Comp 401
Factories

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Concepts Used

- Interfaces
- Abstract Methods
- Action Objects
- Exceptions

New Concepts

- Factory Classes
- Static Factory Methods
- Indirection
- Binding Time
- Reading Files
- Static Blocks
- Reflection
- Multi-Exception Catch Block
- Abstract Factories
- Instance Factory Methods
- Singletons

Counter

```
public interface Counter {
  public void add (int amount);
  public int getValue();
}
```

Implementation 1: Short Counter

```
public class AShortCounter implements Counter {
  short counter;
  public AShortCounter (short initValue) {
      counter = initValue;
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
     return counter;
  }
}
```

Implementation 2: Int Counter

```
public class AnIntCounter implements Counter {
  int counter;
  public AnIntCounter (short initValue) {
    counter = initValue;
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
    return counter;
  }
}
```

Course Visits: Using Short Counter

```
public class ACourseVisits implements CourseVisits{
  Counter youTubeVisi
  Counter mixVisits =
  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

Course Subscriptions: Using Short Counter

```
public class ACourseSubscriptions
        implements CourseSubscriptions{
  Counter youTubeSubscriptio
  Counter mixSubscriptions =
  public void youTubeSubscribed(String aUser) {
    youTubeSubscriptions.add(1);
  }
  public void youTubeUnSubscribed(String aUser) {
    youTubeSubscriptions.add(-1);
  }
  public void mixSubscribed(String aUser) {
    mixSubscriptions.add(1);
  }
  public void mixUnSubscribed(String aUser) {
    mixSubscriptions.add(-1);
  }
}
```

Changing Course Visits: Using Int Counter

```
public class ACourseVisits implements CourseVisits{
  Counter youTubeVisit
  Counter mixVisits =
  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

Instantiating code not reused

Method calls reused

Changing Course Subscriptions

```
public class ACourseSubscriptions
      implements CourseSubscriptions{
  Counter youTubeSubscription
  Counter mixSubscriptions =
  public void youTubeSubscribed(String aUser) {
    youTubeSubscriptions.add(1);
  }
  public void youTubeUnSubscribed(String aUser) {
    youTubeSubscriptions.add(-1);
  }
  public void mixSubscribed(String aUser) {
    mixSubscriptions.add(1);
  }
  public void                                    {
    mixSubsc
  }
}
```

Instantiating code not reused

Method calls reused

Problem

```
public class ACourseVisits implements CourseVisits{
  Counter youTubeVisits
  Counter mixVisits =  r                                  ) 0);
  public void youTubeVisited(String aUser) {              ;
    youTubeVisits.add(1);
  }
  pu

  }
}
```

How to allow easy switching between different alternative implementations

```
  public void mixSubscribed(String aUser) {
    mixSubscriptions.add(1);
  }
}
```

How to make main and other classes instantiating implementations not duplicate code?

Put the code in some method accessible to multiple classes

Static Factory Method

```
public class StaticCounterFactory {
  public static Counter createCounter (short initValue) {
    return new AShortCounter(initValue);
  }
  public static Counter createCounter () {
    return createCounter((short) 0);
  }
}
```

Class instantiated using a static method shareable by multiple accesses

Method can provide actual instantiation arguments to constructors, saving class users from supplying default parameters

Multiple static factory methods taking place of constructors and can be in one class, called static factory, associated with the interface

Multiple related classes can be instantiate by factory methods in a class

Course Visits: Using Factory Methods

Direct instantiation

Indirect instantiation

```
  ublic class ACourseVisits implements CourseVisits{
    beVisi
    sits =
public class AStaticFactoryMethodUsingCourseVisits
    seVisits{
    Visi
    ts =
  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

Indirection: Not doing a task (e.g. instantiation) directly

A la clues in treasure hunt

Course Subscriptions: Using Factory Methods

```
public class AStaticFactoryMethodUsingCourseSubscriptions
        implements CourseSubscriptions{

  public void youTubeSubscribed(String aUser) {
    youTubeSubscriptions.add(1);
  }
  public void youTubeUnSubscribed(String aUser) {
    youTubeSubscriptions.add(-1);
  }
  public void mixSubscribed(String aUser) {
    mixSubscriptions.add(1);
  }
  public void mixUnSubscribed(String aUser) {
    mixSubscriptions.add(-1);
  }
}
```

Change Counter?

```
public class AStaticFactoryMethodUsingCourseSubscriptions
        implements CourseSubscriptions{

  public void youTubeSubscribed(String aUser) {
```

```
public class AStaticFactoryMethodUsingCourseVisits
im
                                                    );

  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

```
}
```

Original Static Factory Method

```
public class StaticCounterFactory {
  public static Counter createCounter (short initValue) {

  }
  public static Counter createCounter () {
    return createCounter((short) 0);
  }
}
```

Changed Static Factory Method

```
public class StaticCounterFactory {
  public static Counter createCounter (short initValue) {

  }
  public static Counter createCounter () {
    return createCounter((short) 0);
  }
}
```

Change not duplicated!

Must have access to source code

Decision made at program writing time

Binding Time

Time when some property of a program (e.g. which counter class, type or value of a variable) bound to a value (a particular counter class, a particular type or value)

Program writing time

Program compile time

Program load time

Program start time

Program runtime

Late binding is (usually) more flexible

Late binding is (usually) less efficient

Changed Static Factory Method

```
public class StaticCounterFactory {
  public static Counter createCounter (short initValue) {

  }
  public static Counter createCounter () {
    return createCounter((short) 0);
  }
}
```

How to make decision at program start time?

Must have access to source code

Decision made at program writing time

Configuration File

Configurable Static Factory Class

Configuration file

ACourseSubscrip | AStaticFactoryM | AStaticConfigur | AStaticFactoryM | counter_config.

```
lectures.factories.counter.AnIntCounter
```

Class reads name of class from configuration file before factory methods are called

Converts name into class object using reflection

Finds constructor object taking short value

Invokes constructor of the class

Changed Static Factory Method

```
public class StaticConfigurableCounterFactory {
public static final String CONFIGURATION_FILE_NAME =
                                "counter_config.txt";
static Class counterClass = AShortCounter.cl
static Constructor counterConstructor;
public static Counter createCounter (short initValue) { … }
public static Counter createCounter () { … }
static { // executed once for each class before it is used
  try {
    Scanner aScanner =
        new Scanner (new File(CONFIGURATION_FILE_NAME));
   counterClass = Class.forName(aScanner
   } catch (FileNotFoundException |
            NoSuchElementException |
            ClassNotFoundException e){
     e.printStackTrace();
   }
}
}
```

Class object

Constructor action object

Scanner passed File object rather than System.in

Name converted into class object

Exceptions?

Changed Static Factory Method

```
public class StaticConfigurableCounterFactory {
public static final String CONFIGURATION_FILE_NAME =
                                "counter_config.txt";
static Class counterClass = AShortCounter.cl
static Constructor counterConstructor;
public static Counter createCounter (short initValue) {
  try {
    counterConstructor =
       counterClass.getConstructor(short.class);
    return (Counter)
       counterConstructor.newInstance(initValue);

  } catch (NoSuchMethodException |
       InstantiationException |
       IllegalAccessException |
       IllegalArgumentException |
       InvocationTargetException  e) {
    e.printStackTrace();
    return new AShortCounter((short) 0);
  }
}
```

Class object

Constructor action object

Parameter type

Constructor threw an exception

Unchanged Static Factory Method

```
public class StaticConfigurableCounterFactory {
….
public static Counter createCounter () {
  return createCounter((short) 0);
}}
```

Binding Time

Time when some property of a program (e.g. which counter class, type or value of a variable) bound to a value (a particular counter class, a particular type or value)

Program writing time

Program compile time

Program load time

Program start time

Program runtime

What is we want an API to change the counter at runtime

Static Factory Method

```
public class StaticCounterFactory {
  public static Counter createCounter (short initValue) {
    return new AShortCounter(initValue);
  }
  public static Counter createCounter () {
    return createCounter((short) 0);
  }
}
```

What is we want an API to change the counter at runtime

More indirection

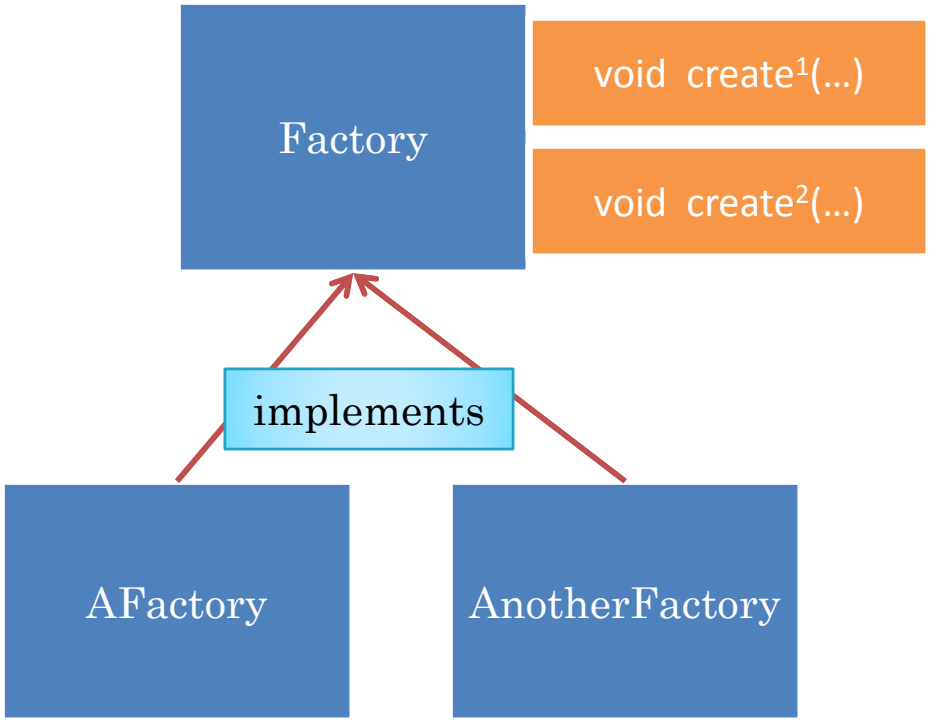
Factory methods be set by the programmer

Make factory methods instance methods

API to set Factories with these methods

Abstract factories used to access the factories

Instantiatable Factory



Provides instance methods for creating one or more related classes

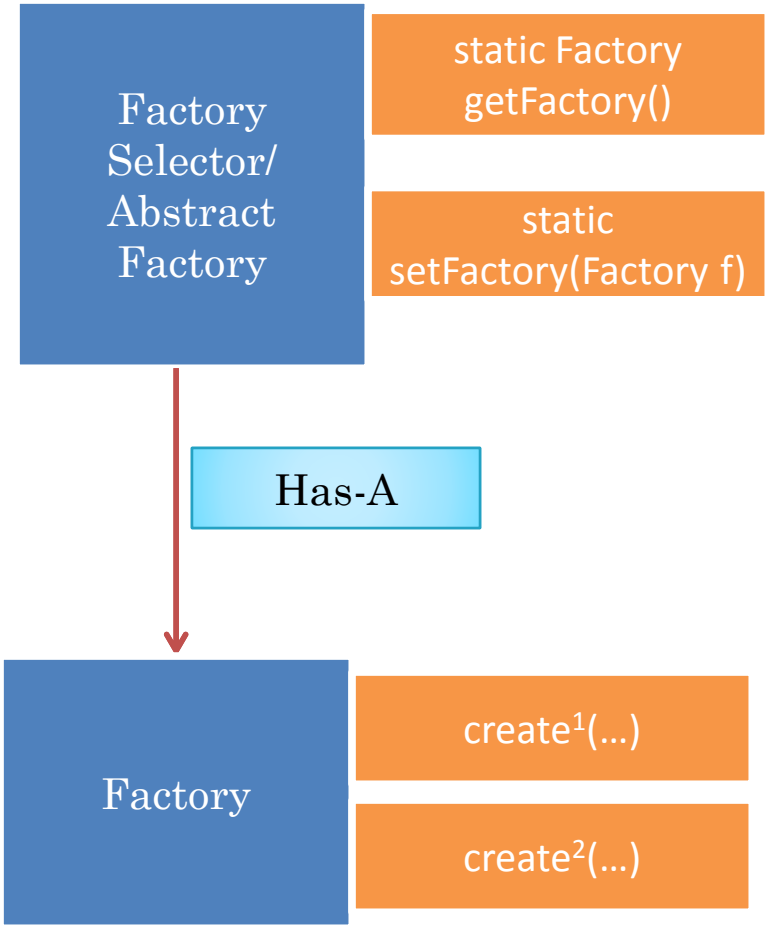
Each method takes instantiation parameters

Different implementations can instantiate different classes

Typically instantiation parameters become constructor parameters

How to choose among different factories?

Abstract Factories or Factory Selectors



Helps choose between factories
Has a link to a Factory instance
Static methods to change and get reference
Can get reference to factory and invoke factory methods
Not an abstract class

Static Factory Methods

```
public class StaticCounterFactory {
  public static Counter createCounter (short initValue) {
    return new AnIntCounter(initValue);
  }
  public static Counter createCounter () {
    return createCounter((short) 0);
  }
}
```

Instantiatble Multple Factory Classes

```
public interface CounterFactory {
  public Counter createCounter (short initValue) ;
  public Counter createCounter ();
}
```

```
public class AnIntCounterFactory implements CounterFactory {
public Counter createCounter(short initValue) {
  return new AnIntCounter(initValue);
}
public Counter createCounter() {
  return createCounter((short) 0);
}}
```

```
public class AShortCounterFactory implements CounterFactory {
public Counter createCounter(short initValue) {
  return new AShortCounter(initValue);
}
public Counter createCounter() {
  return createCounter((short) 0);
}}
```

Abstract Factory/Factory Selector

```
public class StaticCounterFactorySelector {
  static CounterFactory counterFactory =
       new AShortCounterFactory();
  public static CounterFactory getCounterFactory() {
    return counterFactory;
  }
  public static void setCounterFactory (
       CounterFactory aCounterFactory) {
    counterFactory = aCounterFactory;
  }
}
```

Calling Selector Getter

```
public class AFactorySelectorUsingCourseVisits
       implements CourseVisits{
  Counter youTubeVisits = StaticCounterFactorySelector.
                    getCounterFactory().createCounter();
  Counter mixVisits =  StaticCounterFactorySelector.
                    getCounterFactory().createCounter();
  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

Calling Selector Setter

```
public static void main (String[] args) {
  StaticCounterFactorySelector.setCounterFactory(
      new AShortCounterFactory());
  CourseVisits aCourseVisits =
      new AFactorySelectorUsingCourseVisits();
  aCourseVisits.mixVisited("anonymous");
  StaticCounterFactorySelector.setCounte
      new AnIntCounterFactory());
  aCourseVisits =
      new AFactorySelectorUsingCourseVisits();
  aCourseVisits.mixVisited("anonymous2");
}
```

Short counter

Int counter

Binding Time

Time when some property of a program (e.g. which counter class, type or value of a variable) bound to a value (a particular counter class, a particular type or value)

- Program writing time
- Program compile time
- Program load time
- Program start time
- Program runtime

Factory Alternatives

Static factory classes (with static factory methods)

Instantiatable factory classes and abstract factories

Both can ne configurable through a file

Problem

```
public class ACourseVisits implements CourseVisits{
  Counter youTubeVisits
  Counter mixVisits =  r                                  ) 0);
  public void youTubeVisited(String aUser) {              ;
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

```
  public void mixSubscribed(String aUser) {
    mixSubscriptions.add(1);
  }
}
```

How to make main and other classes instantiating implementations not duplicate code?

Put the code in some method accessible to multiple classes

Localized Use?

```
public class ACourseVisits implements CourseVisits{
  Counter youTubeVisits
  Counter mixVisits =  n
  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

How to remove code duplication in a single class

Localized Use

```
public class ACourseVisitsWithFactoryMetho
      implements CourseVisits{
  Counter youTubeVisits = createCounter();
  Counter mixVisits = createCounter();
  public Counter createCounter() {
    return new AnIntCounter ((short) 0);
  }
  public void youTubeVisited(String aUser)
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

Factory method not in special Factory class

Factory method in class that calls it

Or its subclasses

Or its superclasses

A subclass can override factory method used in superclass

Abstract Factory Methods

```
public abstract class
AnAbstractCourseVisitsWithFactoryMethods implements
CourseVisits{
  public abstract Counter createCounter();
  Counter youTubeVisits = createCounter();
  Counter mixVisits = createCounter();
  public void youTubeVisited(String aUser) {
    youTubeVisits.add(1);
  }
  public void mixVisited(String aUser) {
    mixVisits.add(1);
  }
}
```

Concrete Classes

```
public class AnIntCourseVisits extends
AnAbstractCourseVisitsWithFactoryMethods {
  @Override
  public Counter createCounter() {
    return new AnIntCounter ((short) 0);
  }
}
```

```
public class AShortCourseVisits extends
AnAbstractCourseVisitsWithFactoryMethods {
  @Override
  public Counter createCounter() {
    return new AShortCounter ((short) 0);
  }
}
```

Classes can differ only in the factory methods

Different implementation of an interface used by different classes

Factory Alternatives

Static factory classes (with static factory methods)

Instantiatable factory classes and abstract factories with (overridable) instance factory methods

Factory class approach

Instance (overridable), possibly not public factory methods called by the same class or its superclasses or subclasses

Factory method approach

(Special) Factory Classes vs. (Mixed) Factory Methods

- Used by multiple classes that do not have to be related by an IS-A relationship
- Creates a global configuration

- Creates local configurations.
- If class C implements factory method defined in super class S, then configuration applies to C, and all subclasses of C and superclasses between C and S that do not override/implement it

Factory Principle

Keep code that creates and uses an instance in separate methods

Instantiate a class in a special method that does nothing other than instantiating the class and possibly calling methods that initialize the state of the object

The method can be in a special factory class that provides only factory methods or an arbitrary class

Makes it easier to instantiate and substitute classes

Factory Uses

Makes it easier to instantiate and substitute classes

Counting Counters

```
public interface Counter {
  public void add (int amount);
```

```
public class AShortCounter implements Counter {
  short counter;
  public AShortCounter (short initValue) {
      counter = initValue;
  }
```

```
public class AnIntCounter implements Counter {
  int counter;
  public AnIntCounter (short initValue) {
    counter = initValue;
```

How do we count the number of instances of counters that are created?

Create a special counter (that is not counted) to count the other counters

The constructor of classes of other counters increment the special counter

The counter can be used for anyone interested in the count

Not Counting Counter

```
public class AnInstanceCountingShortCounter
      implements Counter {
  short counter;
  public AnInstanceCountingShortCounter (short
initValue) {
      counter = initValue;
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
     return counter;
  }
}
```

Counting Int Counter

```
public class AnInstanceCountingIntCounter
implements Counter {
  int counter;
  public AnInstanceCountingIntCounter (short
       initValue, Counter anInstanceCounter) {
    counter = initValue;
    anInstanceCounter.add(1);
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
    return counter;
  }
}
```

Counting Short Counter

```
public class AnInstanceCountingShortCounter
implements Counter {
  int counter;
  public AnInstanceCountingShortCounter (short
       initValue, Counter anInstanceCounter) {
    counter = initValue;
    anInstanceCounter.add(1);
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
    return counter;
  }
}
```

Counting Int Factory

```
public class AnInstanceCountingIntCounterFactory
      implements InstanceCountingCounterFactory {
  public Counter createCounter(short initValue,
      Counter anInstanceCounter) {
    return new AnInstanceCountingIntCounter
              (initValue, anInstanceCounter);
  }
  public Counter createCounter(
      Counter anInstanceCounter) {
    return createCounter((short) 0,
              anInstanceCounter);
  }
}
```

Counting Factory Interface

```
public interface InstanceCountingCounterFactory {
  public Counter createCounter (short initValue,
      Counter anInstanceCounter) ;
  public  Counter createCounter (
      Counter anInstanceCounter);
}
```

Changed Selector

```
public class InstanceCountingCounterFactorySelector {
  static InstanceCountingCounterFactory
      counterFactory;
  public static InstanceCountingCounterFactory
      getCounterFactory() {
    return counterFactory;
  }
  public static void setCounterFactory
      (InstanceCountingCounterFactory
            aCounterFactory) {
    counterFactory = aCounterFactory;
  }
}
```

Changed Main

```
public static void main (String[] args) {
  Counter instanceCounter = new
      AnInstanceCountingCounter((short)0);
  InstanceCountingCounterFactorySelector.
    setCounterFactory(new
      AnInstanceCountingShortCounterFactory());
  CourseVisits aCourseVisits = new
      AnInstanceCountingCourseVisits(instanceCounter);
  aCourseVisits.mixVisited("anonymous");
  InstanceCountingCounterFactorySelector.
    setCounterFactory(new
      AnInstanceCountingShortCounterFactory());
  aCourseVisits = new
      AnInstanceCountingCourseVisits(instanceCounter);
  aCourseVisits.mixVisited("anonymous2");
  System.out.println ("Num instances:" +
      instanceCounter.getValue());
}
```

Counting Counters

How do we count the number of instances of counters that are created?

Create a special counter (that is not counted) to count the other counters

The constructor of classes of other counters increment the special counter

The counter can be used for anyone interested in the count

Must change the body of counter constructors to increment instance counter

Must change code that accesses instance counter values

Also had to change counter constructor parameters, factory interface, factory implementations, factory selector, factory selector setter caller

Make minimal changes?

Global Counter

Make the instance counter a global object like System.in or System.out
Accesses through a getter rather than public variable
Create it on demand, only if accessed
Factory method creates the counter and returns it

Instance Counter Factory

```
public class InstanceCountingCounterSingletonFactory {
  static Counter instanceCounter;
  public static Counter getCounter() {
    if (instanceCounter == null) {
      instanceCounter = new
          AnInstanceCountingCounter((short)0);
    }
   return instanceCounter;
  }
}
```

Instance Counting Short Counter

```
public class AShortCounter implements Counter {
  short counter;
  public AShortCounter (short initValue) {
    counter = initValue;
    InstanceCountingCounterSingletonFactory.
      getCounter().add(1);
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
     return counter;
  }
}
```

Instance Counting Int Counter

```
public class AnIntCounter implements Counter {
  int counter;
  public AnIntCounter (short initValue) {
    counter = initValue;
    InstanceCountingCounterSingletonFactory.
      getCounter().add(1);  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
    return counter;
  }
}
```

Changed Main

```
public static void main (String[] args) {
  StaticCounterFactorySelector.setCounterFactory(
      new AShortCounterFactory());
  CourseVisits aCourseVisits =
      new AFactorySelectorUsingCourseVisits();
  aCourseVisits.mixVisited("anonymous");
  StaticCounterFactorySelector.setCounterFactory(
      new AnIntCounterFactory());
  aCourseVisits =
      new AFactorySelectorUsingCourseVisits();
  aCourseVisits.mixVisited("anonymous2");
  System.out.println ("Num instances: " +
    InstanceCountingCounterSingletonFactory.
     getCounter().getValue());
  }
}
```

Any class (including tester) can get the counter

SINGLETON?

```
public class InstanceCountingCounterSingletonFactory {
  static Counter instanceCounter;
  public static Counter getCounter() {
    if (instanceCounter == null) {
      instanceCounter = new
        AnInstanceCountingCounter((short)0);
    }
   return instanceCounter;
  }
}
```

Only one instance of a Singleton class (expected to be) instantiated in an application

Can make constructor of any class non public to ensure only a factory in the same package can instantiate it

Not Counting Counter

```
public class AnInstanceCountingShortCounter
      implements Counter {
  short counter;
  public AnInstanceCountingShortCounter (short
initValue) {
      counter = initValue;
  }
  public void add (int amount) {
    counter += amount;
  }
  public int getValue() {
     return counter;
  }
}
```

Can make constructor of any class non public to ensure only a factory (method) in the same package can instantiate it

Common Approach

```
public class ASingletonCounter implements Counter {
  short counter;
  private ASingletonCounter (short initValue) {
    counter = initValue;
  }
  public void add (int amount) {
    counter += amo
  }
  public int getVa
    return counter
  }
  static Counter instance;
  public static Counter getInstance() {
    if (instance != null) {
     instance = new ASingletonCounter ((short) 0);
    }
    return null;
  }
}
```

No other class can create multiple instances

No separation of concerns and and assumes no alternative class exists

Factory Uses

Makes it easier to instantiate and substitute classes

Makes it possible to create global objects on demand

Can be used to force singletons

Java Example

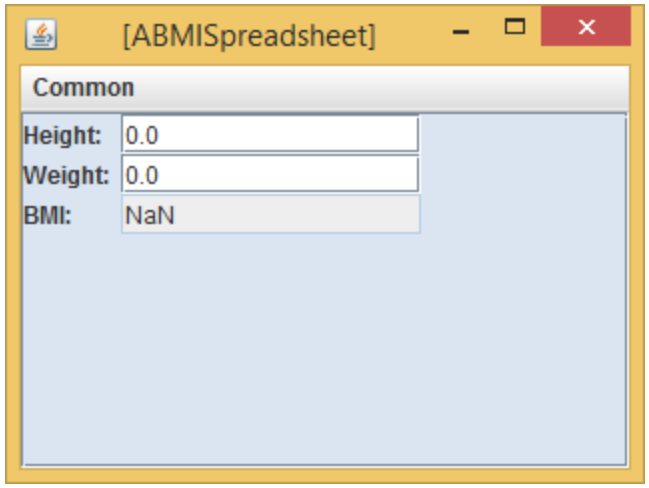
line border

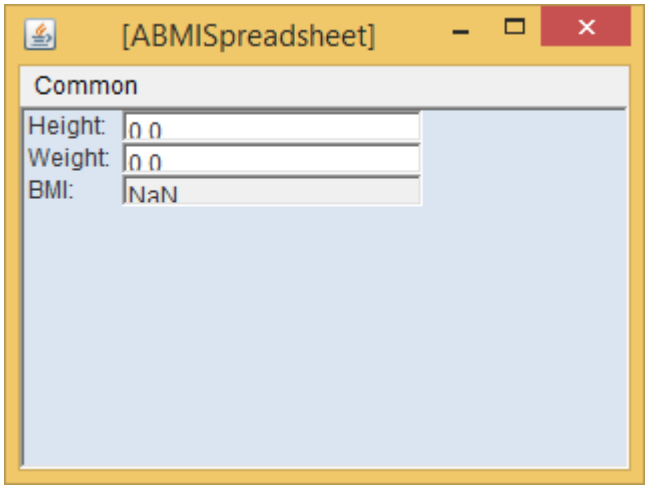
```
LineBorder blackline = BorderFactory.createLineBorder(Color.black);
```

```
LineBorder blackline = new LineBorder(Color.black);
```

Factory can return a single instance of LineBorder for all black line borders

Swing/AWT Substitution





Swing Widgets: JFrame, JPanel, JTextField

AWT Widgets: Frame, Panel, TextField

Factory Practical Examples

- Multiple toolkits provide same kind of widgets with different look and feel/implementations.
- Package java.awt
  - TextField, Button, Panel
- Package javax.swing
  - JTextField, JButton, JPanel
- Could define a common factory interface
  - getTextField(), getButton(), getPanel()
- Java does not define common interfaces

Factory Practical Examples

- ObjectEditor provides a layer that unites
- SwingFactory and AWTFactory classes implement interface
- FactorySelector switches between two sets of classes to change implementation

Swing/AWT Substitution

```
public static void main (String[] anArgs) {
  BMISpreadsheet aBMISpreadsheet = new ABMISpreadsheet();
  VirtualToolkit.setDefaultToolkit(new SwingToolkit());
  ObjectEditor.edit(aBMISpreadsheet);
  VirtualToolkit.setDefaultToolkit(new AWTToolkit());
  ObjectEditor.edit(aBMISpreadsheet);
}
```

SwingToolkit

```
TextFieldSelector.setTextFieldFactory(new SwingTextFieldFactory());
PanelSelector.setPanelFactory(new SwingPanelFactory());
FrameSelector.setFrameFactory(new SwingFrameFactory());
```

Single class ensures matching objects created

AWTToolkit

```
TextFieldSelector.setTextFieldFactory(new AWTTextFieldFactory());
PanelSelector.setPanelFactory(new AWTPanelFactory());
FrameSelector.setFrameFactory(new AWTFrameFactory());
```

Single class ensures matching objects created

Defining our own Factory

```
public class MySwingFrameFactory extends SwingFrameFactory
implements FrameFactory {
@Override
  protected JFrame createJFrame() {
    JFrame aJFrame = new JFrame();
    aJFrame.setCursor(new Cursor (Cursor.CROSSHAIR_CURSOR));
    return aJFrame;
  }
}
```

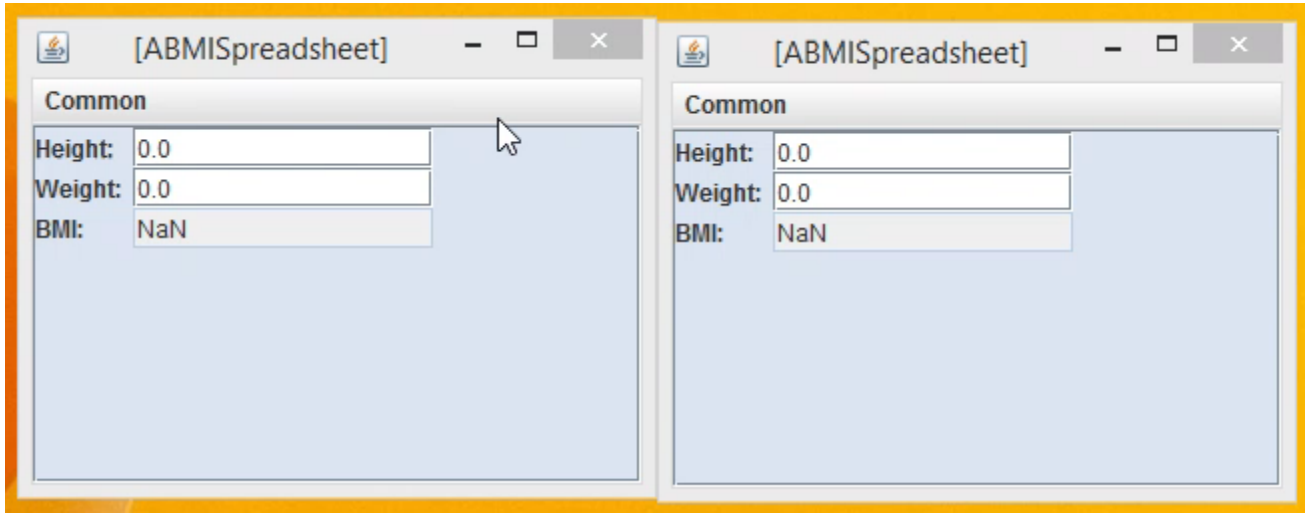
Factory method

Factory class with overriddable factory method

Changing Factory at Runtime

```
public static void main (String[] anArgs) {
  BMISpreadsheet aBMISpreadsheet = new ABMISpreadsheet();
  ObjectEditor.edit(aBMISpreadsheet);
  FrameSelector.setFrameFactory(new MySwingFrameFactory());
  ObjectEditor.edit(aBMISpreadsheet);
}
```

Video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Factory Uses

Makes it easier to instantiate and substitute classes

Makes it possible to create global objects on demand

Can be used to force singletons

Can be used to ensure compatible classes instantiated

Factory Uses

- Should we always instantiate via factories?
- Factory classes add overhead
  - Factory interfaces, classes
  - Factory selector interfaces, classes
- If not using Factory classes, at least use factory methods

Classes vs. Factory

- We also called a class a factory
  - It defines blueprints for its instances
- Factory methods and classes are broker that orders objects for you.
- Factory selector decides between different kinds of brokers
- Analogy
  - I ask my IT department to get me a 4lb laptop
  - They decide to go to the CCI "factory"
  - CCI factory specifies matching computer and accessories
  - These are then ordered from the real factory
- Car Analogy
  - Dealership selling you cars and accessories that go with them.

Factories and Interfaces

- Factories allow us to switch between alternative objects providing same methods
  - AShortCounter and AnIntCounter
  - JTextField and TextField
- Alternative objects must be united by a common interface
- Otherwise common factory interface cannot be defined.
- Moral: define interfaces!