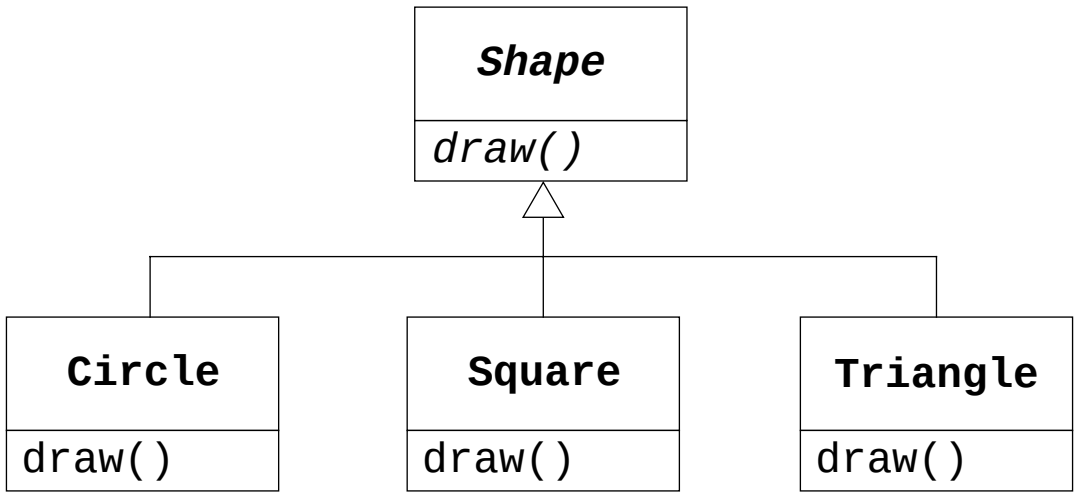
Run-Time Type Identification

Intent

Lets you find the exact type of an object even if your handle is a base type of your object.

Polymorphism

Consider the familiar example:



A code excerpt might be:

```
public abstract class Shape {
   public abstract void draw();
}

public class Circle extends Shape {
   public void draw() {
      // Would really draw into a Graphics object..
      System.out.println("Circle.draw()");
   }
}

// Classes Square, Triangle: Accordingly.
```

A client might create a collection of Shape objects:

```
// In the body of a method:
ArrayList shapes = new ArrayList();
shapes.add(new Circle());
shapes.add(new Square());
shapes.add(new Triangle());
```

A client uses the above collection of Shape objects:

```
// In the body of a method:
ArrayList shapes = ...; // Given as argument,
                        //or created locally.

for (Iterator i = shapes.iterator(); i.hasNext(); ) {
   Object o = i.next();// declared return type of
                       // method next(): Object
   Shape s = (Shape) o;// downcast
   s.draw();
}
```

The actual type contained in variable `s` determines which instance of method `draw()` is executed when applying it to `s`.

If the collection contains an object that hasn't `Shape` as its base class then the unchecked `ClassCastExcpetion` is thrown.

But what if you want to highlight all `Triangle` objects in a given collection of a `Shape` objects?

Downcast

Given a `Shape` object, you can downcast it to a `Triangle` object. If it is not a `Triangle` object, a `ClassCastException` is thrown:

```
Shape s = ...;
Triangle t;
try {
   t = (Triangle) s;
} catch (ClassCastException e) { ... }
```

In this approach, you try the downcast, and if it does not fail, then you know that a given object's type is the one of a particular subtype. This is not always a good style, however.

Checking for an Instance of a Particular Type

Given a collection of Shape objects, you can check if an item of the collection is a `Triangle` object by using the `instanceof` operator:

```
// in a method:
ArrayList shapes = ...; // provide a collection of shapes

for (Iterator i = shapes.iterator(); i.hasNext(); ) {
   Shape s = (Shape) i.next();
   if (s instanceof Triangle) {
      // change color
   }
}
```

However, suppose you want to count the concrete subtypes of a collection of shapes. Using the `instanceof` operator, you end up in a client class with something like:

```
if (s instanceof Circle)   { /* increment circle count   */}
if (s instanceof Square)   { /* increment square count   */}
if (s instanceof Triangle) { /* increment trianlge count */}
```

If you later add a new subtype of `Shape`, you'll have to modify the client code from above:

```
if (s instanceof Circle)   { /* increment circle count   */}
if (s instanceof Square)   { /* increment square count   */}
if (s instanceof Triangle) { /* increment trianlge count */}
if (s instanceof Line)     { /* increment line count     */}
```

The Class Object

Every object in your Java program is an instance of a class. Upon loading the code for a given class, the class itself is represented within the Java program by its *class object*. The class object is an instance of class `Class`.

The class object is created if:

- an instance of that class is created for the first time, or
- you create the class object explicitly.

Explicit Creation/Access of the Class Object. You can perform explicit class object creation or access to via:

- The static `Class.forName()` method:
  `Class cl = Class.forName("`*`fully_quallyfied_Classname`*`");`
- The *class literal*:
  `Class cl = `*`Classname`*`.class;`

Class literals are checked by the compiler at compile-time. They are safer, though, but less flexible. `Class.forName()` is more flexible. For instance, you can provide the string naming the class during execution of the program. `Class.forName()` may throw a checked `ClassNotFoundException`.

A Dynamic Instanceof Operator: Class.isInstance()

Method `Class.isInstance(Object)` allows to check if a given object belongs to a given class or one of its descendants. Counting the `Shape` objects can then be done as follows:

```
class Counter {
   int i;
}
```

In the body of some method:

```
Class[] shapeTypes =
   { Shape.class, Circle.class, Square.class, Triangle.class };
Map map = new HashMap();
for (int i=0; i < shapeTypes.length; i++) {
   map.put(shapeTypes[i], new Counter());
}
```

Array `shapeTypes` contains the set of class objects for the concrete subclasses of class `Shape`, as well as the class object for class `Shape`.

A `HashMap` object is initialized with class objects as the keys, and `Counter` objects as their values.

Given a set of shapes, lets count the total of `Shape` objects as well as the total of each subclass of `Shape`:

```
// in the body of some method:
ArrayList shapes = ...;

for (Iterator i = shapes.iterator(); i.hasNext(); ) {
   Object o = i.next();
   for (int j=0; j < shapeTypes.length; j++) {
      if (shapeTypes[j].isInstance(o)) {
         ((Counter) map.get(shapeTypes[j])).i++;
      }
   }
}
```

Notice that the outer for-loop need not be changed in the case of modifying the array `shapeTypes` of class object.

Notice also that, given for example an instance of a `Circle`, the counters for `Shape` objects and for `Circle` objects are incremented.

Reflection: Run-Time Class Information

Given an instance of class `Class`, you can get the complete type information for objects represented by that instance of class `Class`. for that purpose, some of methods of class `Class` are:

Classes `Constructor`, `Field`, and `Method` belong to package `java.lang.reflect`.

Method	Description
`Class[] getInterfaces()`	Determines the interfaces *implemented* by the class or interface represented by this object.
`Class getSuperclass()`	Returns the `Class` representing the superclass of the entity (class, interface, primitive type or `void`) represented by this `Class`. If this object represents either the `Object` class, an interface, a primitive type, or `void`, then `null` is returned. If this object represents an array class then the `Class` object representing the `Object` class is returned.
`Constructor[] getConstructors()`	Returns an array containing `Constructor` objects reflecting all the public constructors of the class represented by this `Class` object.

Method	Description
`Field[] getFields()`	Returns an array containing `Field` objects reflecting all the accessible public fields of the class or interface represented by this `Class` object.
`Method[] getMethods()`	Returns an array containing `Method` objects reflecting all the public member methods of the class or interface represented by this `Class` object, including those declared by the class or interface and those inherited from superclasses and superinterfaces.
`Class[] getClasses()`	Returns an array containing `Class` objects representing all the public classes and interfaces that are *members* of the class represented by this `Class` object. This includes public class and interface members inherited from superclasses and public class and interface members declared by the class.