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## Template design pattern in java with realtime example

In this tutorial we'll be looking into the Template Design Pattern. We'll try to create a Report Generator that will generate Tax Report and Expense Report. While doing so, we'll be encountering some design issues that we'll solve using the Template Method Design Pattern. It has been divided into two stages: Stage 1 In this section we'll be creating two classes. One for Tax Report Generation and another for Expense Report Generation. Tax Report The TaxReport class. It has a method, generate, that'll do the following tasks: Create MySQL Database Connection Execute a Query to Fetch some Tax related details from the Database Convert the result to a PDF document. Note: Make sure to go through the code comments as well. It'll help you understand the concept better. class TaxReport { public void generate() { createDatabaseConnection(); executeMySQLQuery(); convertToPDF(); } public void createDatabaseConnection() { System.out.println("Creating Database Connection..."); } public void executeMySQLQuery() { System.out.println("Executing MySQL Query..."); } public void convertToPDF() { System.out.println("Converting To PDF..."); } } Expense Report The ExpenseReport class. It has a generate method that'll do the following tasks: Create Postgres Database Connection Execute a Query to Fetch some Tax related details from the Database Convert the result to a XLS document. class ExpenseReport { public void generate() { createDatabaseConnection(); executePostgresQuery(); convertToXLS(); } public void createDatabaseConnection() { System.out.println("Creating Database Connection..."); } public void executePostgresQuery() { System.out.println("Executing Postgres Query..."); } public void convertToXLS() { System.out.println("Converting To XLS..."); } } After performing a quick code review we've got following points to ponder: The createDatabaseConnection methods in both the classes share the same responsibility, i.e., to create a database connection. Same with the methods convertToPDF and convertToXLS. However, their implementations are different but their intention is same, to convert to a format. The way both of them work is same, i.e., Create a DB connection Execute a Query Convert the data received from the Query Response to a presentable format, i.e., XLS or PDF It seems like there is code duplication(or behaviour duplication?). The first thing that comes into the mind is to remove it by creating an abstract class that will hold the common attributes. Stage 2 So, this is what we've created after the review, a new ReportGenerator class abstract class ReportGenerator { final public void generate() { createDatabaseConnection(); executeQuery(); convert(); } public void createDatabaseConnection() { System.out.println("Creating Database Connection..."); } abstract public void executeQuery(); abstract public void convert(); } Two methods, executeQuery and convert, are abstract and the concrete classes must provide the implementation. But there's an implementation for createDatabaseConnection because this property will remain same for all the concrete implementations, although, it can be overridden by them. And following are the implementations for: class TaxReport extends ReportGenerator { public void executeQuery() { System.out.println("Executing MySQL Query..."); } public void convert() { System.out.println("Converting To PDF..."); } } class ExpenseReport extends ReportGenerator { public void createDatabaseConnection() { System.out.println("Creating Database Connection..."); } public void executeQuery() { System.out.println("Executing Postgres Query..."); } public void convert() { System.out.println("Converting To XLS..."); } } Here, we've generalized and abstracted the createConnection method as it remains same for both the classes. Also, we've templatized the way a report is generated, i.e., combining the task: Create a connection Execute a Query Convert the data received from the Query Response to a presentable format, i.e., XLS or PDF into the method generate(). We've delegated the task of executing the Query and converting the response to desired format. This way the algorithm of creating a report remains same, the generate method, but the subclasses can redefine the steps but it cannot updated the structure of the algorithm. Finally the definition from the Wikipedia In object-oriented programming, the template method is one of the behavioral design patterns identified by Gamma et al. in the book Design Patterns. The template method is a method in a superclass, usually an abstract superclass, and defines the skeleton of an operation in terms of a number of high-level steps. I've created these tutorials after learning Design Patterns from this book Head First Design Patterns (A Brain Friendly Guide). Back to: Design Patterns in C# With Real-Time Examples In this article, I am going to discuss the Template Method Design Pattern Real-time Example in C#. Please read our previous article where we discussed the Template Method Design Pattern in C#. Template Method Design Pattern Real-time Example: Coffee Suppose you want to prepare Coffee (let say BruCoffee). Then you need to follow some steps or procedures such as Boil Water, Add Milk, Add Sugar, and Add BruCoffee which is shown in the following image. Suppose you want to prepare Nescafe Coffee. Then also you need to follow the same procedure as BruCofee such as Boil Water, Add Milk, Add Sugar, and Add Nescafe Coffee as shown in the following image. If you see both the coffee preparation procedure, it is almost the same i.e. Boil Water, Add Milk, Add Sugar, Add Coffee type (i.e. Bru and Nescafe), and based on the Coffee it will create either Bru Coffee or Nescafe Coffee. So, the procedure for creating coffee is the same. What I can do here is, I can create some template method (PrepareCoffee) and within that PrepareCoffee template method, I can define the procedure to create the coffee. For better understanding please have a look at the following diagram. Template Method Design Pattern Real-Time Example Implementation – Coffee Let implement the above example step by step using C#. Step1: Creating the Template Method Create a class file with the name CoffeeTemplate.cs and then copy and paste the following code in it. This is going to be an abstract class that defines a set of abstract methods that need to be implemented by the concrete subclasses. But if you want then you can also provide a default implementation and the child class can optionally override the implementation. This abstract class also provides one concrete method (i.e. template method) which defines the order in which those abstract operations should occur. using System; namespace TemplateDesignPattern { public abstract class CoffeeTemplate { // PrepareCoffee method is the template method public void PrepareCoffee() { BoilWater(); AddMilk(); AddSugar(); AddCoffeePowder(); Console.WriteLine(this.GetType().Name + " is Ready"); } protected abstract void BoilWater(); protected abstract void AddMilk(); protected abstract void AddSugar(); protected abstract void AddCoffeePowder(); } } Step2: Creating Concrete Class. The Concrete Classes are going to implement the operations defined by the Abstract Class. As we are going to create two types of coffees i.e. BruCoffee and NescafeCoffee so we are going to create two concrete classes by implementing the abstract CoffeeTemplate class. BruCoffee: Create a class file with the name BruCoffee.cs and then copy and paste the following code in it. using System; namespace TemplateDesignPattern { public class BruCoffee : CoffeeTemplate { protected override void BoilWater() { Console.WriteLine("Water Boild"); } protected override void AddMilk() { Console.WriteLine("Milk Added"); } protected override void AddSugar() { Console.WriteLine("Sugar Added"); } protected override void AddCoffeePowder() { Console.WriteLine("Bru Coffee Powder Added"); } } } NescafeCoffee: Create a class file with the name NescafeCoffee.cs and then copy and paste the following code in it. using System; namespace TemplateDesignPattern { public class NescafeCoffee : CoffeeTemplate { protected override void BoilWater() { Console.WriteLine("Water Boild"); } protected override void AddMilk() { Console.WriteLine("Milk Added"); } protected override void AddSugar() { Console.WriteLine("Sugar Added"); } protected override void AddCoffeePowder() { Console.WriteLine("Nescafe Coffee Powder Added"); } } } Step3: Client Modify the Main method as shown below. Here, we are creating an object of coffee type and then calling the PrepareCoffee method. Based on the type it will create appropriate coffee. using System; namespace TemplateDesignPattern { class Program { static void Main(string[] args) { Console.WriteLine("Nescafe Coffee Preparation"); CoffeeTemplate coffee = new NescafeCoffee(); coffee.PrepareCoffee(); Console.WriteLine(); Console.WriteLine("Bru coffee preparation"); coffee = new BruCoffee(); coffee.PrepareCoffee(); Console.Read(); } } } Output: In the next article, I am going to discuss the Command Design Pattern in C# with real-time examples. Here, in this article, I try to explain the Template Method Design Pattern Real-Time Example in C#. I hope you enjoy this Template Method Design Pattern Real-Time Example in C# article.

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