Builder Pattern Tutorial

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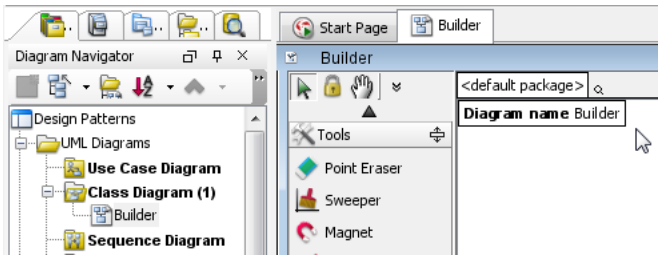
This tutorial is aimed to guide the definition and application of Gang of Four (GoF) builder design pattern. By reading this tutorial, you will know how to develop a model for the builder pattern, and how to apply it in practice.

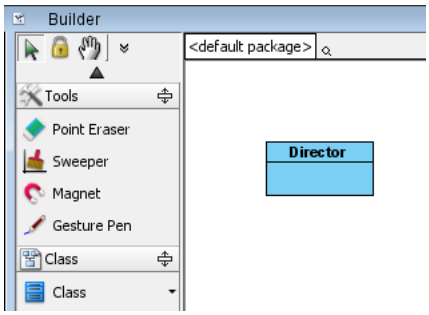
Modeling Design Pattern with Class Diagram

1. Create a new project *Design Patterns*.

2. Create a class diagram *Builder*.



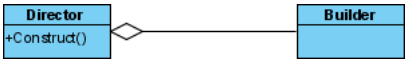
3. Select **Class** from diagram toolbar. Click on the diagram to create a class. Name it as *Director*.



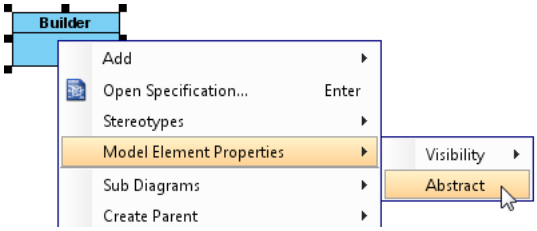
4. Right click on *Director* and select **Add** > **Operation** from the popup menu.

5. Name it as *Construct()*.

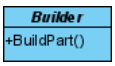
6. Move the cursor over *Director*, make use of resource icon **Aggregation** > **Class** to create an associated class *Builder*.



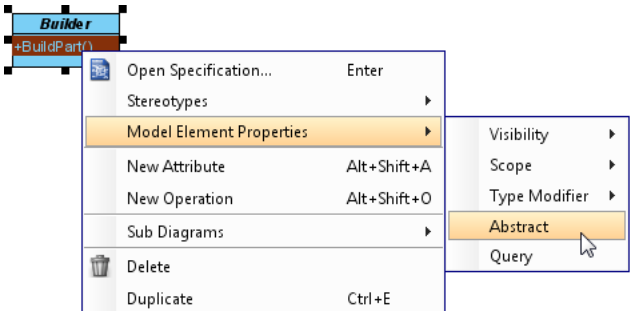
7. Set the *Builder* abstract by right clicking on *Builder* and selecting **Model Element Properties** > **Abstract** from the popup menu.



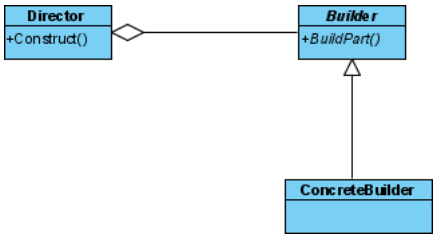
8. Create an operation *BuildPart()* in *Builder*.



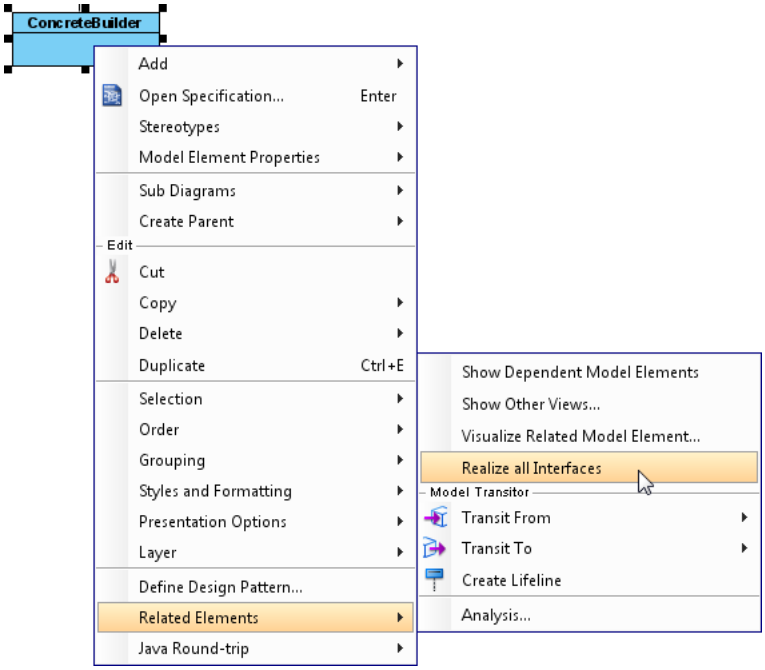
9. Set *BuildPart()* abstract by right clicking on it and selecting **Model Element Properties** > **Abstract** from the popup menu.



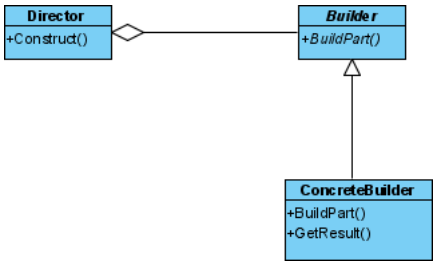
10. Move the cursor over *Builder*, make use of resource icon **Generalization** > **Class** to create a subclass *ConcreteBuilder*.



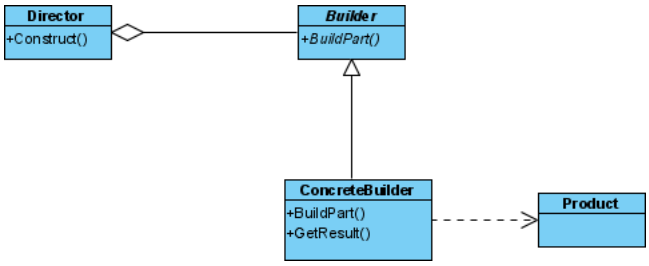
11. Inherit operations from *Builder* by right clicking on *ConcreteBuilder* and selecting **Related Elements** > **Realize all Interfaces** from the popup menu.



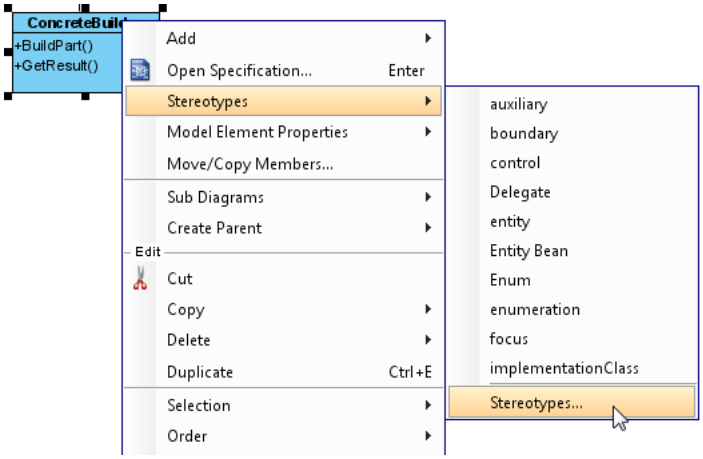
12. Add an operation *GetResult()* to *ConcreteBuilder*. Up to now, the diagram should look like this:



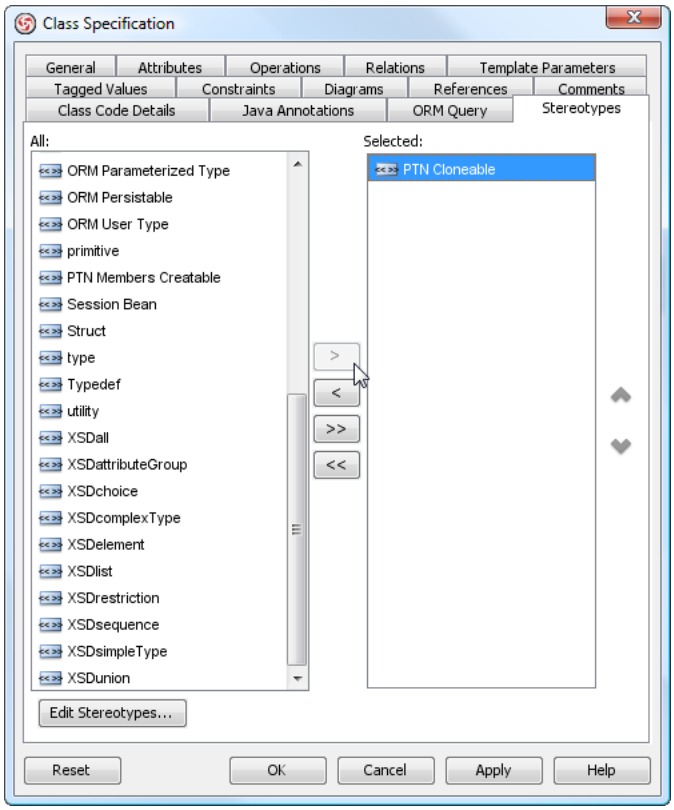
13. Move the cursor over *ConcreteBuilder*, make use of resource icon **Dependency** > **Class** to create a depending class *Product*.



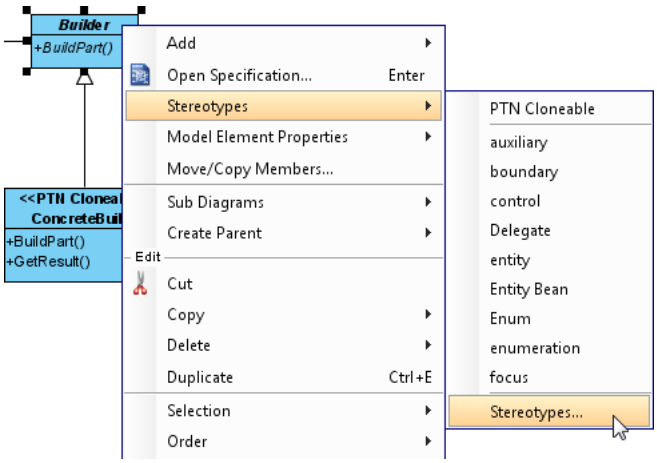
14. In practice, there can be multiple concrete builder classes. To represent this, we need to assign a special stereotype to the *ConcreteBuilder* class. Right click on *ConcreteBuilder* and select **Stereotypes** > **Stereotypes...** from the popup menu.



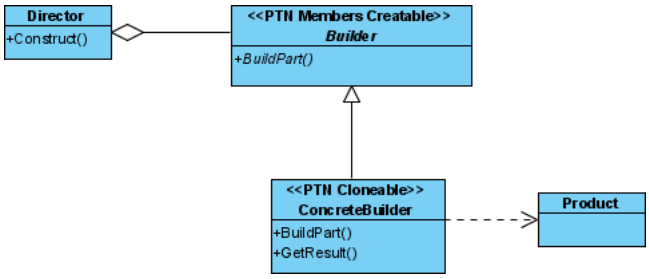
15. Select **PTN Cloneable**, click > to assign it to the **Selected Stereotype** list. Click **OK** to confirm.



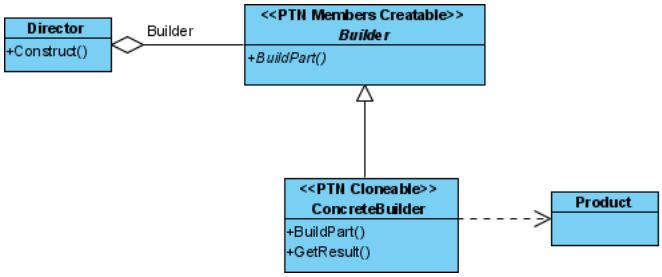
16. In practice, there may be multiple to operations in the *Builder* class for creating parts. To represent this, we need to assign a special stereotype to the *Builder* class. Right click on *Builder* and select **Stereotypes** > **Stereotypes...** from the popup menu.



17. Assign stereotype **PTN Members Creatable** to the class. Click **OK** to confirm.

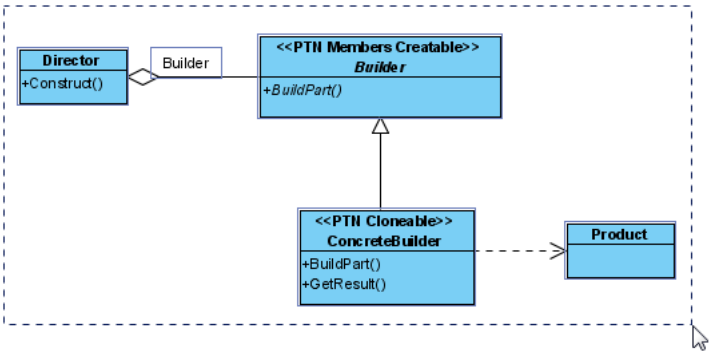


18. For the association end of the association between the *Director* and *Builder* classes, there is a role named *Builder*. Double click on the *Director* end and enter *Builder* as name. The diagram should now become:

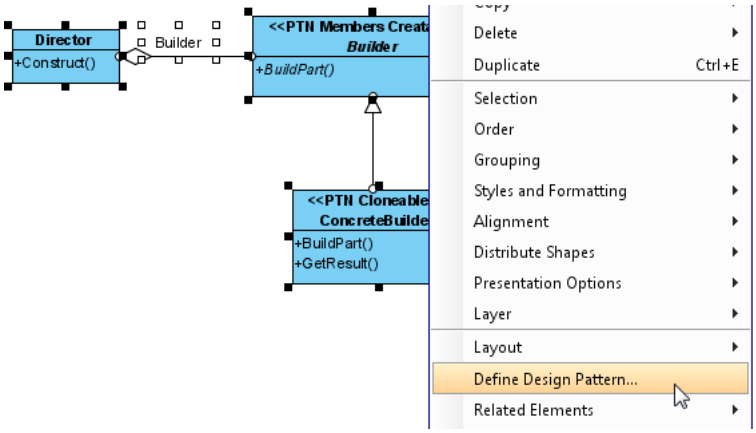


Defining Pattern

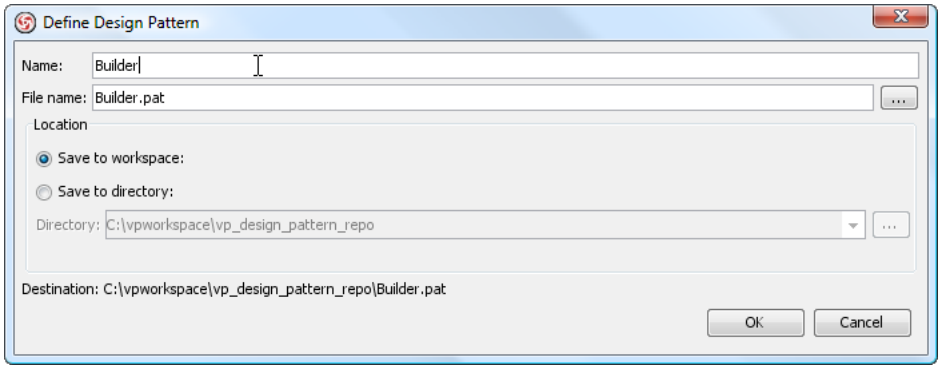
1. Select all classes on the class diagram.



2. Right click on the selection and select **Define Design Pattern...** from the popup menu.



3. In the **Define Design Pattern** dialog box, specify the pattern name *Builder*. Keep the file name as is. Click **OK** to proceed.

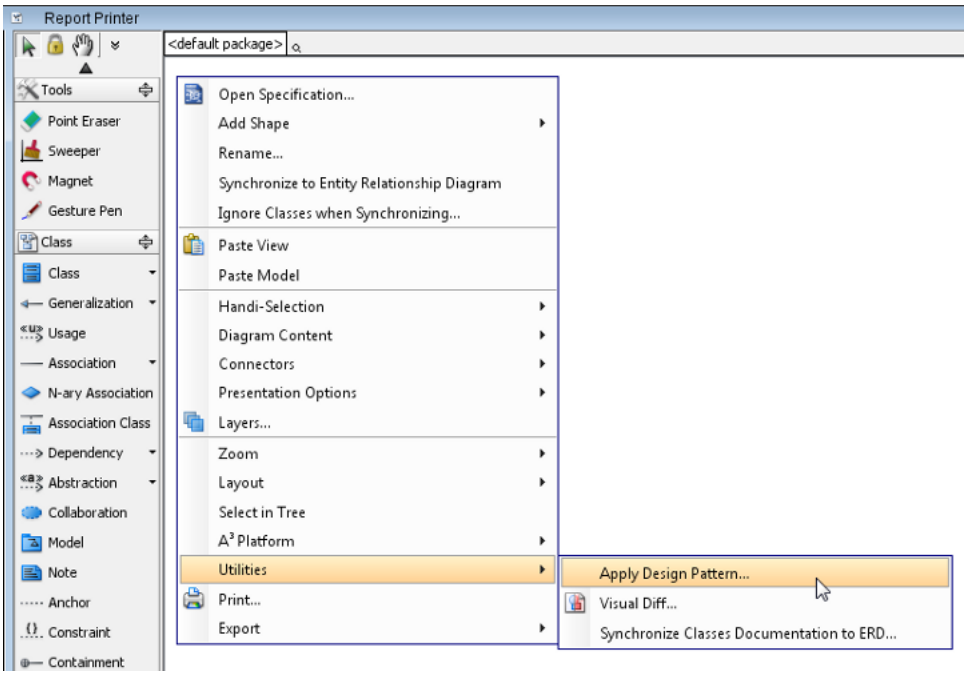


Applying Design Pattern on Class Diagram

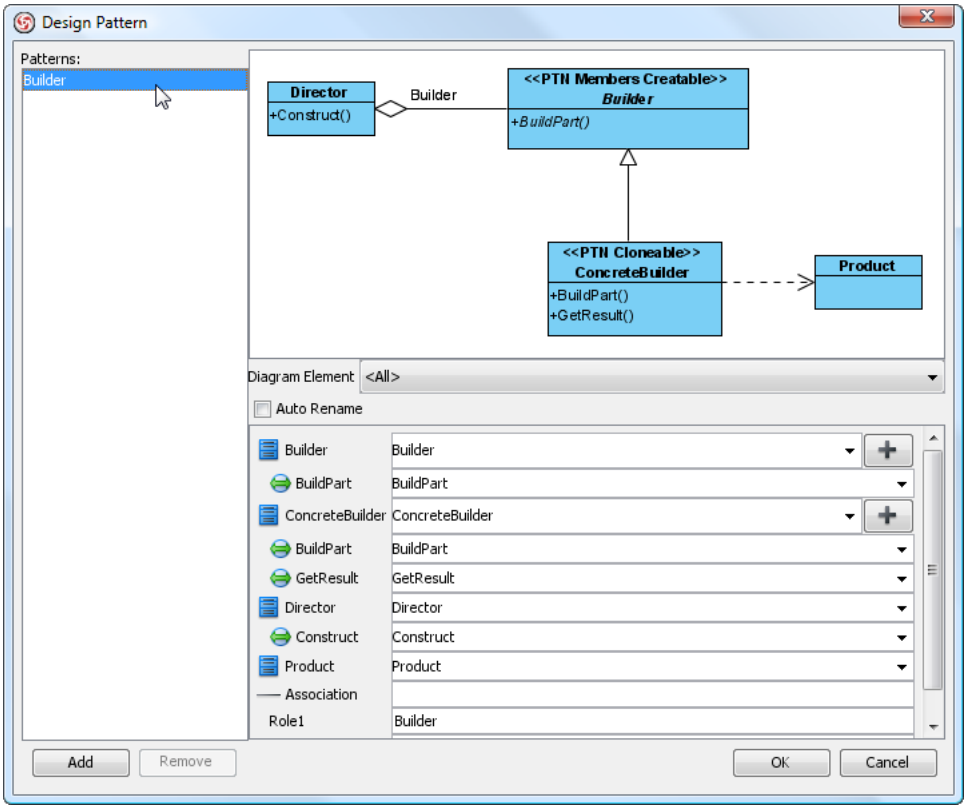
In this section, we are going to apply the builder pattern in modeling a report printing system that offers printing PDF, RTF, and HTML report one after the other, with same content in them.

1. Create a new project *Report Printer*.
2. Create a class diagram *Report Printer*.

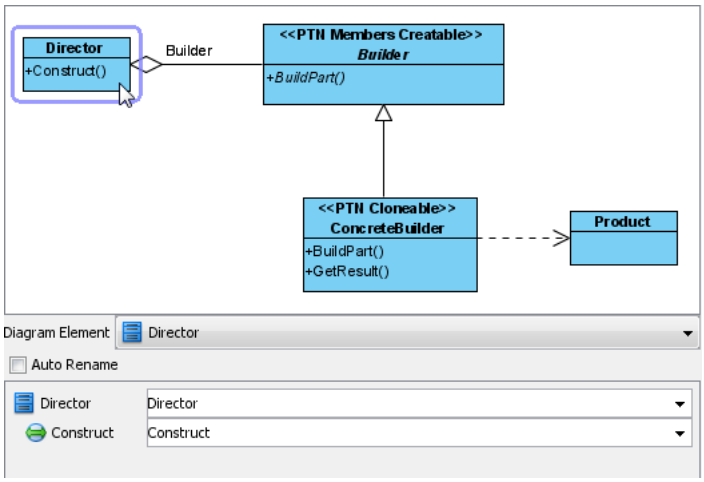
3. Right click on the class diagram and select **Utilities** > **Apply Design Pattern...** from the popup menu.



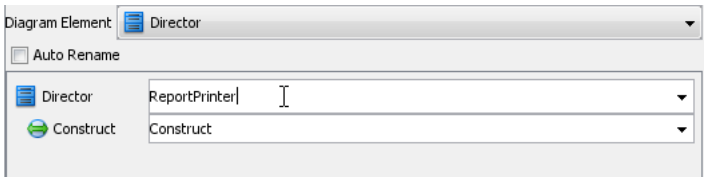
4. In the **Design Pattern** dialog box, select *Builder* from the list of patterns.



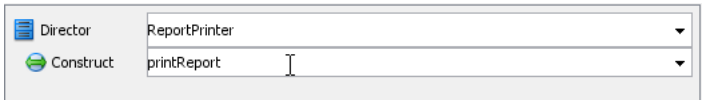
5. Click on *Director* in the preview.



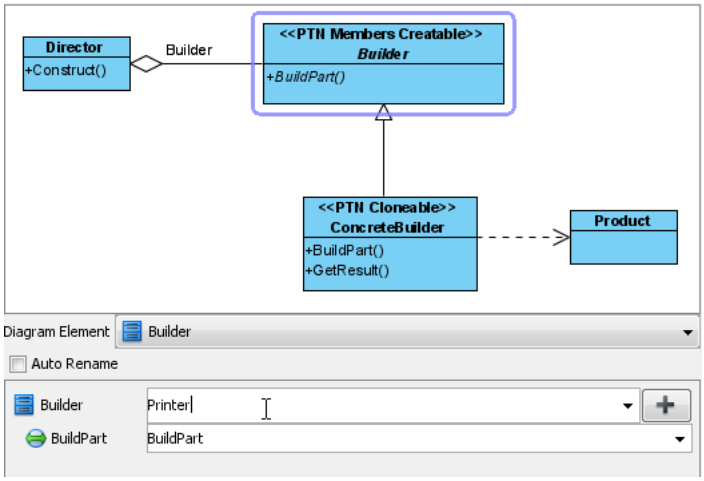
6. Rename *Director* to *ReportPrinter* at the bottom pane.



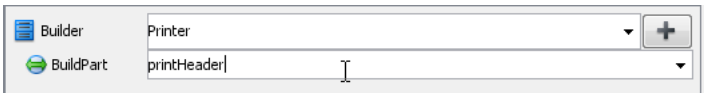
7. Rename the operation *Construct* to *printReport*.



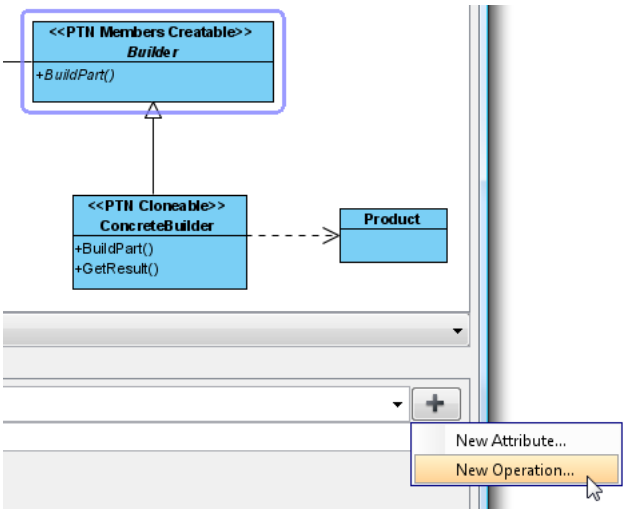
8. Rename the class *Builder* to *Printer*.



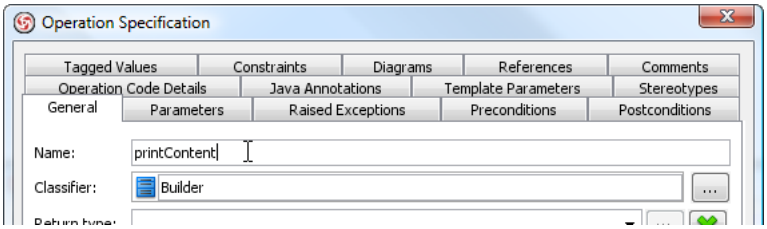
9. Rename the operation *BuildPart* to *PrintHeader*.



10. We need three operations in the *Printer* class for printing header, content and footer. Press the + button, and select **New Operation...** to add more operations.

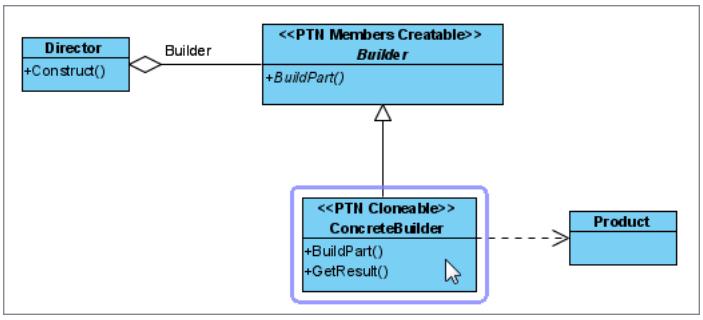


11. In the **Operation Specification**, name the operation printContent. Check **Abstract** at the bottom of dialog box. Click **OK** to confirm.

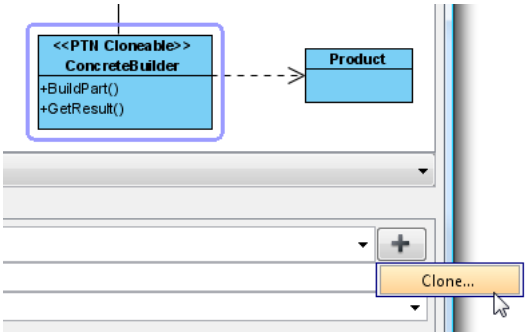


12. Repeat steps 10 and 11 to create the *printFooter* method.

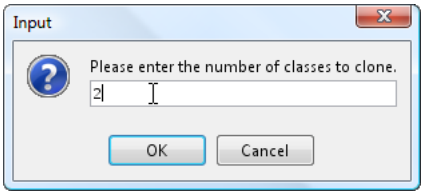
13. Now, clone the *ConcreteBuilder* class to make it have 3 subclasses as printers for PDF, RTF and HTML reports. Select *ConcreteBuilder* in preview pane first.



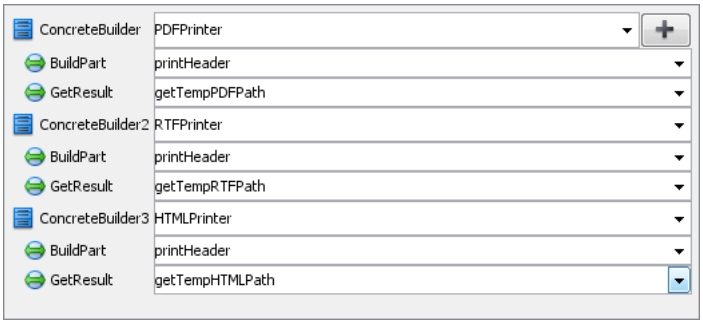
14. Click on the + button and select **Clone**.



15. Select **2** as the number of classes to clone.

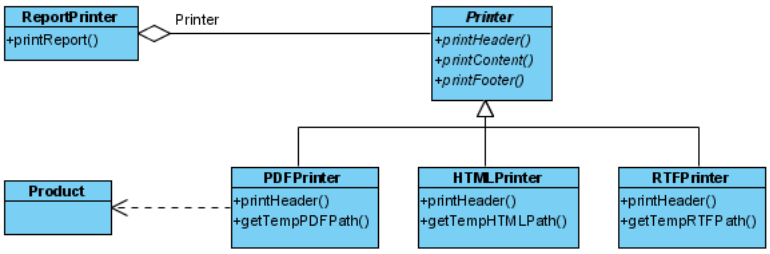


16. Rename the classes and operations as shown below:

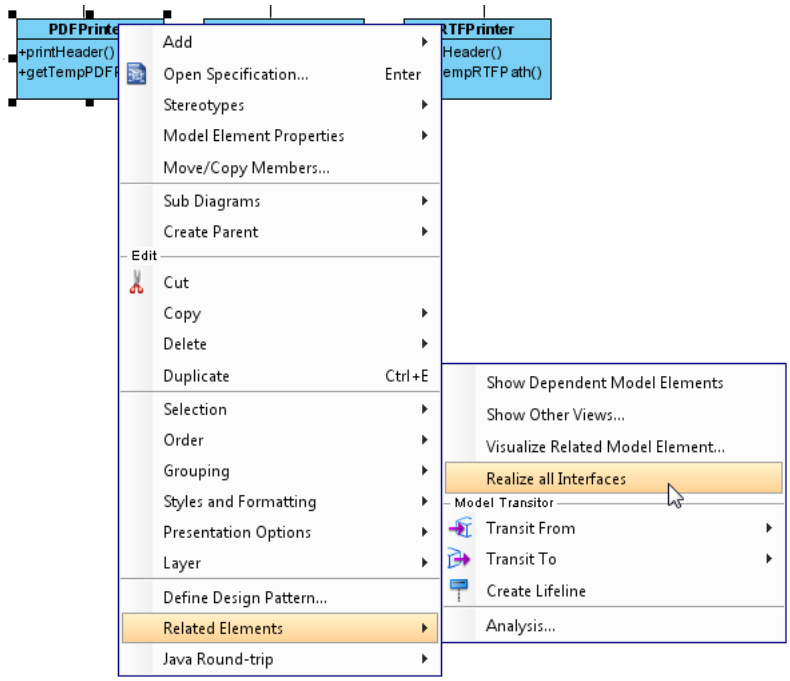


17. Click **OK** to confirm the changes and apply the pattern on diagram.

18. Tidy up the diagram to make it looks like below:

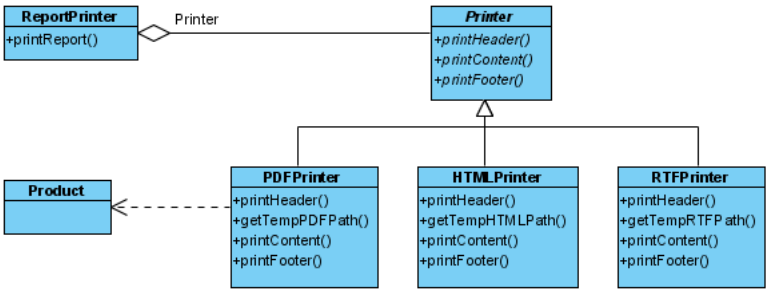


19. Inherits the operations from the *Printer* class to the concrete printer classes. Right click on *PDFPrinter* class and select **Related Elements** > **Realize all Interfaces** from the popup menu.



20. Do the same for classes *HTMLPrinter* and *RTFPrinter*.

21. Rename the role *Builder* to *Printer*. The result should look like this:



Resources

1. Builder.pat
2. Design Patterns.vpp

Related Links

- Full set of UML tools and UML diagrams

Visual Paradigm home page
(https://www.visual-paradigm.com/)

Visual Paradigm tutorials
(https://www.visual-paradigm.com/tutorials/)