COMP 110/L Lecture 19

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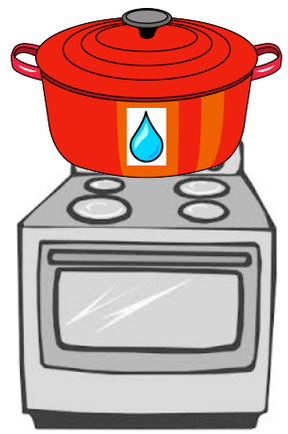
Outline

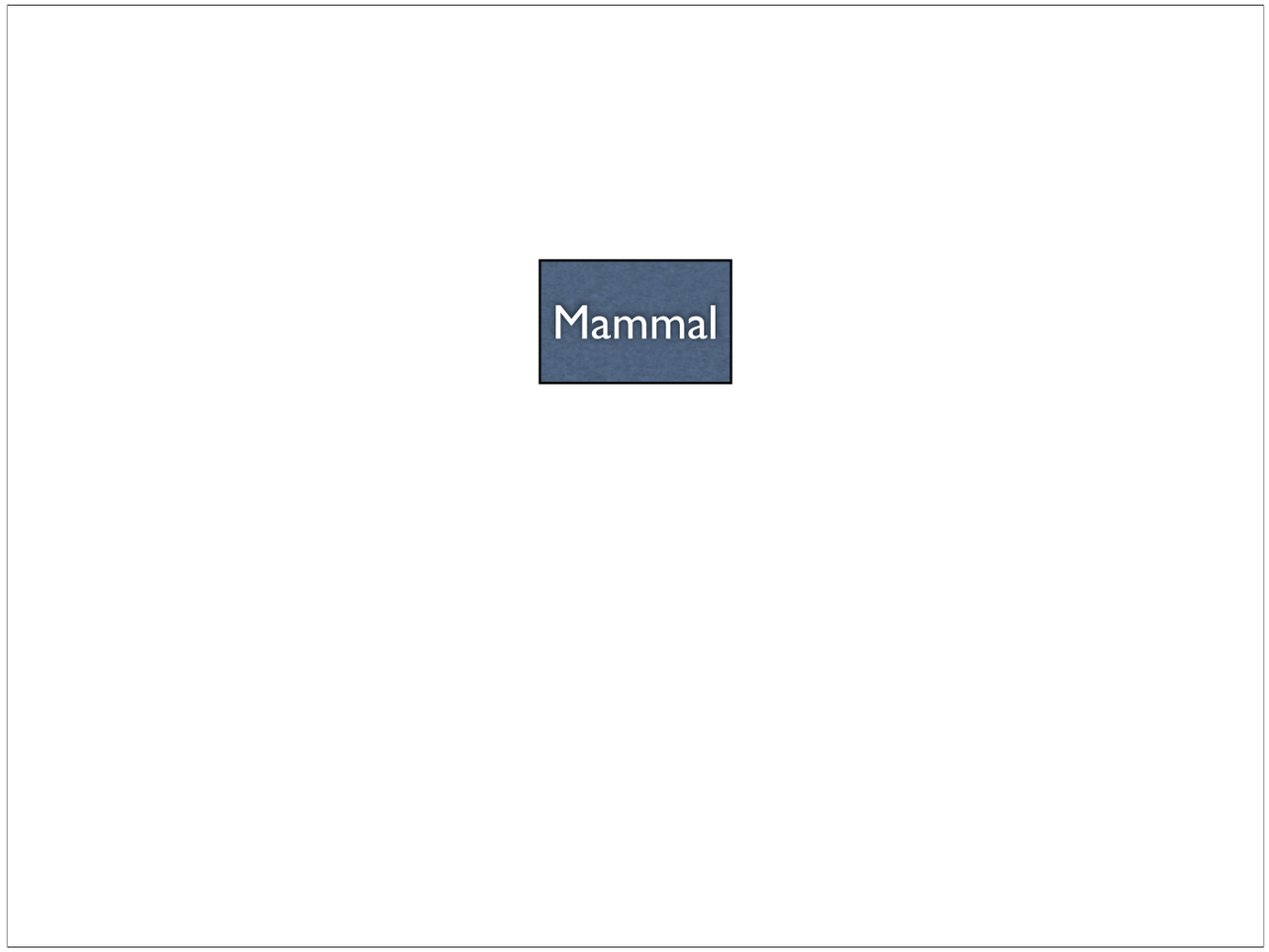
- Inheritance
  - `extends`
  - `super`
- Method overriding
- Automatically-generated constructors

Inheritance

Recap



-We talked about object-oriented programming being about objects interacting with each other in well-defined ways (i.e., through method calls)



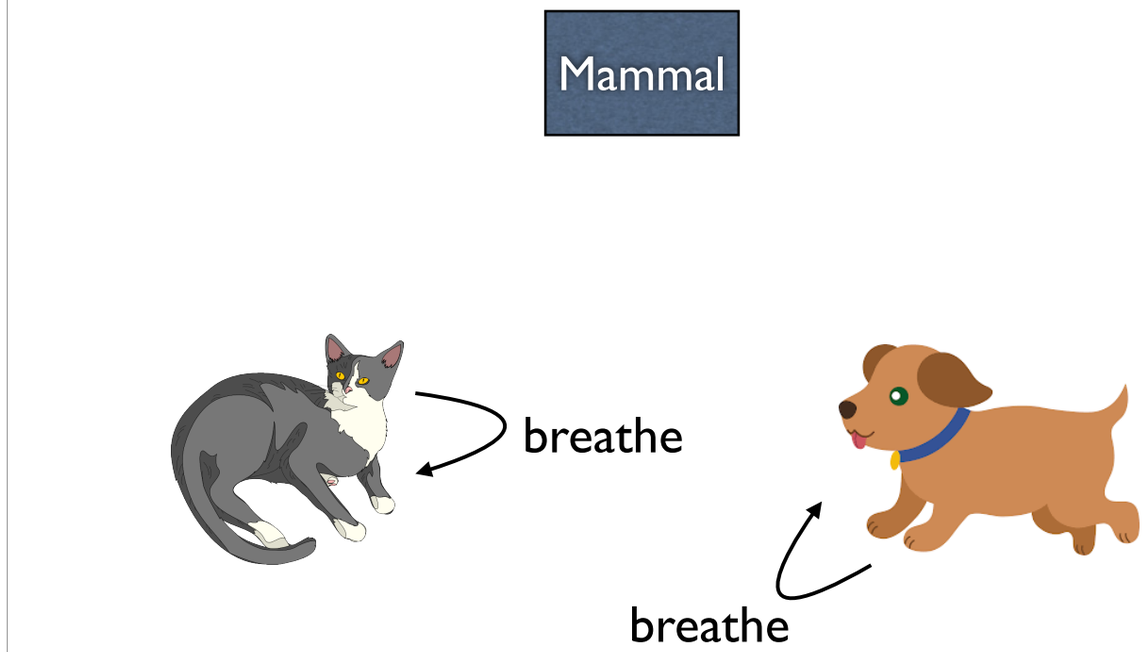
-Let’s say we have mammal objects...

Mammal

-Along with cat objects...

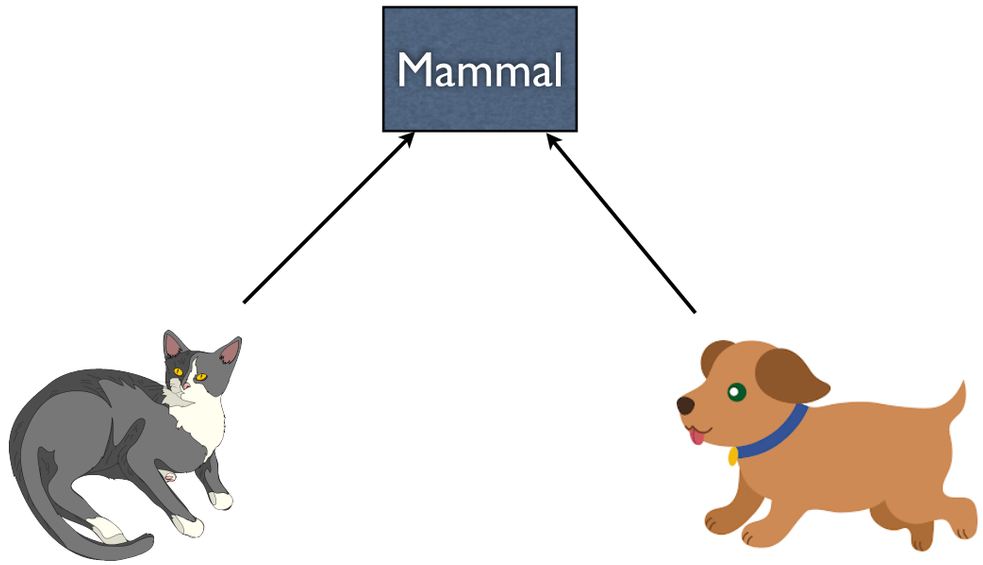
Mammal

-...and dog objects
-Clearly there is some connection between these, as cats and dogs are both mammals



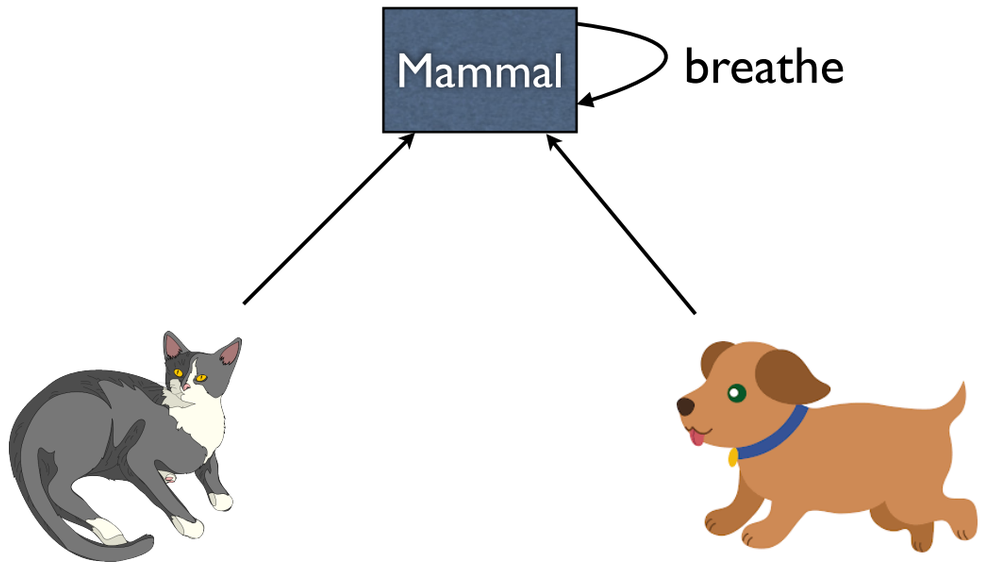
-Both cats and dogs breathe, but these aren't actions which are unique to cats and dogs

Inheritance



-Inheritance allows us to effectively say that cats and dogs are both mammals...

Inheritance



-...and that mammals breathe
-Transitively, this means that cats and dogs both breathe, too
-The big advantage here code-wise is that we only need to define breathe once

extends

`extends`

States that a *subclass* inherits from a *parent* class

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```
public class Mammal {
   ...
}
```

extends

States that a *subclass* inherits from a *parent* class

```
public class Mammal {
   ...
}
```

```
public class Cat extends Mammal {
   ...
}
```

extends

States that a *subclass* inherits from a *parent* class

```
public class Mammal {
   ...
}
```

```
public class Cat extends Mammal {
   ...
}
```

```
public class Dog extends Mammal {
   ...
}
```

super

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Used to invoke the constructor of the parent class.
Another name for the parent class is the *superclass*.

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```
public class BaseClass {
  public BaseClass(String s) {...}
}
```

super

Used to invoke the constructor of the parent class.
Another name for the parent class is the *superclass*.

```
public class BaseClass {
  public BaseClass(String s) {...}
}
```

```
public class Child extends BaseClass {
  public Child(String s) {
    super(s);
  }
}
```

Example

- `Mammal.java`
- `Cat.java`
- `Dog.java`
- `MammalMain.java`

Method Overriding

`toString()` Revisit

`toString()` Revisit

```
public String toString() {
   ...
}
```

-Back in lab 7, you had to define your own toString() method

`toString()` Revisit

```
public String toString() {
   ...
}
```

```
Rectangle(3, 4)
```

-If you defined it correctly, it would output something like this

`toString()` Revisit

```
public String toString() {
   ...
}
```

```
Rectangle(3, 4)
```

```
Rectangle@302b09c9
```

-If you defined it incorrectly, it would give you something like this

`toString()` Revisit

```
public String toString() {
   ...
}
```

`Rectangle(3, 4)`

`Rectangle@302b09c9`

Key point: even without `toString()` defined,
a `String` was still produced.

-If you defined it incorrectly, it would give you something like this

Base `toString()` Origin

- All classes inherit from `Object`,
  even if you don't explicitly say so
- `Object` defines its own `toString()`
  that produces `Rectangle@302b09c9`

Base `toString()` Origin

- All classes inherit from `Object`,
  even if you don't explicitly say so
- `Object` **defines its own** `toString()`
  that produces `Rectangle@302b09c9`

```
public class Object {
  public String toString() { ... }
}
```

-So somewhere in Java, there is a class definition like this

Base `toString()` Origin

- All classes inherit from `Object`,
  even if you don't explicitly say so
- `Object` **defines its own** `toString()`
  that produces `Rectangle@302b09c9`

```
public class Object {
  public String toString() { ... }
}
```

```
public class Rectangle { ... }
```

-You defined your Rectangle class like this

Base `toString()` Origin

- All classes inherit from `Object`, **even if** you don't explicitly say so
- `Object` **defines its own** `toString()` **that produces** `Rectangle@302b09c9`

```
public class Object {
  public String toString() { ... }
}
```

```
public class Rectangle { ... }
```

```
public class Rectangle extends Object {
  ...
}
```

-That code without the explicit extends Object is equivalent to code that does explicitly extend Object
-This is how we end up with Object's toString() method

Overriding Methods

- You can *override* a method definition in a base class by defining a method with the same signature in a subclass
- The method in the subclass will execute *instead of* the method in the parent class

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- You can *override* a method definition in a base class by defining a method with the same signature in a subclass
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```
public class Rectangle {
  public String toString() {
     ...
  }
}
```

-So when you were defining your toString()...

Overriding Methods

- You can *override* a method definition in a base class by defining a method with the same signature in a subclass
- The method in the subclass will execute *instead of* the method in the parent class

```
public class Rectangle extends Object {
  public String toString() {
     ...
  }
}
```

-...you were actually overriding the toString() in Object, since Rectangle implicitly extends from Object
-If you didn't define the toString() method right (e.g., having the wrong signature), then you don't override Object's toString(), and so you end up with Object's (mostly useless) toString() getting used instead of your own

Example

- `OverrideBase.java`
- `OverrideSub.java`
- `OverrideMain.java`

Automatically-Generated Constructors

Automatic Constructors

If you don't define any constructors,
Java will define one for you which takes no arguments.

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```
public class MyClass {
}
```

-So if you write this code...

Automatic Constructors

If you don't define any constructors,
Java will define one for you which takes no arguments.

```
public class MyClass {
}
```

```
public class MyClass {
  public MyClass() {}
}
```

-...you actually get this code
-The code itself isn't written in the file, but it will behave as if it were written in the file

Example:

`AutomaticConstructor.java`

Automatic Constructors

This also applies to subclasses,
as long as the base class has a no-argument constructor

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as long as the base class has a no-argument constructor

```
public class MyBase {}
public class MySub extends MyBase {}
```

-So if you were to write this code...

Automatic Constructors

This also applies to subclasses,
as long as the base class has a no-argument constructor

```
public class MyBase {}
public class MySub extends MyBase {}
```

```
public class MyBase {
  public MyBase() {}
}

public class MySub extends MyBase {
  public MySub() { super(); }
}
```

-...it's actually equivalent to this code

Automatic Constructors

This also applies to subclasses,

as long as the base class has a no-argument constructor

-If this doesn't hold, then the code won't compile

Automatic Constructors

This also applies to subclasses,
as long as the base class has a no-argument constructor

```
public class MyBase {
  // explicit non-no-arg constructor
  // defined - no automatically
  // generated constructors
  public MyBase(int x) {}
}
public class MySub extends MyBase {}
```

-If this doesn't hold, then the code won't compile

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  public MyBase(int x) {}
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public class MySub extends MyBase {
  public MySub() { super(); }
}
```

Does not exist - code will not compile

-If this doesn't hold, then the code won't compile