Creational Pattern: Prototype

Kevin Dockx
Architect

@KevinDockx https://www.kevindockx.com

Coming Up

Describing the prototype pattern

Structure of the prototype pattern

Implementation

- Real-life sample: cloning an Employee and Manager, deriving from Person

Deep copy versus shallow copy

ICloneable interface

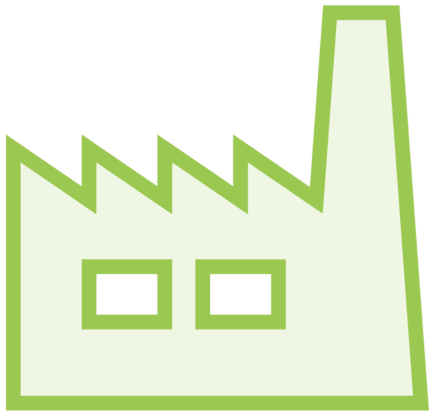
Coming Up

Use cases for this pattern

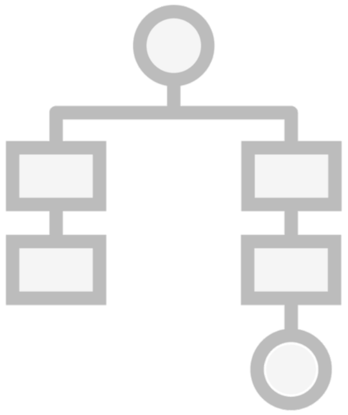
Pattern consequences

Related patterns

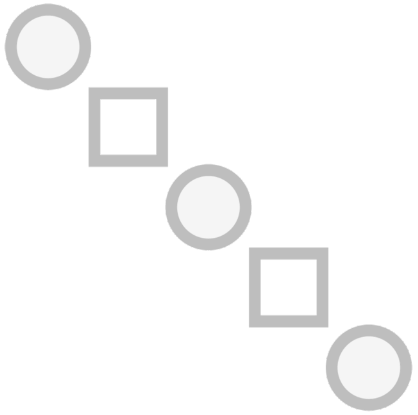
Describing the Prototype Pattern



Creational



Structural



Behavioral

Prototype

The intent of this pattern is to specify the kinds of objects to create using a prototypical instance, and create new objects by copying this prototype

```
var existingManager = new Manager("Cindy");
var existingEmployee = new Employee("Kevin", existingManager);

var newEmployee = new Employee();
newEmployee.Name = existingEmployee.Name;
newEmployee.Manager = existingEmployee.Manager;
```

Describing the Prototype Pattern

```
var existingManager = new Manager("Cindy");
var existingEmployee = new Employee("Kevin", existingManager);

var newEmployee = new Employee();
newEmployee.Name = existingEmployee.Name;
newEmployee.Manager = existingEmployee.Manager;
```

Describing the Prototype Pattern

```
var existingManager = new Manager("Cindy");
var existingEmployee = new Employee("Kevin", existingManager);

var newEmployee = new Employee();
newEmployee.Name = existingEmployee.Name;
newEmployee.Manager = existingEmployee.Manager;
```

Describing the Prototype Pattern

Requires intrinsic knowledge of concrete classes, and how to create them

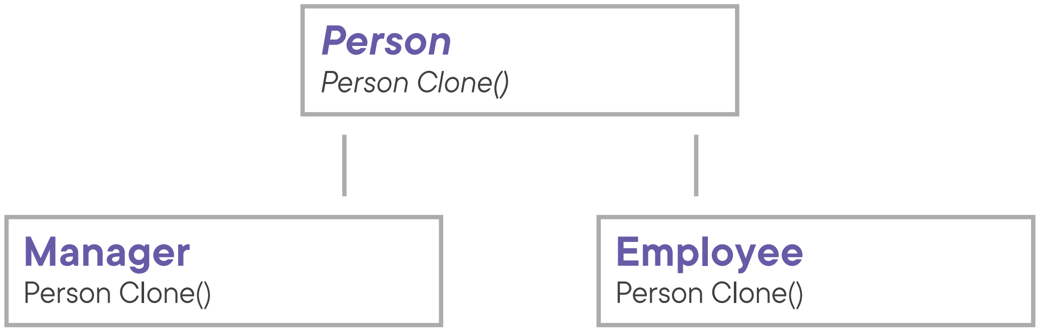
Describing the Prototype Pattern

Describing the Prototype Pattern

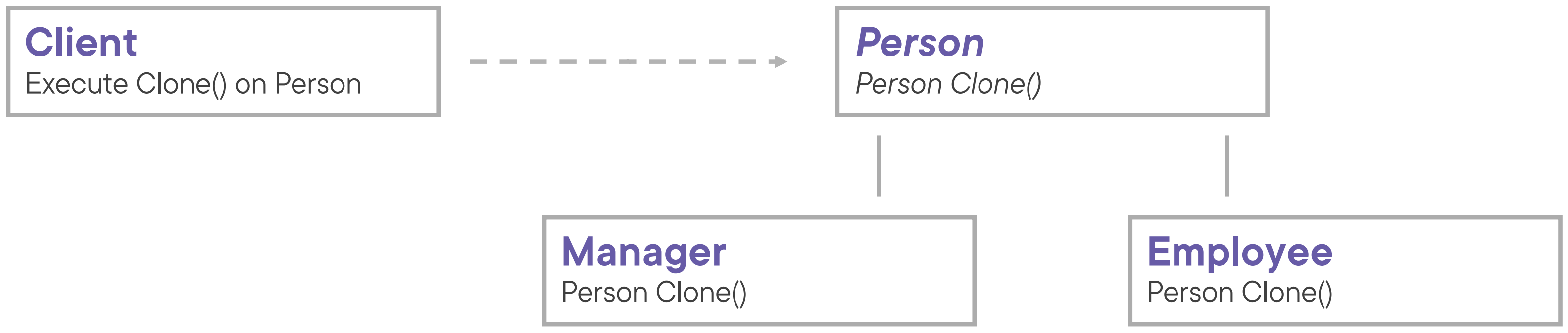
Manager
Clone()

Employee
Clone()

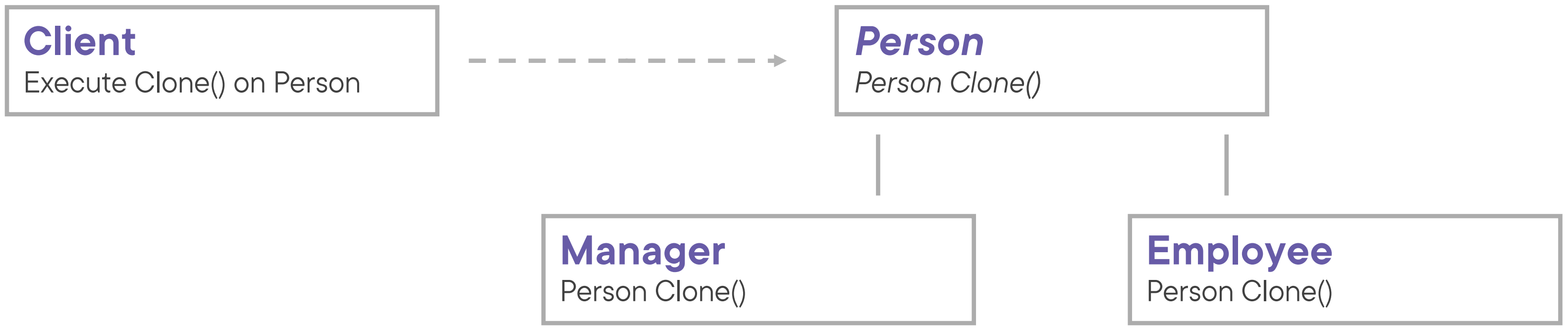
Describing the Prototype Pattern



Describing the Prototype Pattern

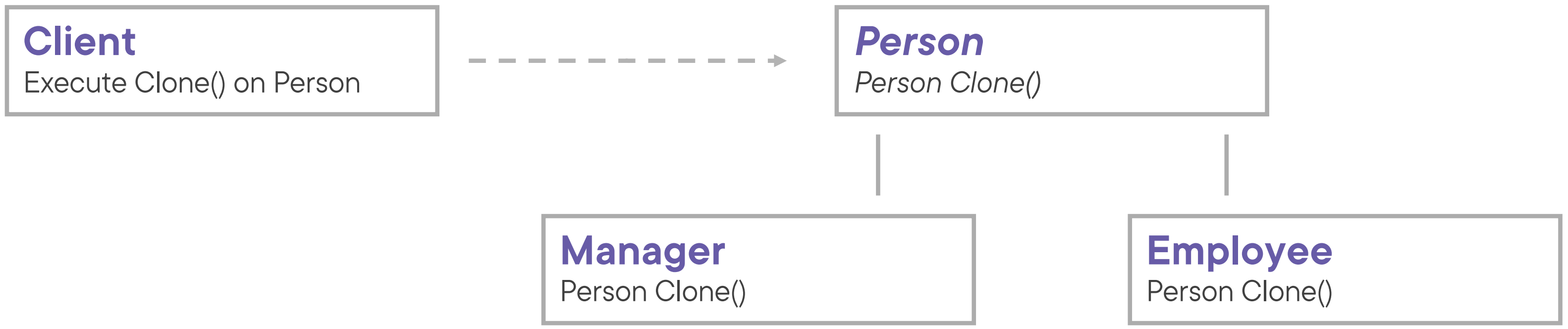


Prototype Pattern Structure

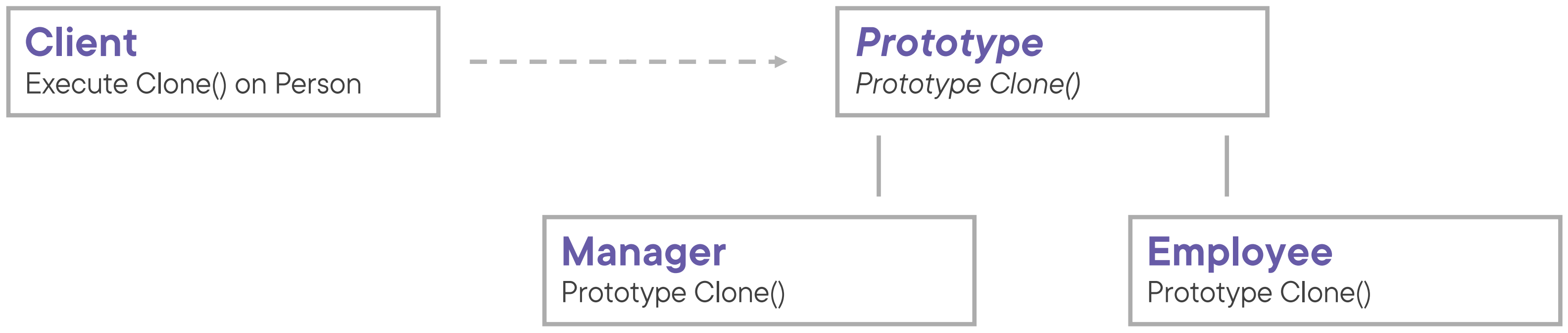


Prototype declares an interface for cloning itself

Prototype Pattern Structure

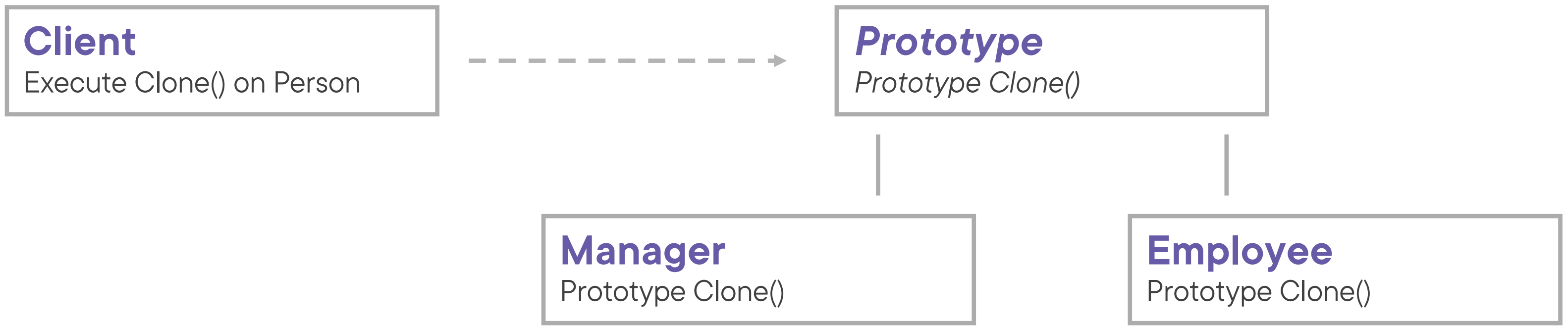


Prototype Pattern Structure

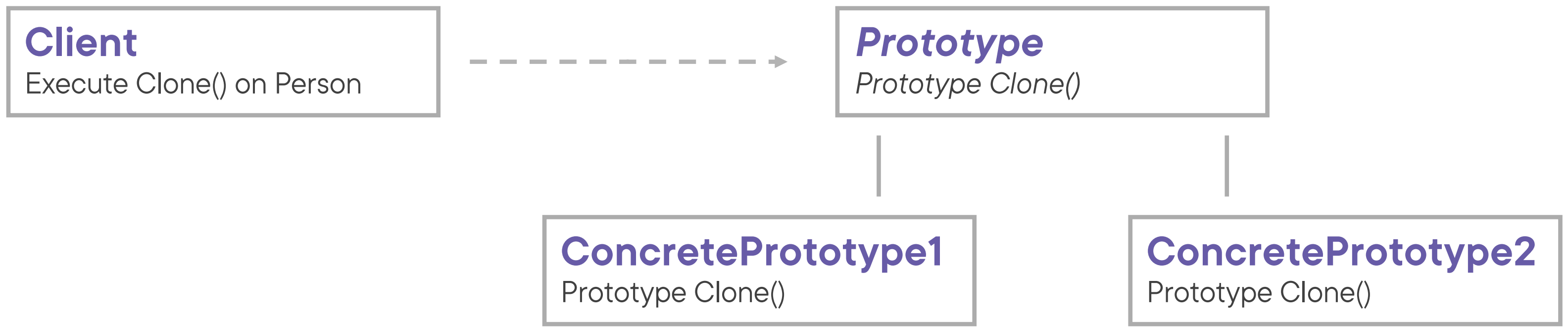


ConcretePrototype implements an operation for cloning itself

Prototype Pattern Structure

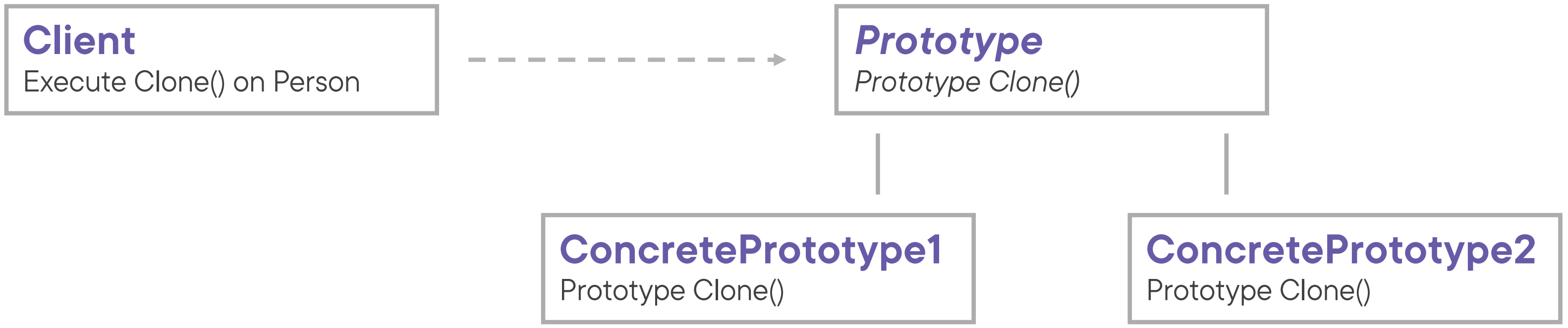


Prototype Pattern Structure

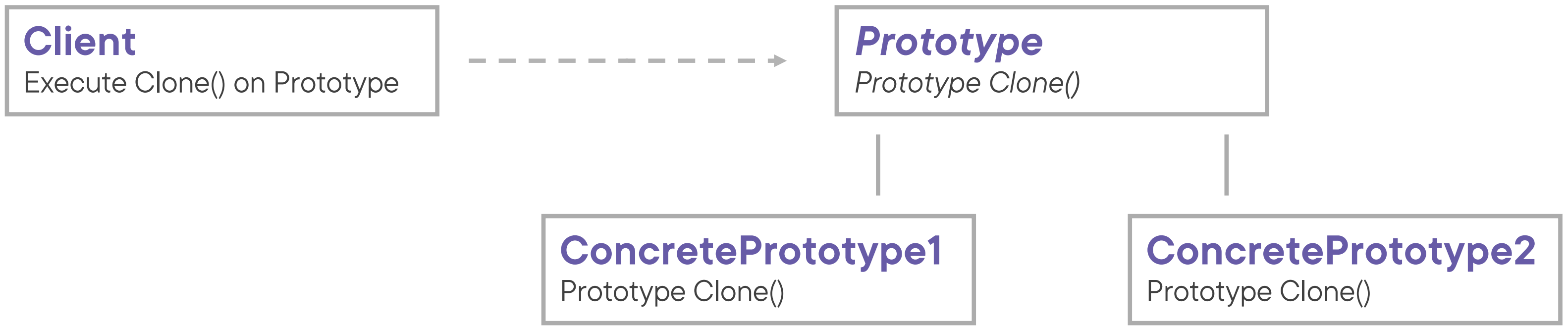


Client creates a new object by asking a **Prototype** to clone itself

Prototype Pattern Structure



Prototype Pattern Structure



Demo

Implementing the prototype pattern

Shallow Copy vs. Deep Copy

Shallow copy

Copy of primitive type values

Complex type values will be shared across clones

Deep copy

Copy of primitive type values and complex type values

Demo

Supporting deep copies

What About the ICloneable Interface?

ICloneable enables us to provide a customized implementation that creates a copy of an existing object

What About the ICloneable Interface?

👎 **It does not specify whether the cloning operation performs a deep copy, a shallow copy, or something in between**

👎 **It doesn't require all property values of the original instance to be copied to the new instance**

👎 **It returns an object, which means the client could need an additional cast**

Use Cases for the Prototype Pattern

When a system should be independent of how its objects are created, and to avoid building a set of factories that mimics the class hierarchy

When a system should be independent of how its objects are created, and when instances of a class can have one of only a few different combinations of states

Pattern Consequences

Prototype hides the ConcreteProduct classes from the client, which reduces what the client needs to know

Reduced subclassing

Each implementation of the prototype base class must implement its own clone method

Related Patterns

Abstract factory
A factory might store a set of prototypes from which it clones when a new instance is requested

Factory method
Factory method is based on inheritance, but doesn't require an initialization step

Singleton
Prototype can be implemented as a singleton

Composite
Can use prototype for convenient object creation

Decorator
Can use prototype for convenient object creation

Summary

Intent of the prototype pattern:

- Specify the kinds of objects to create using a prototypical instance, and create new objects by copying this prototype

Summary

Implementation:

- Subclasses of the `Prototype` implement the `Clone()` method
- Clients work on the `Prototype`

Summary

A shallow copy is a copy of primitive type values, while a deep copy is a copy of primitive type values and complex type values

Up Next:

Structural Pattern: Adapter