

Reflection


Classpath, Casting, Annotations

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Lecture #7 out of 8

90 minutes

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Type Casting
Factory Method
Classpath Scanning
Annotations
Discrimination by Type
Read and Watch

Chapter #1:

Type Casting

Iterable → Collection

Downcasting (**wrong!**):

```
1 int sizeOf(Iterable items) {  
2     int size = 0;  
3     if (items instanceof Collection) {  
4         size = ((Collection) items).size();  
5     } else {  
6         for (Object item : items) {  
7             ++size;  
8         }  
9     }  
10    return size;  
11 }
```

Method overloading (**right!**):

```
1 int sizeOf(Iterable items) {  
2     int size = 0;  
3     for (Object item : items) {  
4         ++size;  
5     }  
6     return size;  
7 }  
8  
9 int sizeOf(Collection items) {  
10    return items.size();  
11 }
```

Implicit Coupling

```
1 int sizeOf(Iterable items) {  
2     int size = 0;  
3     if (items instanceof Collection) {  
4         size = ((Collection) items).size();  
5     } else {  
6         for (Object item : items) {  
7             ++size;  
8         }  
9     }  
10    return size;  
11 }
```

```
1 Iterable<Book> books1 =  
2     new PgBooks1("localhost:5432");  
3 int s1 = sizeOf(books1);  
4  
5 Collection<Book> books2 =  
6     new PgBooks2("localhost:5432");  
7 int s2 = sizeOf(books2);
```

It may be hard to understand why `s2` is evaluated much faster than `s1`, since the signature of `sizeOf()` is the same in both cases.

Pattern Matching in Java 16

Java 11 (**wrong!**):

```
1 int sizeOf(Iterable items) {  
2     int size = 0;  
3     if (items instanceof Collection) {  
4         size = ((Collection) items).size();  
5     } else {  
6         for (Object item : items) {  
7             ++size;  
8         }  
9     }  
10    return size;  
11 }
```

Java 16 (**even worse!**):

```
1 int sizeOf(Iterable items) {  
2     int size = 0;  
3     if (items instanceof Collection c) {  
4         size = c.size();  
5     } else {  
6         for (Object item : items) {  
7             ++size;  
8         }  
9     }  
10    return size;  
11 }
```

C#, Rust, and pattern matching

C#:

```
1 public int sizeof<T>(IEnumerable<T> items) {  
2     if (items is IList<T> list) {  
3         return list.Count;  
4     } else {  
5         return // count them one by one  
6     }  
7 }
```

Some other languages have pattern matching feature, including Kotlin, Scala, Haskell, Elixir, Swift, F#, and Erlang, ... which **contradicts** the principle of encapsulation.

Rust:

```
1 enum Color {  
2     RGB(u8, u8, u8),  
3     Transparent  
4 }  
5 fn paint(c: Color) {  
6     match c {  
7         Color::RGB(r, g, b) =>  
8             println!("#{r}{g}{b}"),  
9         Color::Transparent =>  
10             println!("none")  
11     }  
12 }  
13 fn main() {  
14     let c = Color::RGB(64, 16, 0);  
15     paint(c);  
16 }
```

Chapter #2:

Factory Method

[[IF](#) forName]

Conditional object construction

This is **wrong**:

```
1 interface Figure
2     int surface();
3 class Square implements Figure
4 class Triangle implements Figure
5 class Polygon implements Figure
6
7 class FactoryOfFigures
8     Figure make(int sides) {
9         if (sides == 3) {
10             return new Triangle();
11         } else if (sides == 4) {
12             return new Square();
13         } else {
14             return new Polygon(sides);
15         }
16     }
```

This is **better**:

```
1 class PolymorphicFigure
2     PolymorphicFigure(int sides)
3     int surface() {
4         if (sides == 3) {
5             return new Triangle().surface();
6         } else if (sides == 4) {
7             return new Square().surface();
8         } else {
9             return new Polygon(sides).surface();
10        }
11    }
```

Here, the semantic of object construction is not visible to the client — coupling is loose.

Generating class name from a string

This is **wrong**:

```
1 interface Figure
2     int surface();
3
4 class Square implements Figure
5 class Triangle implements Figure
6 class Polygon implements Figure
7
8 class FactoryOfFigures
9     Figure make(String name) throws Exception {
10         Class<?> c = Class.forName(name);
11         return c.getConstructor().newInstance();
12     }
```

This is **better**:

```
1 class PolymorphicFigure
2     PolymorphicFigure(String name)
3     int surface() {
4         if (name.equals("Triangle")) {
5             return new Triangle().surface();
6         } else if (name.equals("Square")) {
7             return new Square().surface();
8         } else {
9             return new Polygon().surface();
10        }
11    }
```

Chapter #3:

Classpath Scanning

Finding Java classes

```
1 interface Foo {}
2
3 class Bar implements Foo {}
4
5 Reflections rts =
6     new Reflections("");
7 Set<Class<?>> types = rts.get(
8     SubTypes.of(Foo.class).asClass()
9 );
```

```
1 public @interface Foo {}
2
3 @Foo
4 class Bar {}
5
6 Reflections rts =
7     new Reflections("");
8 Set<Class<?>> types = rts.get(
9     SubTypes.of(
10         TypesAnnotated.with(Foo.class)
11     ).asClass()
12 );
```

The library is called Reflections. Instead, use explicit object instantiation.

Chapter #4:

Annotations

I lieu of static methods

```
1 interface Pub
2     String isbn();
3
4 class Book implements Pub
5     @Override public String isbn()
6         /* ... */
7     public static String category()
8         return "book";
9
10 class Journal implements Pub
11     @Override public String isbn()
12         /* ... */
13     public static String category()
14         return "journal";
```

```
1 interface Pub
2     String isbn();
3
4 @Target(ElementType.CLASS)
5 @Retention(RetentionPolicy.SOURCE)
6 public @interface Category
7     String value();
8
9 @Category("book")
10 class Book implements Pub
11     @Override public String isbn()
12         /* ... */
13
14 @Category("journal")
15 class Journal implements Pub
16     @Override public String isbn()
17         /* ... */
```

Locating methods

```
1 @Target(ElementType.METHOD)
2 @Retention(RetentionPolicy.SOURCE)
3 public @interface Path
4     String url;
5
6 class BookController
7     @Path("/book-title")
8     String title()
9         // Build HTML page and return it
```

```
1 String dispatch(String url) {
2     c = new BooksController();
3     b = BooksController.class;
4     for (Method m : b.getDeclaredMethods()) {
5         if (m.isAnnotationPresent(Path.class)) {
6             Annotation a = m.getAnnotation(Path.class);
7             if (a.url().equals(url)) {
8                 return m.invoke(c);
9             }
10        }
11    }
12    return "404 Page not found";
13 }
```

Dependency Injection Container

```
1 interface Shipment
2     int cost();
3
4 class Cart
5     @Inject private Shipment shmt;
6     private Book book;
7     void setBook(Book b)
8         this.book = b;
9     int cost()
10         return this.book.price() + this.shmt.cost();
11
12 container = new Container();
13 c = container.make(Cart.class);
14 c.setBook(new Book("1984"));
15 x = c.cost();
```

```
1 class Container {
2     private HashMap<Class, Object> cache =
3         new ConcurrentHashMap<>();
4     T make(Class<T> type) {
5         // 1. Find @Inject-annotated "shmt" field;
6         // 2. Make an instance of "Shipment";
7         // 3. Store it in the "cache";
8         // 4. Make an instance of "Cart";
9         // 5. Store "cart" in the "cache";
10        // 6. Assign "shipment" to "cart.shmt";
11        // 7. Return "cart".
12    }
13 }
```

How do you think, at the step no.2, what class will be instantiated?

Dependency Injection *without* a Container

```
1 interface Shipment
2     int cost();
3
4 class Cart
5     @Inject private Shipment shmt;
6     private Book book;
7     void setBook(Book b)
8         this.book = b;
9     int cost()
10         return this.book.price() + this.shmt.cost();
11
12 container = new Container();
13 c = container.make(Cart.class);
14 c.setBook(new Book("1984"));
15 x = c.cost();
```

```
1 interface Shipment
2     int cost();
3
4 class Cart
5     private final Shipment shmt;
6     private final Book book;
7     Cart(Shipment s, Book b)
8         this.shmt = s;
9         this.book = b;
10    int cost()
11        return this.book.price() + this.shmt.cost();
12
13 c = new Cart(new MyShipment(), new Book("1984"));
14 x = c.cost();
```

Chapter #5:

Discrimination by Type

Polymorphism vs. Casting

```
1 interface Figure
2     void rotate(int d);
3
4 class Circle implements Figure
5     void rotate(int d) //...
6     int radius() //...
7
8 class Square implements Figure
9     void rotate(int d) //...
10    int side() //...
```

```
1 // This is polymorphism:
2 int surface(Figure f)
3     return f.surface()
4
5 // This is type casting:
6 int surface(Figure f)
7     if (f instanceof Circle c) {
8         return c.radius()
9     } else if (f instanceof Square s) {
10        return s.side() * s.side();
11    } else {
12        throw new Exception("oops");
13    }
```

Chapter #6:

Read and Watch

Dependency Injection Containers are Code Polluters by me (2014)

Class Casting Is a Discriminating Anti-Pattern by me (2015)

Java Annotations Are a Big Mistake by me (2016)

Reflection Means Hidden Coupling by me (2022)

Java Annotations Are a Bad Idea, at JDK.io conference (2017)

Constructors or Static Factory Methods? by me (2017)

Strong Typing without Types by me (2020)