Template DP

Problem

- A beverage joint sells coffee and tea.
    - Preparing Coffee process: Boil water, Brew coffee in boiling water, Pour coffee in cup, Add sugar and milk
    - Preparing Tea process: Boil water, Brew tea in boiling water, Pour tea in cup, Add lemon

  Draw a class diagram to simulate the coffee and Tea preparations.

Principle

A specific logic should be present once and once only in an application.

Result of this Principle
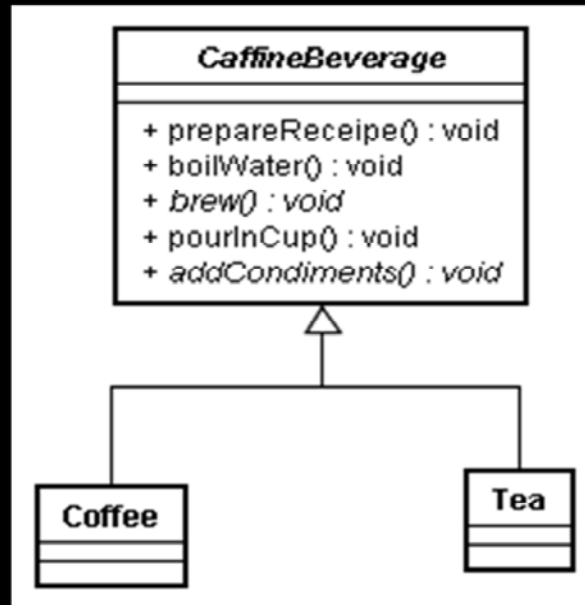
Code modifications are simple

Code size reduced.

Easy understanding.

Probably the most important principle.

This principle is called DRY (Don't Repeat Yourself) or Once and Only Once principle.

Solution

CaffineBeverage

+ prepareReceipe() : void
+ boilWater() : void
+ *brew() : void*
+ pourInCup() : void
+ *addCondiments() : void*

Coffee

Tea

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The code of prepareReceipe is

```
void final prepareReceipe() {
  boilWater();
  brew();
  pourInCup();
  addCondiments();
}
```

It defines the skeleton of an algorithm in a method, deferring some steps to subclasses.
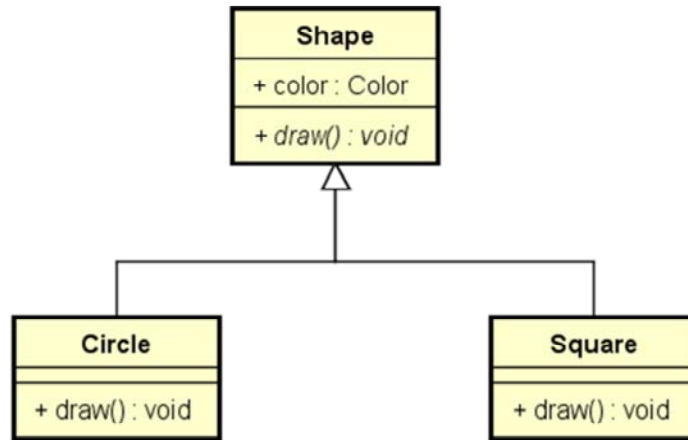
It lets subclasses redefine certain steps of an algorithm without changing the algorithm's structure.

Maximized code reuse.

Otherwise code would have been duplicated.

Knowledge about the algorithm is concentrated in the base class. Subclasses can provide custom implementations.
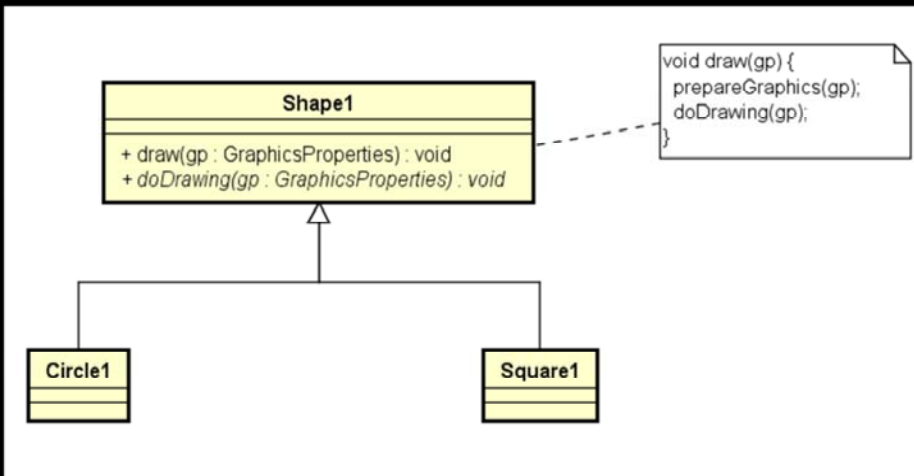
The draw function of Circle and Square will need to use Color via some getter function. This breaks encapsulation principle for Shape.

Template DP

```
void draw(gp) {
  prepareGraphics(gp);
  doDrawing(gp);
}
```

Shape1

+ draw(gp : GraphicsProperties) : void
+ doDrawing(gp : GraphicsProperties) : void
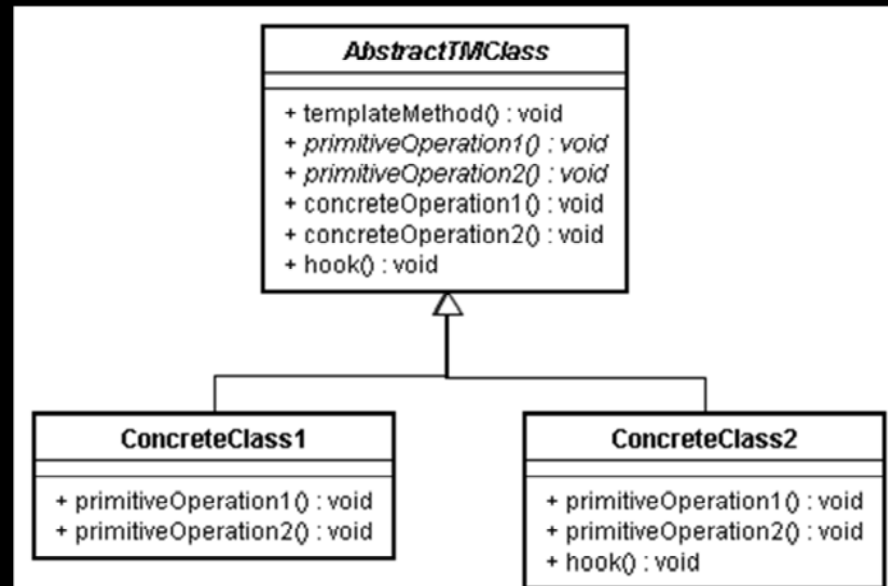
Circle1

Square1

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GraphicProperties can have color, line thickness, etc.

Based on the values in graphicProperties, different instance varialbes in Shape1 can be set.

doDrawing function will exist for each derived class now

Implementing Template DP

AbstractTMClass

+ templateMethod() : void
+ *primitiveOperation1() : void*
+ *primitiveOperation2() : void*
+ concreteOperation1() : void
+ concreteOperation2() : void
+ hook() : void

ConcreteClass1

+ primitiveOperation1() : void
+ primitiveOperation2() : void

ConcreteClass2

+ primitiveOperation1() : void
+ primitiveOperation2() : void
+ hook() : void

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Concrete methods carry out some basic operation. They are final.

Primitive methods whose implementation must be provided in the subclasses. They are abstract.

Hooks are methods that is declared in the base class. They are often empty. Sometimes they have a default implementation. The subclass can override it, if required.
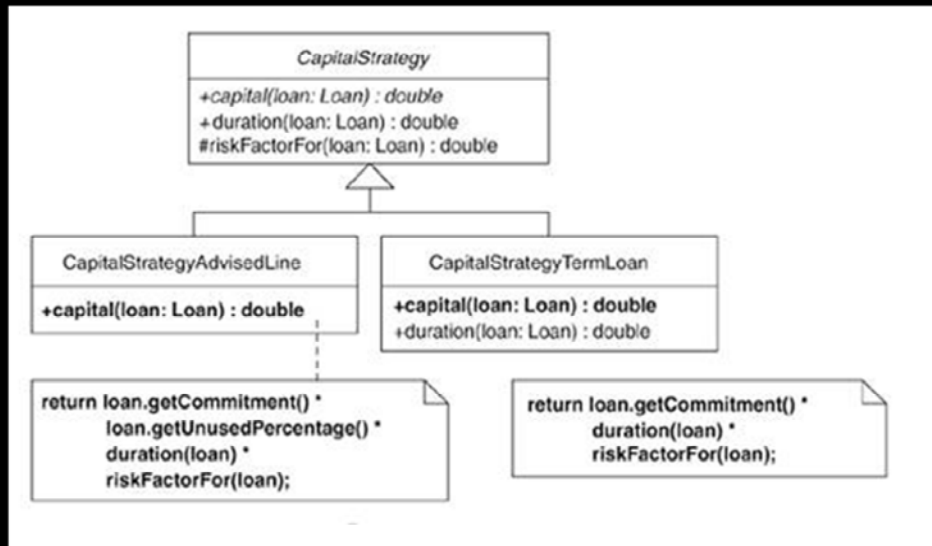
This DP is used

To implement the invariant parts of an algorithm once and leave it up to subclasses to implement the behavior that can vary.

When common behavior among subclasses should be factored and localized in a common class to avoid duplication.
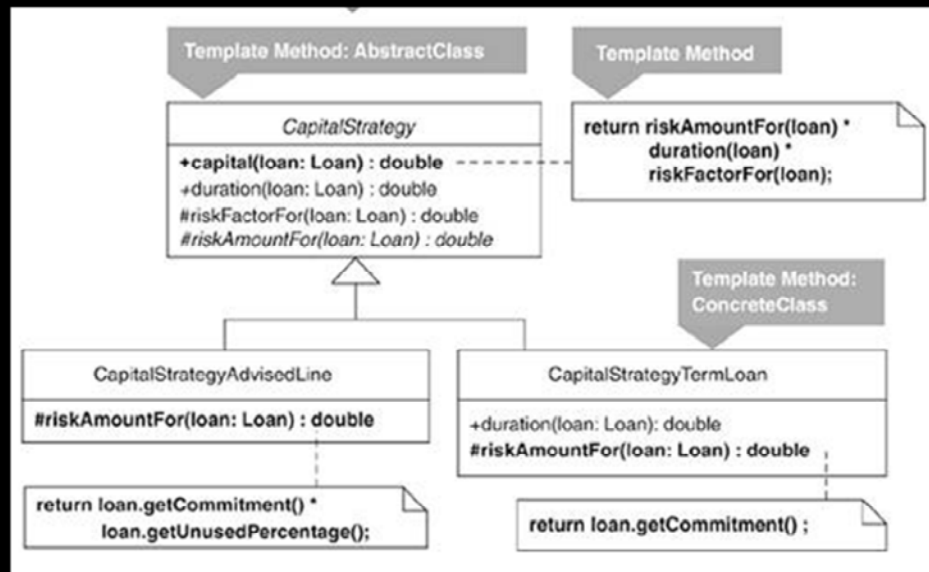
This DP is used often in frameworks / libraries.

Two methods in subclasses perform similar steps in the same order, yet the steps are different.

Generalize the methods by extracting their steps into methods with identical signatures, then pull up the generalized methods to form a Template Method.
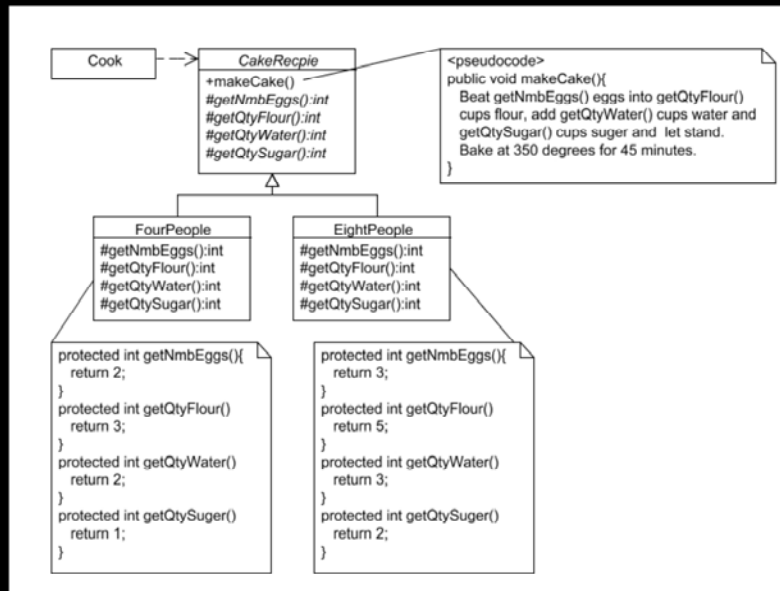
+Removes duplicated code in subclasses by moving invariant behavior to a superclass.

+Simplifies and effectively communicates the steps of a general algorithm.

+Allows subclasses to easily customize an algorithm.

–Complicates a design when subclasses must implement many methods to flesh out the algorithm.

Examples Of Template DP

- Arrays.sort uses template DP.
  - It calls the compareTo function of Objects.
- InputStream has a **read** method. Subclasses must implement this method as it is used by the template method **read(byte[] b)**
- The **paint** method in JFrame is a hook.
- The **init,start,stop,destroy** methods in an Applet are hooks.

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Strategy DP implements the entire algorithm while the Template DP implements only a partial algorithm in the subclasses.

Strategy defines a family of algorithms and makes them interchangeable via composition. Template defines one algorithm but allows customization of steps in the algorithm via Inheritance.

Assignment

- We have three types of credit cards: Visa, MasterCard and Diners Club. For a transaction we need to check
  - Expiry date > today
  - Valid characters 0 to 9
  - Check digit algorithm
  - Length of numbers is different for different cards
  - Account is in good standing. Each card gives a customized algorithm for this purpose.
- QCoffee

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Instead use the Tax computation problem in the exercise that has lot of duplication.

OOAD slides: Open Closed Principle, Guidelines (keep things that vary separately),

Inheritance vs. Delegation, Airline Reservation System, Same Person – Multiple roles, A person can change roles Now, Stack is not ArrayList, What is the output, Bat cannot be a bird, Liskov Substitution Principle,

Does Subclass make sense, Avoid Deep inheritance, All Inherited features should make sense in subclasses, Reorganize (Ellipse, circle)