# Comp-304 : Factory and Proxy Patterns

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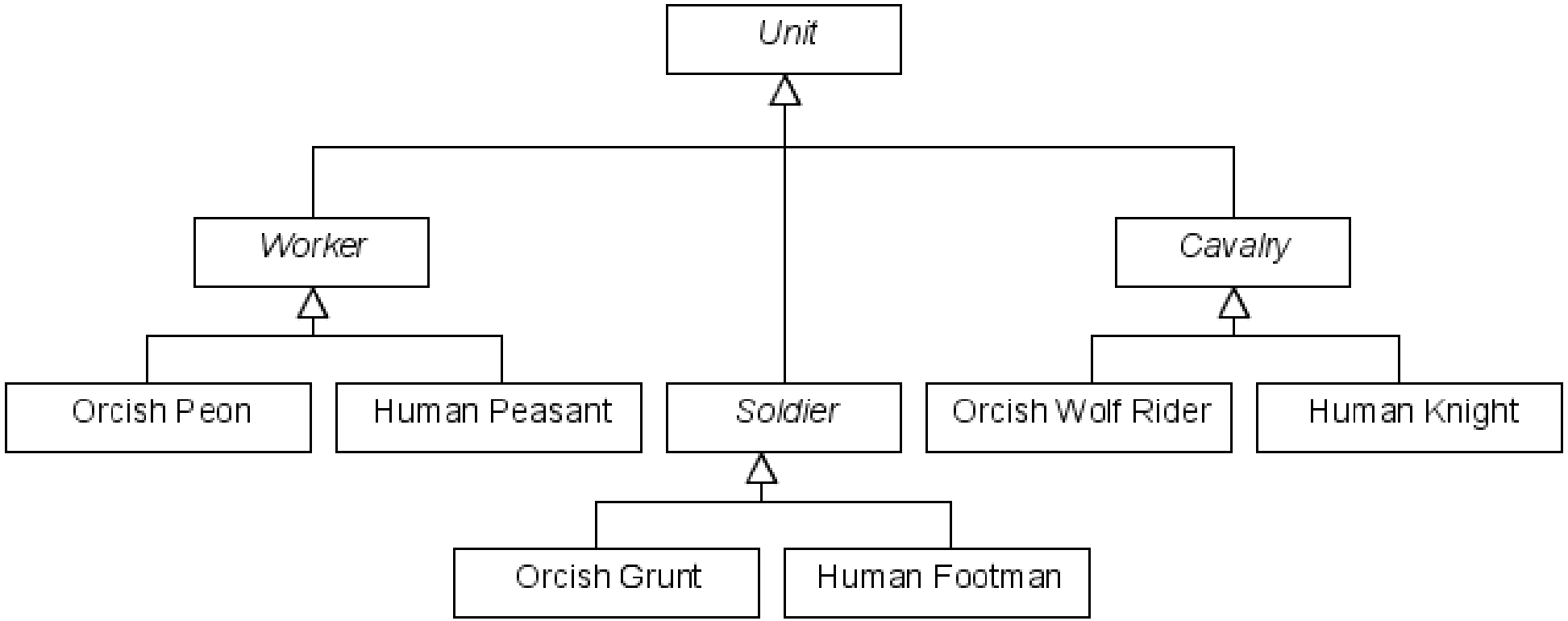
# Reminder

Mercury class evaluations

# 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

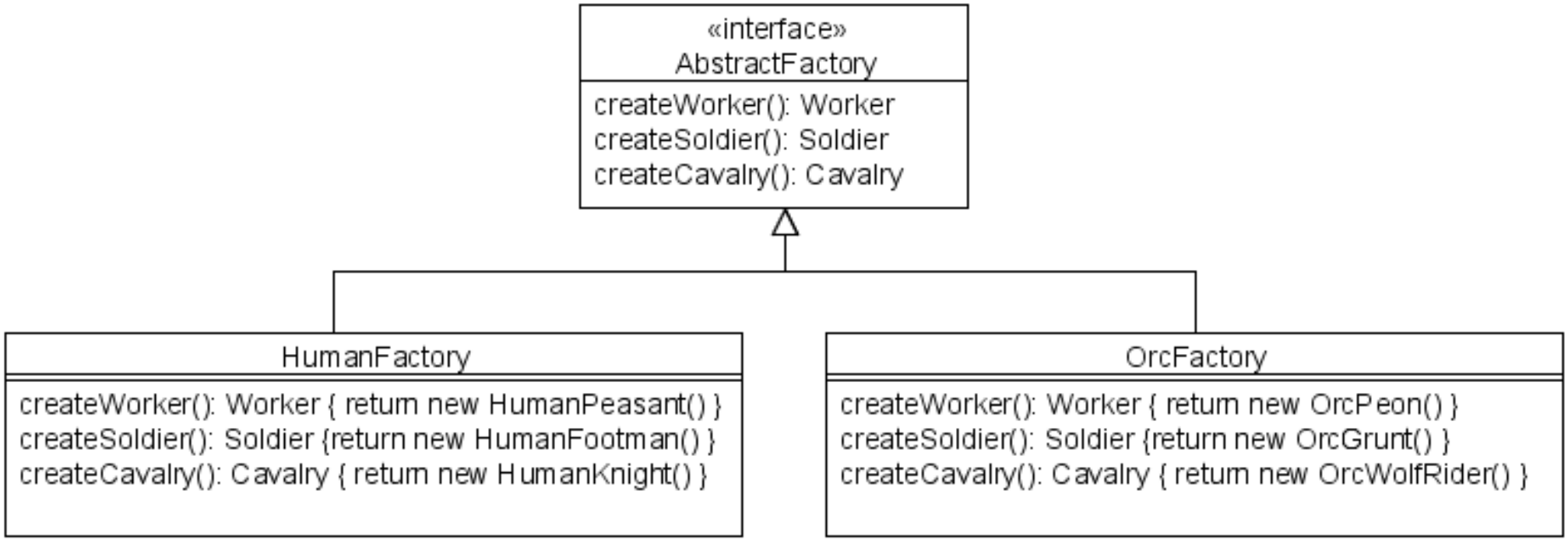
# Abstract Factory

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

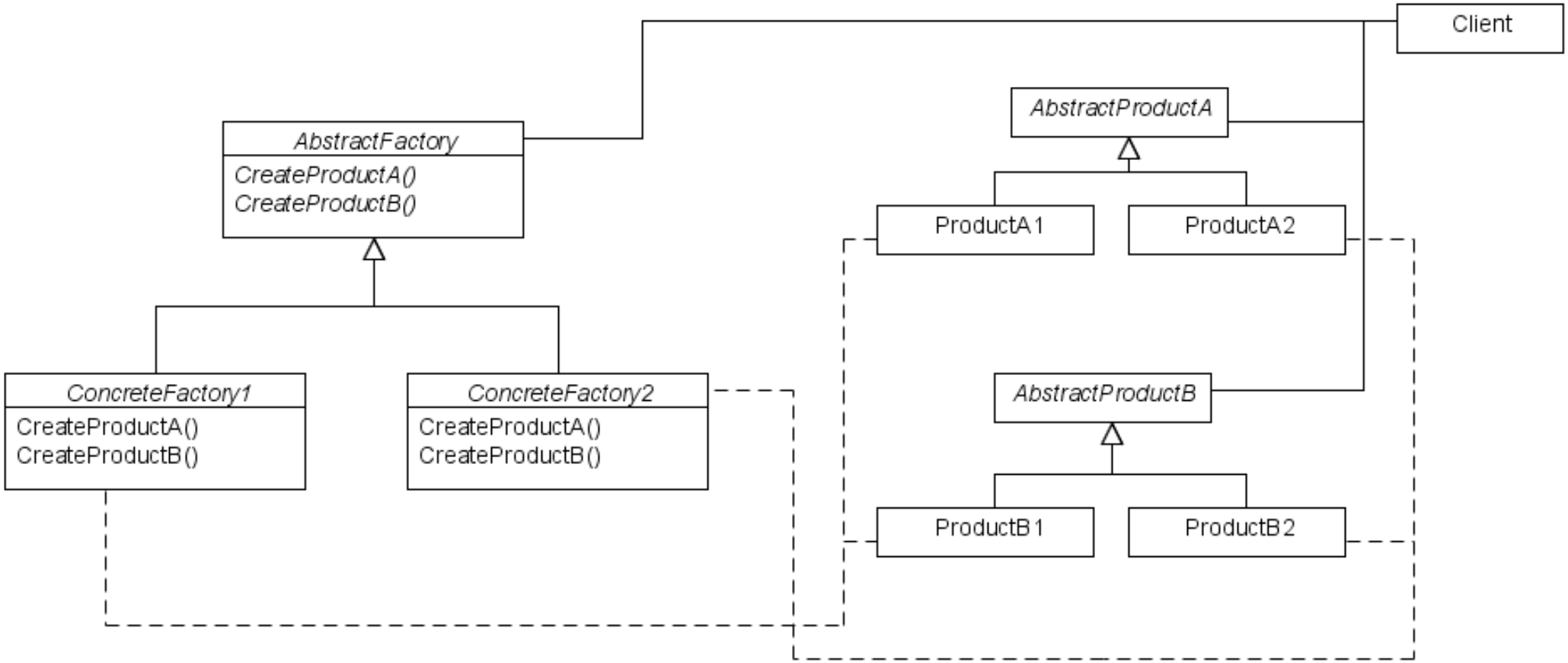
# Applicability

- 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

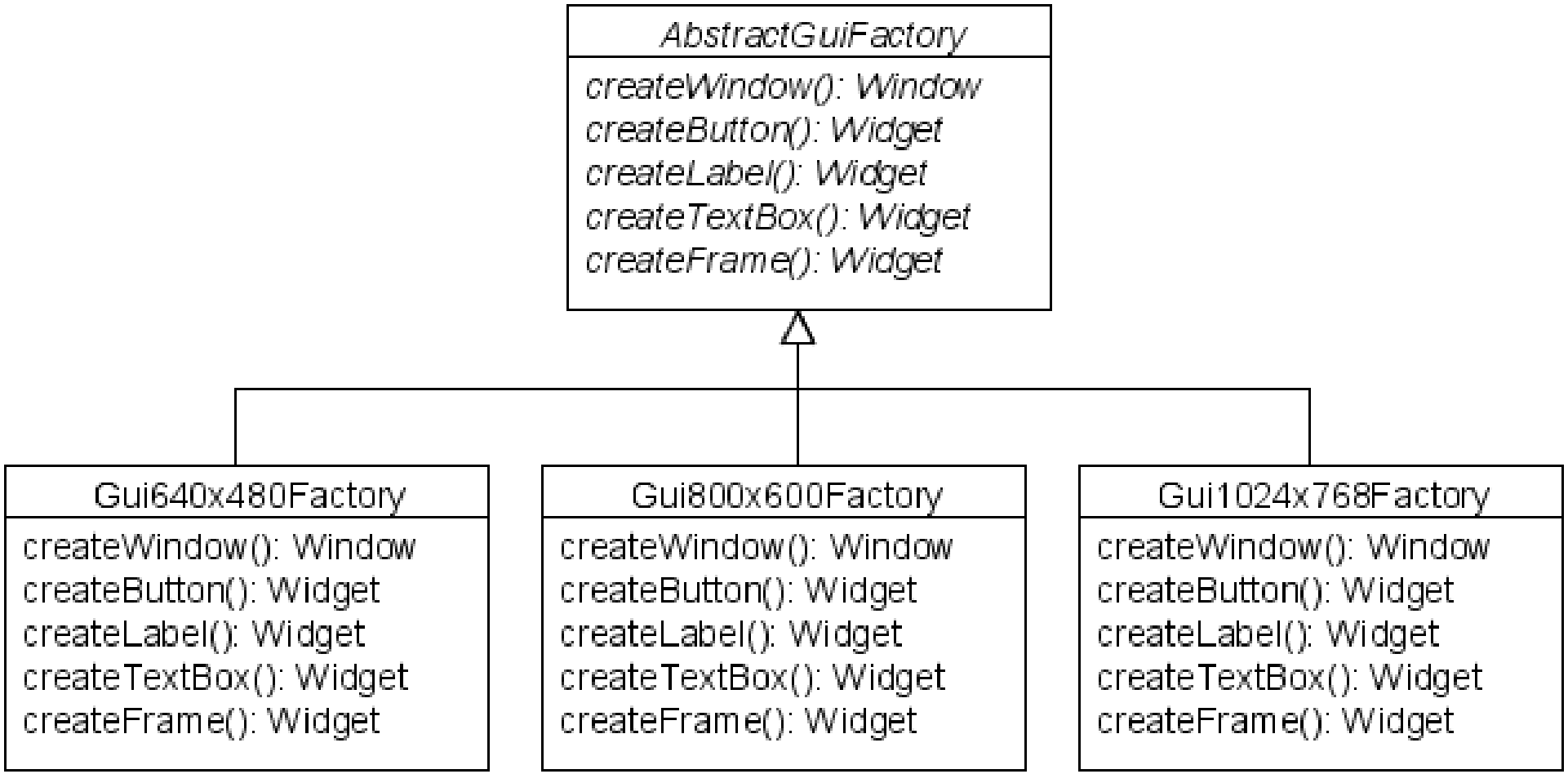
# Consequences

- 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


AbstractGuiFactory
createWindow(): Window
createButton(): Widget
createLabel(): Widget
createTextBox(): Widget
createFrame(): Widget
Gui640x480Factory
createWindow(): Window
createButton(): Widget
createLabel(): Widget
createTextBox(): Widget
createFrame(): Widget
Gui800x600Factory
createWindow(): Window
createButton(): Widget
createLabel(): Widget
createTextBox(): Widget
createFrame(): Widget
Gui1024x768Factory
createWindow(): Window
createButton(): Widget
createLabel(): Widget
createTextBox(): Widget
createFrame(): Widget

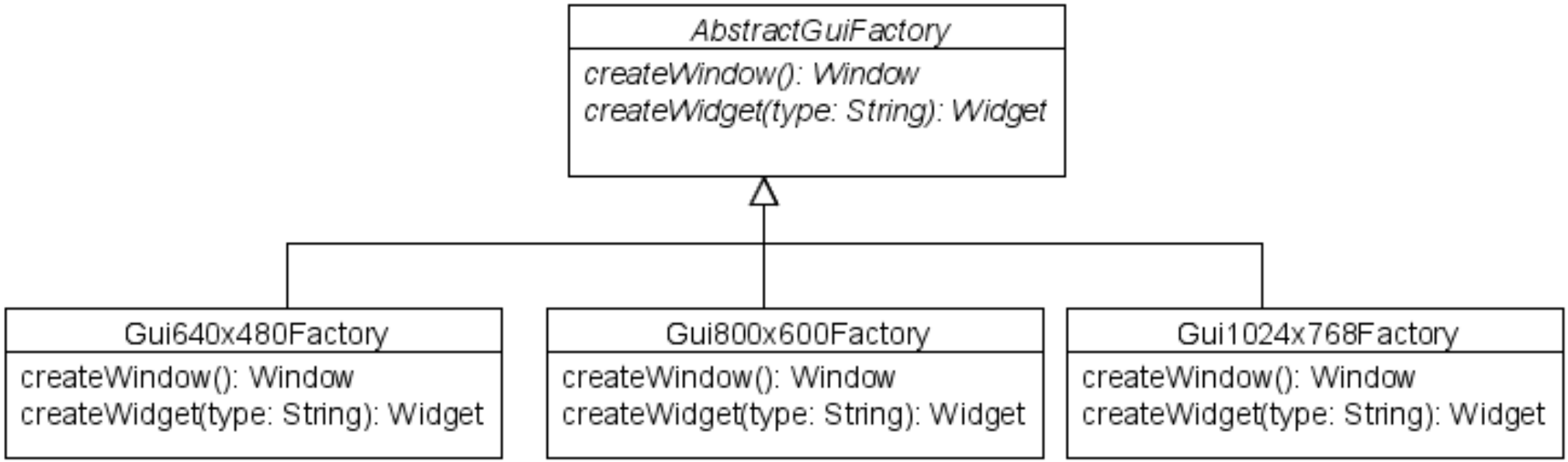
# Factories as Singletons

- 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.

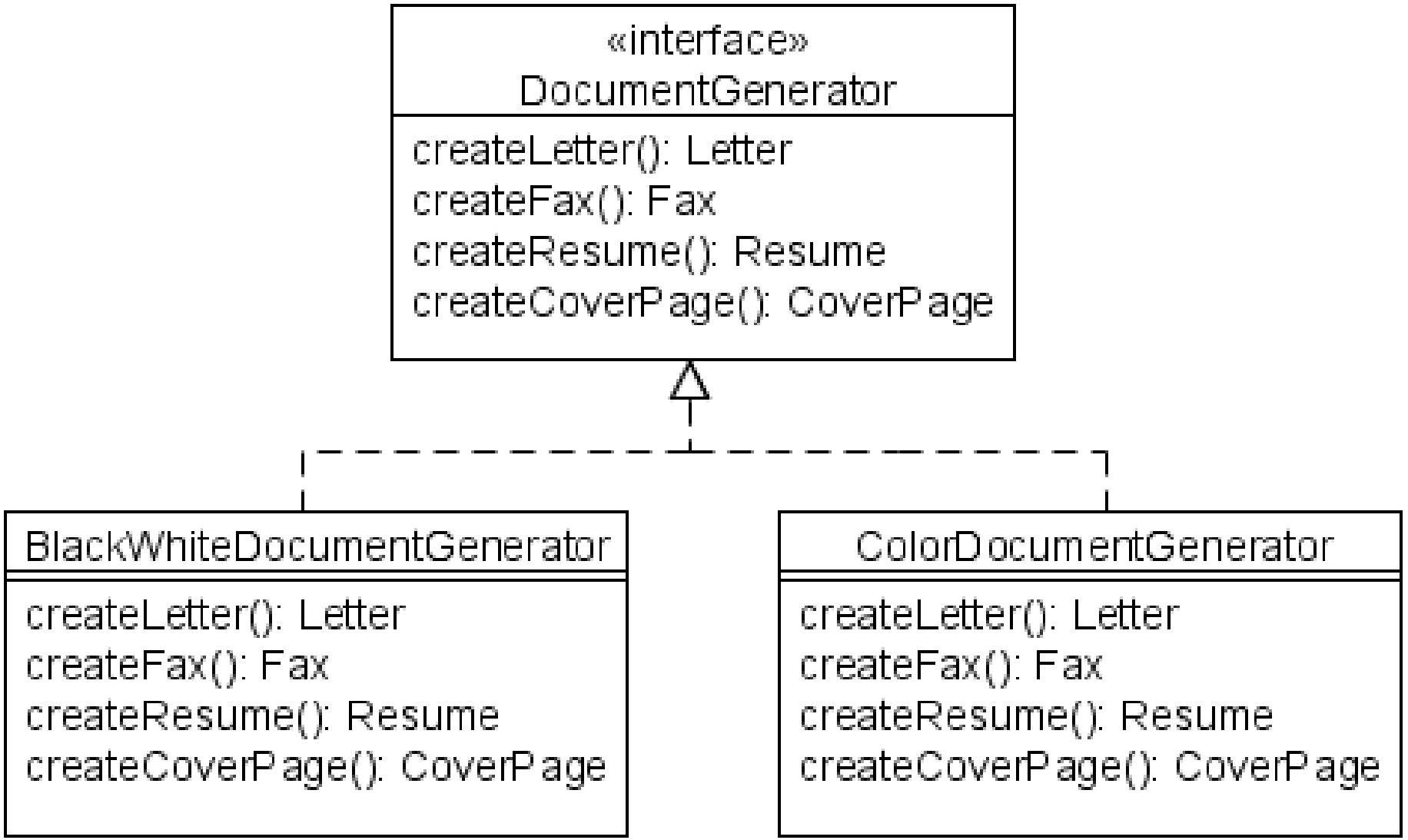
# Example


AbstractGuiFactory
createWindow(): Window
createWidget(type: String): Widget
Gui640x480Factory
createWindow(): Window
createWidget(type: String): Widget
Gui800x600Factory
createWindow(): Window
createWidget(type: String): Widget
Gui1024x768Factory
createWindow(): Window
createWidget(type: String): Widget

# The Problems ...

- As already mentioned, this is not a safe design.
  - Implementing in all factories
  - Coercision
- 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

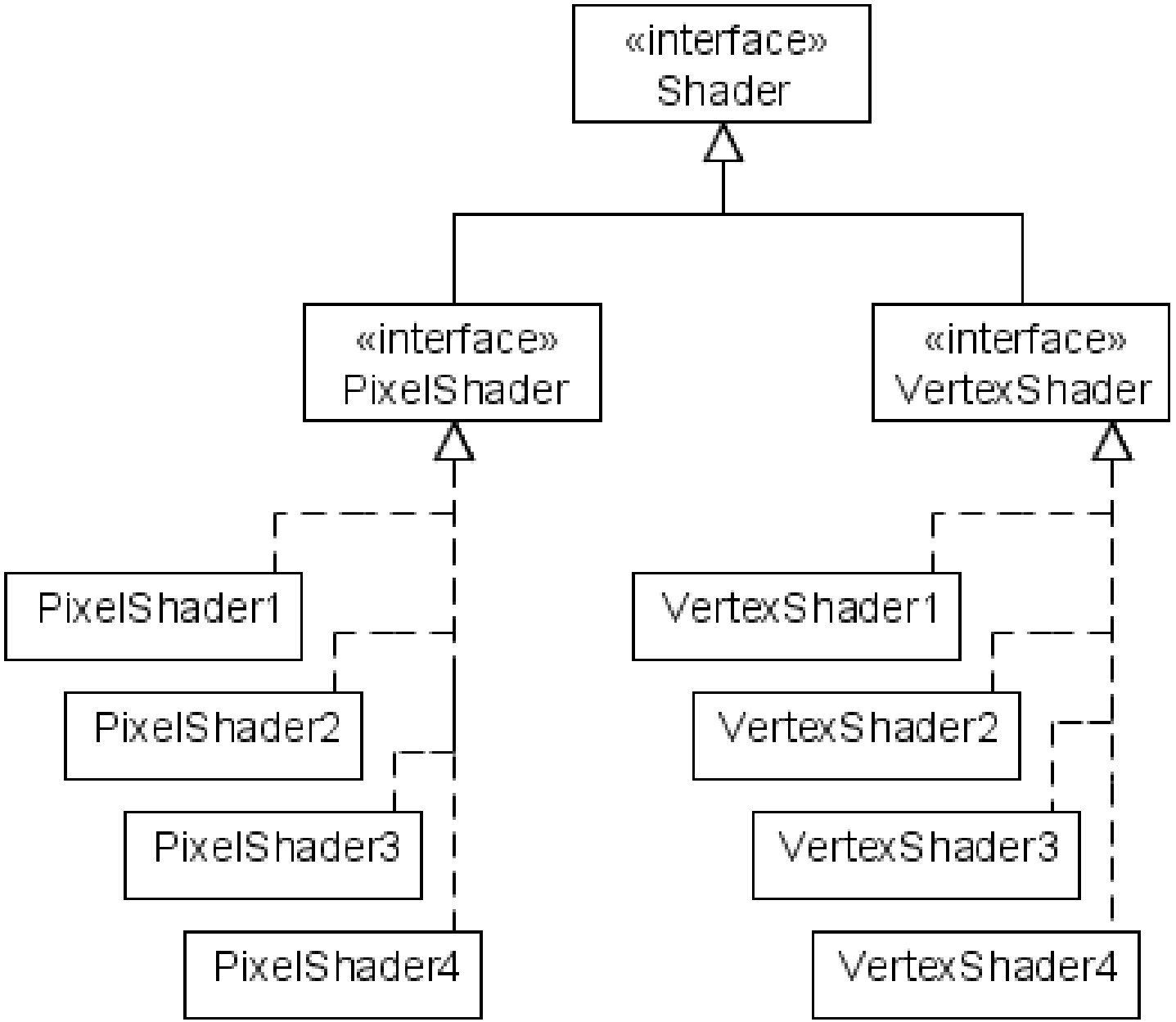
# Shader Objects

- 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

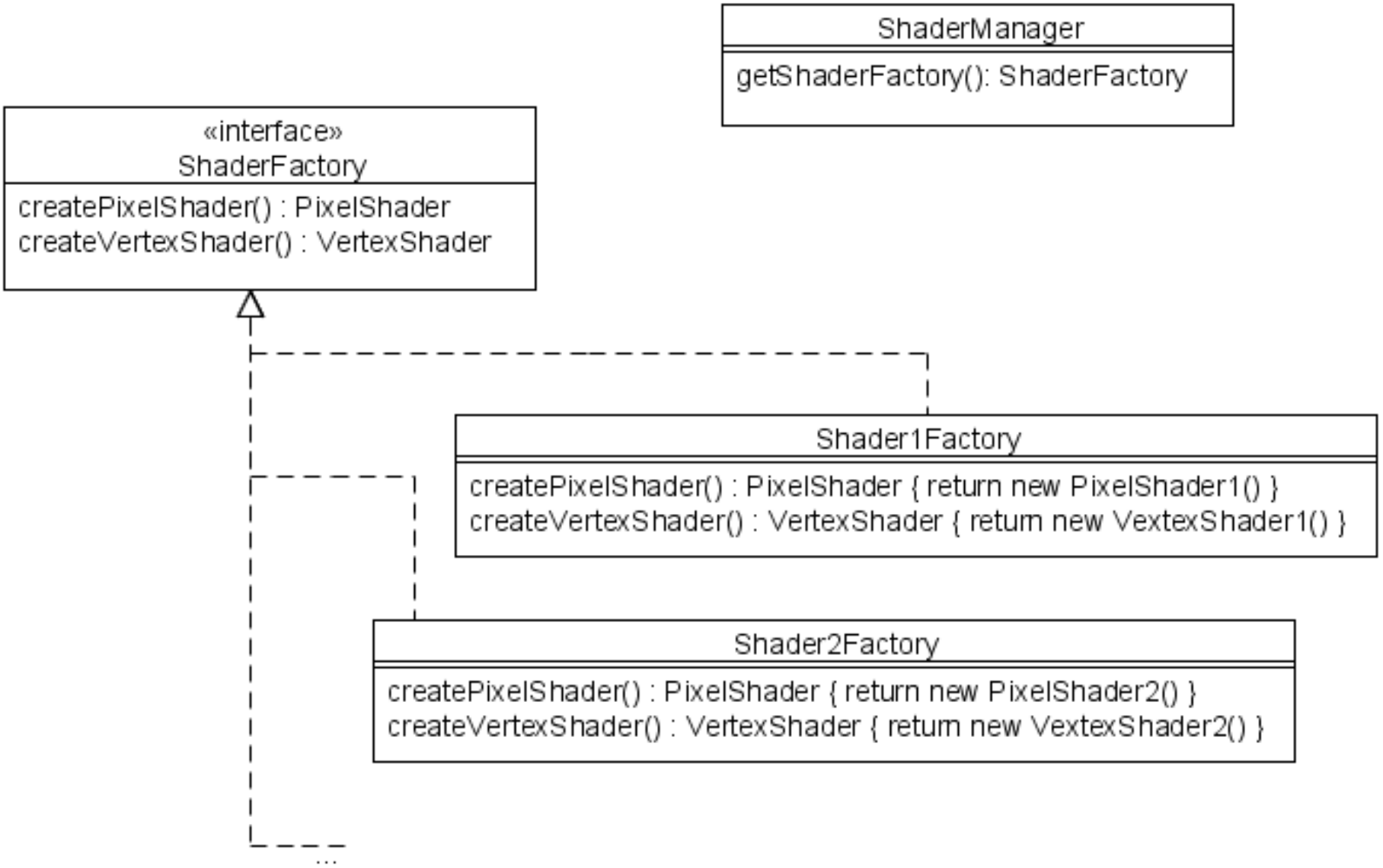
# Shader Objects



# 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

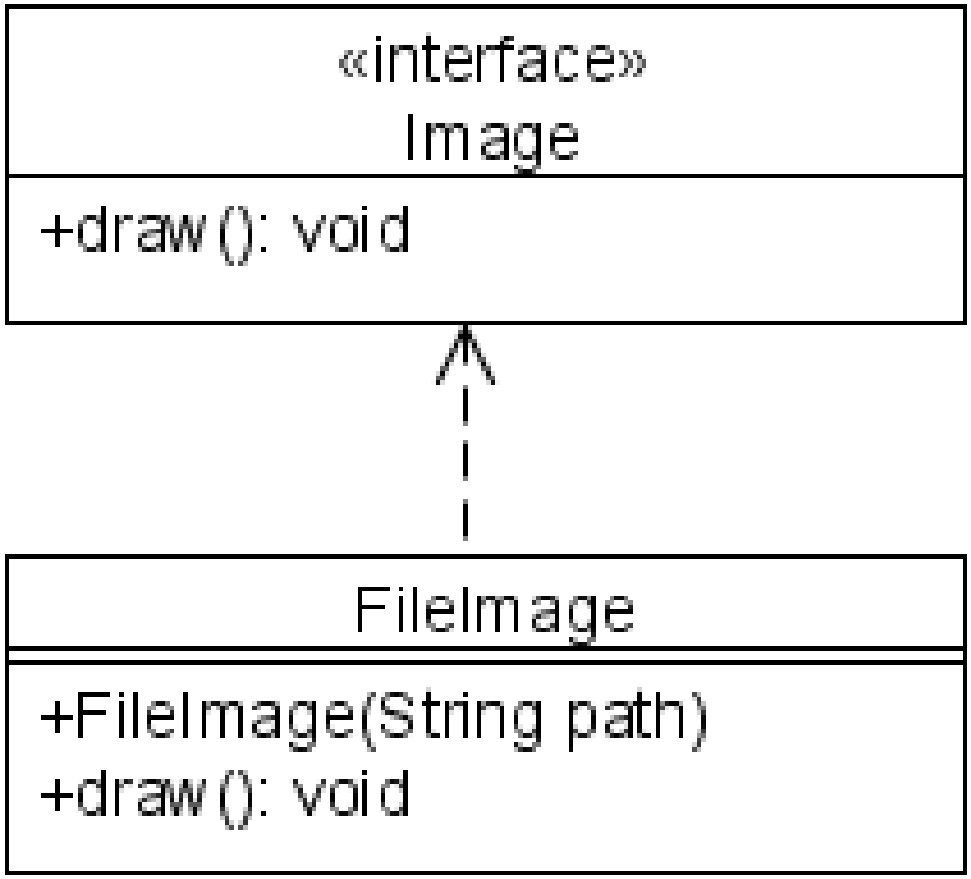


# Performance Problem

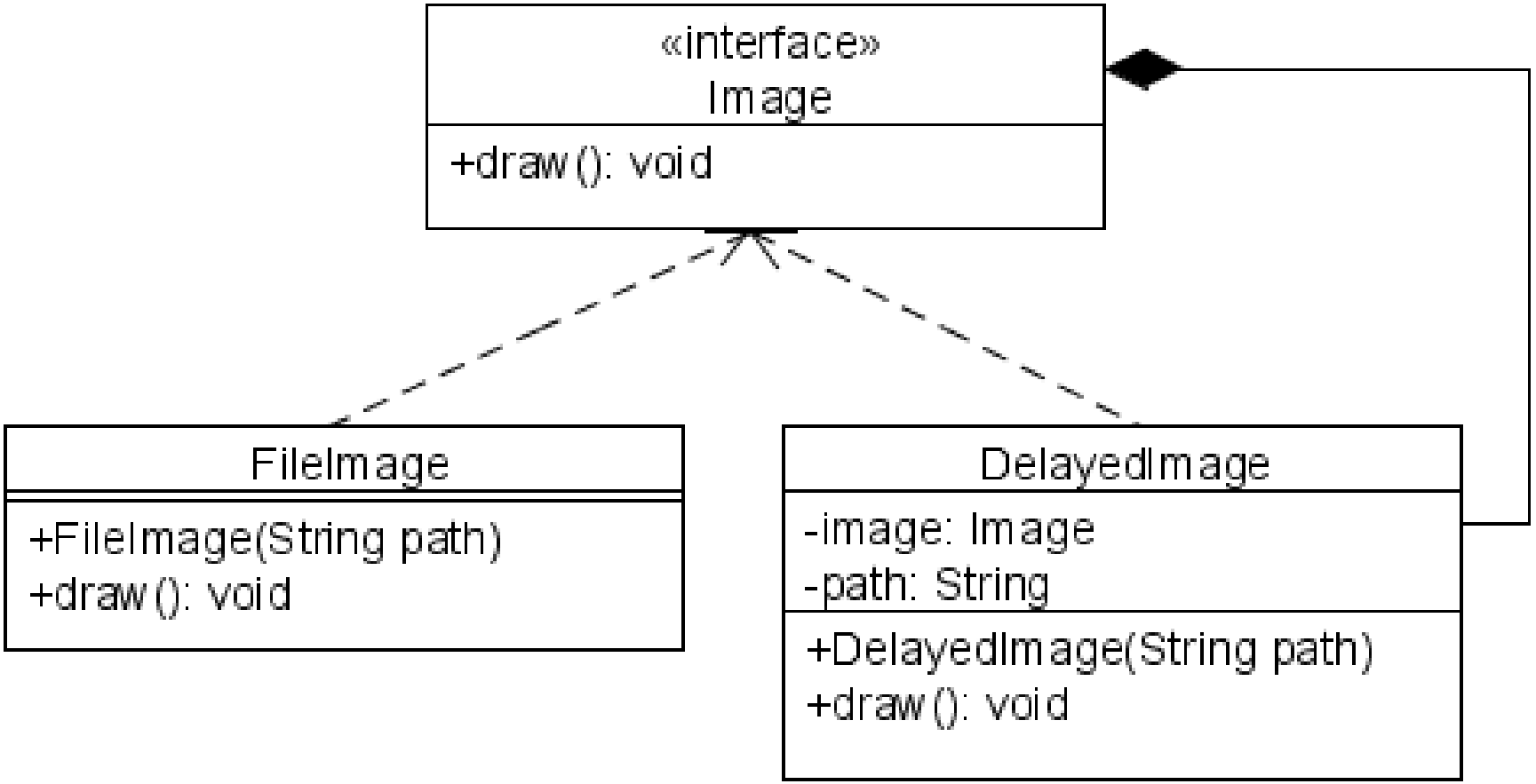
- Game X takes 30 seconds to load a level.
  - It needs to load 300 images.
- On average, a level only uses 50 images.
- Images are stored in an FileImage class
  - FileImage is a proprietary class file from a 3rd party library
- How can I improve performance and minimize code changes?

Original idea from Wikipedia

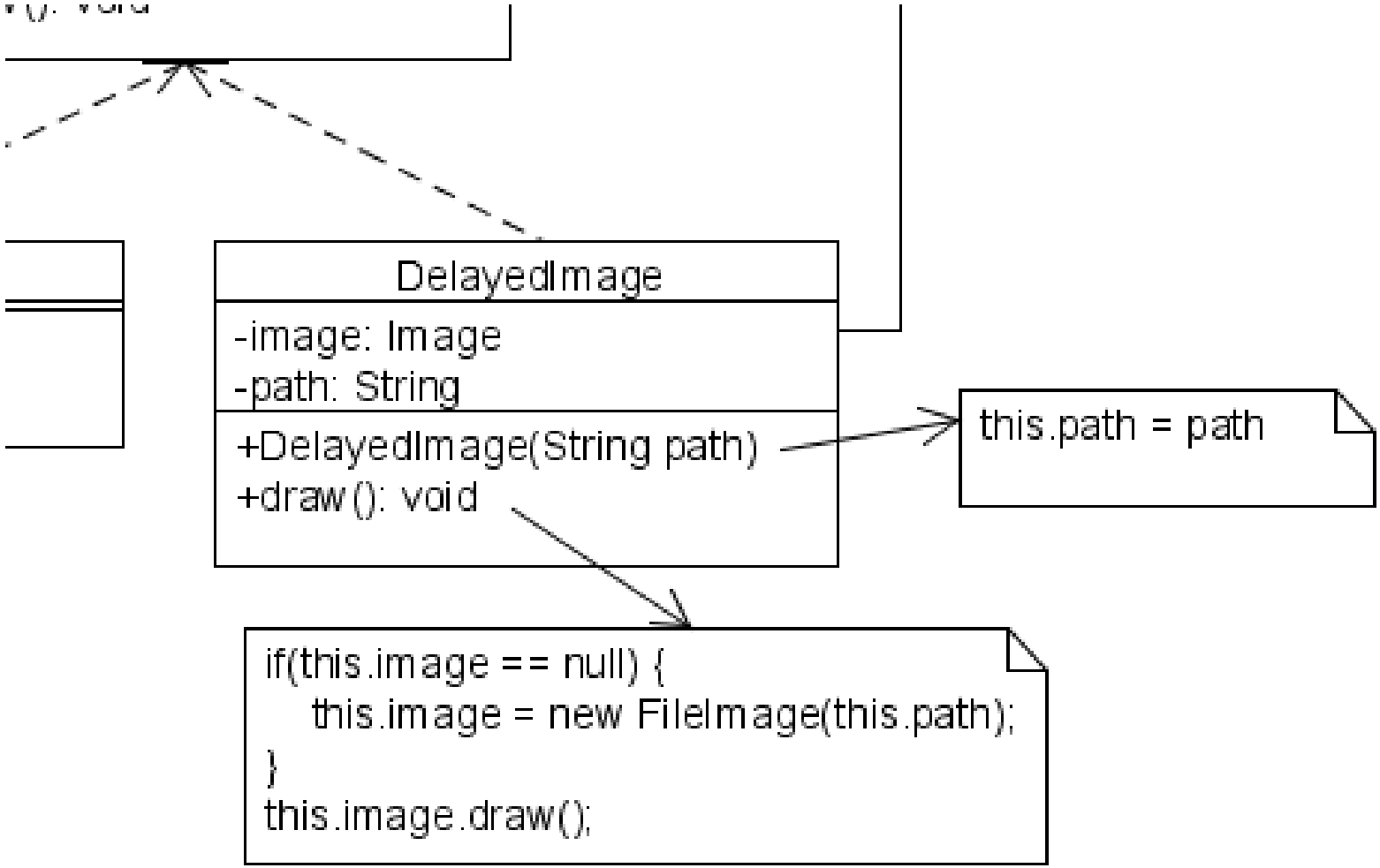
# Image and FileImage



# DelayedImage



# Focus on DelayedImage



# Proxy

- Provide a surrogate or placeholder for another object to control access to it.
- Aka: Surrogate

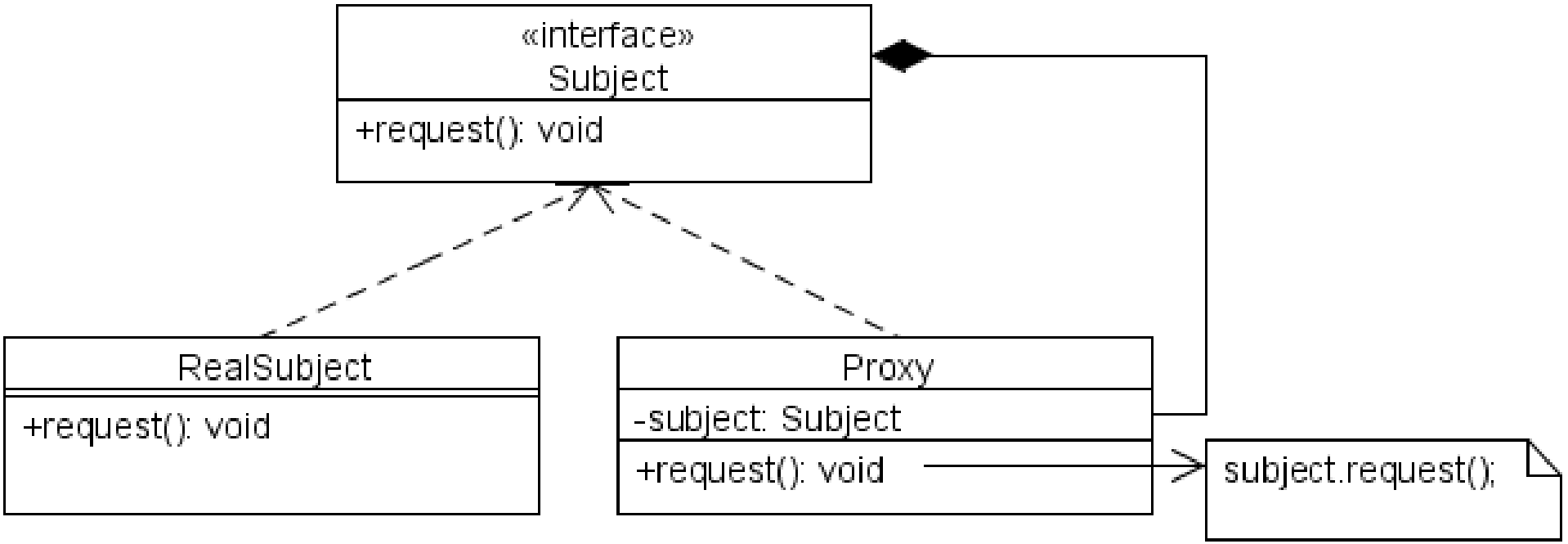
# What is a proxy?

- A proxy is
  - a person authorized to act for another person
  - an agent or substitute
  - the authority to act for another

# Motivation

- Sometimes, you want to modify the behavior of an object (or control access to it), without modifying the object itself.

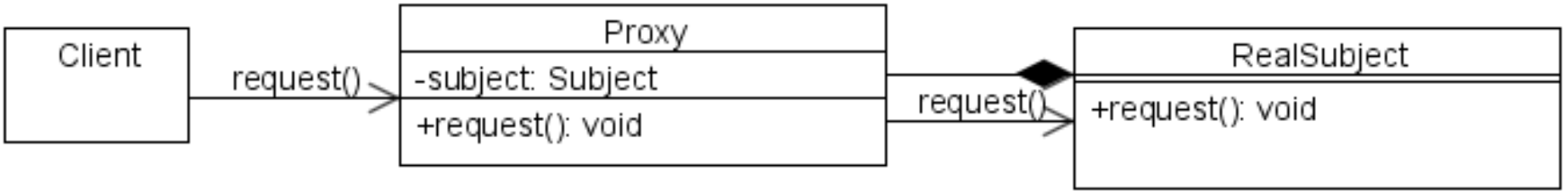
# Structure


«interface»
Subject
+request(): void
RealSubject
+request(): void
Proxy
-subject: Subject
+request(): void
subject.request();

# When to use?

- Use the Proxy pattern when
  - You want to remotely access a local object.
  - You want to create expensive objects on demand.
  - You want to protect the original object.
  - You want to make the original object smarter.

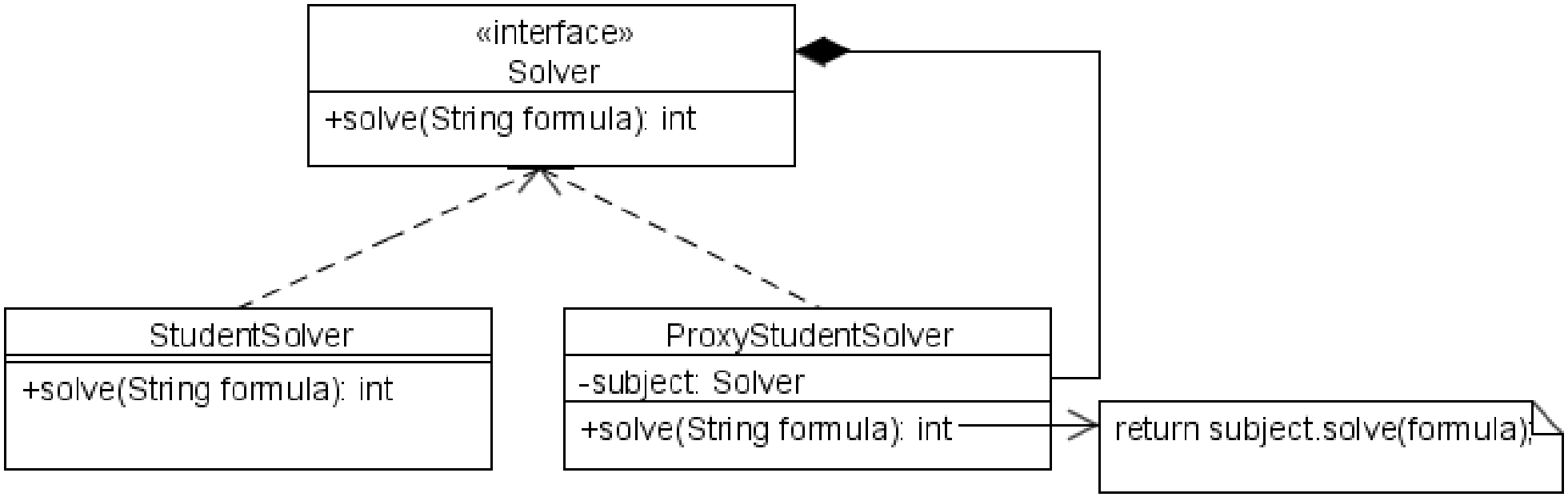
# How does it work?



# Implementation Issues

- Proxies are even easier to use (and transparent) in languages where you can …
  - Override the member access operators.
  - Use Aspects.
- Proxy doesn't need to know the concrete type of the subject.
- What to do with proxies without subjects?

# Arithmetic Example

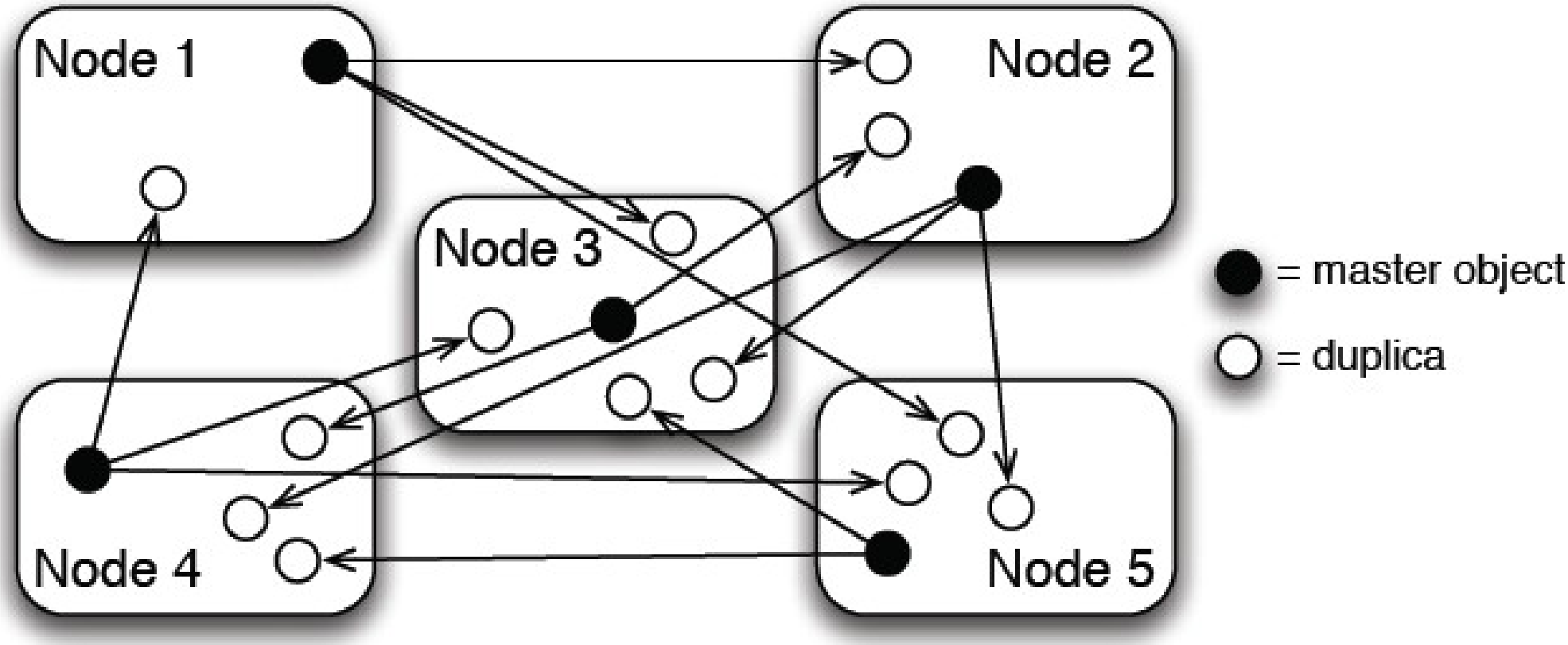


# Solution

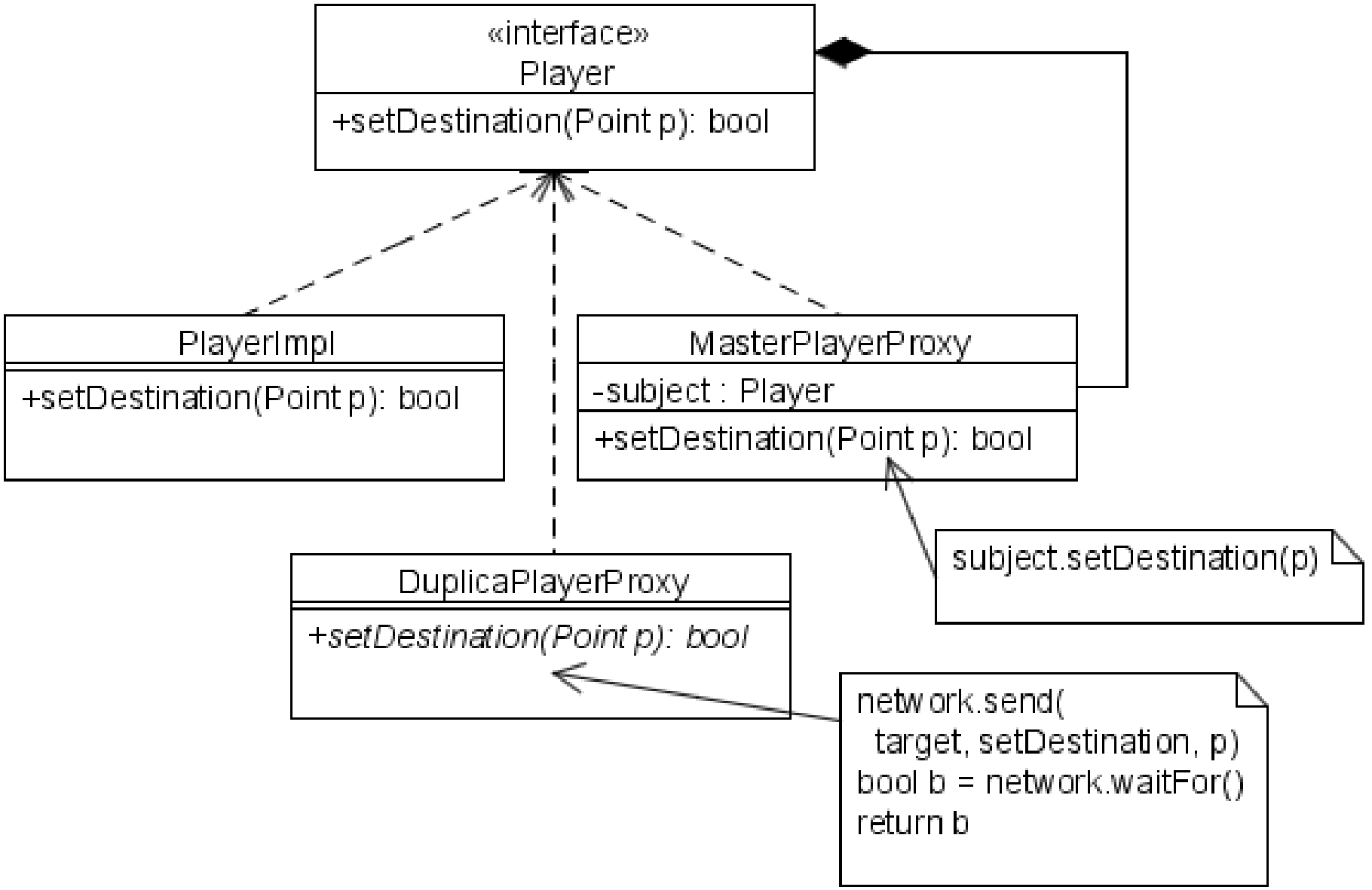
17 911 178

# Mammoth Example

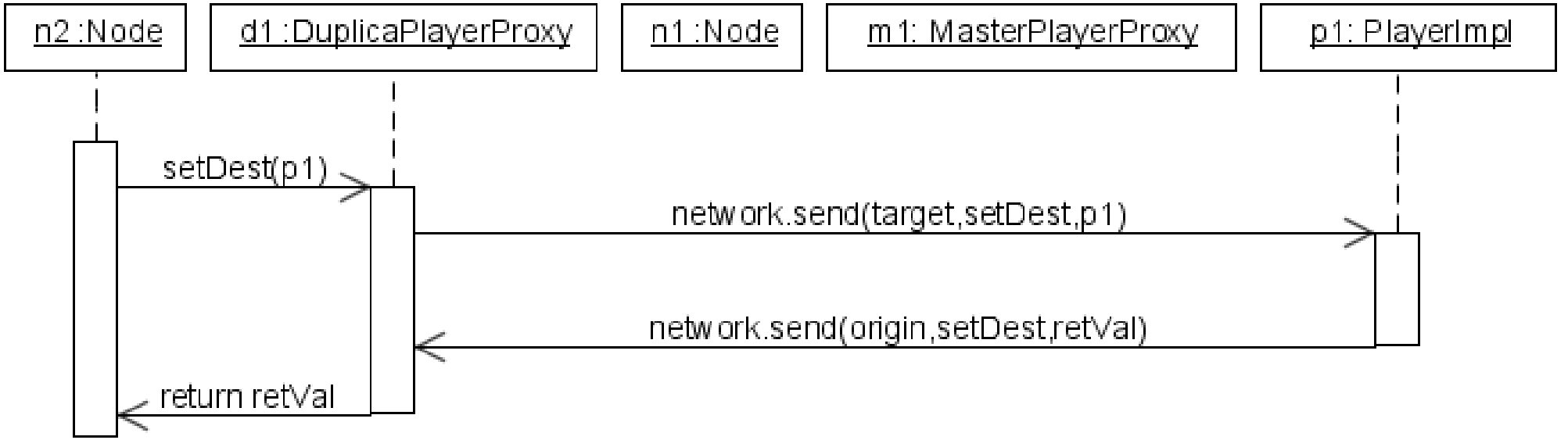
# Replication Systems

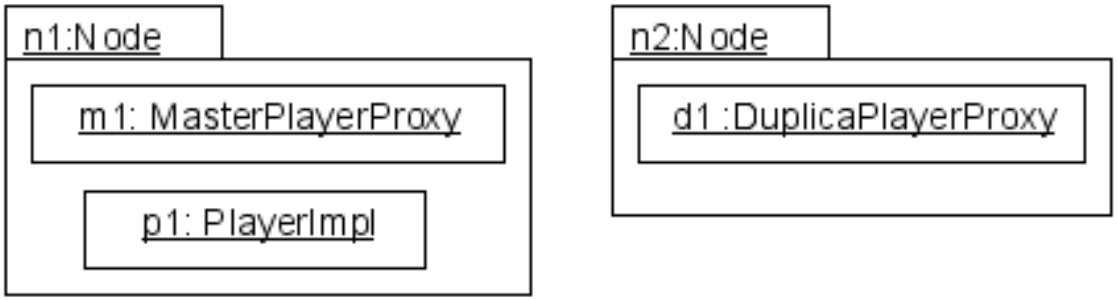


# Architecture

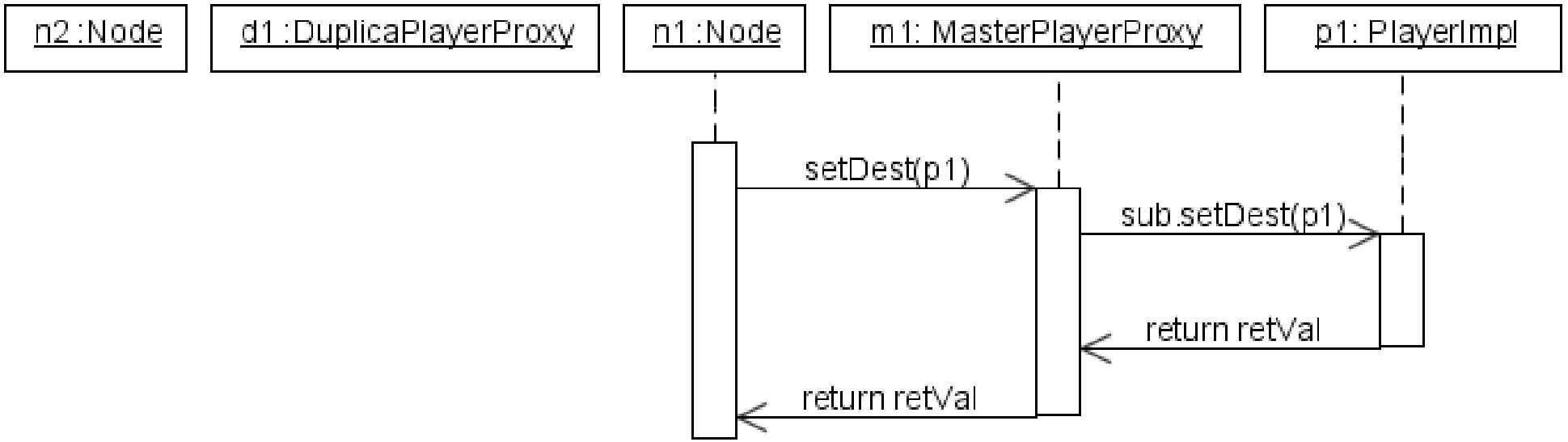


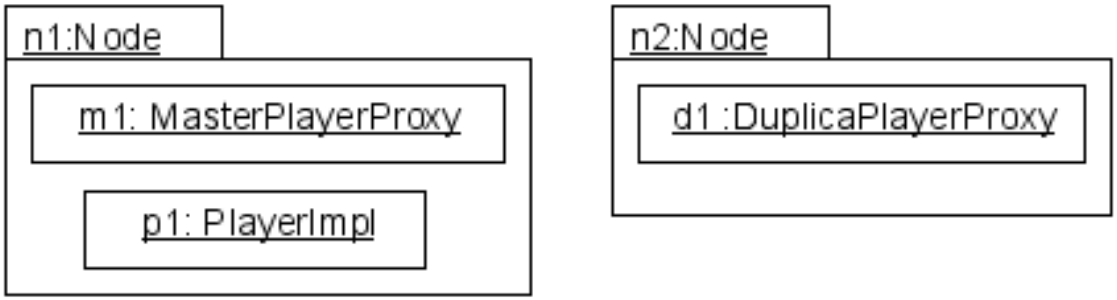
# Remote Call


n2 :Node
d1 :DuplicaPlayerProxy
n1 :Node
m1: MasterPlayerProxy
p1: PlayerImpl
setDest(p1)
network.send(target,setDest,p1)
network.send(origin,setDest,retVal)
return retVal

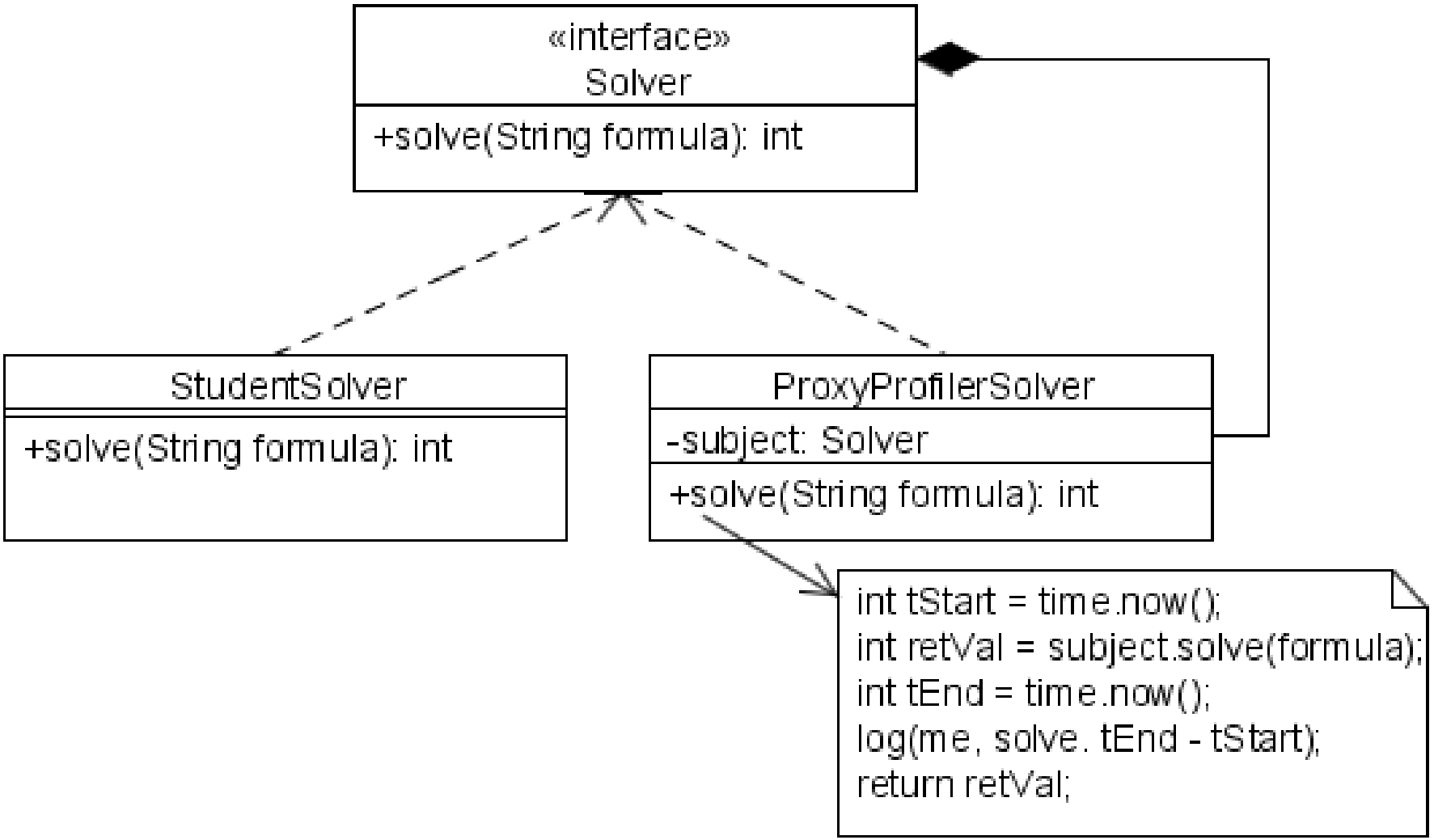

n1:Node
m1: MasterPlayerProxy
p1: PlayerImpl
n2:Node
d1 :DuplicaPlayerProxy

# Local Call


n2 :Node
d1 :DuplicaPlayerProxy
n1 :Node
m1: MasterPlayerProxy
p1: PlayerImpl
setDest(p1)
sub.setDest(p1)
return retVal
return retVal


n1:Node
m1: MasterPlayerProxy
p1: PlayerImpl
n2:Node
d1 :DuplicaPlayerProxy

# Profiler Example



# Other Types of Proxies

- Copy-On-Write Proxy - Defers copying (cloning) a target object until required by client actions. Really a form of virtual proxy.
- Protection (Access) Proxy - Provides different clients with different levels of access to a target object
- Cache Proxy - Provides temporary storage of the results of expensive target operations so that multiple clients can share the results
- Firewall Proxy - Protects targets from bad clients (or vice versa)
- Synchronization Proxy - Provides multiple accesses to a target object
- Smart Reference Proxy - Provides additional actions whenever a target object is referenced such as counting the number of references to the object

# Extending 3rd party tools

- You don't have the code.
- Can't always subclass existing code.
- Proxies are the next best things.

# Design Patterns, the big picture

- Design Patterns are solutions to problems.
- You can teach them with lectures, but that's not optimal.
- To appreciate them, you need to use them.
- And first them in using them is recognizing when to use them.

# The Design Pattern Challenge!

## Name that Design Pattern
## Left vs Right Edition

<insert inspirational music here>

# Question 1

I need to efficiently update several displays monitoring the content of a file, every time the file is updated.

# Question 2

I need to be able to queue actions, since I can only process one at a time.

# Question 3

I need to generate objects from either the Fire, Water, Air or Earth family of objects.

# Question 4

I need to traverse a data structure containing Ninja, Monkey, Pirates and Zombie objects.

# Question 5

I need to make sure that a maximum of three copies of my SuperCache object exists.

# Question 6

I need to make a library I just purchased type compatible with an existing one.

# Question 7

I need to add security to an object from the library I just purchased.

# Question 8

I need my application to process all orders in an identical fashion, regardless if they have sub-orders or not.