Software 1 with Java

Recitations No. 13-14
(Summary)

Singleton

- Ensures a class has only one instance and provides a global access point to it.

```
public class Logger {
        private static final Logger instance = new Logger();

        private Logger() {…}

        public static Logger getInstance() {
                return instance;
        }
}
```

Singleton (cont.)

```
public class Logger {
    private static Logger instance;

    private Logger() {…}

    public static Logger getInstance() {
        if (instance == null)
            instance = new Logger();

        return instance;
    }
}
```

Lazy evaluation

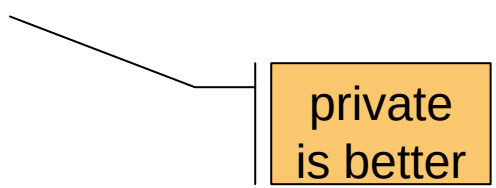
Enumeration

- Enforces a final set of instances and provides a global access point to them.

```
public final class Boolean … {
        public static final Boolean FALSE  = new Boolean(false);
        public static final Boolean TRUE = new Boolean(true);

        // Constructor
        public Boolean(boolean value) {…}
        // Factory Method
        public static Boolean valueOf(boolean b) {…}
        …
}
```

Enumeration (cont.)

```
public final class Boolean …{
    public static final Boolean FALSE  = new Boolean(false);
    public static final Boolean TRUE = new Boolean(true);

    public Boolean(boolean value) {…}

    static Boolean valueOf(boolean b) {
        return (b ? Boolean.TRUE : Boolean.FALSE);
    }
}
```



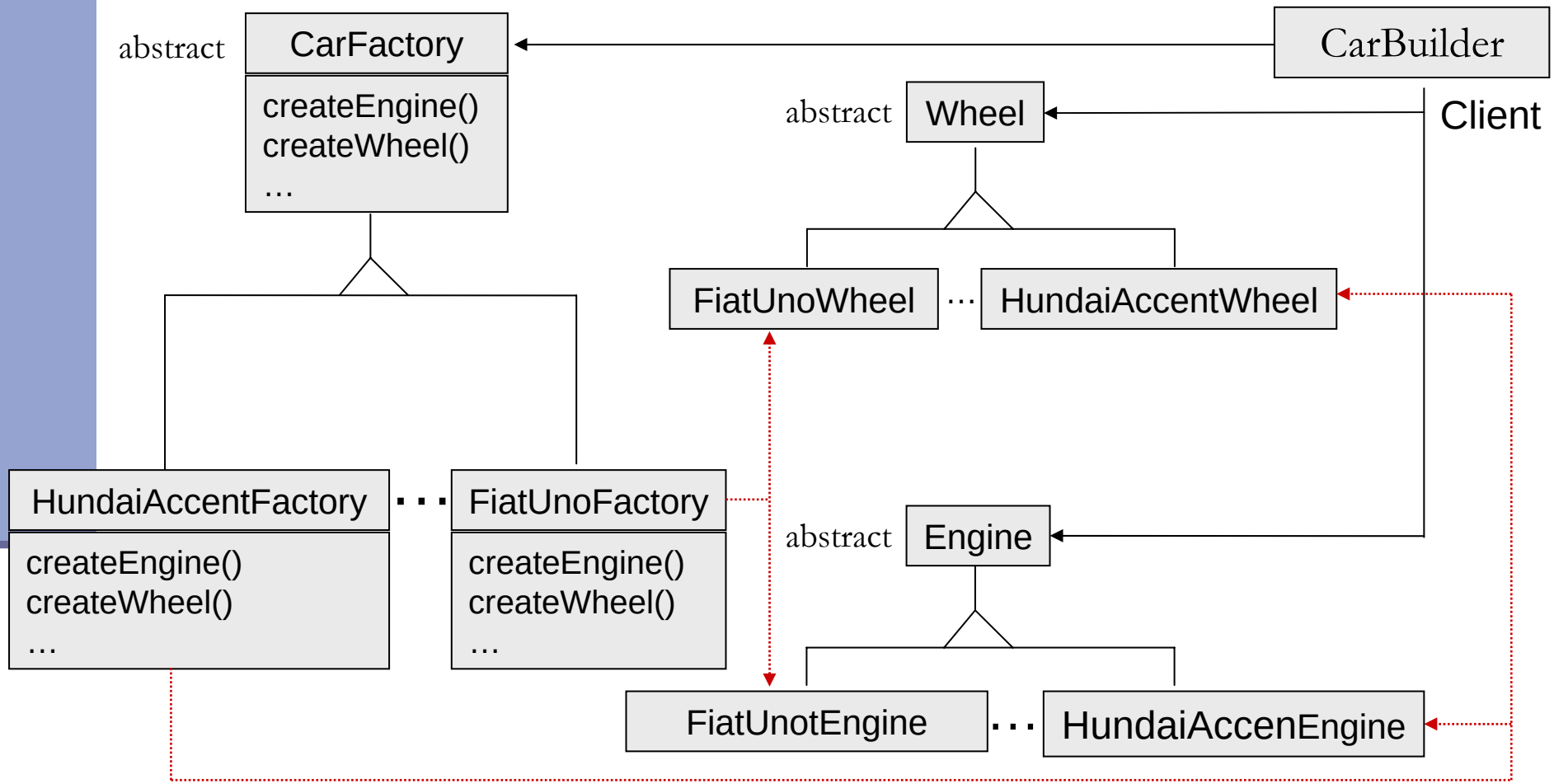
Abstract Factory

- Useful for creating families of related objects without specifying their concrete classes
- Example: An application for building cars
  - builds various types of cars:

    Hundai-Accent, Peuget 205 GTI, Fiat-Uno etc.
  - all cars have the same overall structure, i.e. consist of the same components:

    engine, wheels, brakes etc.
  - The components are different.

Abstract Factory (cont.)



Abstract Factory (cont.)

- Isolates concrete classes
- Exchanging product families is easy
- Promotes consistency among products
- Supporting new kinds of products involves changing the AbstractFactory class and all of its subclasses.
- Typically implemented as a singleton.

Initialization

```
public class Foo {
    static int bar;

    public static void main (String args []) {
        bar += 1;
        System.out.println("bar = " + bar);
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Initialization

```
public class Test {
    private int a = getB();
    private int b = 5;

    private int getB() {
        return b;
    }

    public static void main(String args[]) {
        System.out.println((new Test()).a);
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception? If yes, why? If no, what is the output?

Initialization

```
public class Test {
    private int b = 5;
    private int a = getB();

    private int getB() {
        return b;
    }

    public static void main(String args[]) {
        System.out.println((new Test()).a);
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception? If yes, why? If no, what is the output?

Initialization

```
public static void main(String args[]) {
    int i;
    System.out.println(i);
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Pass by Value

```
public class PassTest1{

    public static void changeInt(int value) {
        value = 55;
    }

    public static void main(String args[]) {
        int val;

        // Assign the int
        val = 11;
        // Try to change it
        changeInt(val);
        // What is the current value?
        System.out.println(val);
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Pass by Value

```
public class PassTest2 {

  public static void changeObjectRef(MyPoint ref) {
     ref = new MyPoint(1, 1);
  }
  public static void main(String args[]) {
     MyPoint point;
     // Assign the point
     point = new MyPoint(22, 7);
     // Try to change it
     changeObjectRef(point);
     // What is the current value?
     System.out.println(point);
  }
}
```

```
public class MyPoint {
      private int x;
      private int y;

      public MyPoint(int x, int y) {
            this.x = x;
            this.y = y;
      }

      @Override
      public String toString() {
            return "(" + x + "," + y + ")";
      }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Pass by Value

```
public class PassTest3 {

  public static void changeObjectAttr(MyPoint ref){
            ref.setX(4);
  }
  public static void main(String args[]) {
     MyPoint point;
     // Assign the point
     point = new MyPoint(22, 7);

     changeObjectAttr(point);

     // What is the current value?
     System.out.println(point);
  }
}
```

```
public class MyPoint {
      private int x;
      private int y;

      public MyPoint(int x, int y) {
            this.x = x;
            this.y = y;
      }
      public void setX(int x) {
            this.x = x;
      }
      @Override
      public String toString() {
            return "(" + x + "," + y + ")";
      }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Pass By-Value

```
public class Test {
  private static class Value { int v = 1; }

  public static void main(String[] args) {
    Test test = new Test();
    int v = 2;
    Value value = new Value();
    value.v = 3;
    foo(value, v);
    System.out.println(value.v + " " + v);
  }

  private static void foo(Value value, int v) {
    v= 4;
    value.v = 5;
    value =  new Value();
    System.out.println(value.v + " " + v);
  }
}
```

What is the output?

A Word about Interfaces

- An interface can extend several interfaces
- Interface methods are by definition public and abstract:

```
public interface MyInterface {
   public abstract int foo1(int i);
   int foo2(int i);
}
```

The type of foo1 and foo2 is the same.

Interfaces

```
public interface Foo {
        public void bar()
                throws Exception;
}

public class FooImpl implements Foo {
        public void bar() {
                System.out.println("An exception is not thrown");
        }

        public static void main(String args[]) {
                Foo foo = new FooImpl();
                foo.bar();
        }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Interfaces

```
public interface Foo {
    public void bar()
        throws Exception;
}

public class FooImpl implements Foo {
    public void bar() {
        System.out.println("No exception is thrown");
    }

    public static void main(String args[]) {
        FooImpl foo = new FooImpl();
        foo.bar();
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception? If yes, why? If no, what is the output?

Interfaces and Inheritance

Consider the following class hierarchy:

Interface **Animal** {…}
class **Dog** implements Animal{…}
class **Poodle** extends Dog {…}
class **Labrador** extends Dog {…}

Which of the following lines (if any) will not compile?

```
Poodle poodle = new Poodle();
Animal animal = (Animal) poodle;
Dog dog = new Labrador();
animal = dog;
poodle = dog;
```

Interfaces and Inheritance

```
class A {
    public void print() {
        System.out.println("A");
    }
}

class B extends A implements C {
}

interface C {
    void print();
}
```

Is there any error?

Interfaces and Inheritance

```
class A {
    void print() {
        System.out.println("A");
    }
}

class B extends A implements C {
}

interface C {
    void print();
}
```

Is there any error?

Method Overriding & Visibility

```
public class A {
    public void print() {
        System.out.println("A");
    }
}

public class B extends A {
    protected void print() {
        System.out.println("B");
    }
}
```

```
public class C {
    public static void main(String[] args) {
        B b = new B();
        b.print();
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Method Overriding & Visibility

```
public class A {
    protected void print() {
        System.out.println("A");
    }
}

public class B extends A {
    public void print() {
        System.out.println("B");
    }
}
```

```
public class C {
    public static void main(String[] args) {
        B b = new B();
        b.print();
    }
}
```

What is the output?

Method Overloading & Overriding

```
public class A {
    public float foo(float a, float b) throws IOException{
    }
}

public class B extends A {
    …
}
```

Which of the following methods can be defined in B:

1. float foo(float a, float b){…}
2. public int foo(int a, int b) throws Exception{…}
3. public float foo(float a, float b) throws Exception{…}
4. public float foo(float p, float q){…}

Answer: 2 and 4

Method Overriding

```
public class A {
    public void print() {
        System.out.println("A");
    }
}

public class B extends A {
    public void print(){
        System.out.println("B");
    }
}
```

```
public class C {
    public static void main(String args[]){
            B b = new B();
            A a = b;

            b.print();
            a.print();
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Inheritance

```
public class A {
    public void foo() {
        System.out.println("A.foo()");
    }

    public void bar() {
        System.out.println("A.bar()");
        foo();
    }
}

public class B extends A {
    public void foo() {
        System.out.println("B.foo()");
    }
}
```

```
public class D {
    public static void main(String[] args) {
        A a = new B();
        a.bar();
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Inheritance

```
public class A {
    private void foo() {
        System.out.println("A.foo()");
    }

    public void bar() {
        System.out.println("A.bar()");
        foo();
    }
}

public class B extends A {
    public void foo() {
        System.out.println("B.foo()");
    }
}
```

```
public class D {
    public static void main(String[] args) {
        A a = new B();
        a.bar();
    }
}
```

Does the code compile? If no, why?
Does the code throw a runtime exception?
If yes, why? If no, what is the output?

Inheritance

```
public class A {
        public void foo() {…}
}

public class B extends A {
    public void foo() {…}
}
```

How can you invoke the foo method of A within B?

Inheritance

```
public class A {
        public void foo() {…}
}

public class B extends A {
    public void foo() {…}
}

public  class C extends B {
    public void foo() {…}
}
```

How can you invoke the foo method of A within C?

Inheritance & Constructors

```
public class A {
    String bar = "A.bar";

    A() { foo(); }

    public void foo() {
        System.out.println("A.foo(): bar = " + bar);
    }
}

public class B extends A {
    String bar = "B.bar";

    B() { foo(); }

    public void foo() {
        System.out.println("B.foo(): bar = " + bar);
    }
}
```

```
public class D {
    public static void main(String[] args) {
        A a = new B();
        System.out.println("a.bar = " + a.bar);
        a.foo();
    }
}
```

What is the output?

Inheritance & Constructors

```
public class A {
        protected B b = new B();
        public A() { System.out.println("in A: no args."); }
        public A(String s) { System.out.println("in A: s = " + s); }
}

public class B {
        public B() { System.out.println("in B: no args."); }
}

public class C extends A {
        protected B b;
        public C() { System.out.println("in C: no args."); }
        public C(String s) { System.out.println("in C: s = " + s); }
}

public Class D {
        public static void main(String args[]) {
                C c = new C();
                A a = new C();
        }
}
```

What is the output?

Inheritance & Constructors

```
public class A {
        protected B b = new B();
        public A() { System.out.println("in A: no args."); }
        public A(String s) { System.out.println("in A: s = " + s); }
}

public class B {
        public B() { System.out.println("in B: no args."); }
}

public class C extends A {
        protected B b;
        public C() { System.out.println("in C: no args."); }
        public C(String s) { System.out.println("in C: s = " + s); }
}

public class D {
        public static void main(String args[]) {
                C c = new C("c");
                A a = new C("a");
        }
}
```

What is the output?

Inheritance & Constructors

```
public class A {
        protected B b = new B();
        public A() { System.out.println("in A: no args."); }
        public A(String s) { System.out.println("in A: s = " + s); }
}

public class B {
        public B() { System.out.println("in B: no args."); }
}

public class C extends A {
        protected B b;
        public C() { System.out.println("in C: no args."); }
        public C(String s) { System.out.println("in C: s = " + s); }
}

public class D {
        public static void main(String args[]) {
                C c = new C("c");
                A a = new C("a");
        }
}
```

What will happen if we remove this line?

Inheritance & Constructors

```
public class A {
        String bar = "A.bar";
}

public class B extends A {
        String bar = "B.bar";
        B() { foo(); }
        public void foo() {
                System.out.println("B.foo(): bar = " + bar);
        }
}
```

```
public class D {
        public static void main(String[] args) {
                A a = new B();
                System.out.println(a.bar);
                a.foo();
        }
}
```

What is the result?

Local Class

```
public class Test {
    public int a = 0;
    private int b = 1;

    public void foo(final int c) {
        int d = 2;

        class InnerTest {
            private void bar(int e) {
                                    // highlighted line
            }
        }
    }
}
```

Which variables (a, b, c, d, e) are accessible at the highlighted line?

Good-Luck!!!