CSSE2002/7023

Semester 1, 2021

Programming in the Large

Week 3.1: More Inheritance and Things Going Wrong

In this Session

- Interfaces
- `super`
- Duck Typing (Python vs Java)
- Casting
- Consequences of Java's Design
- Handling Errors

Quick Recap – Classes and Objects

- Class
- Object

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- Class – describes the behaviour and state of a type.
- Object – is an instance of a class. It stores one instance of the state that the class describes. Behaviours described by the class are applicable to the object / instance.

Quick Recap – Inheritance Access

```
public class X {
  public int one;
  private int two;
  protected String three;

  public X() {...}
  private X(int arg) {...}

  public int f() {...}
  private int g() {...}
  protected int h() {...}
}
```

```
public class Y
    extends X {

}
```

```
public class Z {

}
```

More Inheritance

`class Child extends Parent` ⇒

`Child` gets the following from `Parent`

1. (public/protected) methods and variables
   - what it says it can do
2. Method bodies/implementation
   - how it does it

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Sometimes all we care about is what public methods are present in a class (not trying to inherit code).

- Only #1

Interfaces

An `interface` is a type like a class but it contains no method bodies.

e.g. `java.lang.Comparable`
declares a single method, `compareTo` which takes an object and returns an `int` $\in \{< 0, 0, > 0\}$.

So any code which takes objects and will need to order them, could specify them as being of type `Comparable`.

e.g. `int doStuff(Comparable c[])`

Interfaces

To declare that your class will implement an interface use `implements`.

```
public class Duck extends Fowl
        implements Comparable, Clonable
```

`Duck` inherits code and members from the `Fowl` class.

and

Has all the methods which `Comparable` and `Clonable` say should be there.

Interfaces

`InterfaceExample.java`

- A class implementing an interface is responsible for supplying method bodies for everything declared in the interface.
- Could be used to advertise that your class has additional useful capabilities.
- Could be used to indicate that your class belongs to multiple groups. (e.g. Someone is both a staff member and a student.)
- `interfaces` fill a role taken by abstract[1] classes in other languages.
    - Necessary because Java only allows extending from a single class[2].

[1] which Java also has

[2] "single inheritance" – Python allows multiple inheritance

super

SquareN.java

- Use of super, shadowing and this

No Ducks

Python will let you write code to access a member without knowing whether it actually exists — it checks at runtime.

Java won't let you try to access something unless it is sure (at compile time) that it exists.

```
Object obj = "Hello";
int l1 = obj.length(); // compile error
                       // Object has no .length()

Object obj = "Hello";
String s1 = (String)obj;
int l1 = s1.length();
```

OR

```
Object obj = "Hello";
int l1 = ((String) obj).length();
```

Casting

`(newtype) oldvalue` – called a “typecast” or just “cast”.

- Tells the compiler that you want a *newtype* value of *oldvalue*.

```
(int) 1.7
long x = 100; (float) x
```

Some casts will be made automatically (implicitly)

- “smaller” types $\rightarrow$ “larger” types.
    - e.g. `int` to `long`, `float` to `double`
- integer types $\rightarrow$ floating point types.
    - e.g. `int` to `float`

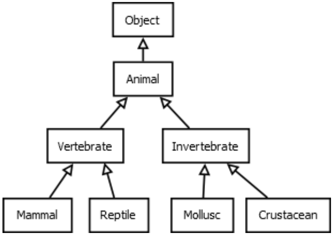
Casting a variable does not change the value of the variable.

Casting References

`(String) obj`

- Returns a reference which can be used to access `String` members in `obj`.
- Changes the compiler's view of what it is looking at.
- It does not change `obj` itself.
- If the compiler does not know of an inheritance relationship between the known type of `obj` and the cast type, it will not compile.
- At runtime, Java will check to see if the cast is valid.
    - If it isn't, it will throw a `ClassCastException`.

Casting References



From	**To**	**Implicit?**	**Error?**
Vertebrate	Animal	yes	—
Vertebrate	Mammal	no	runtime?
Vertebrate	Object	yes	—
Vertebrate	Mollusc	no	compile

“Upcasts” can be implict, “Downcasts” can’t.

You cannot cast between primitives and objects.
e.g. `(String) 5;` is no bueno.

Consequences of Java's Design

- All callable code is in methods
  - No free functions
  - Greater use of "`static`" than in other languages
  - More implementation/non-model classes (e.g. for call backs)
- All variables and constants must be in classes or methods.
- Primitive types are not objects:
  - Containers only hold objects
  - Need wrapper classes for some things
- Single inheritance means interfaces are needed to declare extra capabilities into hierachy

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    - Variants: String, enums

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Everything so far has used the return value to get info out.