Design Patterns

Abstract Factory Pattern

Who should create?

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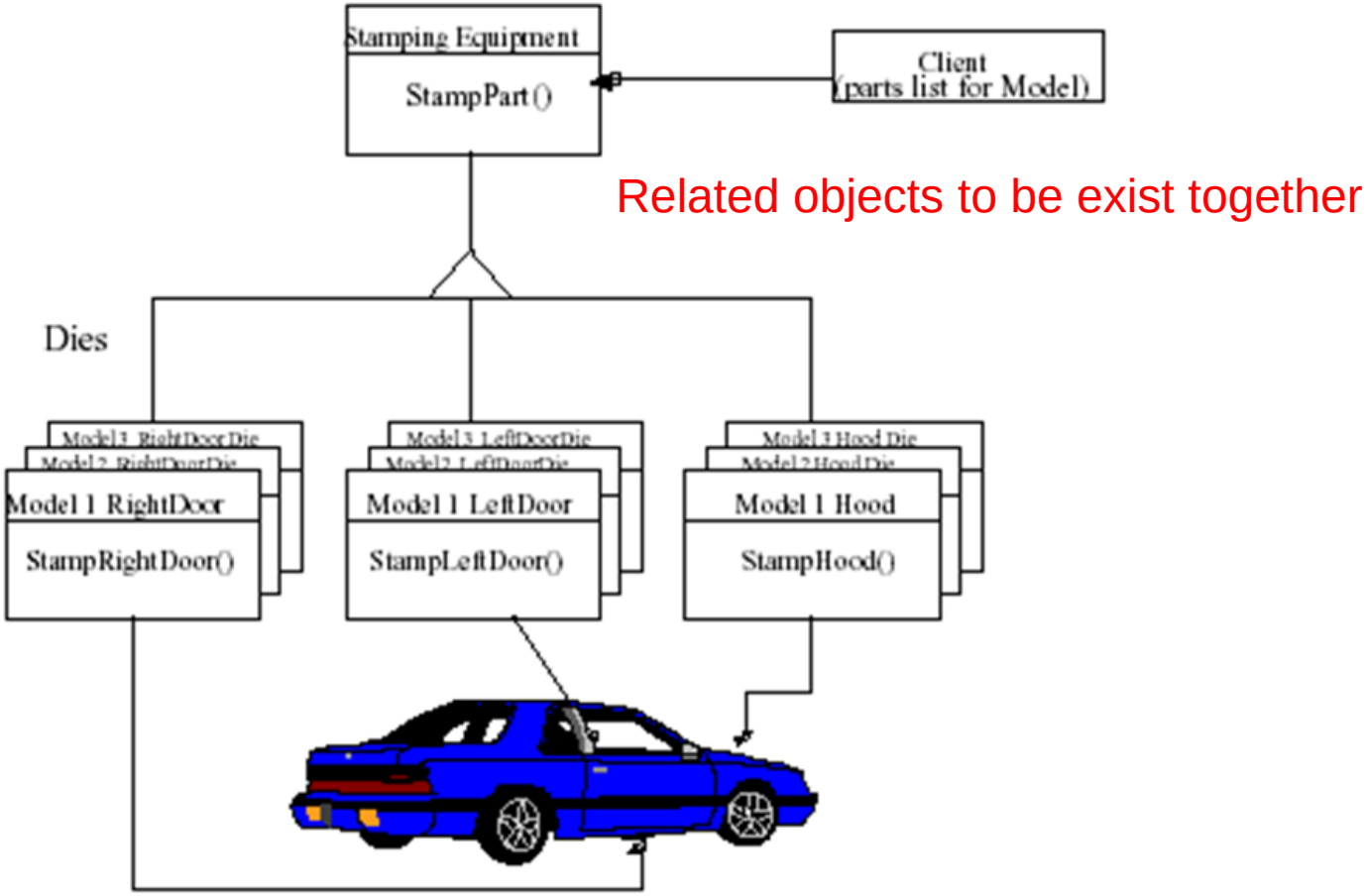
revised from, www.uwosh.edu/faculty_staff/huen/262/f09/slides/10_ Strategy_Pattern.ppt***

Creator of Creators

- What is object family ?



May be you kill the dreams but prevention of mismatchings is important
(model1lefdoor-model2rightdoor)

What is ?

- This pattern is one level of abstraction higher than factory pattern

- This means that the abstract factory returns the factory of classes. Like Factory pattern returned one of the several sub-classes, this returns such factory which later will return one of the sub-classes

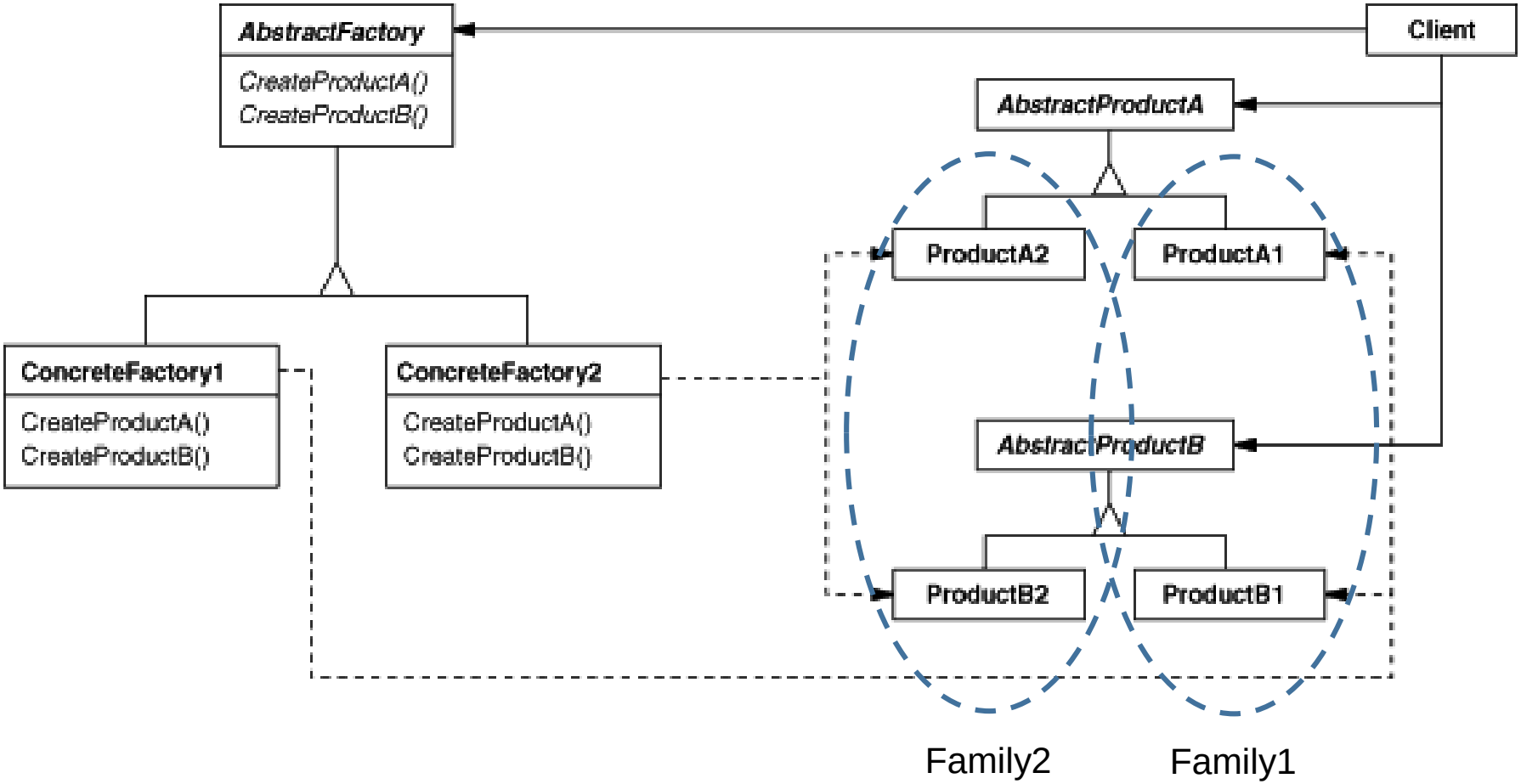
Intend?

"provide an interface for creating families of related or dependent objects without specifying their concrete class"

When it is useful ?

- a system should be independent of how its products are created, composed, and represented
- a system should be configured with one of multiple families of products
- a family of related product objects is designed to be used together, and you need to enforce this constraint
- you want to provide a class library of products, and you want to reveal just their interfaces, not their implementations

Structure


AbstractFactory
CreateProductA()
CreateProductB()
Client
AbstractProductA
ProductA2
ProductA1
ConcreteFactory1
CreateProductA()
CreateProductB()
ConcreteFactory2
CreateProductA()
CreateProductB()
AbstractProductB
ProductB2
ProductB1
Family2
Family1

Components

AbstractFactory (GUIFactory)

- declares an interface for operations that create abstract product objects.

ConcreteFactory (WinFactory, OSXFactory)

- implements the operations to create concrete product objects.

AbstractProduct (Button)

- declares an interface for a type of product object.

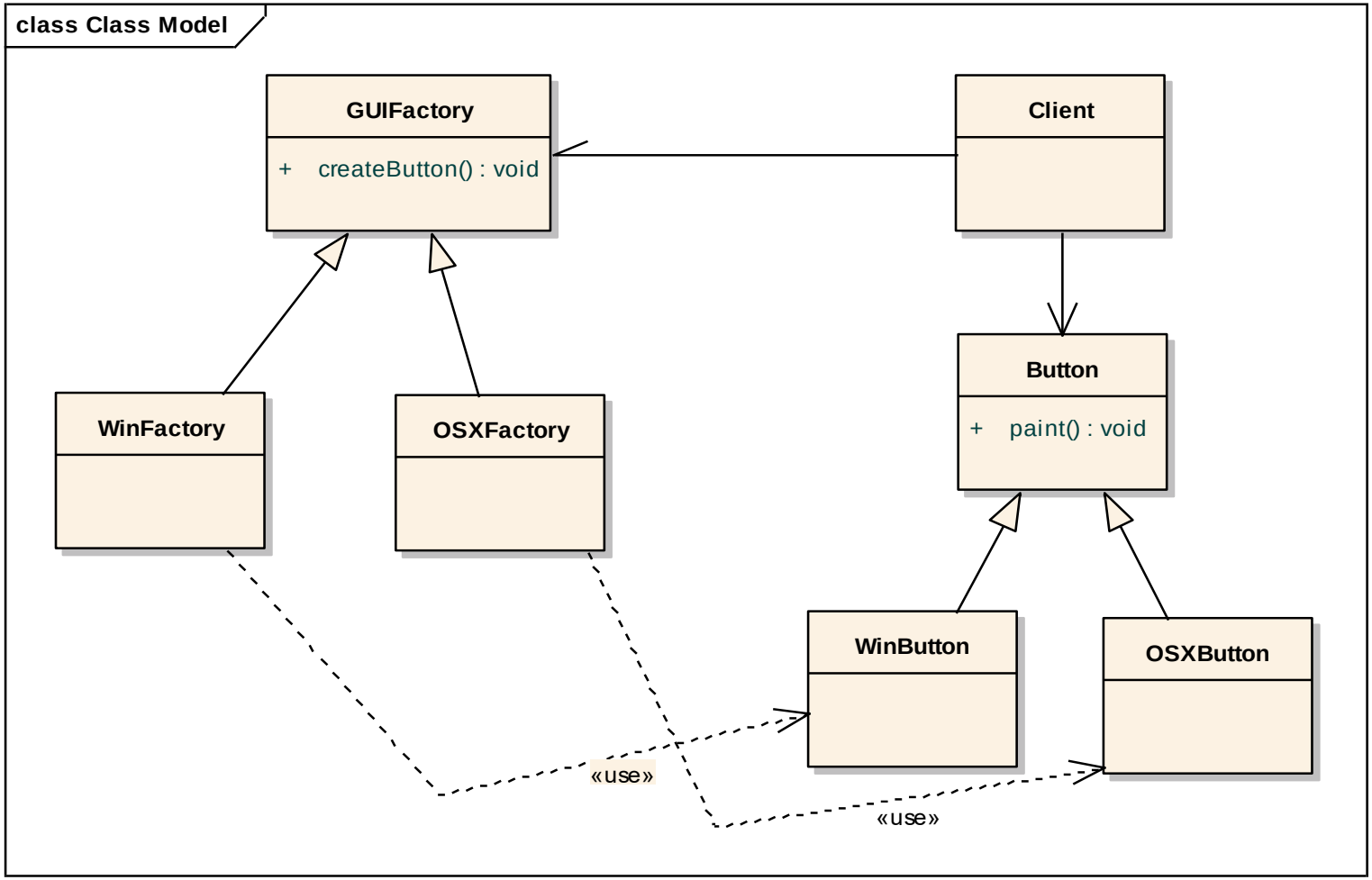
ConcreteProduct (WinButton, OSXButton)

- defines a product object to be created by the corresponding concrete factory.
- implements the AbstractProduct interface.

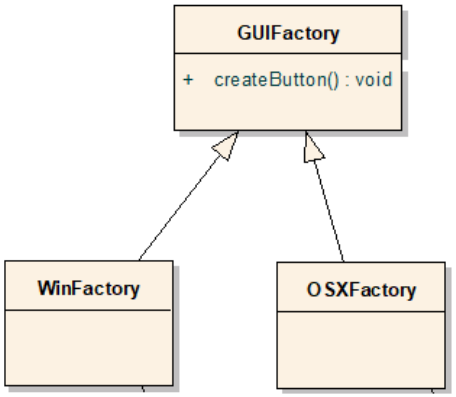
Client

- uses only interfaces declared by AbstractFactory and AbstractProduct classes

Easy Sample (No Config)



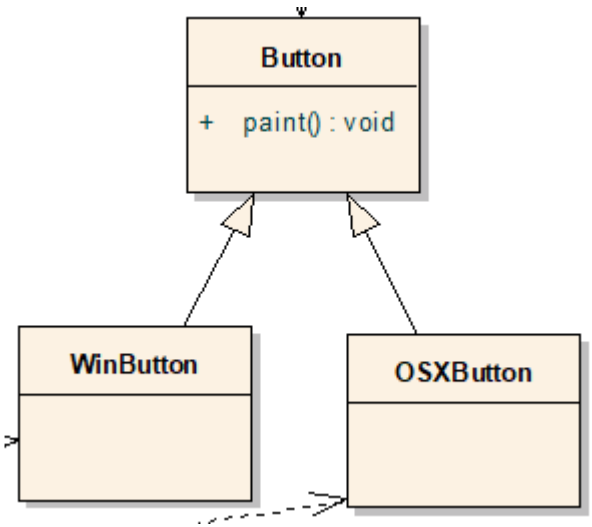
Factories




```
public abstract class GUIFactory {
   public static GUIFactory getFactory() {
      int sys = readFromConfigFile("OS_TYPE");
      if (sys == 0) {
         return(new WinFactory());
      } else {
         return(new OSXFactory());
      }
   }
   public abstract Button createButton();
}
class WinFactory extends GUIFactory {
   public Button createButton() {
      return(new WinButton());
   }
}
class OSXFactory extends GUIFactory {
   public Button createButton() {
      return(new OSXButton());
   }
}
```

→ it is overridden in concrete factories

Product Creation

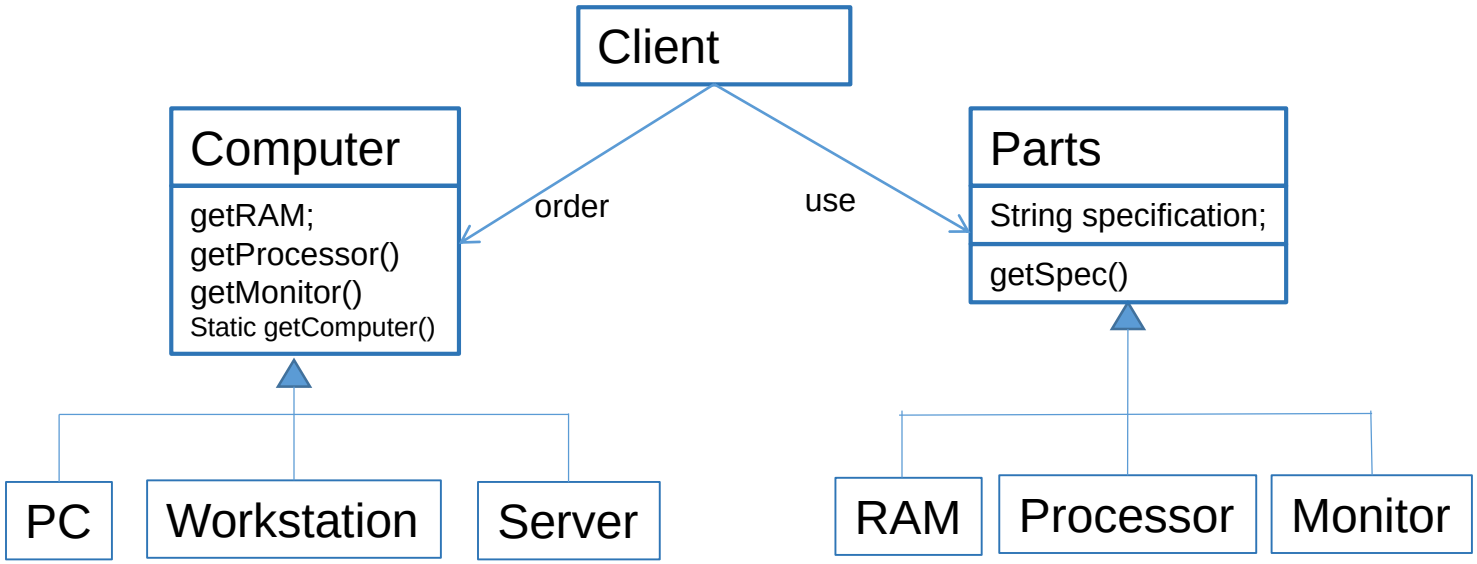



```
public abstract class Button {
  private String caption;
  public abstract void paint();
  public String getCaption(){
     return caption;
  }
  public void setCaption(String caption){
     this.caption = caption;
  }
}
class WinButton extends Button {
   public void paint() {
      System.out.println("I'm a WinButton: " + getCaption());
   }
}
class OSXButton extends Button {
   public void paint() {
      System.out.println("I'm a OSXButton : " + getCaption());
   }
}
```

```java
public class Application {
   public static void main(String[] args) {
      GUIFactory aFactory = GUIFactory.getFactory(); // get Concrete Factory
      Button aButton = aFactory.createButton();  // get Concrete Product
      aButton.setCaption("Play"); // use Concrete Product
      aButton.paint();
   }
}

//output is
//I'm a WinButton: Play
//or
//I'm a OSXButton: Play
```

Sample 2 – with config, instant product creation



- Suppose we need to get the specification of various parts of a computer based on which work the computer will be used for.
- The different parts of computer are, say Monitor, RAM and Processor. The different types of computers are PC, Workstation and Server.

abstract base class Computer

```
abstract class Computer {
   private static Computer comp;
   public abstract Parts getRAM();
   public abstract Parts getProcessor();
   public abstract Parts getMonitor();
   public static Computer getComputer(String computerType){
      if (computerType.equals("PC"))
      {          comp = new PC();      }
      else if(computerType.equals("Workstation"))
      {          comp = new Workstation();       }
      else if(computerType.equals("Server"))
      {          comp = new Server();        }
      return comp;
   }
}
```

class Parts

```
class Parts {
   public String specification;
   public Parts() {}
   public Parts(String specification)
      {
      this.specification =
            specification;
      }
   public String getSpec() {
      return specification;
   }
}

class RAM extends Parts {
   public RAM(String specification)
      {
      this.specification =
            specification;
      }
}
```

```
class Processor extends Parts {
   public Processor(String
      specification)
      {
      this.specification =
            specification;
      }
}

class Monitor extends Parts {
   public Monitor(String
            specification)
      {
      this.specification =
            specification;
      }
}
```

sub-classes of Computer

```
class PC extends Computer {
    public Parts getRAM() {
        return new RAM("8 GB");
    }
    public Parts getProcessor() {
        return new Processor("M");
    }
    public Parts getMonitor() {
        return new Monitor("15 inches");
    }
}
```

```
class Workstation extends Computer{
    public Parts getRAM() {
        return new RAM(32 GB");
    }
    public Parts getProcessor() {
        return new Processor("Z Series");
    }
    public Parts getMonitor() {
        return new Monitor("19 inches");
    }
}
```

```
class Server extends Computer{
    public Parts getRAM() {
        return new RAM("128 GB");
    }
    public Parts getProcessor() {
        return new Processor("Zeon");
    }
    public Parts getMonitor() {
        return new Monitor("17 inches");
    }
}
```

Client

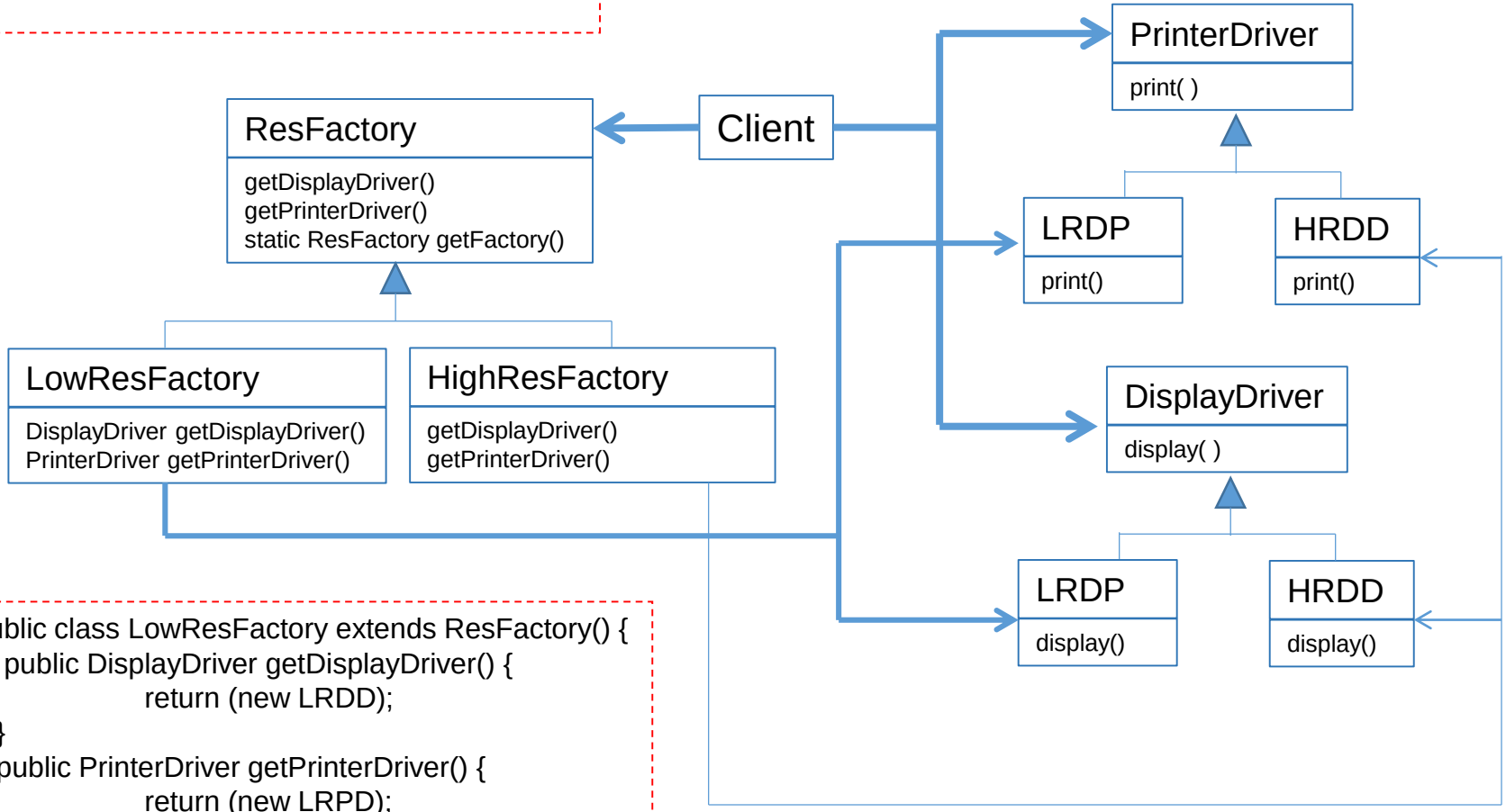
```
public class Client {

    public static void main(String args[]) {

        Computer c = Computer.getComputer("Workstation");
        System.out.println(c.getMonitor().getSpec());
        System.out.println(c.getRAM().getSpec());
        System.out.println(c.getProcessor().getSpec());
    }
}
```

```
public abstract class ResFactory() {
public static Resfactory getFactory(){
    if (System.power is Low)
      return LowResFactory()
    else  return HighResFactory()
  }
  public abstract DisplayDriver getDisplayDriver();
  public abstract PrinterDriver getPrinterDriver();
}
```

```
public class Client {
  public static void main(String args[]) {
    PrinterDirver p = (ResFactory.getFactory()).getPrinterDriver();
    DisplayDirver d = (ResFactory.getFactory()).getDisplayDriver();
    p.print();
    d.display();
  }
}
```




```
public class LowResFactory extends ResFactory() {
    public DisplayDriver getDisplayDriver() {
                return (new LRDD);
   }
   public PrinterDriver getPrinterDriver() {
                return (new LRPD);
   }
}
```

(+)

- *It isolates concrete classes.*

Product class names are isolated in the implementation of the concrete factory. They do not appear in the client code.

(+)

- *It makes exchanging product families easy.*

The class of a concrete factory appears only once in the application (when it is instantiated) Easy to change the concrete factory an application uses. The whole product family changes at once

(+)

- *It promotes consistency among products.*

When products are designed to work together, it’s important that an application use objects only from one family at a time. Abstract Factory makes this easy to enforce

Builder vs Abstract Factory

- Builder constructs a complex object step by step depending on the data presented to it

- Abstract Factory returns a family of related classes

Abstract Factory vs Factory Method

- The Factory Method can make a set of objects, with the objects created only as a set.

  The Abstract Factory can make a number of related objects, with each object created individually.

  So, maybe in a restaurant anology the abstract factory would be "a la carte" and the factory method "fixed price".