

# CS 152

## Computer Programming Fundamentals

### Inheritance

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# Inheritance

*We don't inherit the earth from our parents,  
We only borrow it from our children.*

# What is inheritance?

- Just as for humans, sub classes (children) inherit certain properties from their parents.
- Object Oriented - Doesn't happen if no objects
- One mother/father (super) object
- Child inherits all public and protected members

# Inheritance

It is the same thing as having parents!

- You get part of what they have, but you can form your own way.
- If there are parents, there are usually grand-parents too. You get something from them as well. . .

# Everything is an Object

- The Object class is the Adam/Eve of Java.
- All classes are subclasses of the Object class
- Therefore they inherit certain methods (such as `toString()`)
- `Object.toString()` prints out the address of the object

## Subclasses extend parents...

In java, all classes extend at least the `Object` class (implicitly).

To extend means to get certain properties from your parent

# extends example

An example:

---

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

public class ChildClass extends ParentClass {
    public void tryit() { print(); }

    public static void main(String[] argv) {
        ChildClass test = new ChildClass();
        test.tryit();
    }
}
```

ChildClass inherited print(); from  
ParentClass!

# All classes extend Object

If no parent class is given, parent is Object

---

```
public class Foo {
```

is equivalent to

---

```
public class Foo extends Object {
```



## this and super

There are two keywords that are often used with inheritance. They are:

- `this` – a reference to the current object instance. Ex: to address an instance variable you may always do: `this.variable`
- `super` – a reference to the (parent) object that created this object instance. Use `super` to access methods that you are overriding in the parent.
  - Note! Calls to `super()` constructors must always be the first line in your constructor (if you want to)!
  - You can also call other constructors in your object such as `this()`.

# Overriding – Overloading

- A class can (as you know) define methods
- When one class inherits another, the derived class can “override” a method in the *base class*.
- Overriding methods must have the same name, same number of parameters, and same type of all parameters
- Different from overloading (where types, or number of parameters must differ)
- If a method is specified as  
`public final void methodName()`  
it can not be overridden.

## Overriding – Overloading cont...

- Methods can be both overridden and overloaded at the same time.
- Fields can not be overridden, only hidden
- Only *accessible methods* can be overridden
- Static members are always hidden (so impossible to override)

# Access modifiers

`public` Accessible to all

`private` Only this class

`protected` Only this class and its subclasses

*`package-private`* No modifier. This class and others in same package.

# Overriding – Annotation

- The compiler can help check that you are doing what you think you are doing.
- The `@Override` annotation tells the compiler that you intend to override a method from the superclass.
- If you don't, compiler will complain.

---

```
public class Bar extends Foo {  
    @Override  
    public int fooMethod() {  
    }  
}
```

# Multiple types

- A subclass can be assigned to a variable of the supertype class.
- If you want to check if it's one or the other, you can use the `instanceof` keyword to check:

```
if ( obj instanceof MyClass ) ...
```

- `instanceof` works with interfaces, too!

## Final classes and methods

Classes and methods that are defined as final cannot be extended or overridden respectively. Can be useful if you're sure that you don't want your class extended.

- Increased security
- Guarantees specific implementation
- Generally should only call `final` helpers in constructors.

# Another inheritance example

```
public class Student {  
  
    public String toString() {  
        return "I'm a student";  
    }  
}
```

```
public class Undergrad extends Student {  
  
    public String toString () {  
        return super.toString() + " in college!";  
    }  
}
```



# I'm curious...

Think of our two classes Student and Undergrad

- In the case of:

```
Student myStudent = new Undergrad();
```

- How does Java know how to execute the overridden method toString() in Undergrad when the programmer calls:

```
myStudent.toString();
```

especially in the case where the Student class was compiled before Undergrad?

# Dynamic (Late) Binding

- Compiler puts in a flag saying “Use applicable definition for method toString()” when compiling, since it doesn’t know what definition it will use later.
- Method definition is chosen based on the current object’s place in the inheritance chain, not by the type naming the current object!
- Even typecasts will not change this behavior:  
`Student myStudent = (Student) new Undergrad();`  
`myStudent.toString();` will still call the Undergrad toString() method.

# Polymorphism

*the quality or state of existing in or assuming different forms*

*In object oriented programming, the term is used to describe a variable that may refer to objects whose class is not known at compile time, and which respond at run time according to the actual class of the object to which they refer.*

Definitions from [dictionary.com](http://dictionary.com)

# Dynamic Binding vs. Polymorphism

- Sounds like the same thing. . .
- That's because it is because both phrases describe the same process but from different perspectives:
  - Polymorphism is at the object level (for the programmer)
  - Dynamic Binding is the compiler's way of realizing polymorphism
- Sometimes used interchangeably. Note though, original definition of polymorphism was only referring to type generality, but has been redefined for object oriented programming.

# instanceof

- Can be used to see if instances were created from the same class.
- Useful when comparing objects - makes for a better comparison
- Syntax:  
`<object> instanceof <type>`
- Add to equals or compareTo method to ensure that there's class correspondence.