

Abstract Classes and Interfaces



Colorado State University
Department of Computer Science

Slides Originally Created by Albert Lionelle (Albert.Lionelle@colostate.edu),
updated by Marcia Moraes (marcia.moraes@colostate.edu)

Announcements

TODO Reminders:

Readings are due **before** lecture

- Reading 23 (zybooks) – you should have already done that 😊
- Lab 15
- Reading 24 (zyBooks) – you should have already done that 😊
- Practical Project Lecture
- RPA 11

Keep practicing your RPAs in a spaced and mixed manner 😊

NEXT WEEK – Exam 3 Week
Catch up, if you need!

“

The harder you work for
something, the greater
you'll feel when you
achieve it.

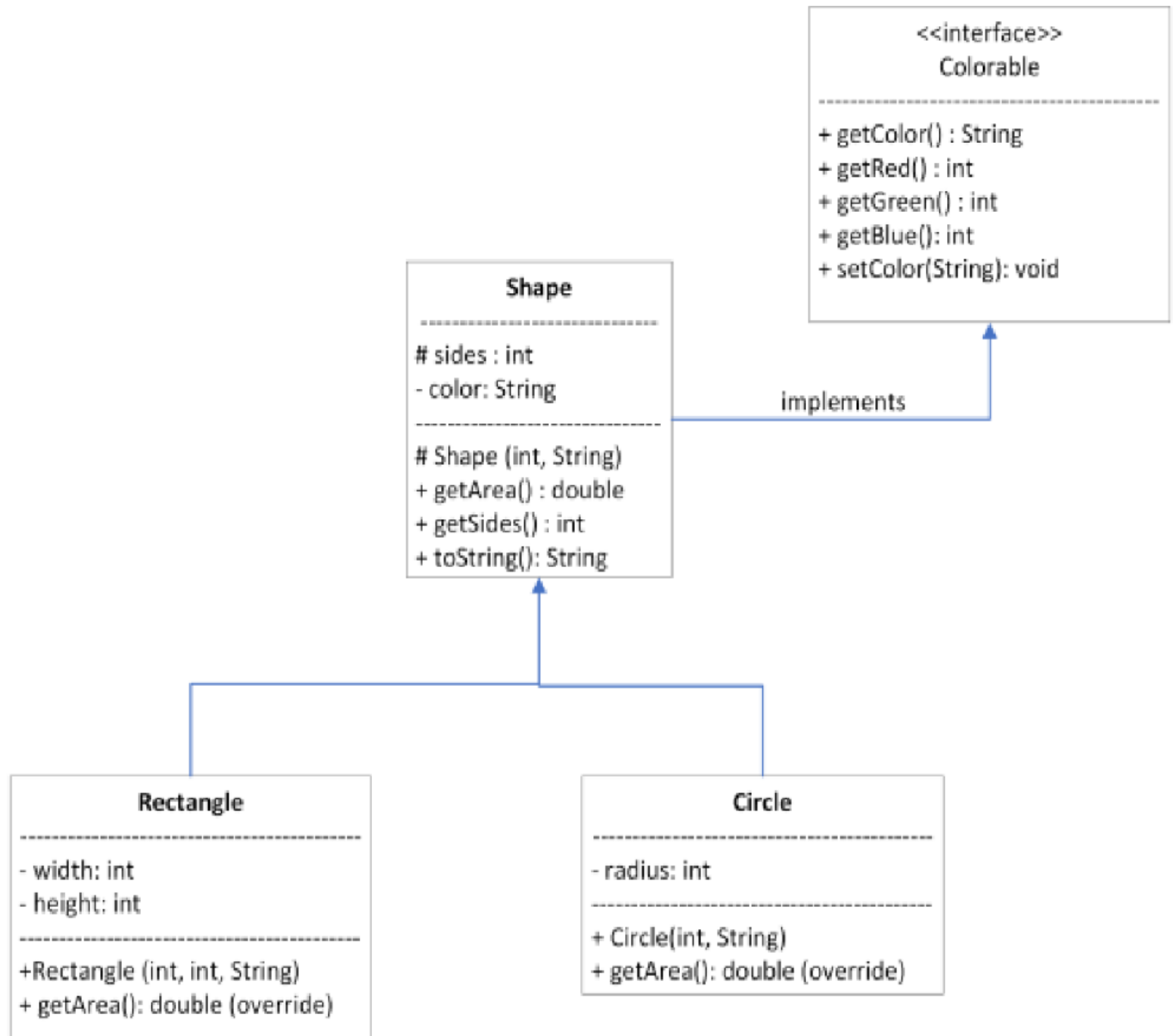
GRACIOUSQUOTES.COM

Help Desk

Day	Time : Room
Monday	2 PM - 5 PM : CSB 120
Tuesday	6 PM - 8 PM : Teams
Wednesday	3 PM - 5 PM : CSB 120
Thursday	6 PM - 8 PM : Teams
Friday	3 PM - 5 PM : CSB 120
Saturday	12 PM - 4 PM : Teams
Sunday	12 PM - 4 PM : Teams

Recall Activity

- Define the following elements:
- Interface
- Methods that are overwritten
- Superclasses and Subclasses
- Does `getArea()` really make sense for `Shape`?



Inheritance

- Creates an is-a relationship between classes
- Allows fully implemented 'more generalized' classes as the super classes
 - specialized subclasses as the subclasses inherits instance variables and methods from the super class
- Uses the key word extends
 - can only extend / inherited from one immediate parent (but can have 'chain' of parents)

```
Circle crcl = new Circle(10, "234,255,123");  
  
System.out.println("The color is " + crcl.getColor());
```

Polymorphism

- Allows the subclass to be declared as the super
 - actually a subclass can 'substitute' in for the super
- Extremely useful for things like Arrays and ArrayLists

```
Shape[] shapes = new Shape[3]; // fixed size
shapes[0] = crcl;
shapes[1] = new Rectangle(23, 5, "123,125,255");

System.out.println(Arrays.toString(shapes));
```

```
[Sides: 1, Area: 314.16, Sides: 4, Area: 115.00, null]
```

Abstract Class

- What if a method you write, needs specific information?
 - Unique to subtypes / children
 - BUT – the rest of the method is general
- Enter Abstract classes
 - Classes that are not **complete** by themselves
 - Contain **partial** implementations of a class
 - With other methods that are **required** to be completed by children.
- Class is abstract, some methods are abstract
- Can't be instantiated
 - but can have constructors the children can inherit

Abstract Example

```
public class Paladin extends AbstractJob {  
    private double modifier = 1.6;  
    @Override  
    public double getJobModifier() {  
        return modifier;  
    }  
  
    public Paladin(String name) {  
        super(name);  
    }  
}
```

Child

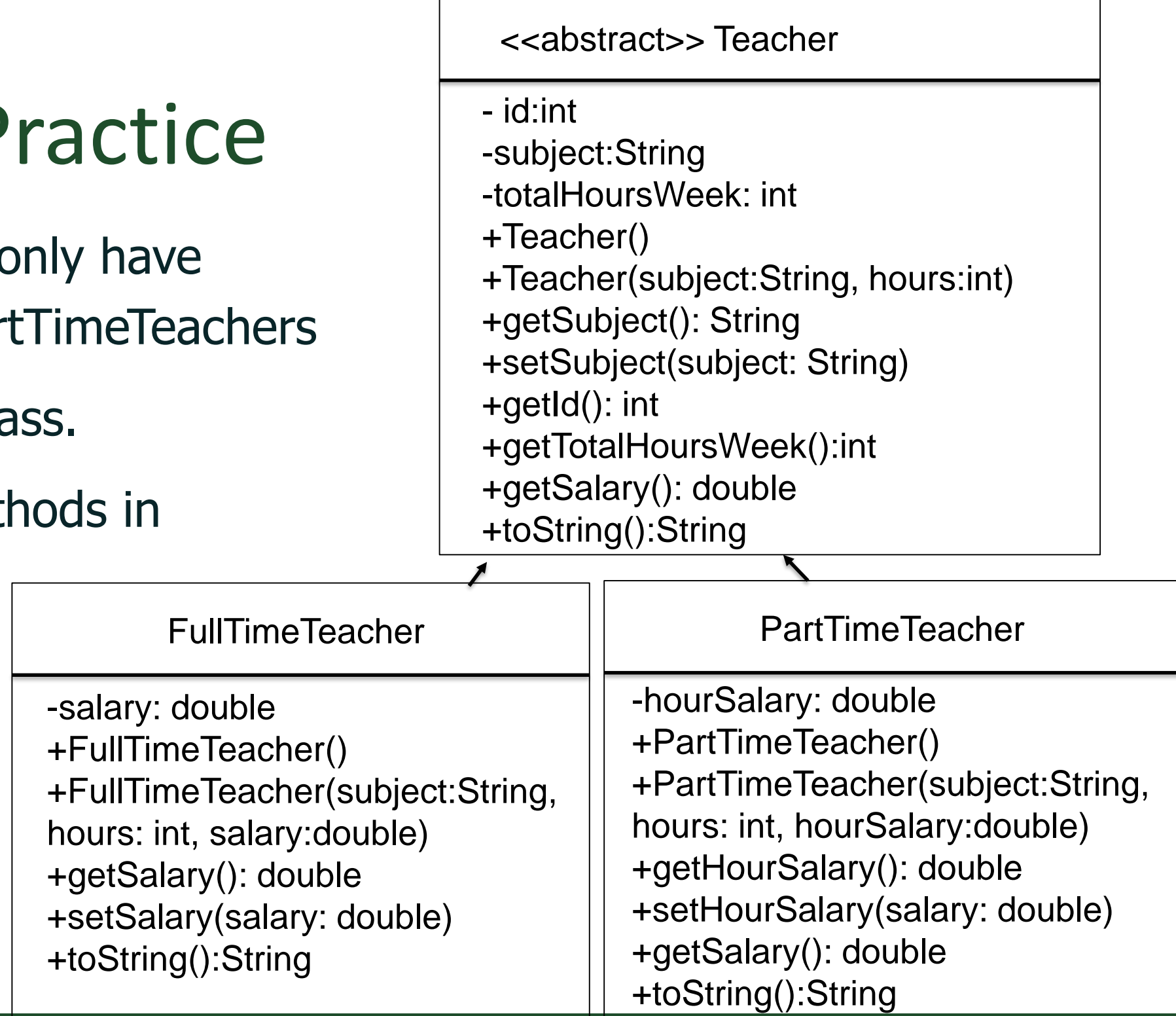
```
public static void main(String[] args) {  
    Paladin cecil = new Paladin("Cecil");  
    System.out.println(cecil.getArmor());  
}
```

```
public abstract class AbstractJob {  
    protected String name;  
    protected ArrayList<String> inventory;  
  
    private int armor;  
    private int attack;  
  
    public abstract double getJobModifier();  
    // unique to sub classes  
  
    public double getArmor() {  
        return armor * getJobModifier();  
    }  
  
    public AbstractJob(String name) {  
        this.name = name;  
        this.armor = 1;  
        this.attack = 1;  
        inventory = new ArrayList<>();  
    }  
}
```

parent

Abstract Class Practice

- Considering that we can only have FullTimeTeachers and PartTimeTeachers
- Teacher as an abstract class.
- Is there any abstract methods in Teacher?



Interfaces

- Inheritance Limitation: Can only inherit **one** class directly
 - meaning, there can be a chain of classes
- What if we wanted to 'inherit' from more than one class?
- Enter interfaces
 - **contracts** that define what methods will be implemented
 - contains no implementation – just definitions
 - uses **implements** in the class to say class is following the contract
- Common Interface
 - Comparable ([specification](#))
 - implementing it – allows objects to be sorted in ArrayList!
 - compareTo is the method

Interface example

```
public class Paladin extends AbstractJob implements MeleeType, HealerType {  
    private double modifier = 1.6;  
    @Override  
    double getJobModifier() {  
        return modifier;  
    }  
    @Override  
    public double getCureModifier() {  
        return 1.5;  
    }  
    @Override  
    public double getMP() {  
        return 10.5;  
    }  
    @Override  
    public boolean hasSwordAttack() { return true; }  
    @Override  
    public int calcSwordDamage() {  
        return (int)(100*getJobModifier());  
    }  
}
```

```
graph LR
    subgraph HealerType
        H1[double getCureModifier()]
        H2[double getMP()]
    end
    subgraph MeleeType
        M1[boolean hasSwordAttack()]
        M2[int calcSwordDamage()]
    end
    subgraph Paladin
        P1[double getJobModifier()]
        P2[double getCureModifier()]
        P3[double getMP()]
        P4[boolean hasSwordAttack()]
        P5[int calcSwordDamage()]
    end
    H1 --> P2
    H2 --> P3
    M1 --> P4
    M2 --> P5
```

```
public interface HealerType {  
    double getCureModifier();  
    double getMP();  
}
```

```
public interface MeleeType {  
    boolean hasSwordAttack();  
    int calcSwordDamage();  
}
```

Interface Example in Java

- Comparable

- requires you implement `.compareTo(T obj)`
- T is your object
- Allows you to sort based on your own ideas!

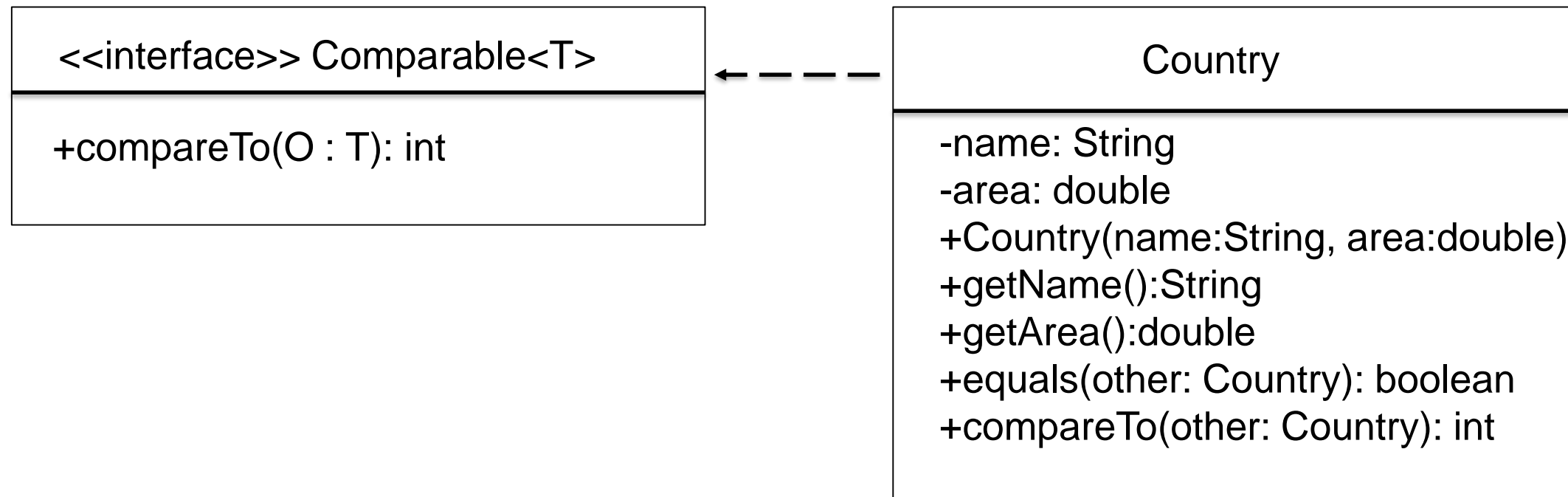
```
public static void main(String[] args) {  
    ArrayList<Paladin> list = new ArrayList<>();  
    list.add(new Paladin("Cecil"));  
    list.add(new Paladin("Caliban"));  
    Collections.sort(list); // puts Caliban before Cecil  
    System.out.println(list); // Caliban, Cecil  
}
```

```
public class Paladin extends AbstractJob implements Comparable<Paladin> {  
    private double modifier = 1.6;  
    @Override  
    public double getJobModifier() {  
        return modifier;  
    }  
    @Override  
    public int compareTo(Paladin obj2) {  
        return name.compareTo(obj2.name);  
    }  
  
    public Paladin(String name) { super(name); }  
}
```

-1 if less than
0 if equal
1 if greater

Interface Practice

- Implement a list of Countries that can be ordered by their area.
- Need to implement interface Comparable and the method compareTo the areas.



[Download Abstract class and Interface – classes for this lecture](#)