

A large red square with a white border, centered on a white background. Inside the square, the text "Discussion 4: Inheritance" is written in white.

Discussion 4: Inheritance

Administrivia

- Project 1B released, due Friday 2/9
- Midterm 2/12, 8-10 PM
 - Check Piazza for room assignments
 - Material up to 2/7
- Guerrilla Section this Saturday 2/10
- Sign up for CSM sections ASAP
- One-on-one tutoring sign ups on Piazza weekly

Subclass

Superclass

```
public class Fish {
```

```
    int weight;
```

```
    public Fish(int w) {  
        weight = w;  
    }
```

```
    public void swim() {  
        System.out.println("splash");  
    }
```

```
}
```

Salmon inherits these from Fish

This invokes the super
class's constructor

```
public class Salmon extends Fish {
```

```
    String home;
```

```
    public Salmon(int w, String h) {  
        super(w);  
        home = h;  
    }
```

```
    public void migrate() {  
        System.out.println("Migrating to " + home);  
    }  
}
```

Static vs Dynamic type: what fits in the box?

Static type

Dynamic type

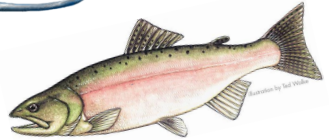
`Fish fish1 = new Fish();`

`Fish fish2 = new Salmon();`

`Salmon salmon1 = new Salmon();`

`Salmon salmon2 = new Fish();`

`Salmon salmon3 = fish2;`



Overriding/Overloading

```
public class Fish {
```

```
    int weight;
```

Overriding: exact same
method signature

```
    public void swim() {  
        System.out.println("splash");  
    }  
}
```

Overloading: same name,
different parameters

```
public class Salmon extends Fish {  
    String home;
```

```
    public Salmon(int w, String h) {  
        super(w);  
        home = h;  
    }
```

```
    public void swim() {  
        System.out.println("splish splash");  
    }
```

```
    public void swim(int speed) {  
        System.out.println("swimming at " +  
            speed + " mph");  
    }  
}
```

Dynamic Method Selection

```
Fish fish = new Fish();  
Salmon salmon = new Salmon();  
Fish bob = new Salmon();
```

```
fish.swim();  
salmon.swim();  
bob.swim();
```

```
fish.swim(5);  
salmon.swim(5);  
bob.swim(5)
```

Compile time: static
method lookup

Run time: dynamic
method lookup

Dynamic Method Selection

```
Fish fish = new Fish();  
Salmon salmon = new Salmon();  
Fish bob = new Salmon();
```

```
fish.swim();  
salmon.swim();  
bob.swim();
```

```
fish.swim(5);  
salmon.swim(5);  
bob.swim(5)
```

splash

splish splash

splish splash

compile-time error

swimming at 5 mph

compile-time error

Compile time: static
method lookup

Run time: dynamic
method lookup

Casting

```
Fish redFish = new Fish();
```

```
Fish blueFish = new Salmon();
```

```
blueFish.swim(5); /* This wouldn't compile before */
```

```
((Salmon) blueFish).swim(5); /* Now it does! */
```

```
((Salmon) redFish).swim(5); /* This compiles but gives you a  
runtime error (ClassCastException) */
```


Interfaces

```
public interface Plant {  
    public void grow();  
    public void photosynthesize();  
}
```

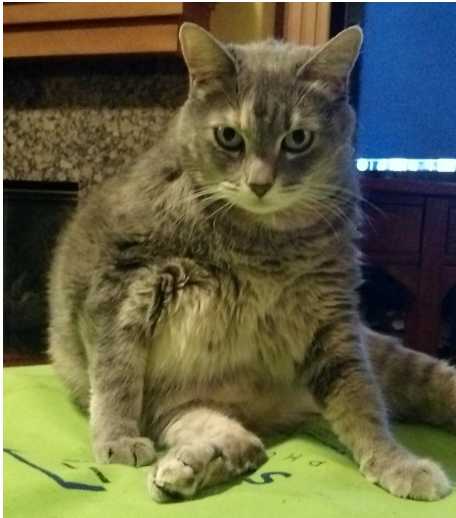
Rose promises to provide
implementations of all of Plant's
abstract methods

```
public class Rose implements Plant {  
    public int height;  
    public void grow() { height += 1; }  
    public void photosynthesize() {  
        System.out.println("Rose feels energized!");  
    }  
}
```

```
Plant plant = new Rose();  
Plant plant = new Plant(); ❌
```

Creating Cats

- What will Cat inherit from Animal?
- How can we rewrite as little code as possible?



Creating Cats

```
public class Cat extends Animal {  
  
    public Cat(String name, int age) {  
        super(name, age);        // Call superclass' constructor.  
        this.noise = "Meow!";    // Change the value of the field.  
    }  
  
    @Override  
    public void greet() {  
        System.out.println("Cat " + name + " says: " + makeNoise());  
    }  
}
```

Raining Cats and Dogs

- Remember dynamic method lookup for overridden methods
- Casting forces the compile-time type of an object



johnsu.deviantart.com/art/Raining-Cats-and-Dogs-30291521

Raining Cats and Dogs

```
Animal a = new Animal("Pluto", 10);  
Cat c = new Cat("Garfield", 6);  
Dog d = new Dog("Fido", 4);  
a.greet();           // (A) Animal Pluto says: Huh?  
c.greet();           // (B) Cat Garfield says: Meow!  
d.greet();           // (C) Dog Fido says: WOOF!  
a = c;  
((Cat) a).greet();   // (D) Cat Garfield says: Meow!  
a.greet();           // (E) Cat Garfield says: Meow!
```

What if we added this line?

```
Animal a = new Animal("Pluto", 10);
```

```
Dog d = new Dog("Fido", 4);
```

```
a = new Dog("Spot", 10);
```

```
d = a;
```

Compiler error because the static type of d is Dog and the static type of a is Animal. We can fix this by casting:

```
d = (Dog) a;
```

An Exercise in Inheritance Misery (Extra)

```
class C extends B {  
  
    public int y = x + 1;  
  
    public void m2() {System.out.println("Cm2-> " + super.x);}   
  
    /*public void m4() {System.out.println("Cm4-> " +  
    super.super.x); }} can't do super.super */  
  
    public void m5() {System.out.println("Cm5-> " + y);}   
}
```

An Exercise in Inheritance Mystery (Extra)

```
\\ B a0 = new A();
```

Dynamic type must be B or subclass of B

```
\\ a0.m1();
```

cascading: prev line failed, so a0 can't be initialized

```
\\ a0.m2(16);
```

cascading: prev line failed, so a0 can't be initialized

An Exercise in Inheritance Mystery (Extra)

```
A b0 = new B();
```

```
System.out.println(b0.x);
```

[prints "5"]

```
b0.m1();
```

[prints "Am1-> 5"]

```
b0.m2();
```

[prints "Bm2-> 5"]

```
\\ b0.m2(61);
```

m2 (int y) not defined in static type of b0

An Exercise in Inheritance Mystery (Extra)

```
B b1 = new B();
```

```
b1.m2(61);           [prints "Bm2-> 61"]
```

```
b1.m3();             [prints "Bm3-> called"]
```

```
A c0 = new C();
```

```
c0.m2();             [prints "cm2-> 5"]
```

```
\\ C c1 = (A) new C(); Can't assign c1 to an A
```

An Exercise in Inheritance Mystery (Extra)

```
A c0 = new C();
```

```
A a1 = (A) c0;
```

```
C c2 = (C) a1;
```

```
c2.m3();
```

```
[print Bm3-> called]
```

```
\\ c2.m4();
```

```
C.m4() is invalid
```

```
c2.m5();
```

```
[print Cm5-> 6]
```

An Exercise in Inheritance Mystery (Extra)

```
A c0 = new C();
```

```
A b0 = new B();
```

```
((C) c0).m3();           [print Bm3-> called]
```

```
\\ (C) c0.m3();          NOT RUNTIME ERROR This would cast the result  
of what the method returns and it returns void therefore  
compile-time error
```

```
b0.update();
```

```
b0.m1();                 [print Am1-> 99]
```