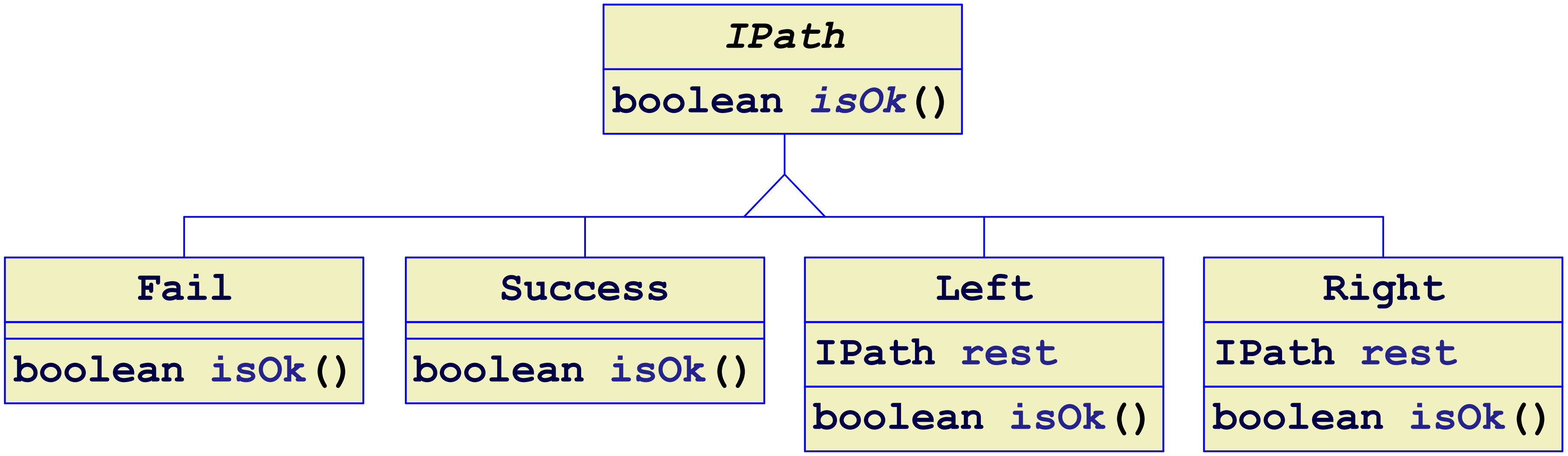
- **Nesting Variants to Refine Contracts**
- **Common Functionality in Abstract Classes**
- **Nesting without Abstract**

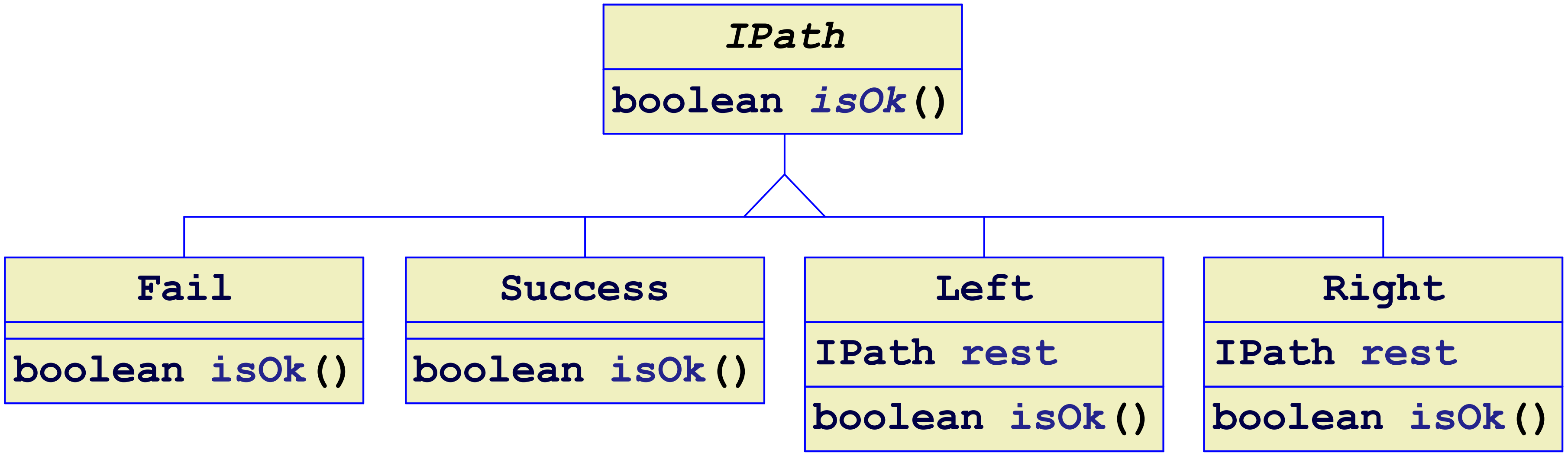
Path Classes



No escape:

```
new Fail()
```

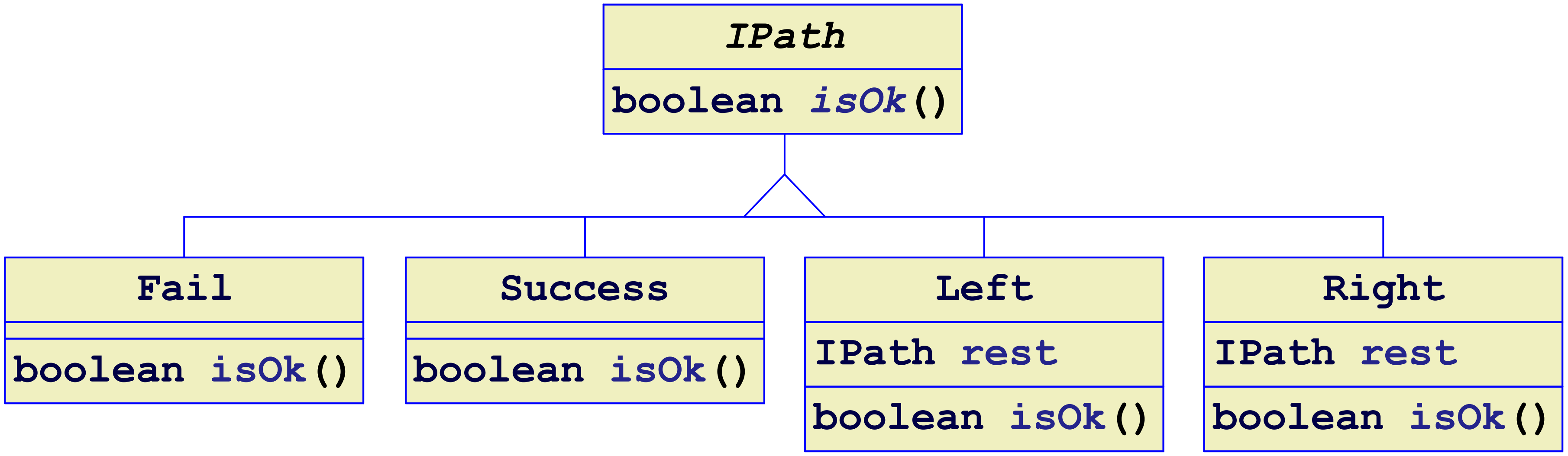
Path Classes



Door is an immediate escape:

```
new Success()
```

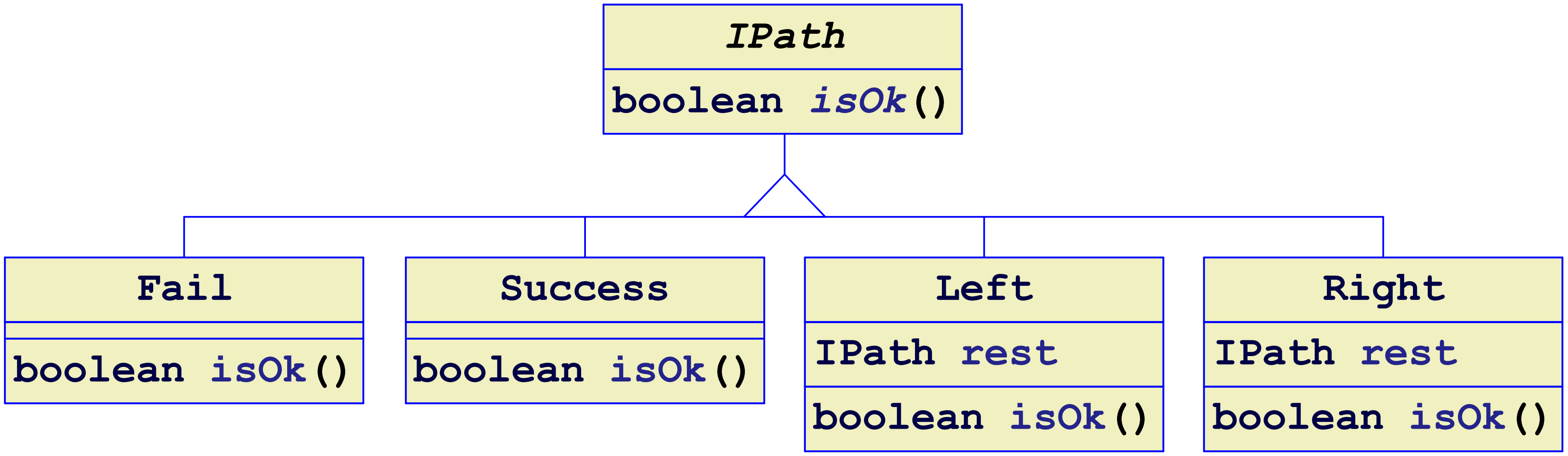
Path Classes



Turn left, then right, then you're there:

```
new Left(new Right(new Success()))
```

Path Classes



What's this?

```
new Left(new Right(new Fail()))
```

We'd prefer to ensure that **Left** and **Right** to extend only successful paths

Paths Reconsidered

Our current definition:

- A path is either
  - failure
  - immediate success
  - left followed by a path
  - right followed by a path

A better definition:

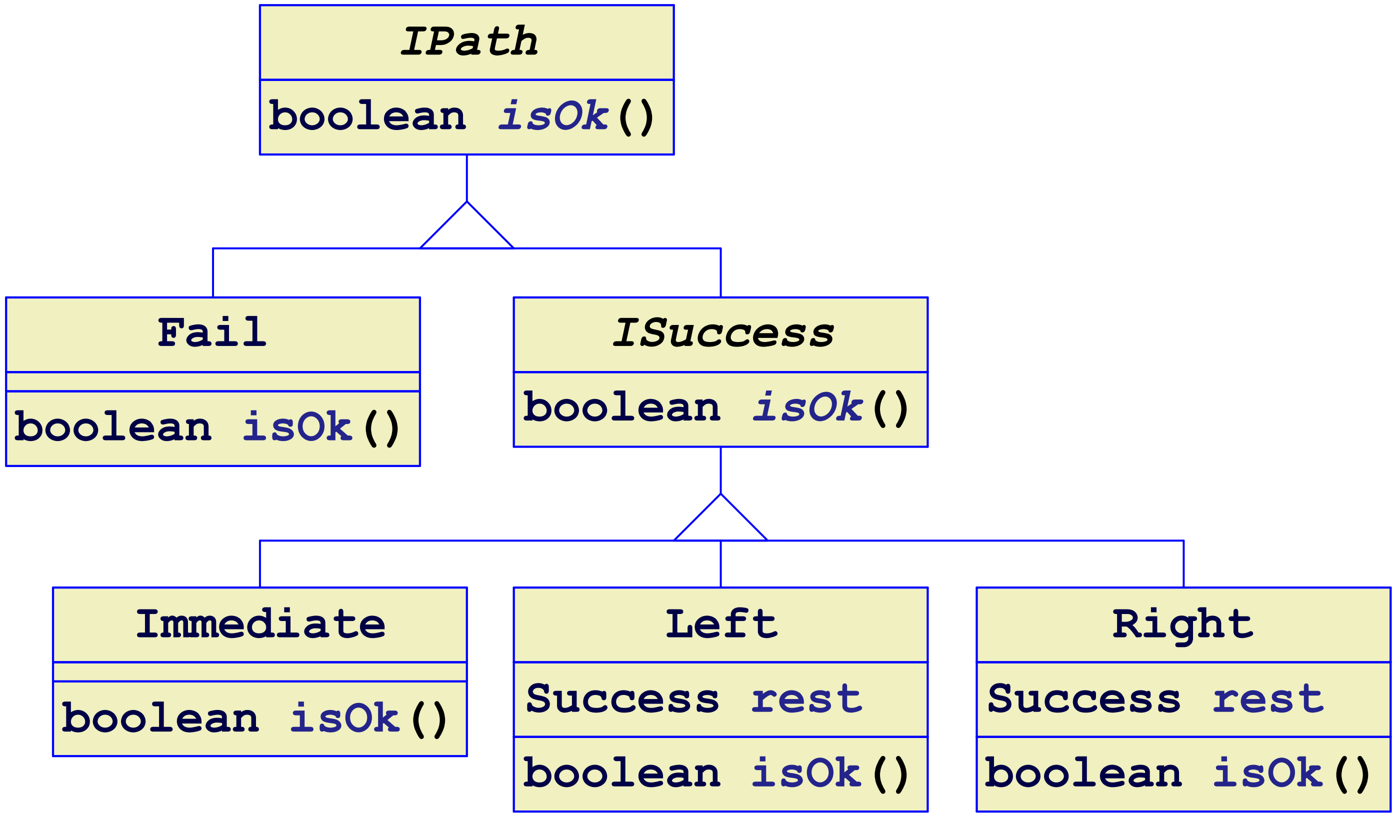
- A path is either
  - failure
  - success
- A success is either
  - immediate
  - left followed by success
  - right followed by success

Nested Variants

- A path is either
  - failure
  - success
- A success is either
  - immediate
  - left followed by success
  - right followed by success

To translate this into Java, a variant of the interface **`IPath`** must itself be an interface with variants

Revised Path Classes



Revised Path Class Code

```
interface IPath {
  boolean isOk();
}

class Fail implements IPath {
  Fail() { }
  public boolean isOk() { return false; }
}

interface ISuccess extends IPath {
}

class Immediate implements ISuccess {
  Immediate() { }
  public boolean isOk() { return true; }
}

class Right implement ISuccess {
  ISuccess rest;
  Right(ISuccess rest) { this.rest = rest; }
  public boolean isOk() { return true; }
}

class Left implements ISuccess {
  ISuccess rest;
  Left(ISuccess rest) { this.rest = rest; }
  public boolean isOk() { return true; }
}
```

Copy

- **Nesting Variants to Refine Contracts**
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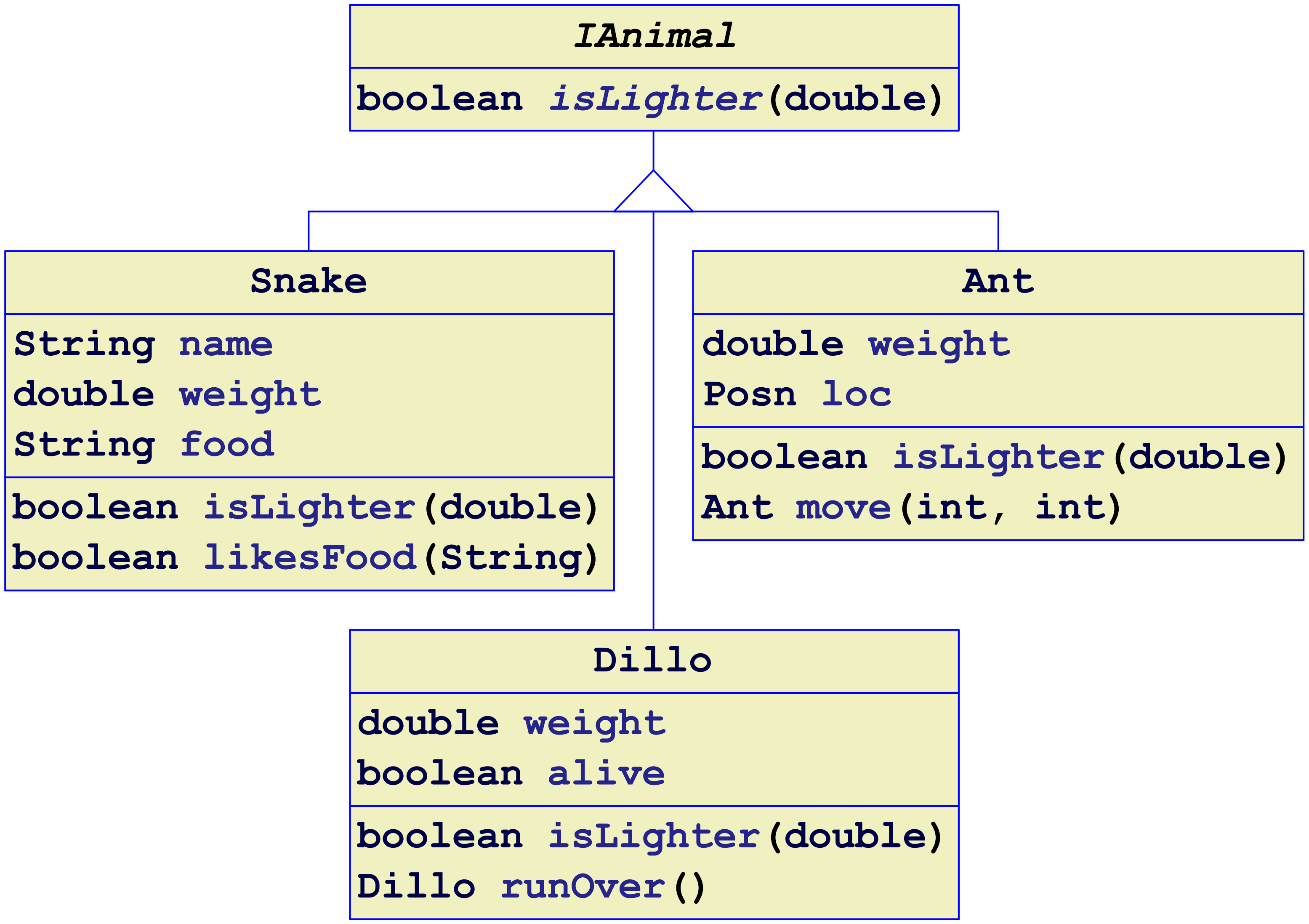
Common Animal Behavior

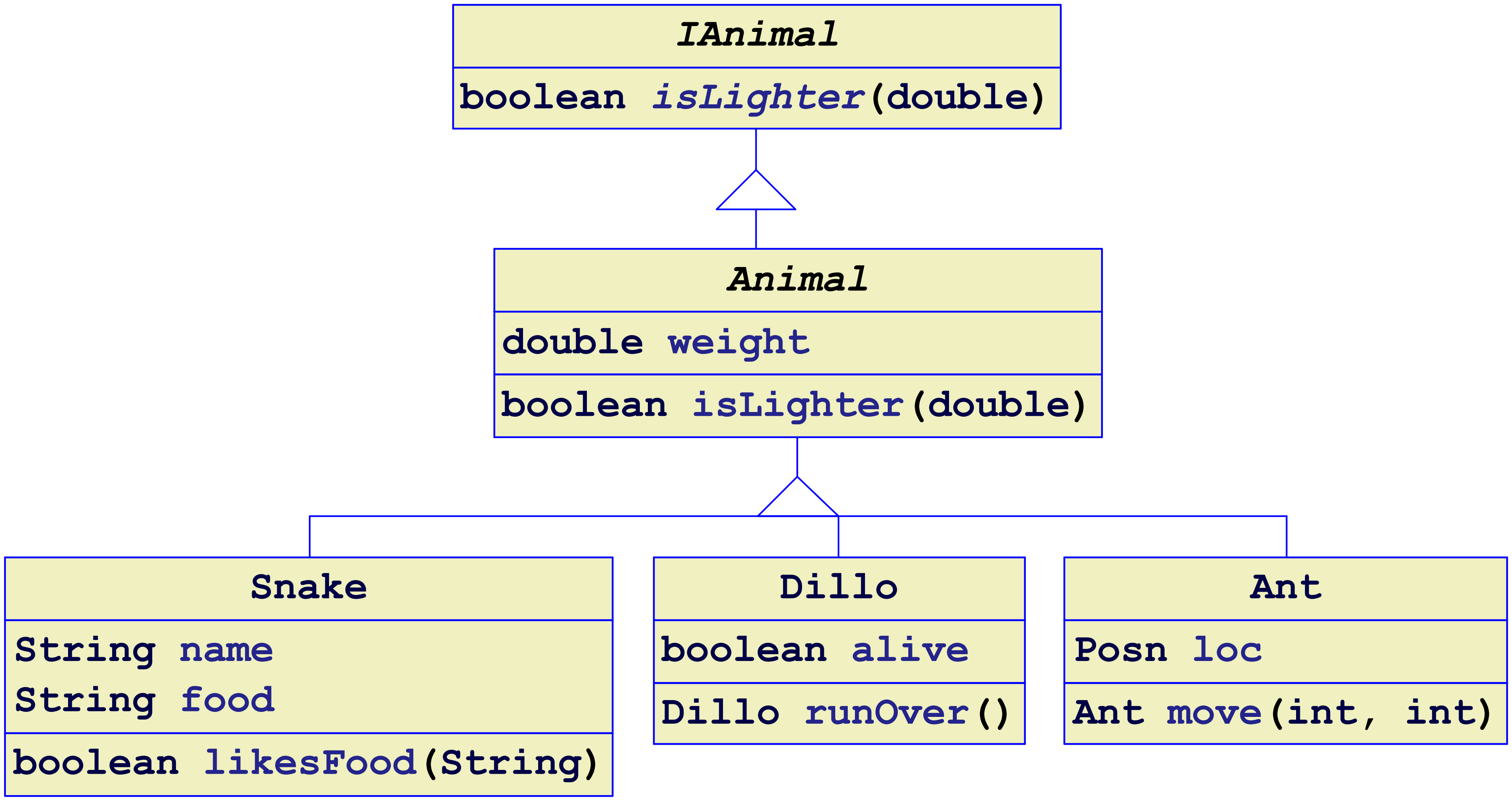
All animals have a **`weight`** field:



Common Animal Behavior

Move the common field into the **Animal** **abstract class**

Also move **isLighter**, since it uses only **weight**



Interface

An **`interface`**:

`IAnimal`
`boolean` *`isLighter`*`(double)`

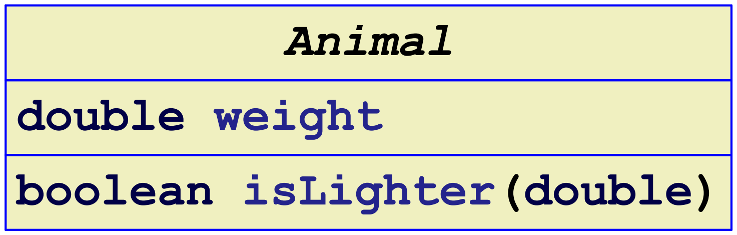
- No fields
- Methods declared, but not implemented
- **`new`** ***`IAnimal`*** **`()`** doesn’t work
- Use with **`implements`**

```
interface IAnimal { ... }

class Snake implements IAnimal { ... }
```

Abstract Class

An **`abstract class`**:



- Can have fields
- Methods implemented
- **`new`** ***`Animal`*** **`()`** doesn’t work
- Use with **`extends`**

```
abstract class Animal implements IAnimal { ... }

class Snake extends Animal { ... }
```

Fields in Abstract Classes

An `abstract class` needs a constructor:

```
abstract class Animal implements IAnimal {
  double weight;
  Animal(double weight) {
    this.weight = weight;
  }
  boolean isLighter(int n) {
    return this.weight < n;
  }
}
```

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Classes that extend a Class with Fields

Extensions of ***`Animal`*** must now supply the **`super`** class with its field:

```
class Snake extends Animal {
  String name;
  String food;
  Snake(String name, double weight, String food) {
    super(weight);
    this.name = name;
    this.food = food;
  }
  boolean likesFood(String s) {
    return this.food.equals(s);
  }
}
```

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Classes that extend a Class with Fields

Extensions of ***Animal*** must now supply the **super** class with its field:

```
class Snake extends Animal {
  String name;
  String food;
  Snake(String name, double weight, String food) {
    super(weight);
    this.  e = name;
    this.f
  }
  boolean                                {
    return                               ;
  }
}
```

The **super** keyword in a constructor calls the extended class's constructor

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Classes that extend a Class with Fields

Extensions of ***`Animal`*** must now supply the **`super`** class with its field:

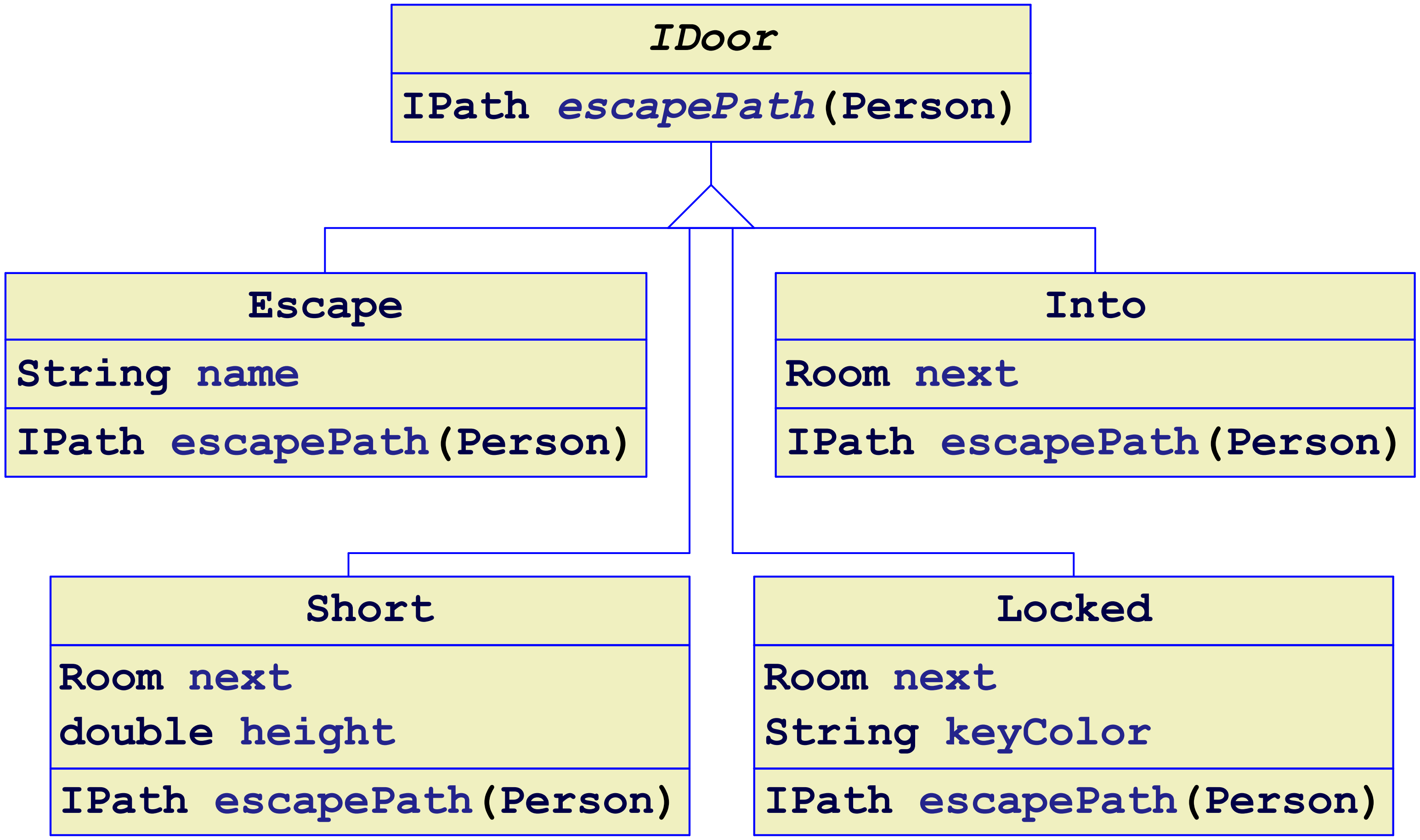
```
class Snake extends Animal {
  String name;
  String food;
  Snake(String name, double weight, String food) {
    super(weight);
    this.
    this.f
  }
  boolean                {
    return                ;
  }
}
```

A **`super`** call must appear before the other statements

Copy

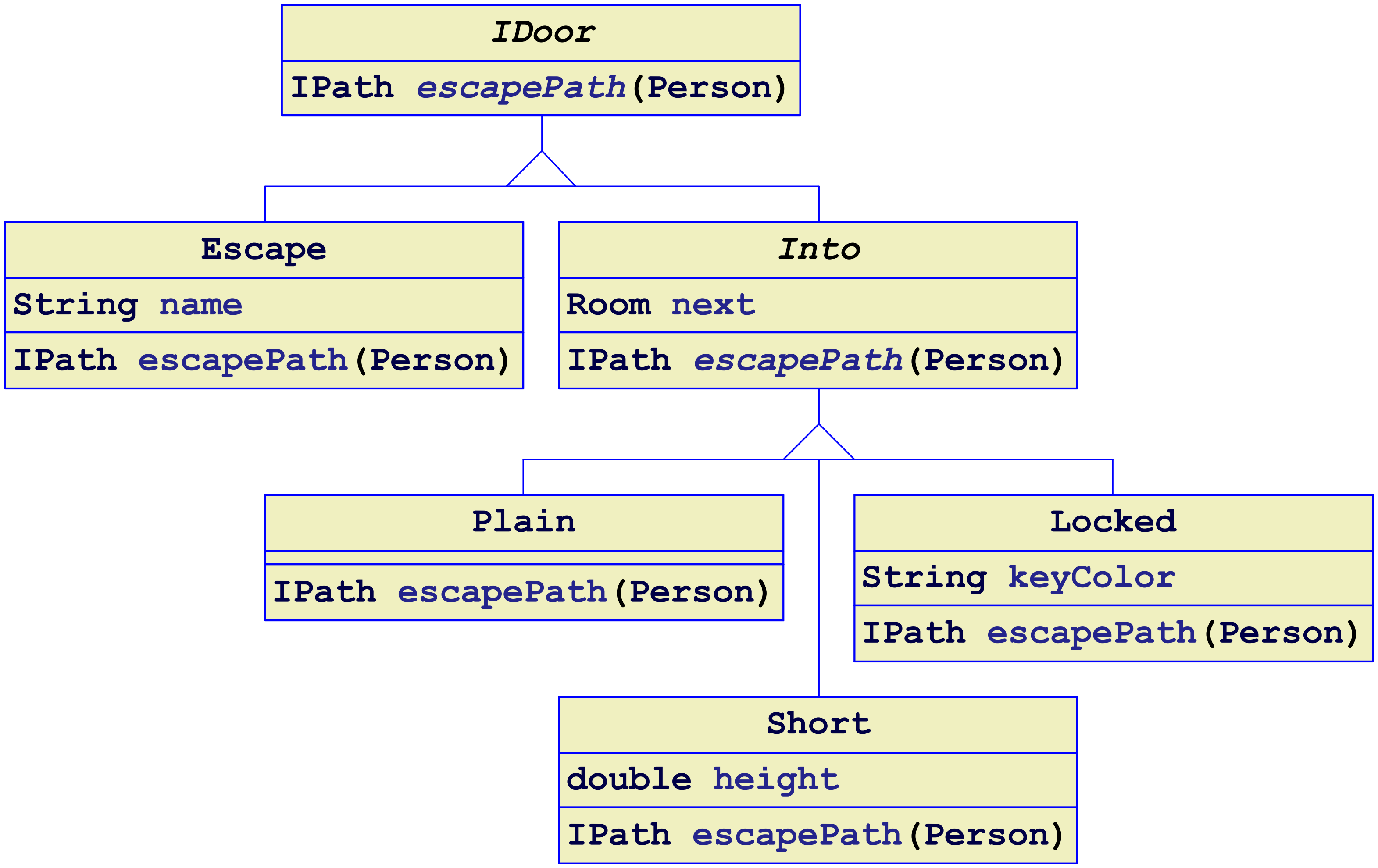
- Nesting Variants to Refine Contracts
- Common Functionality in Abstract Classes
- Nesting without Abstract

More Common Features



Most new kinds of door will have a **`next`** field, like **`Into`**

Doors



The `escapePath` method isn't always the same, but the `this.next.escapePath(p)` part is always the same...

Method Parts in Abstract Classes

```
abstract class Into extends Door {
  Room next;
  Into(Room next) {
    this.next = next;
  }
  Path escapePath(Person p) {
    return this.next.escapePath(p);
  }
}
```

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Chaining to a Super Method

```
class Short extends Into {
  double height;
  Short(Room next, double height) {
    super(next);
    this.height = height;
  }
  Path escapePath(Person p) {
    if (p.isShorter(this.height))
      return super.escapePath(p);
    else
      return new Fail();
  }
}
```

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Chaining to a Super Method

```
class Short extends Into {
  double height;
  Short(Room next, double height) {
    super(next);
    this.height = height;
  }
  Path escapePath(Person p) {
    if (p.isShorter(this.height))
      return super.escapePath(p);
    else
      return new Fail();
  }
}
```

Copy

The `escapePath` in `Short` ***overrides*** the method in *`Into`*

Chaining to a Super Method

```
class Short extends Into {
  double height;
  Short(Room next, double height) {
```

Using the **super** keyword in **super.escapePath** means to call the extended class’s method

```
    if (p.isShorter(this.height))
      return super.escapePath(p);
    else
      return new Fail();
  }
}
```

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The **escapePath** in **Short** ***overrides*** the method in ***Into***

Chaining to a Super Method

```
class Short extends Into {
  double height;
  Short(Room next, double height) {
    super(next);
    this.height = height;
  }
  Path escapePath(Person p) {
    if (p.isShorter(this.height))
      return super.escapePath(p);
    else
      return new Fail();
  }
}
```

Copy

The `escapePath` in `Short` ***overrides*** the method in *`Into`*

Plain Door

```
class Plain extends Into {
  Plain(Room next) {
    super(next);
  }
  Path escapePath(Person p) {
   return super.escapePath(p);
  }
}
```

Plain Door

```
class Plain extends Into {
  Plain(Room next) {
    super(next);
  }
  Path escapePath(Person p) {
   return super.escapePath(p);
  }
}
```

The overriding **`escapePath`** merely chains to **`super`**, so it isn't needed

Plain Door

```
class Plain extends Into {
  Plain(Room next) {
    super(next);
  }
}
```

The overriding `escapePath` merely chains to `super`, so it isn't needed

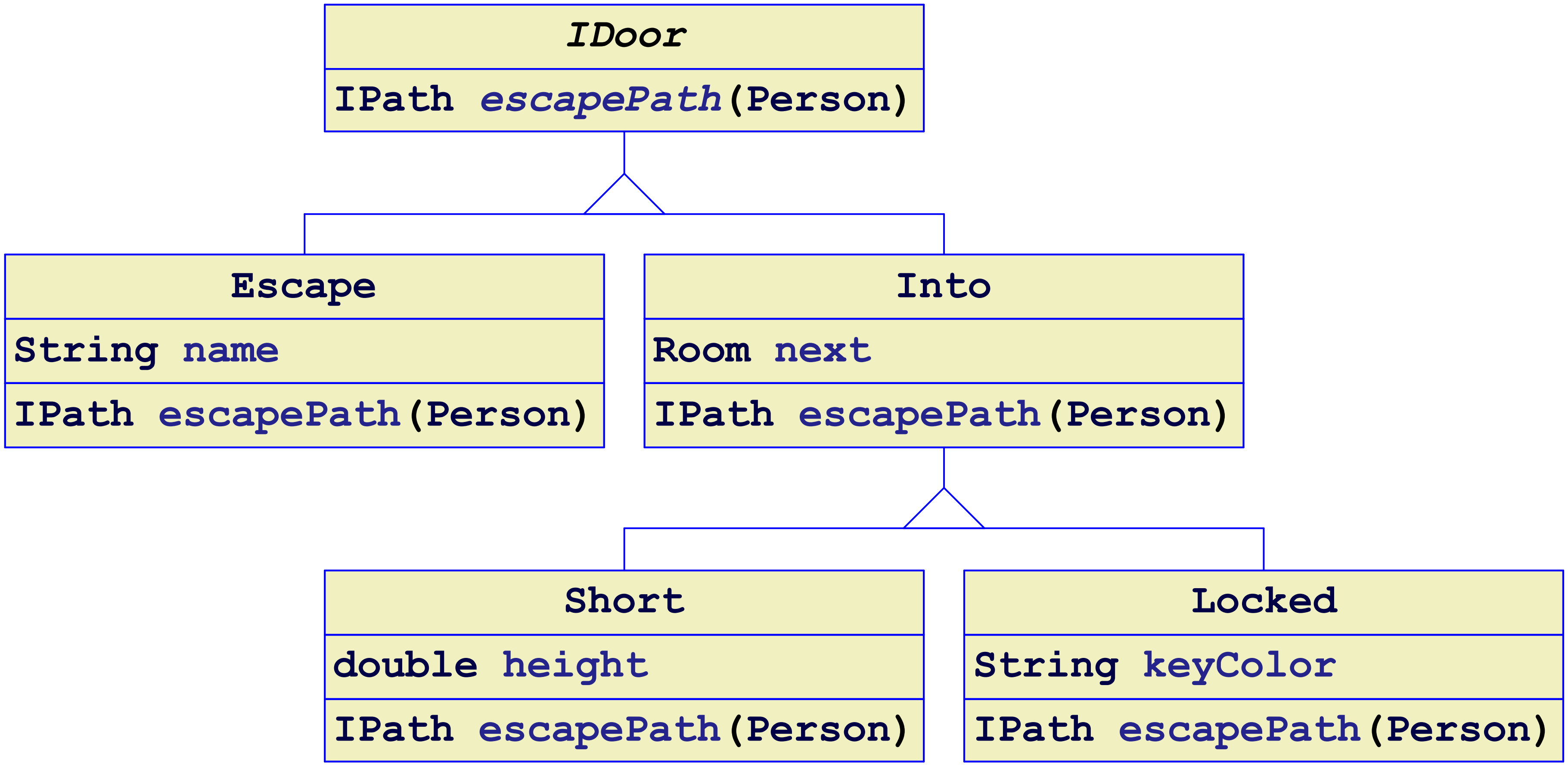
Plain Door

```
class Plain extends Into {
  Plain(Room next) {
    super(next);
  }
}
```

The overriding `escapePath` merely chains to `super`, so it isn’t needed

In fact, we can do away with the `Plain` class completely, and just make `Into` non-`abstract`

Doors Revised



Summary

- An `interface` can extend an `interface`
- An `abstract class` can implement an `interface`
- An `abstract class` can declare fields
- A `class` can extend a `class`
- Use `super(...)` when the extended class has a constructor
- Use `super.method(...)` to chain to an overridden method