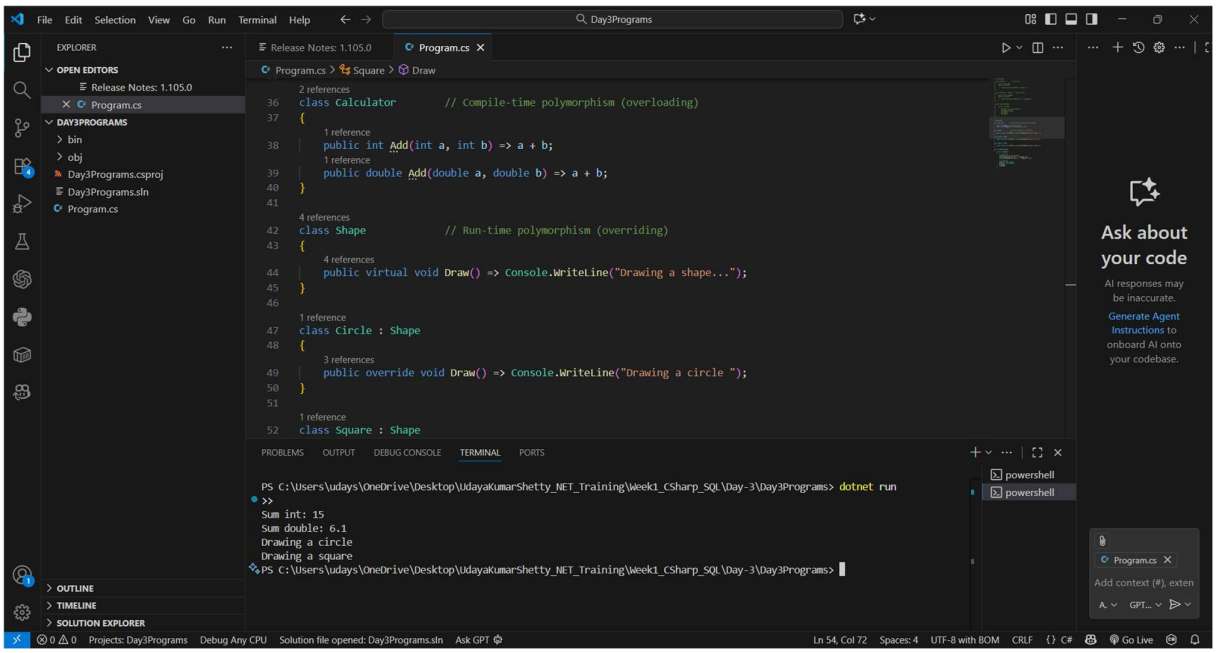
Concept	**Keyword**	**Example**
Inheritance	:	class B : A { }
Polymorphism	virtual, override	Method overriding
Abstraction	abstract, interface	Abstract classes, interfaces
Encapsulation	private, public	Data hiding
Static Class	static	Utility methods
Sealed Class	sealed	Prevent inheritance
Constructor	same as class name	Initialization
Destructor	~ClassName()	Cleanup
Namespace	namespace	Logical grouping

Snapshots:

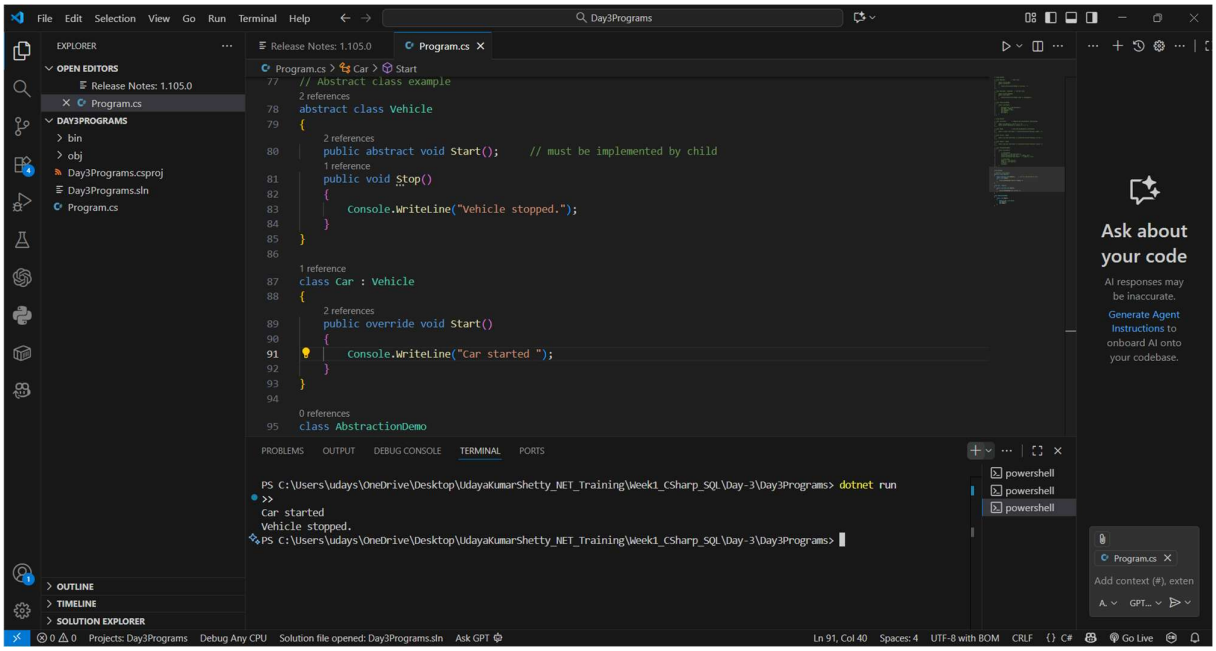
Inheritance



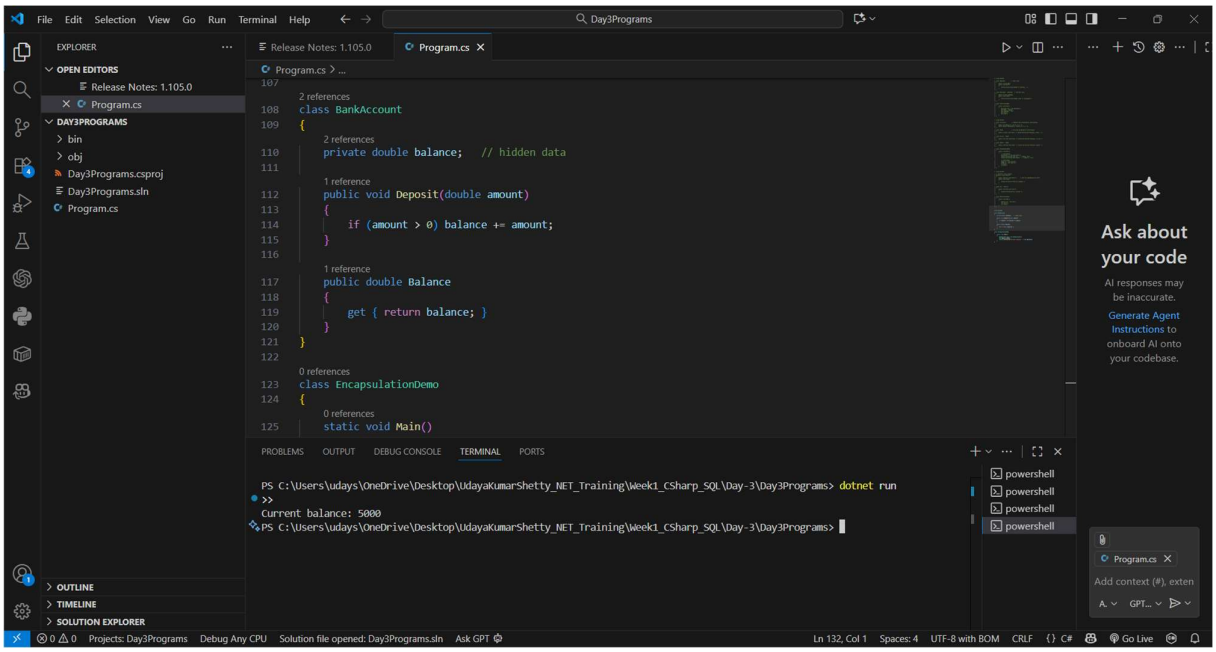
Polymorphism (Overloading + Overriding)



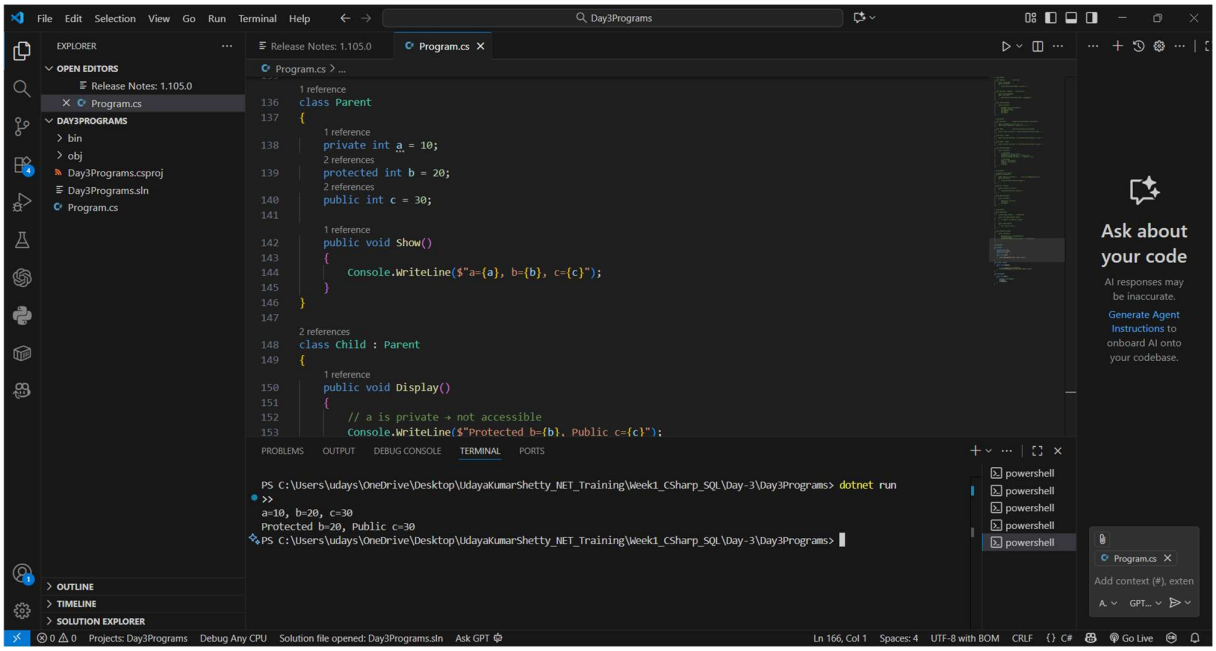
Abstraction



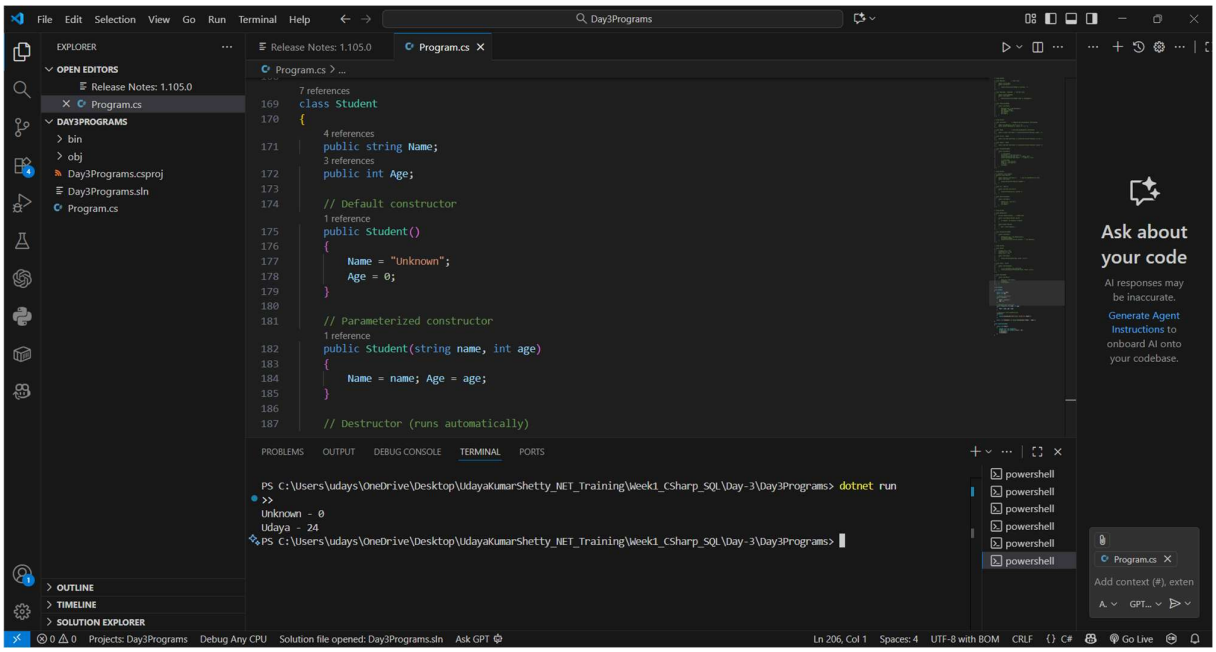
Encapsulation



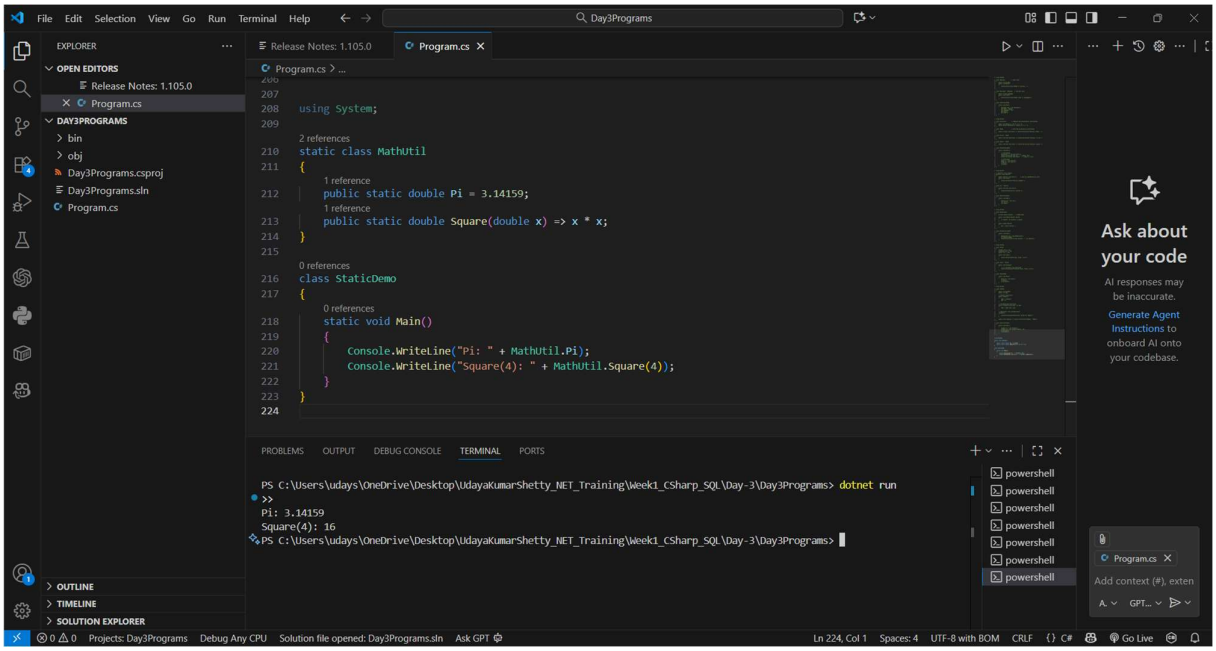
Access Modifiers Example



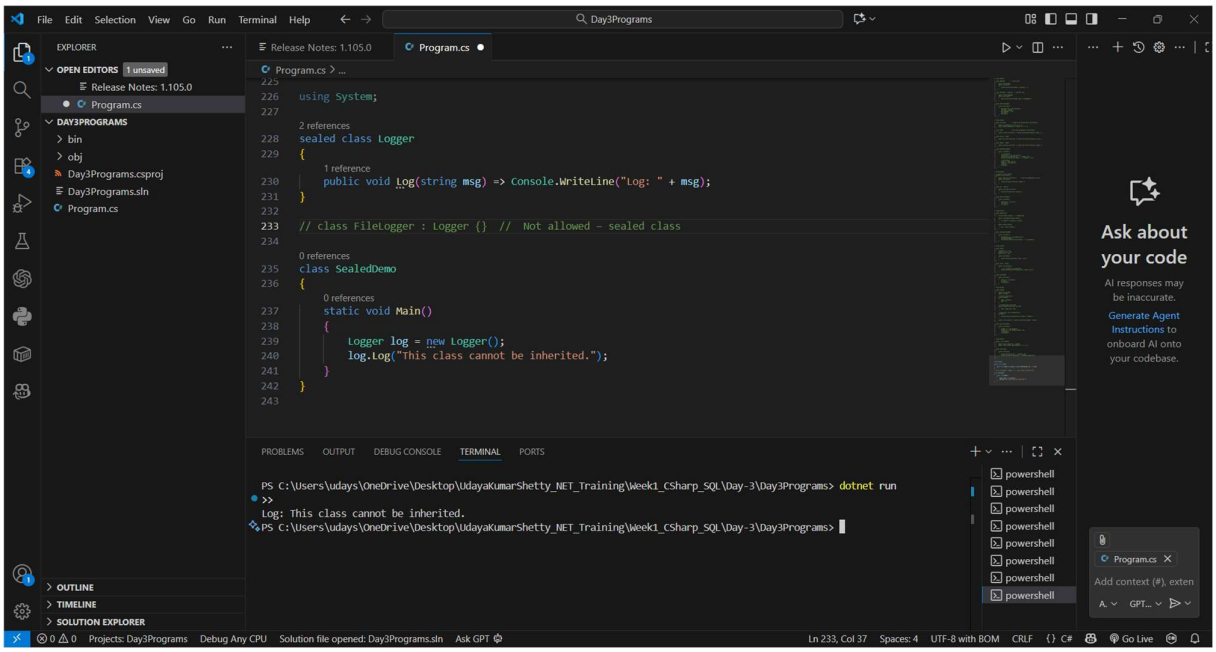
Constructors & Destructors



Static Class & Members



Sealed Class



Namespace Example