Reflection
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- Remember project 1?
  - Used reflection to find module class
    - http://webserver:port/HelloWorld/Foo

- We’ll cover some basics of reflection
  - Highly condensed version of
    - Reflection: Java Technology’s Secret Weapon, by Odendahl (on web page)
What is Reflection?

- Makes classes, methods, and fields objects that can be manipulated at run time
  - Can determine fields and methods of class
  - Can instantiate class given a String containing its name
  - Can invoke methods given a String with name
  - Can create classes an runtime

What Reflection Isn’t

- Doesn’t add any power to the language
  - Given access to all the source code

- Not the solution to every problem
  - Use sparingly, if at all
java.lang.Class

- Object of type Class represents a class
  - Useful for
    - Making instances of a class
    - Getting information about fields/methods
  - Most uses of reflection start with a Class
- Primitive types also have a Class
  - e.g., int.class

Getting Some Class

- Use Object method getClass()
  - Class c = “hello”.getClass();
- Use class literal
  - Class c = String.class;
- Use the class name
  - Class c = Class.forName(“java.lang.String”)
Making Objects

• Class object for no-arg constructor
  ```java
  Class c;
  Foo f = (Foo) c.newInstance();
  ```

• Constructor object otherwise
  ```java
  Class c;
  Class[] cArg = { String.class };  
  Constructor cons = c.getConstructor(cArg);  
  Object[] consArg = { "hello" };  
  Foo f = (Foo) cons.newInstance(consArg);
  ```

Working with Fields

• Can get Field objects from Class
  – Can also get all fields in Class
  ```java
  Class c = x.getClass(); // get class of obj x
  Field f = c.getField("foo");
  ...(Type-of-foo) f.get(x); ...
  ...(Type-of-foo) f.set(x, value);...
  ```
**Invoking Methods**

• Get from Class object
  – Invoke just like constructor

```java
Class c = x.getClass();
Class[] cArg = { String.class };
Method m = c.getMethod("bar", cArg);
Object[] mArg = { "hello" };
Foo f = (m-result-type) m.invoke(x, mArg);
```

**Putting It All Together**

• Example from JavaOne slides:
```java
public static void main(String[] args) throws Exception {
    Field f = System.class.getField("out");
    PrintStream out = (PrintStream) f.get(null);
    Class[] paramTypes = { String.class };
    Method m = PrintStream.class.getMethod("println", paramTypes);
    String[] params = (String[]) Array.newInstance(String.class, 1);
    Array.set(params, 0, "Hello, world!");
    m.invoke(out, params);
}
```