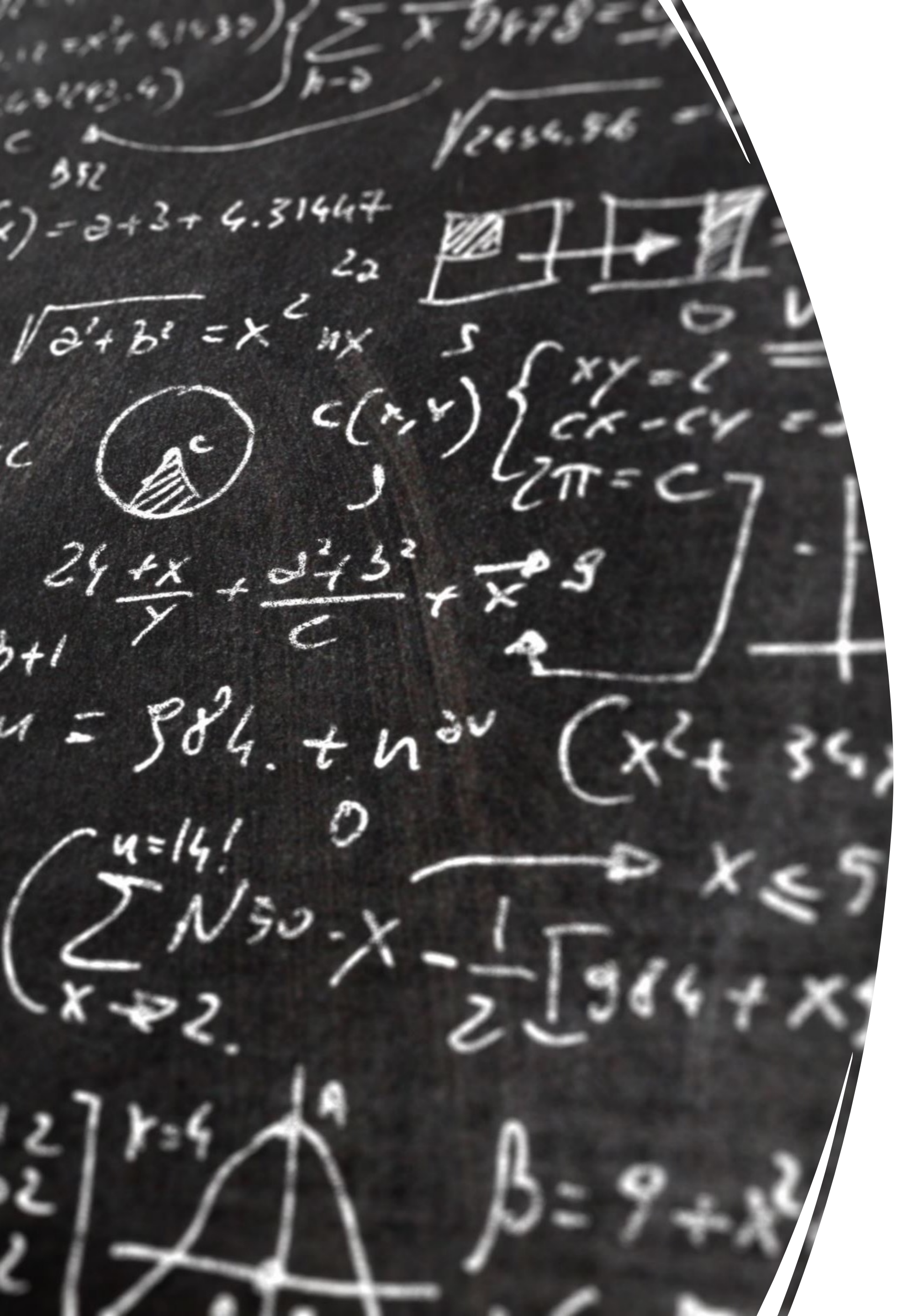


CS 113 – Computer Science I

Lecture 18 – Relationships

Adam Poliak

03/23/2023

Announcements

- HW07
  - Releasing tonight
  - Due Wednesday 03/29
- Midsemester feedback
- Office hours today:
  - 4-4:45pm

Outline

- Review
- Access modifiers
- Inheritance

Using objects: some special methods

The **constructor method** is called when you do a `new`

accesors (aka getters)
return the values of instance variables

mutators (aka setters)
set the values of instance variables

toString()
returns a string representation of an object

this

`this` is a special keyword that refers to the object inside an instance method

Access modifiers

Specify the access-level of instance variables/methods

- `public`
  - code outside of the class can access the variable/method
- `private`
  - code outside of the class cannot access the variable/method
- `protected`
  - Allow subclasses to accesses data in parent class

Default in java is `public`

Access modifiers

Default in java is `public`

In this class, make instance data private

Designing Classes

What properties does a bird have and what can it do?

- Size, color, feathers, fly

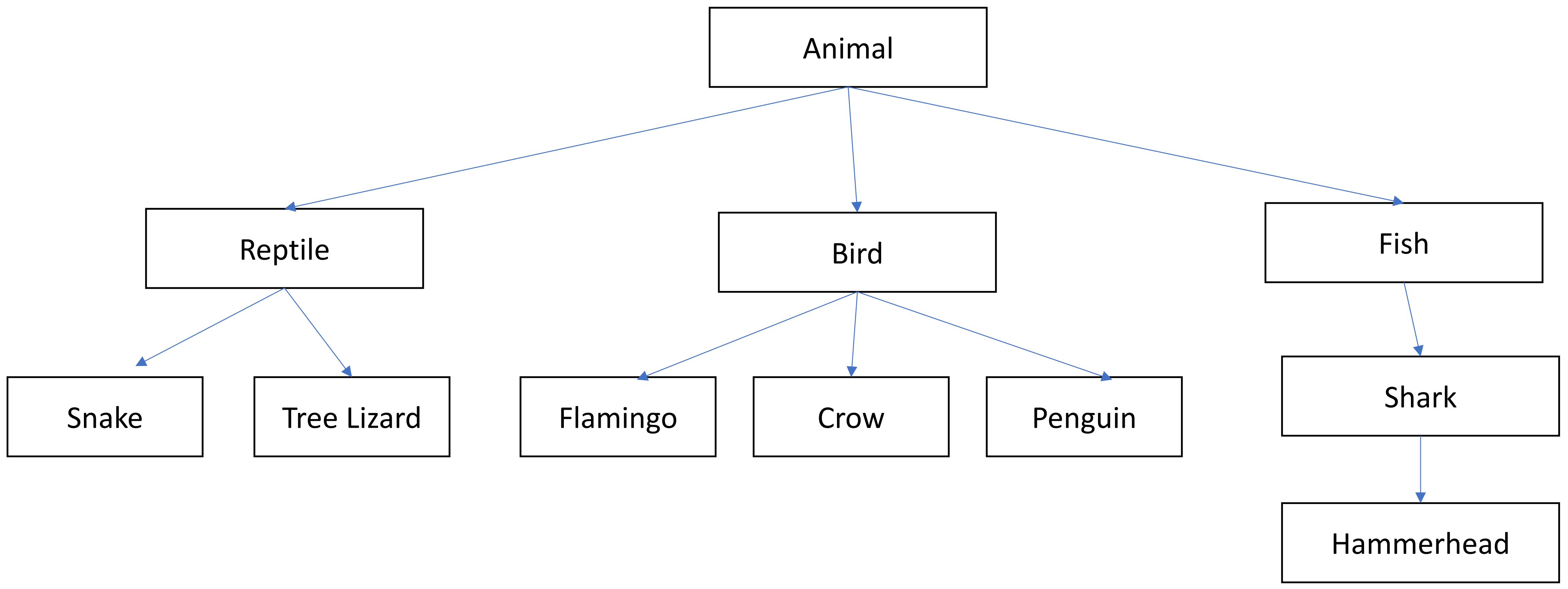
What properties does a lion have and what can it do?

- Size, color, hair, runs

What properties does a kangaroo have and what can it do?

- Size, color, arms, jumps

Inheritance: feature for organizing classes into hierarchies

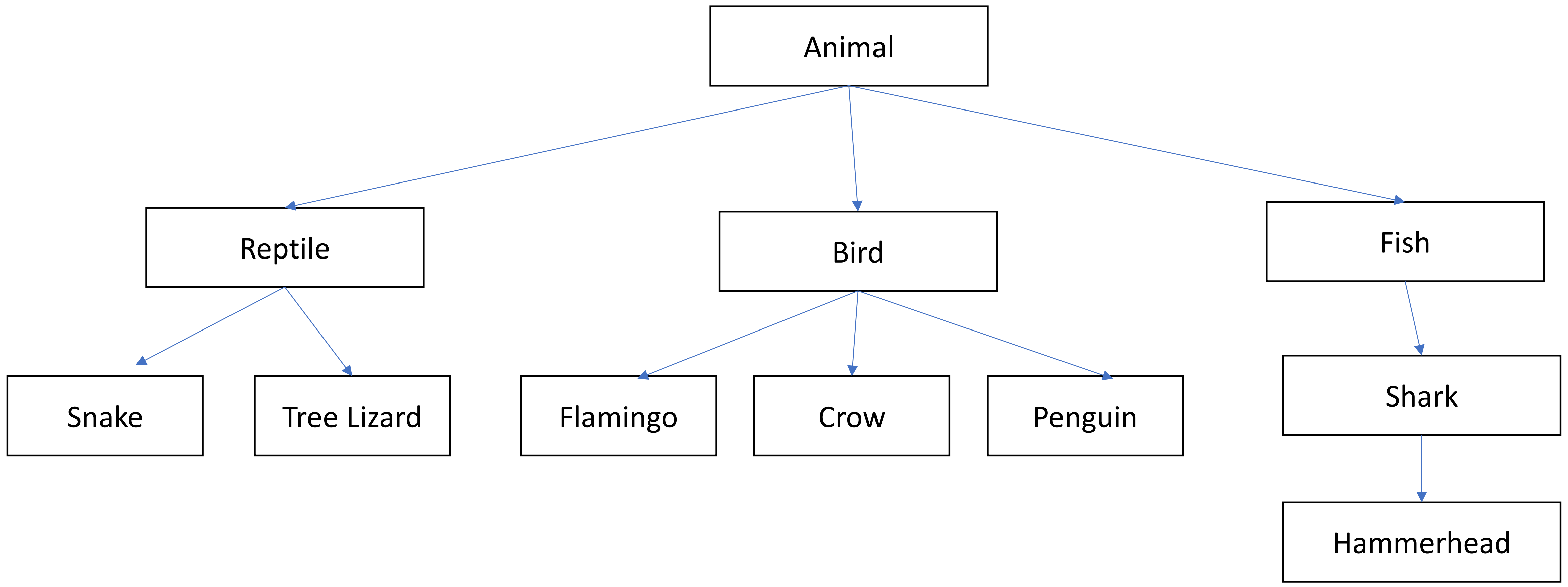


Class inheritance

Classes can be arranged hierarchically where,

a child class ”inherits” from a parent class

Inheritance: feature for organizing classes into hierarchies



Inheritance: subclasses refine behavior/state

Subclasses can override methods from parent class

Exercise

1. Implement getter functions for instance variables inside Animal

2. In Zoo.java, call the getters and output the values to console

Polymorphism

Program can treat all objects that extend a base class the same

Java automatically calls the specific methods for each subclass

Polymorphism: Demo

```java
public class Zoo {
    public static void main(String[] args) {
        Animal animal1 = new Animal();
        animal1.locomote();

        Animal animal2 = new Reptile();
        animal2.locomote();
    }
}
```

```java
public class Animal {
    public Animal() {
    }
    public void locomote() {
        System.out.println("I am moving!");
    }
}
```

```java
public class Reptile extends Animal {
    public Reptile() {
    }
    public void locomote() {
        System.out.println("I am walking!");
    }
}
```

Exercise: What is the output of this program?

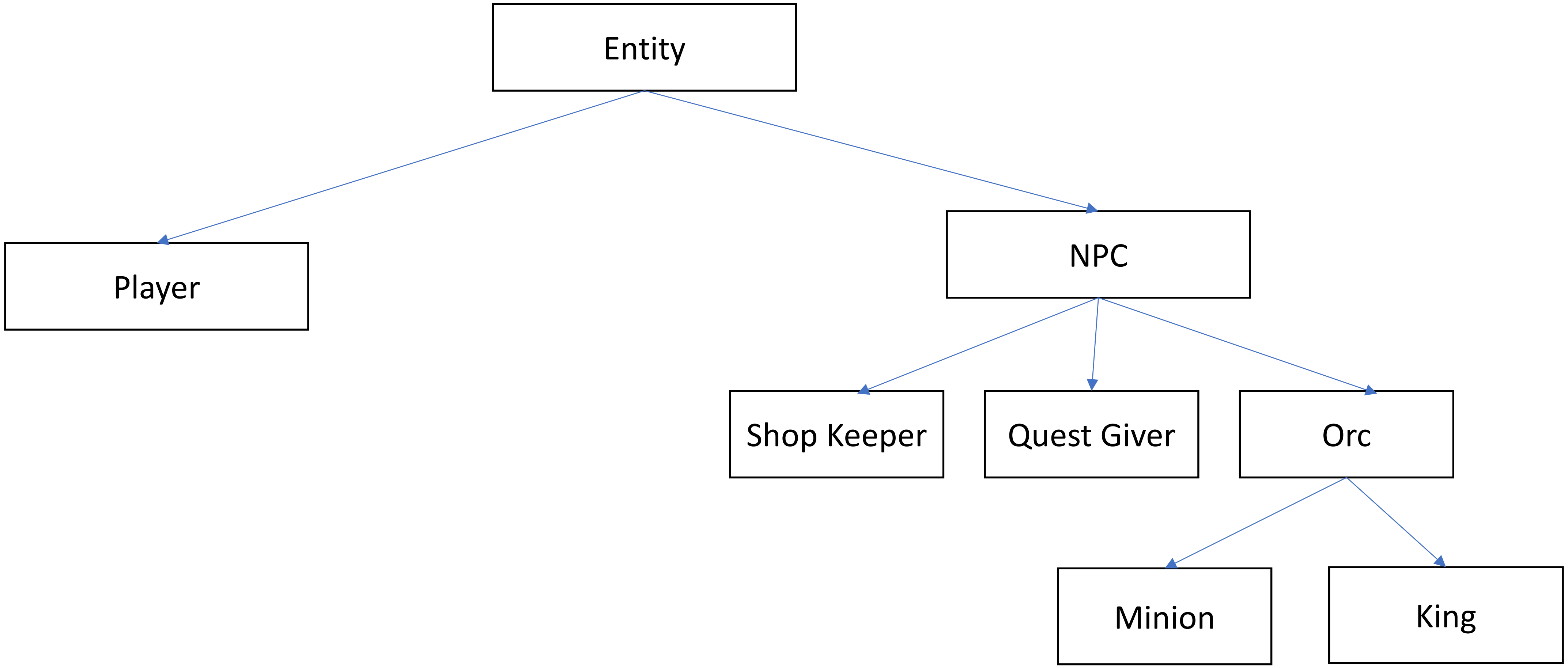
```
public class Zoo {
   public static void main(String[] args) {
      Animal animal1 = new Animal();
      animal1.locomote();

      Animal animal2 = new Fish();
      animal2.locomote();
   }
}
```

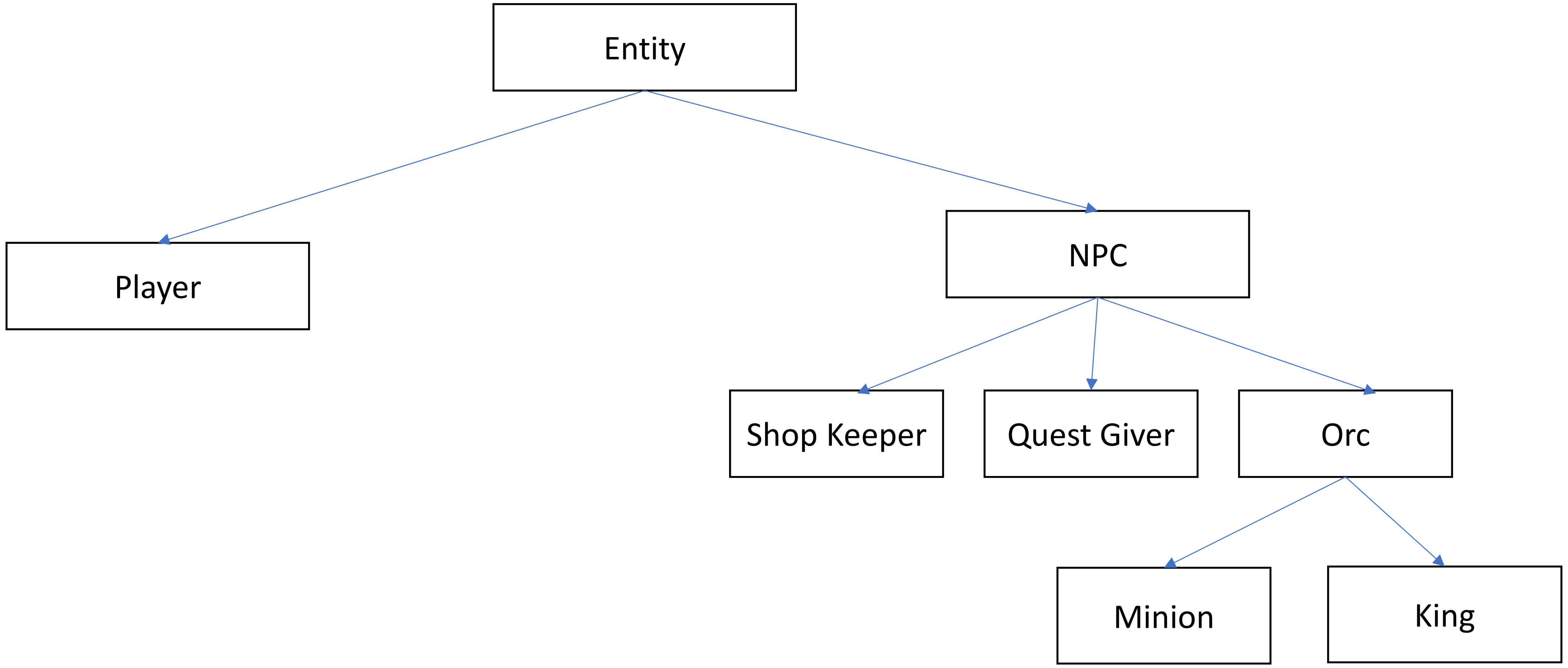
```
public class Animal {
   public Animal() {
   }
   public void locomote() {
      System.out.println("I am moving!");
   }
}
```

```
public class Fish extends Animal {
  public Fish() {
  }
  public void locomote() {
    System.out.println("I am swimming!");
  }
}
```

Question: How would we implement Minion?



Inheritance



Inheritance: subclasses refine behavior/state

Subclasses can override methods from parent class

```java
class Animal {

    public Animal(String name, boolean hasHair,
                  int numberLegs, boolean swimable) {
        this.hasHair = hasHair;
        this.numberLegs = numberLegs;
        this.name = name;
        this.swimable = swimable;
    }
```

```java
public class Fish extends Animal {

    public Fish(String name, boolean hasHair,
                int numLegs, boolean swimable) {
        this.name = name;
        this.hasHair = hasHair;
        this.numberLegs = numLegs;
        this.swimable = swimable;
    }
```

Inheritance: constructors - `super();`

```
super();
```

reference variable that is used to refer parent class constructor

Inheritance: subclasses refine behavior/state

Subclasses can override methods from parent class

```java
class Animal {

    public Animal(String name, boolean hasHair,
                  int numberLegs, boolean swimable) {
        this.hasHair = hasHair;
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        this.name = name;
        this.swimable = swimable;
    }
```

```java
public class Fish extends Animal {

    public Fish(String name, boolean hasHair,
                int numLegs, boolean swimable) {
        this.name = name;
        this.hasHair = hasHair;
        this.numberLegs = numLegs;
        this.swimable = swimable;
    }
```

Inheritance: constructors - `super();`

```java
class Animal {

    public Animal(String name, boolean hasHair,
                    int numberLegs, boolean swimable) {
        this.hasHair = hasHair;
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        this.name = name;
        this.swimable = swimable;
    }
```

```java
public class Fish extends Animal {

    public Fish(String name, boolean hasHair,
                    int numLegs, boolean swimable) {
        this.name = name;
        this.hasHair = hasHair;
        this.numberLegs = numLegs;
        this.swimable = swimable;
    }
```

```java
public class Fish extends Animal {

    public Fish(String name, boolean hasHair,
                    int numLegs, boolean swimable) {
        super();
    }
```

Inheritance: constructors - `super();`

`super();`

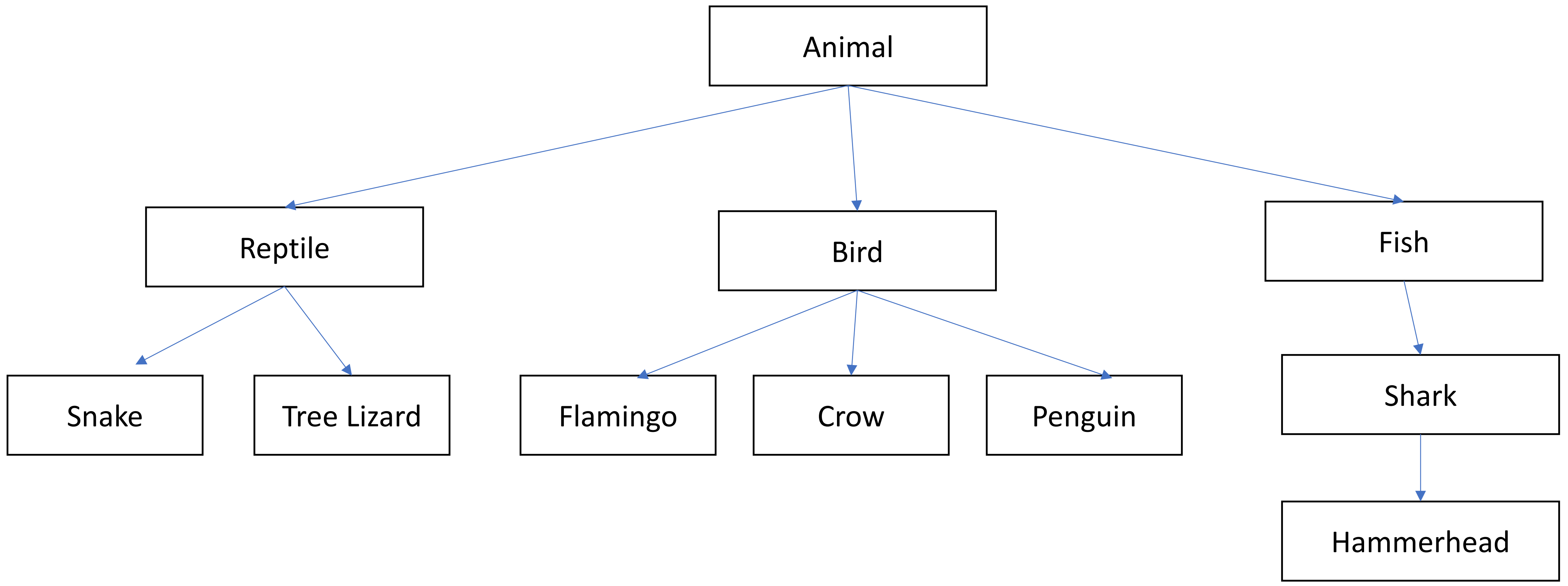
reference variable that is used to refer parent class constructors

Note:

`super:`

reference variable that is used to refer parent class object

Inheritance: feature for organizing classes into hierarchies



interfaces

A common set of methods that each implementing class must include (like a blueprint)

Contract for a class to implement a certain set of methods

Implementing class *inherits* a list of functions from the interface

methods in an interface are `abstract`

- declared method without an implementation
- contains just method signature

Define an interface using the `interface` keyword

Implementing an interface

1. Use `implements` keyword instead of `extends` (demo)

2. Implement the functions

Inheritance vs Extends

Interfaces (subtyping)

- `implements`
- Guarantees same types have same functions
  - Though the same functions are implemented differently
- A class can implement multiple interfaces
- An interface can extend another interface

Inheritance (subclassing)

- `extends`
- Reuses implementations
- Consequences:
  - Dependent on base class
  - Changes in superclass affects all subclasses
  - Can re-use code inside classes
- A class can extend just one parent class