FACTORY METHOD

**Intent**

Define an interface for creating an object, but let subclasses decide which class to instantiate. Factory Method lets a class defer instantiation to subclasses.

**Also Known As**

Virtual Constructor

**Motivation**

Frameworks use abstract classes to define and maintain relationships between objects. A framework is often responsible for creating these objects as well.

Consider a framework for applications that can present multiple documents to the user. Two key abstractions in this framework are the classes Application and Document. Both classes are abstract, and clients have to subclass them to realize their application-specific implementations. To create a drawing application, for example, we define the classes DrawingApplication and DrawingDocument. The Application class is responsible for managing Documents and will create them as required—when the user selects Open or New from a menu, for example.

Because the particular Document subclass to instantiate is application-specific, the Application class can't predict the subclass of Document to instantiate—the Application class only knows *when* a new document should be created, not *what kind* of Document to create. This creates a dilemma: The framework must instantiate classes, but it only knows about abstract classes, which it cannot instantiate.

The Factory Method pattern offers a solution. It encapsulates the knowledge of which Document subclass to create and moves this knowledge out of the framework.

Application subclasses redefine an abstract CreateDocument operation on Application to return the appropriate Document subclass. Once an Application subclass is

*Fuente: Design Patterns. Erich Gamma, Richard Helm, Ralf Johnson, John Vlissides
Addison – Wesley Professional Computing Series*
instantiated, it can then instantiate application-specific Documents without knowing their class. We call CreateDocument a **factory method** because it's responsible for "manufacturing" an object.

### Applicability

Use the Factory Method pattern when

- a class can't anticipate the class of objects it must create.
- a class wants its subclasses to specify the objects it creates.
- classes delegate responsibility to one of several helper subclasses, and you want to localize the knowledge of which helper subclass is the delegate.

### Structure

**Participants**

- **Product** (Document)
  - defines the interface of objects the factory method creates.
- **ConcreteProduct** (MyDocument)
  - implements the Product interface.
- **Creator** (Application)
  - declares the factory method, which returns an object of type Product.
  - may call the factory method to create a Product object.
- **ConcreteCreator** (MyApplication)
  - overrides the factory method to return an instance of a ConcreteProduct.

### Collaborations

- Creator relies on its subclasses to define the factory method so that it returns an instance of the appropriate ConcreteProduct.

### Consequences

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Factory methods eliminate the need to bind application-specific classes into your code. The code only deals with the Product interface; therefore it can work with any user-defined ConcreteProduct classes.

A potential disadvantage of factory methods is that clients might have to subclass the Creator class just to create a particular ConcreteProduct object. Subclassing is fine when the client has to subclass the Creator class anyway, but otherwise the client now must deal with another point of evolution.

Here are two additional consequences of the Factory Method pattern:

1. **Provides hooks for subclasses.** Creating objects inside a class with a factory method is always more flexible than creating an object directly. Factory Method gives subclasses a hook for providing an extended version of an object.

   In the Document example, the Document class could define a factory method called CreateFileDialog that creates a default file dialog object for opening an existing document. A Document subclass can define an application-specific file dialog by overriding this factory method. In this case the factory method is not abstract but provides a reasonable default implementation.

2. **Connects parallel class hierarchies.** In the examples we've considered so far, the factory method is only called by Creators. But this doesn't have to be the case; clients can find factory methods useful, especially in the case of parallel class hierarchies.

   Parallel class hierarchies result when a class delegates some of its responsibilities to a separate class. Consider graphical figures that can be manipulated interactively; that is, they can be stretched, moved, or rotated using the mouse. Implementing such interactions isn't always easy. It often requires storing and updating information that records the state of the manipulation at a given time. This state is needed only during manipulation; therefore it needn't be kept in the figure object. Moreover, different figures behave differently when the user manipulates them. For example, stretching a line figure might have the effect of moving an endpoint, whereas stretching a text figure may change its line spacing.

   With these constraints, it's better to use a separate Manipulator object that implements the interaction and keeps track of any manipulation-specific state that's needed. Different figures will use different Manipulator subclasses to handle particular interactions. The resulting Manipulator class hierarchy parallels (at least partially) the Figure class hierarchy:
The Figure class provides a CreateManipulator factory method that lets clients create a Figure's corresponding Manipulator. Figure subclasses override this method to return an instance of the Manipulator subclass that's right for them. Alternatively, the Figure class may implement CreateManipulator to return a default Manipulator instance, and Figure subclasses may simply inherit that default. The Figure classes that do so need no corresponding Manipulator subclass—hence the hierarchies are only partially parallel.

Notice how the factory method defines the connection between the two class hierarchies. It localizes knowledge of which classes belong together.