# Comp-304 : Factory
Lecture 31

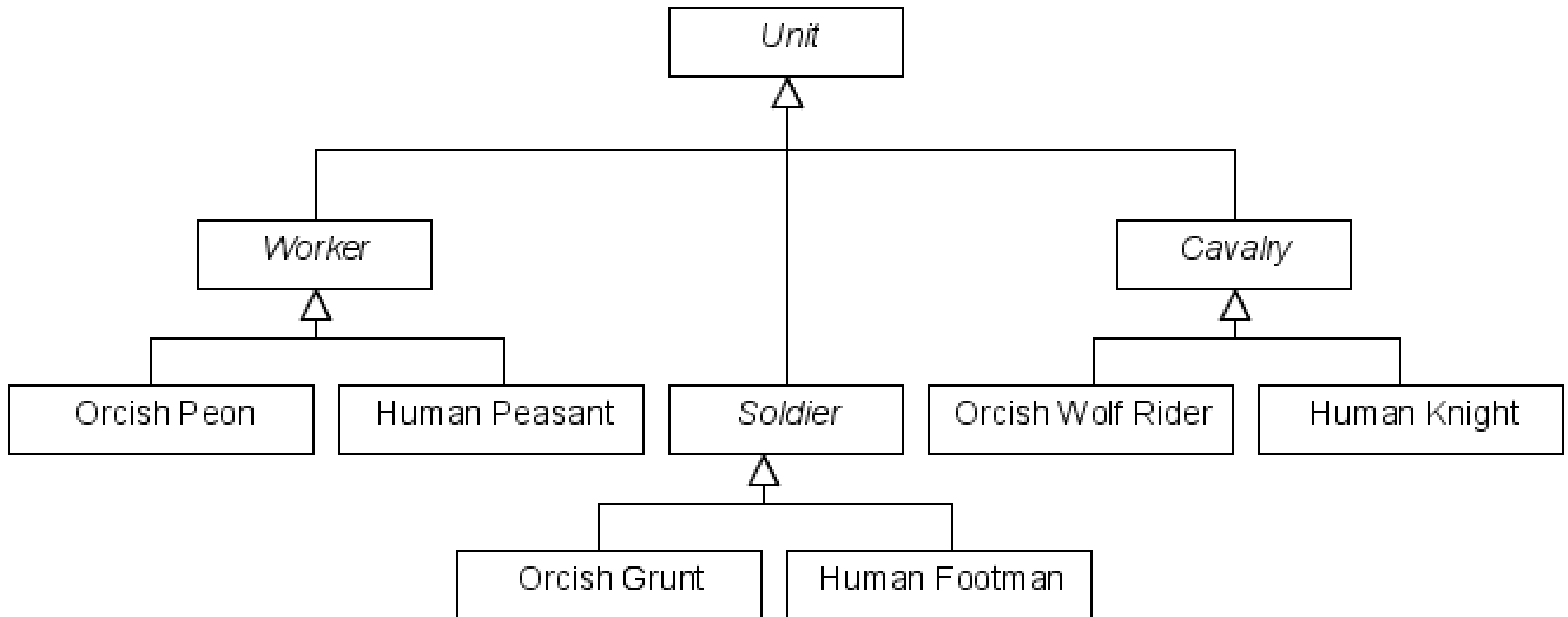
Alexandre Denault
Original notes by Hans Vangheluwe
Computer Science
McGill University
Fall 2007

# Mercury

$$10 / 23 = 43.5\%$$

# Human vs Orc

- The following classes are from a real time strategy game where Humans and Orcs face each other for supremacy




- Each Human unit has an Orcs counterpart which is identical.

# If ... else ...

- The interface for players playing either race is identical.
- Thus, every function that creates a unit has a similar piece of code:

```
Worker worker;
if (player.race == RACE.HUMAN) {
    worker = createPeasants()
} else {
    worker = createPeon()
}
```

- This is bad because
  - It's code duplication.
  - It's going to make things complicated when I add another race.
- What can I do to avoid this?

# Factory Patterns

- Factory patterns are examples of creational patterns
- They hide how objects are created and help make the overall system independent of how its objects are created and composed.

# Two Types

- Class creational patterns focus on the use of inheritance to decide the object to be instantiated
  - Factory Method
- Object creational patterns focus on the delegation of the instantiation to another object
  - Abstract Factory

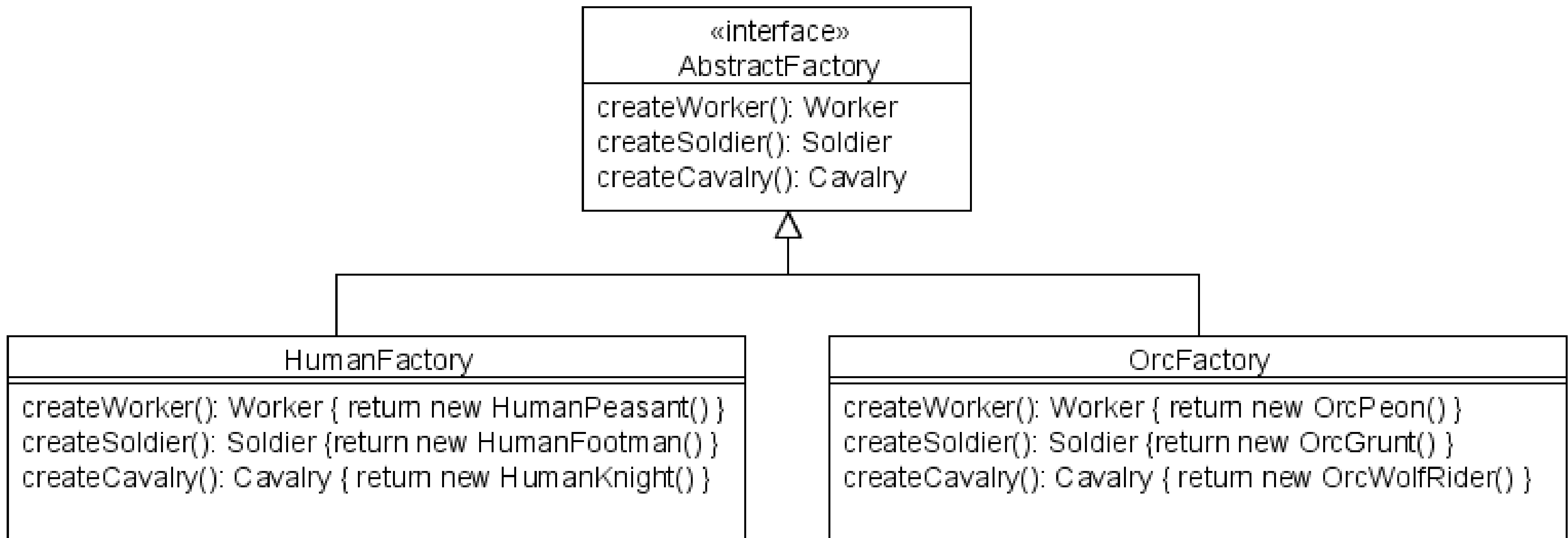
# Abstract Factory

- Provide an interface for creating families of related or dependent objects without specifying their concrete classes.

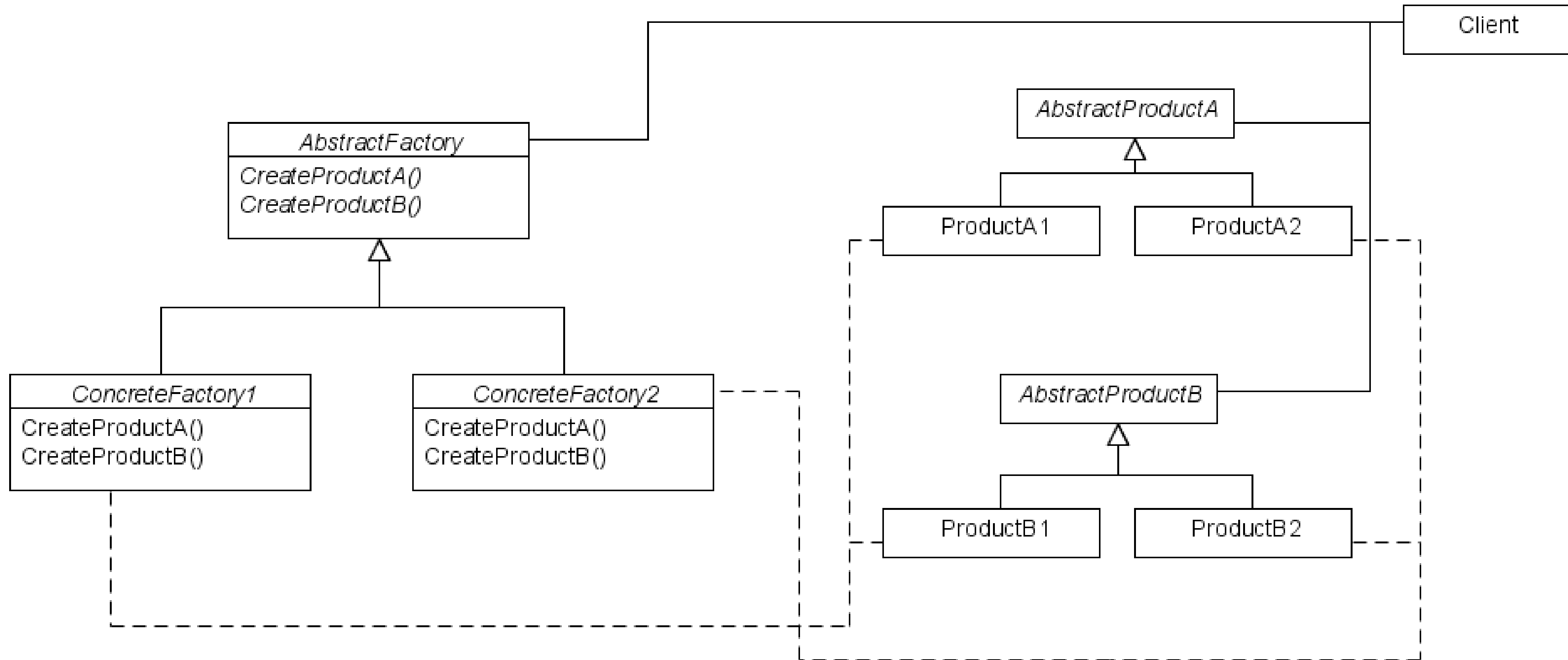
# Applicability

- Use the Abstract Factory pattern in any of the following situations:
  - A system should be independent of how its products are created, composed, and represented
  - A class can't anticipate the class of objects it must create
  - A system must use just one of a set of families of products
  - A family of related product objects is designed to be used together, and you need to enforce this constraint

# Families of Soldiers



# Class Diagram



# Participants

- AbstractFactory
  - Declares an interface for operations that create abstract product objects
- ConcreteFactory
  - Implements the operations to create concrete product objects
- AbstractProduct
  - Declares an interface for a type of product object
- ConcreteProduct
  - 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

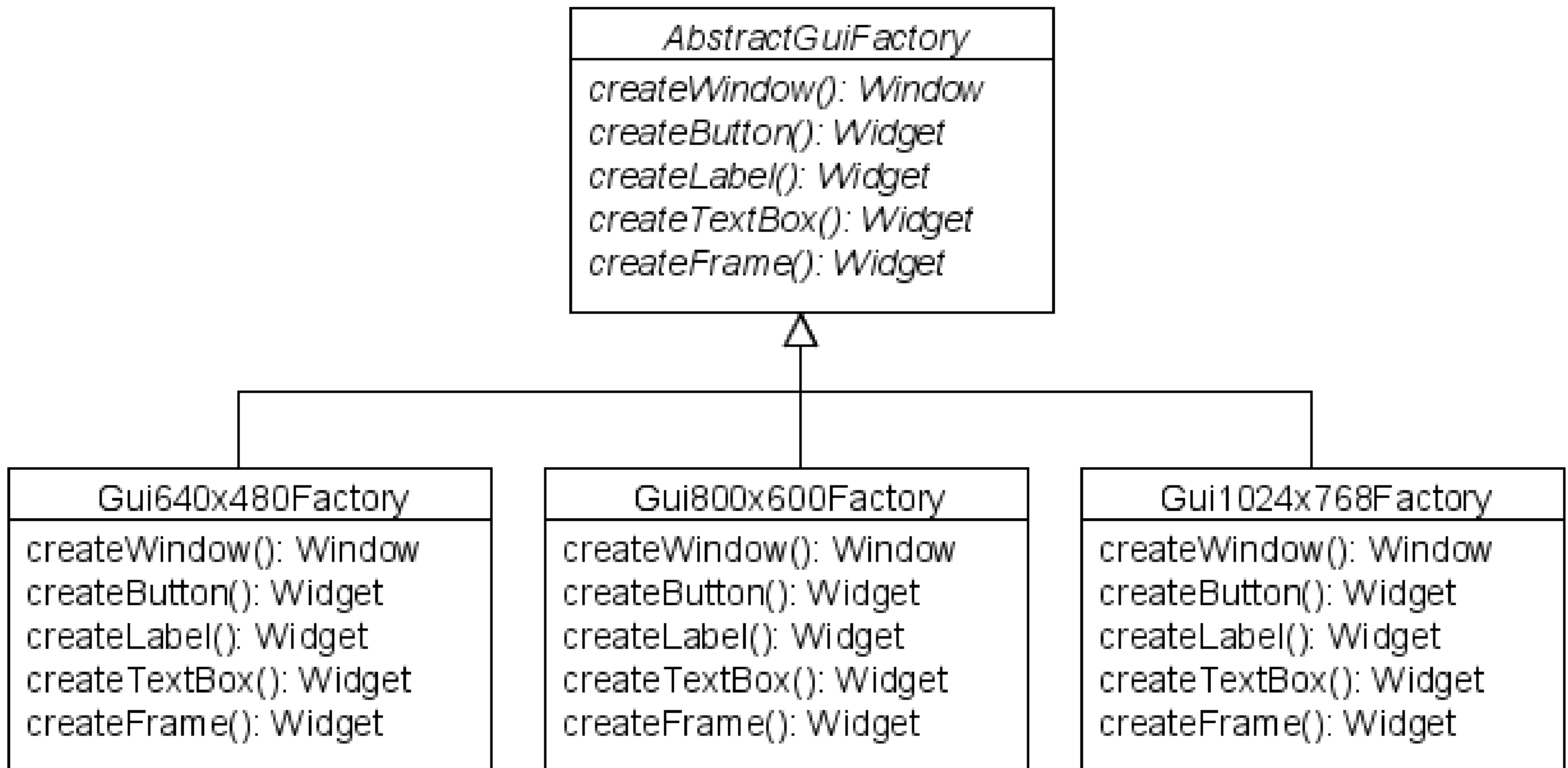
# Consequences

- Exchanging or adding product families is easy.
- It also promotes consistencies among product (across families).
- However, adding new products involves a lot more modifications.

# GUI Systems Games

- Before 3D acceleration, GUI system in game very sensitive to screen resolution variations.
- For gameplay reasons, whatever the screen resolution, the GUI had to be the same size.
- Because of this complexity, many games had only one resolution.

# GUIFactory



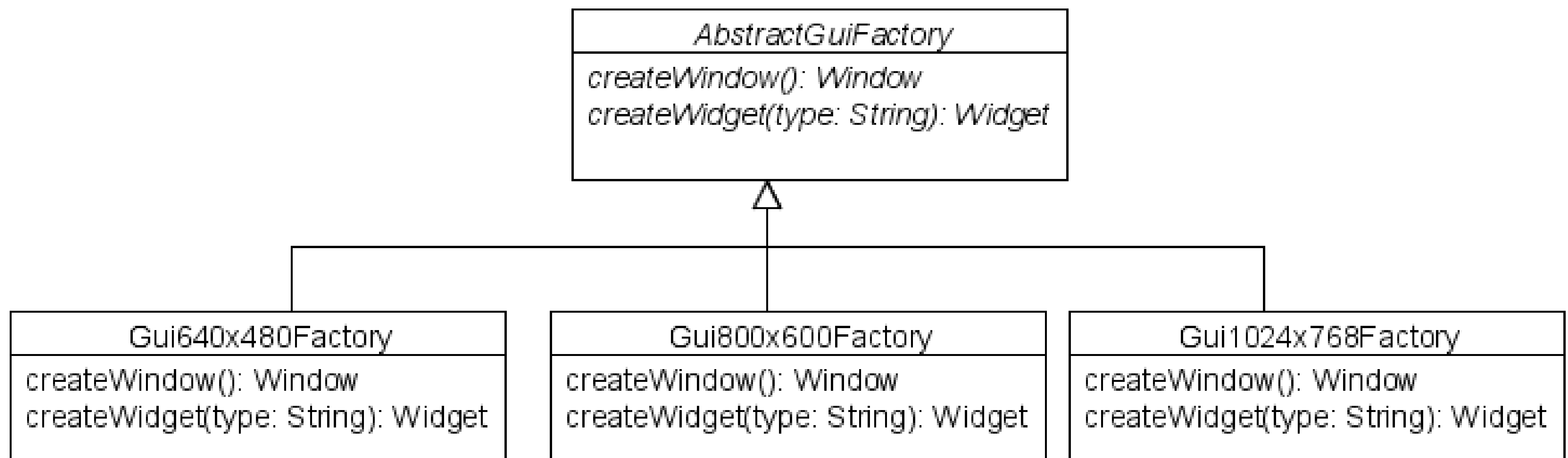
# Factories as Singletons

- Typically, you only need one instance of a factory per product family.
- That makes it an ideal candidate for Singleton.

# Extensible Factories

- One of the big limitation of Abstract Factory is the impact of adding new products.
- A flexible, but less safe design, is to parameterize the object you want to create.

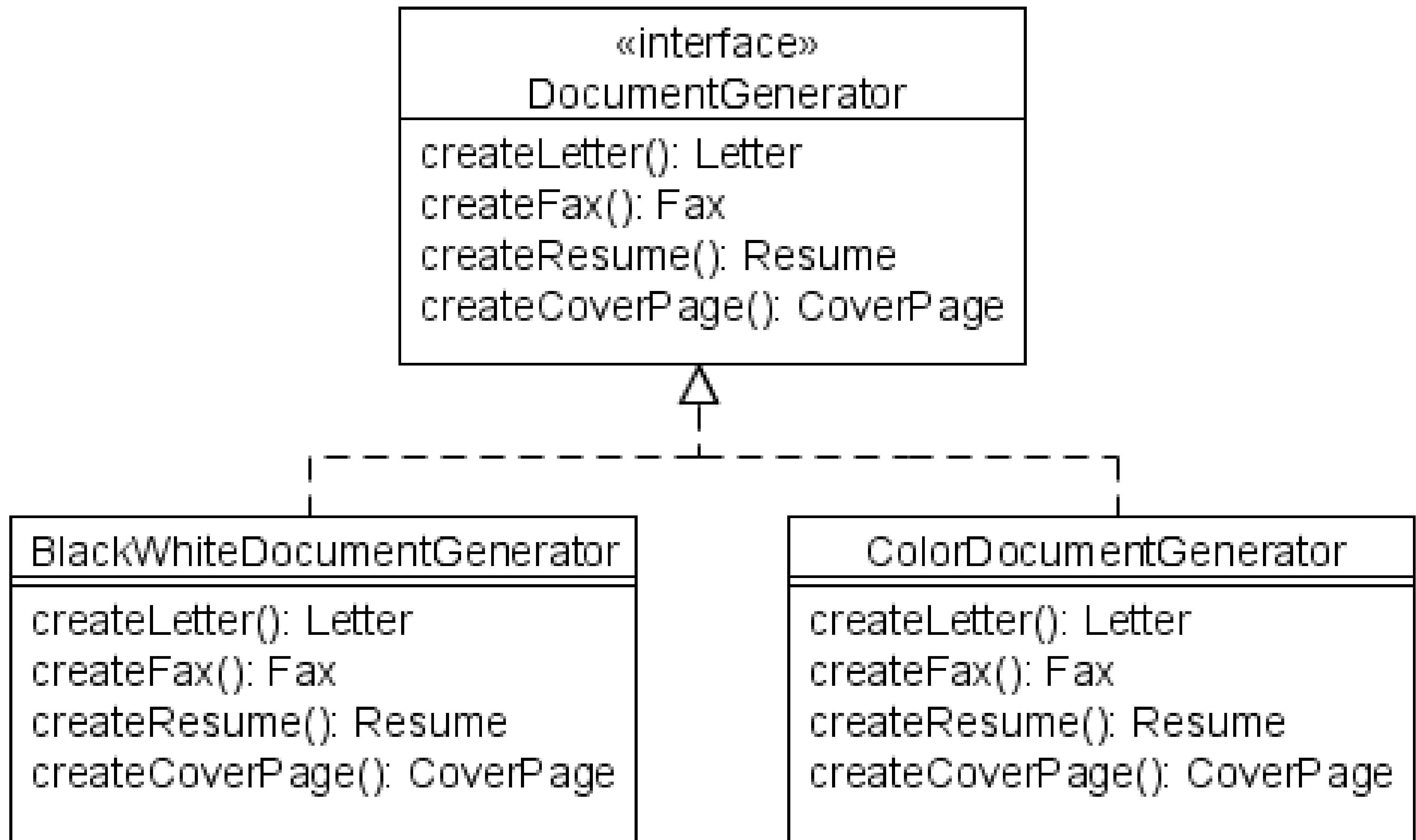
# Example



# The Problems ...

- As already mentioned, this is not a safe design.
  - Implementing in all factories
  - Coercion
- In addition, all return Products must have the same return type.

# Another Example



# Let design this ...

- I'm currently designing a unified driver for Nvidia Geforce cards.
- This unified driver supports the following cards.
  - Geforce 2
  - Geforce 3
  - Geforce 4
  - Geforce FX
  - Geforce 6
  - Geforce 7
  - Geforce 8

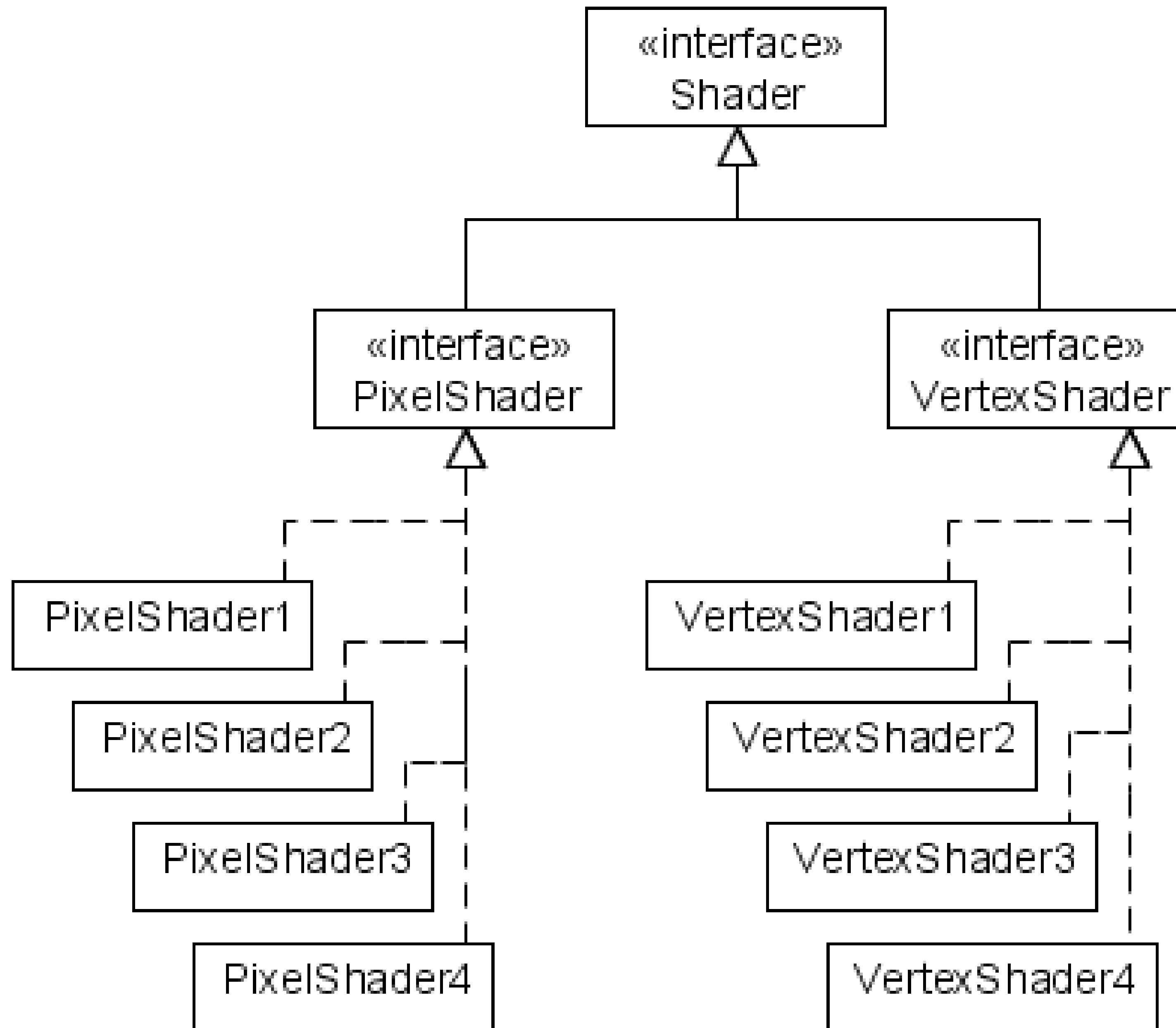
# Shader Objects

- Shaders are programs written specifically for graphic cards to perform visual effects.
- Two main types of shaders exist:
  - Pixel shaders : works on a 2D image / texture
  - Vertex shaders : works on a 3D mesh

# Shader Support

- Different architectures support different types of shaders.
  - Geforce 2,3,4 : Pixel and Vertex Shaders 1.0
  - Geforce FX : Pixel and Vertex Shaders 2.0
  - Geforce 6, 7 : Pixel and Vertex Shaders 3.0
  - Geforce 8 : Pixel and Vertex Shaders 4.0

# Shader Objects



# Creating these objects

- As already mentioned, different cards create different types of shader objects.
  - If a particular functionality is not supported by a particular card, it is sometimes emulated in software.
- However, an OpenGL or DirectX application should be able to create shader objects in a generic fashion.
  - i.e. It doesn't need to know we have a Geforce FX.

# ShaderFactory