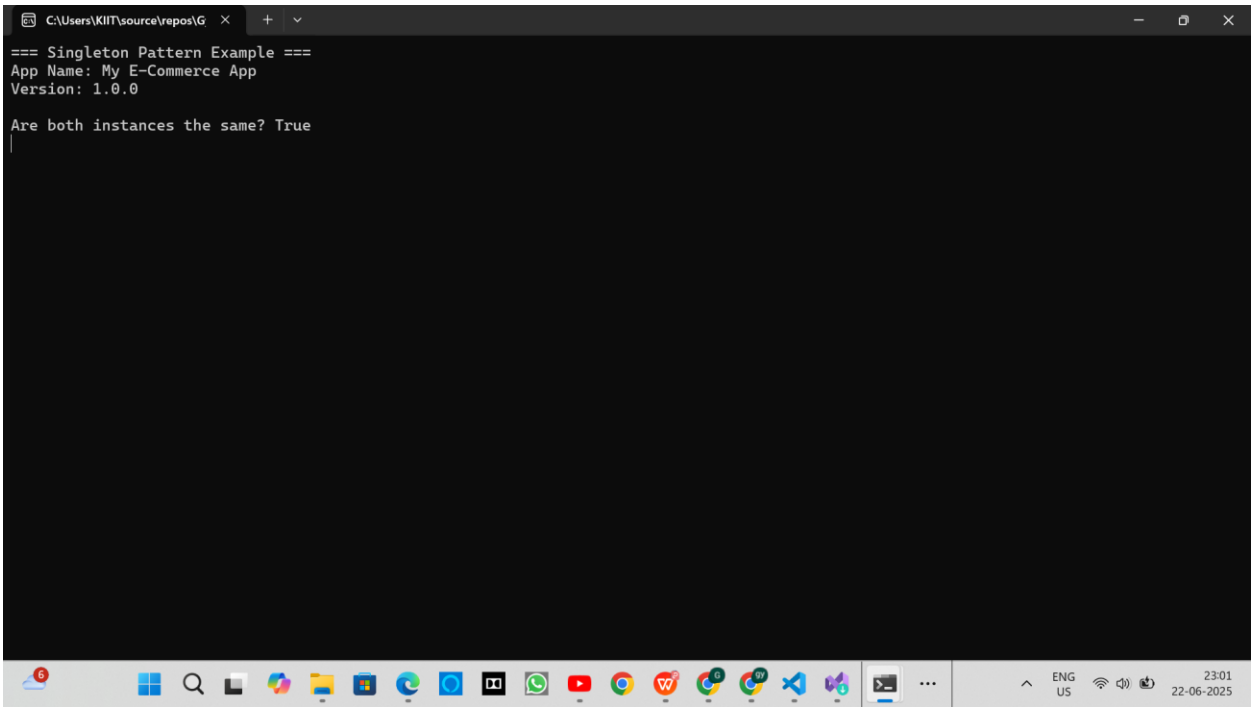
1.

```
using System;

namespace SingletonPatternApp
{
  // Singleton class
  public sealed class AppConfig
  {
    private static AppConfig _instance = null;
    private static readonly object _lock = new object();

    // Private constructor prevents external instantiation
    private AppConfig()
    {
      AppName = "My E-Commerce App";
      Version = "1.0.0";
    }

    // Public static method to get the instance
    public static AppConfig Instance
    {
      get
      {
        // Double-checked locking for thread safety
        if (_instance == null)
        {
```

```
            lock (_lock)
            {
                if (_instance == null)
                {
                    _instance = new AppConfig();
                }
            }
        }
        return _instance;
    }
  }

  // Properties
  public string AppName { get; private set; }
  public string Version { get; private set; }

  // Example method
  public void DisplayConfig()
  {
    Console.WriteLine($"App Name: {AppName}");
    Console.WriteLine($"Version: {Version}");
  }
}

class Program
{
```

```
        static void Main(string[] args)
        {
            Console.WriteLine("=== Singleton Pattern Example ===");

            AppConfig config1 = AppConfig.Instance;
            AppConfig config2 = AppConfig.Instance;

            config1.DisplayConfig();

            Console.WriteLine("\nAre both instances the same? " + (config1 == config2));

            Console.ReadLine();
        }
    }
}
```



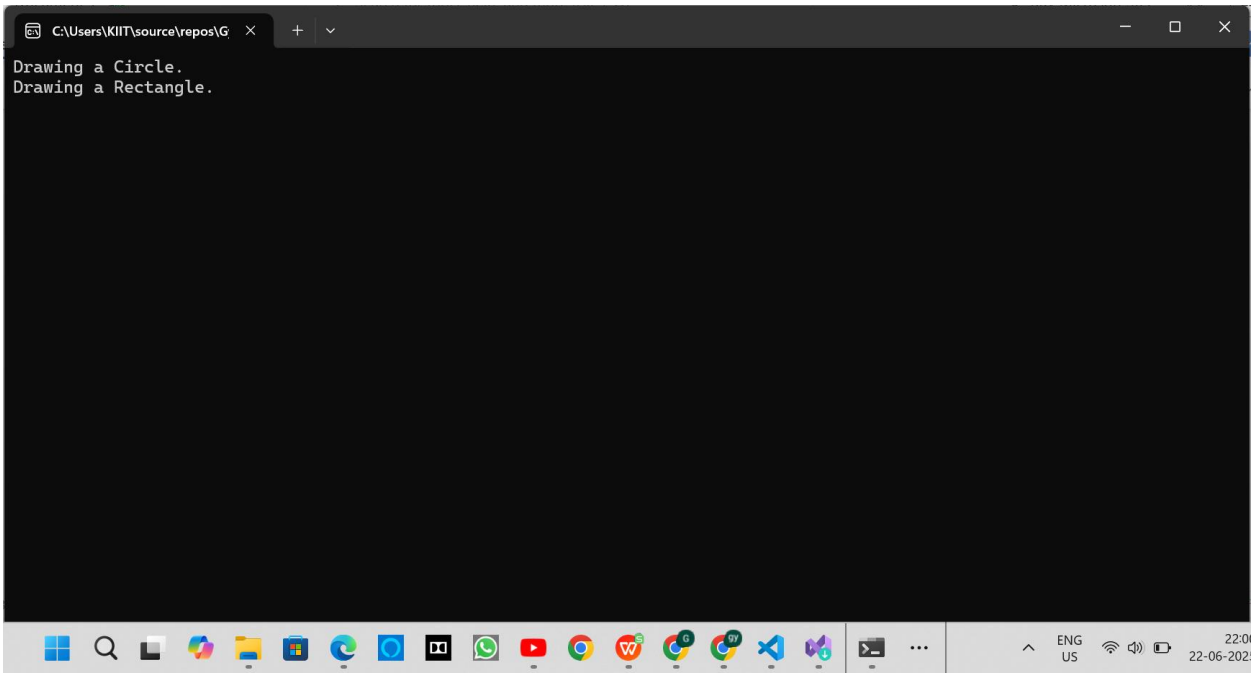
2.

```
using System;


namespace FactoryPatternExample
{
   // Product Interface
   public interface IShape
   {
      void Draw();
   }


   // Concrete Products
   public class Circle : IShape
   {
      public void Draw()
```

```
    {
        Console.WriteLine("Drawing a Circle.");
    }
}

public class Rectangle : IShape
{
    public void Draw()
    {
        Console.WriteLine("Drawing a Rectangle.");
    }
}

// Abstract Factory
public abstract class ShapeFactory
{
    public abstract IShape CreateShape();
}

// Concrete Factories
public class CircleFactory : ShapeFactory
{
    public override IShape CreateShape()
    {
        return new Circle();
    }
```

```
}

public class RectangleFactory : ShapeFactory
{
    public override IShape CreateShape()
    {
        return new Rectangle();
    }
}

class Program
{
    static void Main(string[] args)
    {
        ShapeFactory factory;

        // Use CircleFactory
        factory = new CircleFactory();
        IShape circle = factory.CreateShape();
        circle.Draw();

        // Use RectangleFactory
        factory = new RectangleFactory();
        IShape rectangle = factory.CreateShape();
        rectangle.Draw();
```

```
        Console.ReadLine();
      }
    }
}
```



3.

```
using System;
using System.Collections.Generic;
using System.Linq;

namespace EcommerceSearchApp
{
   // Product class to represent each product
   public class Product
```

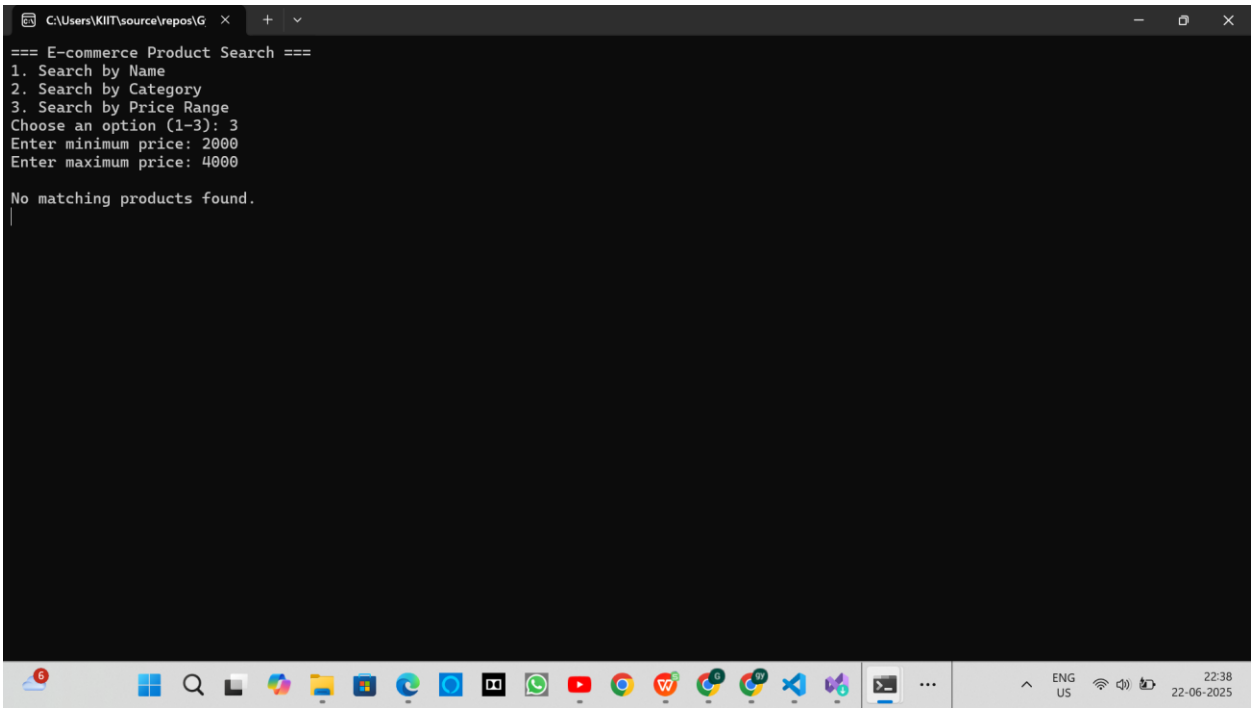
```
{
    public int Id { get; set; }
    public string Name { get; set; }
    public string Category { get; set; }
    public decimal Price { get; set; }
}

// Search Engine class implementing search features using DSA
public class ProductSearchEngine
{
    private List<Product> products;
    private Dictionary<string, List<Product>> categoryMap;

    public ProductSearchEngine()
    {
        products = new List<Product>();
        categoryMap = new Dictionary<string, List<Product>>();
        LoadSampleProducts();
        BuildCategoryMap();
    }

    // Load static products into the list
    private void LoadSampleProducts()
    {
        products.Add(new Product { Id = 1, Name = "iPhone 14", Category = "Electronics",
Price = 79999 });
```

```
        products.Add(new Product { Id = 2, Name = "Samsung Galaxy S23", Category = "Electronics", Price = 69999 });
        products.Add(new Product { Id = 3, Name = "Nike Air Max", Category = "Footwear", Price = 12000 });
        products.Add(new Product { Id = 4, Name = "Adidas Running Shoes", Category = "Footwear", Price = 10000 });
        products.Add(new Product { Id = 5, Name = "Sony Headphones", Category = "Electronics", Price = 15000 });
    }

    // Build a category map for efficient lookup
    private void BuildCategoryMap()
    {
        categoryMap = products
            .GroupBy(p => p.Category.ToLower())
            .ToDictionary(g => g.Key, g => g.ToList());
    }

    // Search products by partial name match (case-insensitive)
    public List<Product> SearchByName(string keyword)
    {
        return products
            .Where(p => p.Name.ToLower().Contains(keyword.ToLower()))
            .ToList();
    }

    // Search products by category using dictionary
```

```
    public List<Product> SearchByCategory(string category)
    {
        string key = category.ToLower();
        return categoryMap.ContainsKey(key) ? categoryMap[key] : new List<Product>();
    }

    // Search by price range
    public List<Product> SearchByPriceRange(decimal min, decimal max)
    {
        return products
            .Where(p => p.Price >= min && p.Price <= max)
            .ToList();
    }
}

class Program
{
    static void Main(string[] args)
    {
        ProductSearchEngine searchEngine = new ProductSearchEngine();

        Console.WriteLine("=== E-commerce Product Search ===");
        Console.WriteLine("1. Search by Name");
        Console.WriteLine("2. Search by Category");
        Console.WriteLine("3. Search by Price Range");
        Console.Write("Choose an option (1-3): ");
```

```
string choice = Console.ReadLine();

List<Product> results = new List<Product>();

switch (choice)
{
    case "1":
        Console.Write("Enter product name keyword: ");
        string name = Console.ReadLine();
        results = searchEngine.SearchByName(name);
        break;

    case "2":
        Console.Write("Enter product category (e.g., Electronics): ");
        string category = Console.ReadLine();
        results = searchEngine.SearchByCategory(category);
        break;

    case "3":
        Console.Write("Enter minimum price: ");
        decimal min = decimal.Parse(Console.ReadLine());

        Console.Write("Enter maximum price: ");
        decimal max = decimal.Parse(Console.ReadLine());

        results = searchEngine.SearchByPriceRange(min, max);
```

```
            break;

        default:
            Console.WriteLine("Invalid choice.");
            break;
    }

    // Display search results
    if (results.Any())
    {
        Console.WriteLine("\nSearch Results:");
        foreach (var product in results)
        {
            Console.WriteLine($"#{product.Id} | {product.Name} | {product.Category} |
₹{product.Price}");
        }
    }
    else
    {
        Console.WriteLine("\nNo matching products found.");
    }

    Console.ReadLine();
  }
 }
}
```



4.

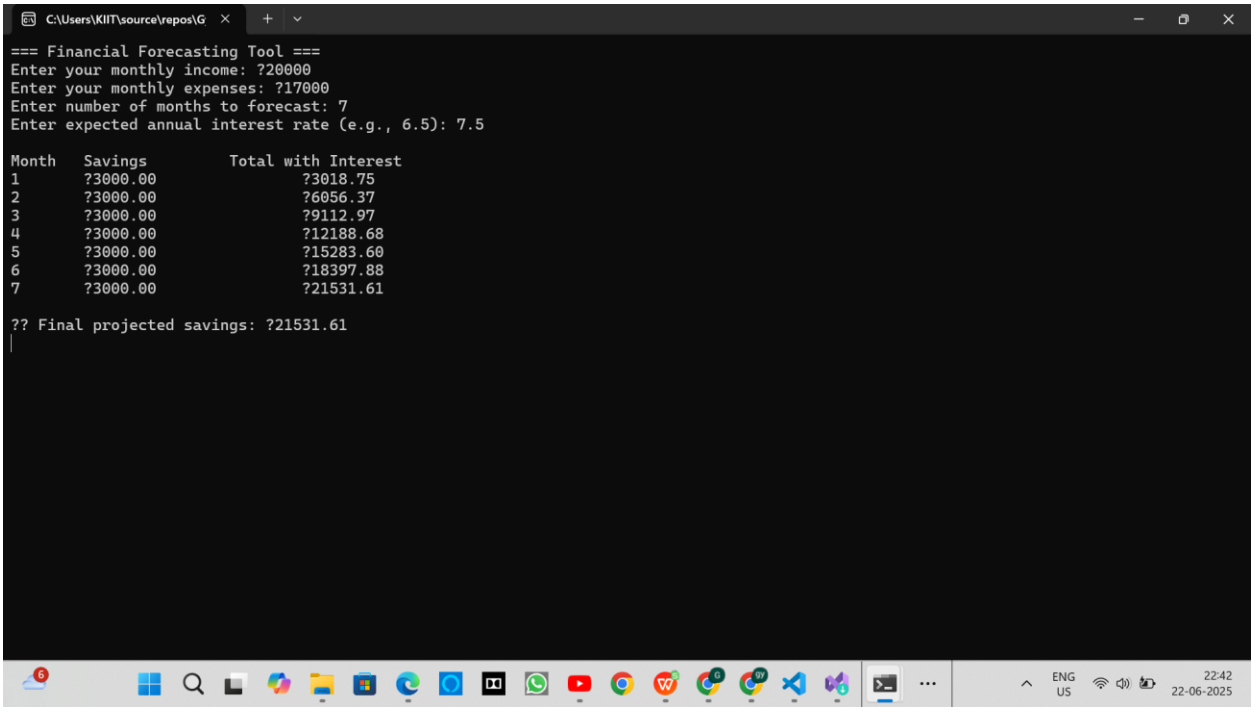
```
using System;

using System.Collections.Generic;


namespace FinancialForecastApp

{

   // Stores forecast for each month

   public class ForecastRecord

   {

      public int Month { get; set; }

      public decimal MonthlySavings { get; set; }

      public decimal TotalWithInterest { get; set; }


      public ForecastRecord(int month, decimal savings, decimal total)
```

```
    {
        Month = month;
        MonthlySavings = savings;
        TotalWithInterest = total;
    }
}

// Forecasting logic using List (DSA)
public class FinancialForecaster
{
    public List<ForecastRecord> GenerateForecast(decimal income, decimal expenses,
int months, decimal annualInterest)
    {
        List<ForecastRecord> records = new List<ForecastRecord>();
        decimal monthlySavings = income - expenses;
        decimal monthlyRate = annualInterest / 100 / 12;
        decimal total = 0;

        for (int i = 1; i <= months; i++)
        {
            total = (total + monthlySavings) * (1 + monthlyRate);
            records.Add(new ForecastRecord(i, monthlySavings, total));
        }

        return records;
    }
```

```
}

class Program
{
    static void Main(string[] args)
    {
        Console.WriteLine("=== Financial Forecasting Tool ===");

        decimal income = ReadDecimal("Enter your monthly income: ₹");
        decimal expenses = ReadDecimal("Enter your monthly expenses: ₹");
        int months = ReadInt("Enter number of months to forecast: ");
        decimal interest = ReadDecimal("Enter expected annual interest rate (e.g., 6.5): ");

        var forecaster = new FinancialForecaster();
        var forecast = forecaster.GenerateForecast(income, expenses, months, interest);

        Console.WriteLine("\nMonth\tSavings\t\tTotal with Interest");
        foreach (var record in forecast)
        {
Console.WriteLine($"{record.Month}\t₹{record.MonthlySavings:F2}\t\t₹{record.TotalWithInterest:F2}");
        }

        var final = forecast[forecast.Count - 1];
        Console.WriteLine($"\n📈 Final projected savings: ₹{final.TotalWithInterest:F2}");
```

```
        Console.ReadLine();
    }

    static decimal ReadDecimal(string prompt)
    {
        decimal value;
        Console.Write(prompt);
        while (!decimal.TryParse(Console.ReadLine(), out value))
        {
            Console.Write("Invalid number. Try again: ");
        }
        return value;
    }

    static int ReadInt(string prompt)
    {
        int value;
        Console.Write(prompt);
        while (!int.TryParse(Console.ReadLine(), out value))
        {
            Console.Write("Invalid number. Try again: ");
        }
        return value;
    }
}
```

}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=== Financial Forecasting Tool ===
Enter your monthly income: ?20000
Enter your monthly expenses: ?17000
Enter number of months to forecast: 7
Enter expected annual interest rate (e.g., 6.5): 7.5
Month Savings Total with Interest
1 ?3000.00 ?3018.75
2 ?3000.00 ?6056.37
3 ?3000.00 ?9112.97
4 ?3000.00 ?12188.68
5 ?3000.00 ?15283.60
6 ?3000.00 ?18397.88
7 ?3000.00 ?21531.61
?? Final projected savings: ?21531.61
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US
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