Assignment 03

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C# Bootcamp Week 2: Design Patterns Assignment

E-Commerce Order Management System

Assignment Overview

You will build a comprehensive E-Commerce Order Management System that demonstrates mastery of key design patterns and SOLID principles. This project simulates a real-world scenario where you'll implement order processing, inventory management, and payment handling using industry-standard design patterns.

Learning Objectives

By completing this assignment, you will:

- Implement the Factory, Singleton, Strategy, and Repository patterns
- Apply SOLID principles in practical scenarios
- Design clean, maintainable, and extensible code architecture
- Understand separation of concerns in enterprise applications
- Practice proper use of interfaces and abstractions

System Requirements

Core Functionality

Your system must support:

1. Product Management: Create, read, update products with different categories
2. Order Processing: Handle customer orders with various payment methods
3. Inventory Tracking: Manage stock levels and availability
4. Payment Processing: Support multiple payment strategies
5. Logging & Configuration: System-wide logging and configuration management

Technical Requirements

- Project Type: Console Application with clear menu system
- Architecture: Clean separation of concerns across layers
  Design Pattern Implementation Requirements

1. Factory Pattern (Creational)
Requirement: Implement a Product Factory to create different product types.
Implementation Details

```
public enum ProductCategory
{
    Electronics,
    Clothing,
    Books,
    HomeGarden
}
```

Expected Behavior:

- Factory creates appropriate product types (Electronics, Clothing, Books, HomeGarden)
- Each product type has unique behavior in GetProductDetails()
- Factory handles invalid category gracefully
- Products have category-specific properties (e.g., Electronics have warranty, Books have ISBN)

2. Singleton Pattern (Creational)
Requirement: Create a thread-safe Configuration Manager and Logger.
Implementation Details:

```
public interface IConfigurationManager
{
    string GetSetting(string key);
    void SetSetting(string key, string value);
}
public interface ILogger
{
    void LogInfo(string message);
    void LogError(string message);
    void LogWarning(string message);
}
```

Expected Behavior:

- Thread-safe singleton implementation
- Configuration manager stores app settings (database connection, API keys, etc.)
- Logger writes to console with timestamps and log levels
- Both singletons properly handle concurrent access

3. Strategy Pattern (Behavioral)
Requirement: Implement multiple payment processing strategies.
Required Strategies:

- CreditCardPayment: Validates card number, expiry, CVV
- PayPalPayment: Uses email and password validation
- BankTransferPayment: Requires routing and account numbers
- CryptoPayment: Uses wallet address validation
  Expected Behavior:
- Each strategy has unique validation logic
- Strategies can be swapped at runtime
- Payment context manages strategy selection

- Each payment type has different success/failure scenarios

4. Repository Pattern (Layered Abstraction)
Requirement: Implement repository pattern for data access layer.
Implementation Details:

```
public interface IRepository
{
    GetByIdAsync(string id);
    GetAllAsync();
    AddAsync(T entity);
    UpdateAsync(T entity);
    DeleteAsync(string id);
}
public interface IProductRepository : IRepository
{
    Task> GetByCategory (ProductCategory category);
    GetLowStockProducts (int threshold);
}
public interface IOrderRepository : IRepository
{
    GetOrdersByCustomer(string customerId);
    GetOrdersByDateRange(DateTime start, DateTime end);
}
```

Expected Behavior:

- In-memory implementation (no actual database required)
- Generic repository pattern with specific implementations
- Repository abstracts data access from business logic
- SOLID Principles Application

Project Structure

```
ECommerceOrderSystem/
├── Models/
├── Factories/
├── Singletons/
├── Strategies/
├── Repositories/
├── Services/
└── Program.cs
```

Sample Application Flow
Your console application should provide a menu-driven interface:
=== E-Commerce Order Management System ===

1. View Products
2. Add New Product
3. Create Order
4. Process Payment
5. View Orders
6. Check Inventory

7. System Logs
8. Configuration
9. Exit
   Please select an option:

Deliverables

Code Submission
• Complete C# solution with all required patterns
• Proper error handling and validation
• Console application with working menu system

Documentation

Submit a Design Document (2-3 pages) that includes:

1. Architecture Overview: High-level system design diagram
2. Pattern Implementation: Explanation of how each pattern is implemented
3. SOLID Principles: Examples of how you applied each principle
4. Challenges & Solutions: Problems encountered and how you solved them
5. Future Enhancements: How the system could be extended