INTRODUCTION TO JAVA

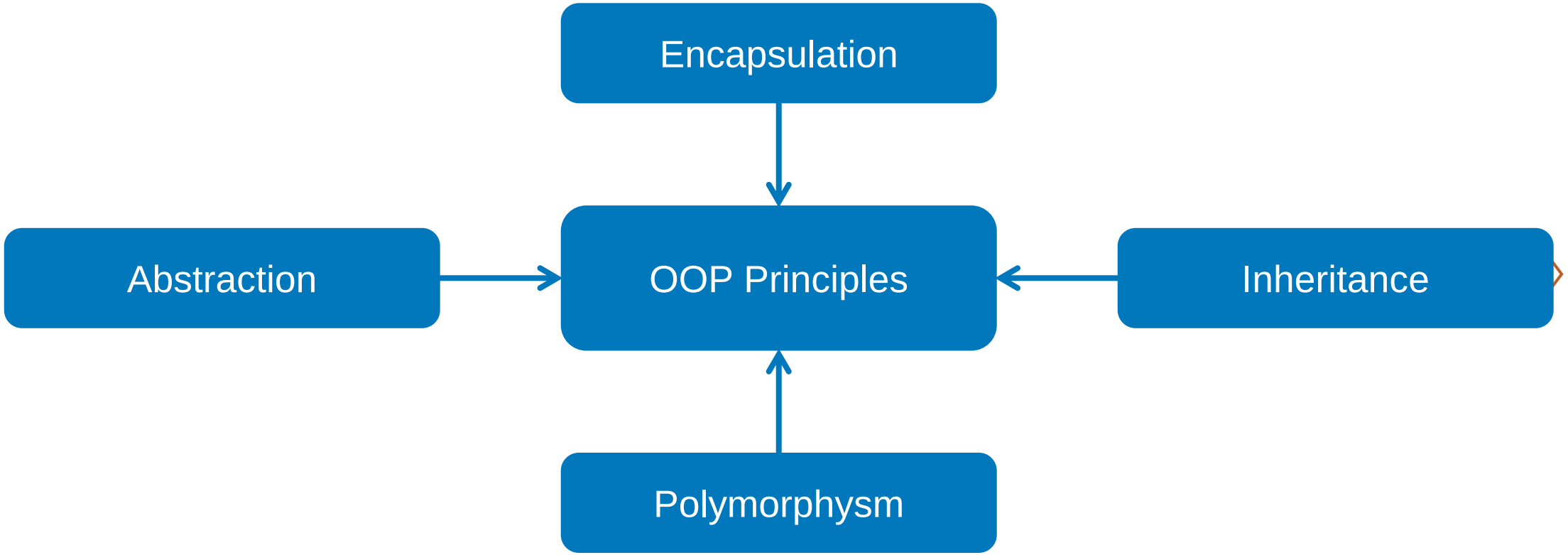
Java 1.0

INHERITANCE

Lesson # 08

OBJECT-ORIENTED PROGRAMMING PRINCIPLES

PILLARS OF OBJECT-ORIENTED PROGRAMMING



INHERITANCE

INHERITANCE OVERVIEW

- The process by which one class acquires the properties (data members or fields) and behavior (methods) of another class is called inheritance
- The aim is to provide the reusability of code so that a class has to write only unique features

INHERITANCE CONCEPTS

- Child class
  - The class that extends the features of another class is known as child class, subclass or derived class
- Parent class
  - The class whose properties and functionalities are inherited by another class is known as parent class, superclass or base class

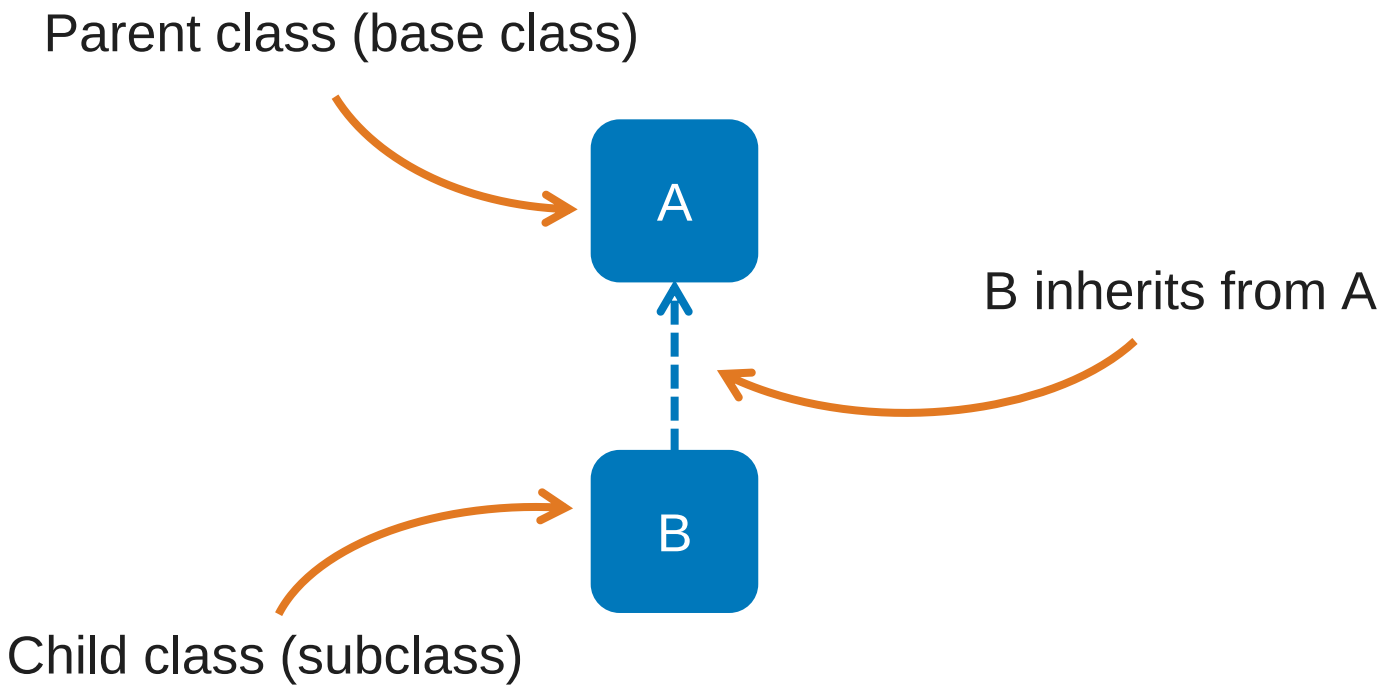
JAVA TYPES OF INHERITANCE

- Single inheritance
  - Refers to a child and parent class relationship where a class extends the another class
- Multilevel inheritance
  - Refers to a child and parent class relationship where a class extends the child class

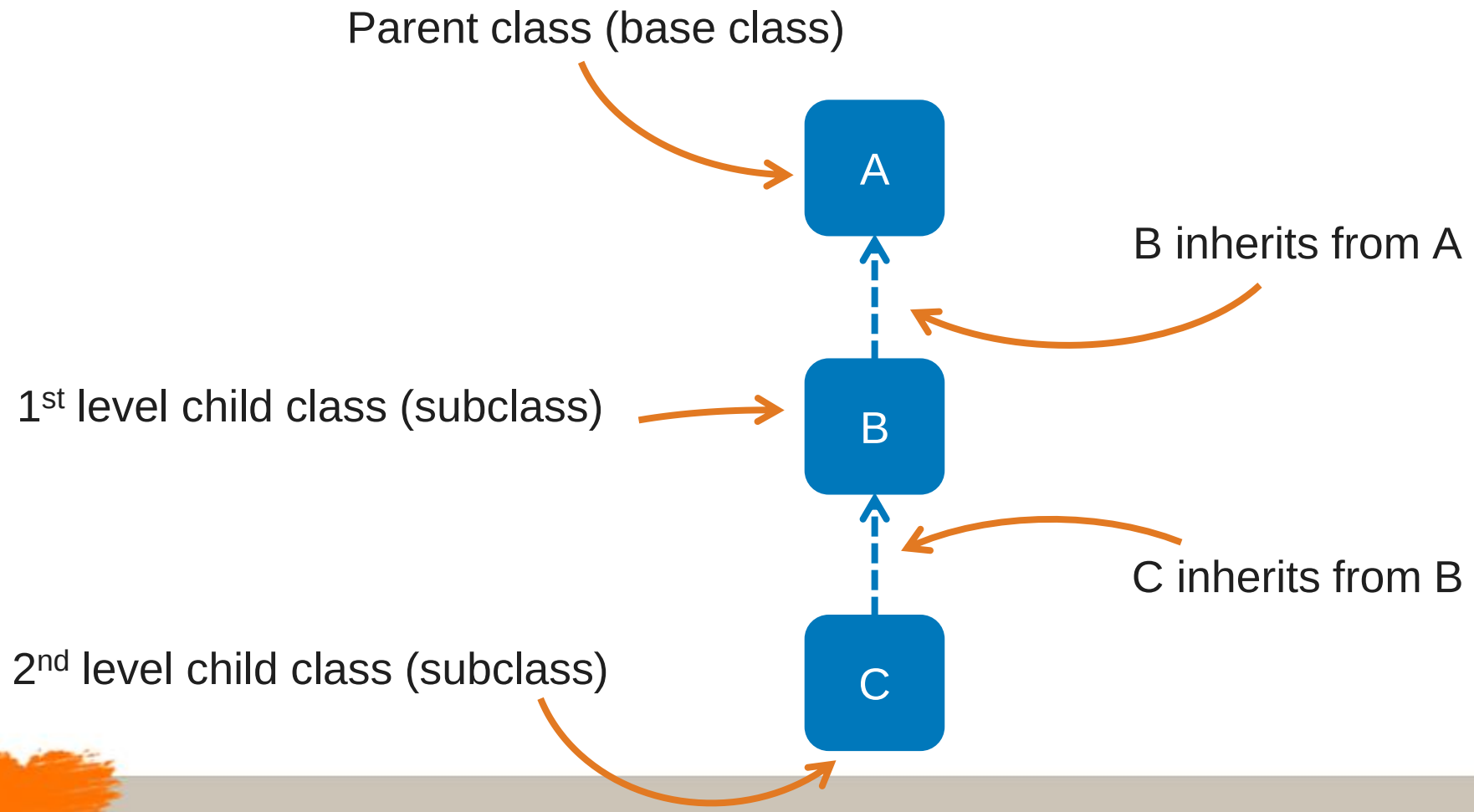
JAVA TYPES OF INHERITANCE

- Hierarchical inheritance
  - Refers to a child and parent class relationship where more than one classes extends the same class
- Hybrid inheritance
  - Combination of more than one types of inheritance in a single program

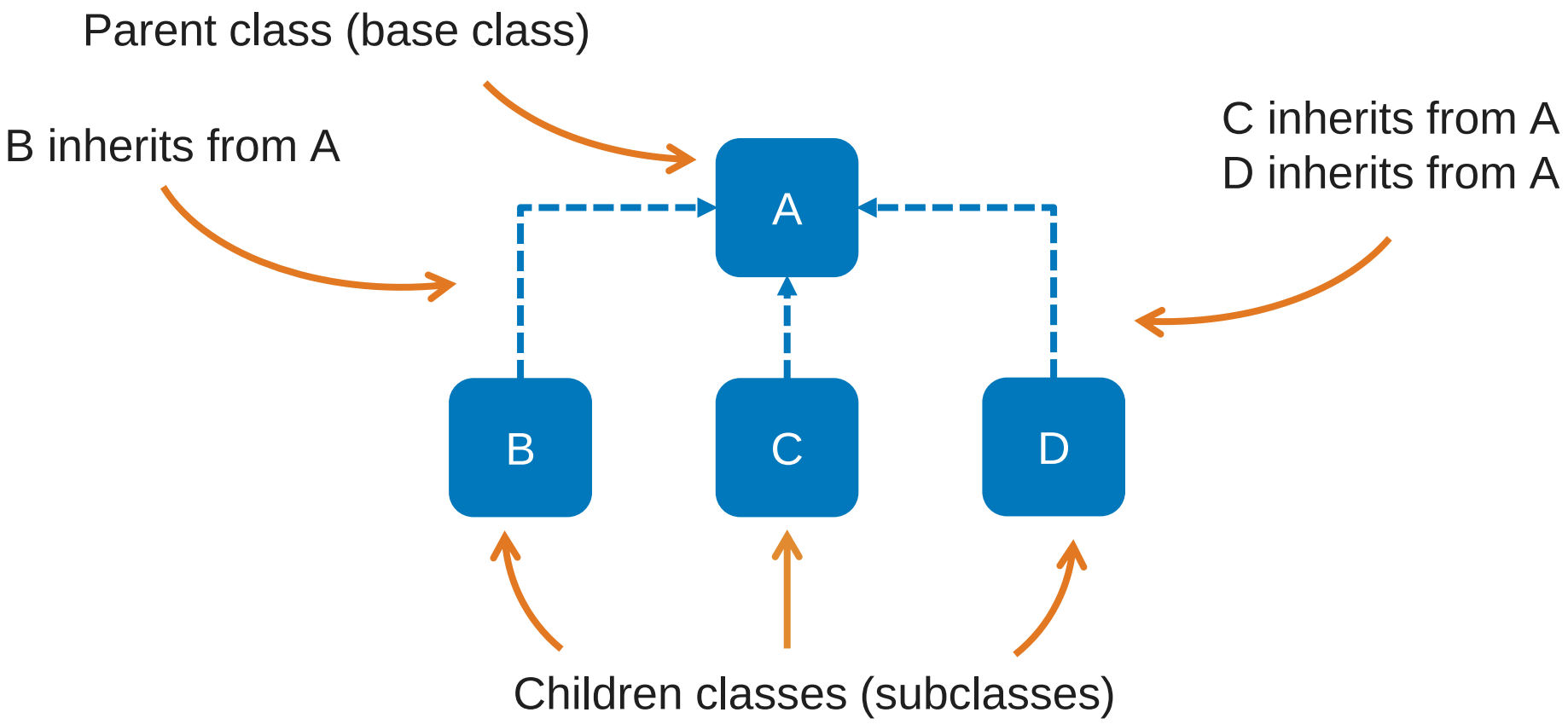
SINGLE INHERITANCE



MULTILEVEL INHERITANCE



HIERARCHICAL INHERITANCE



INHERITANCE EXAMPLE

Protected allows subclasses access fields or methods

```
public class Bicycle {

    protected String brand;
    protected int speed;

    public Bicycle(String brand, int speed) {
        this.brand = brand;
        this.speed = speed;
    }

    public void accelerate() {
        this.speed++;
    }

    public void decelerate() {
        this.speed--;
    }

    @Override
    public String toString() {
        return "Bicycle{" +
                "brand='" + brand + '\'' +
                ", speed=" + speed +
                '}';
    }
}
```

INHERITANCE EXAMPLE

Subclass

Keyword stating inheritance process

Base class

Call parent's constructor

```
public class MountainBicycle extends Bicycle {

    protected int gear;

    public MountainBicycle(String brand, int speed, int gear) {
        super(brand, speed);
        this.gear = gear;
    }

    public void changeGear(int gear) {
        this.gear = gear;
    }

    @Override
    public String toString() {
        return "MountainBicycle{" +
                "gear=" + gear +
                ", brand='" + brand + '\'' +
                ", speed=" + speed +
                '}';
    }
}
```

INHERITANCE EXAMPLE

Code

```
Bicycle bicycle = new Bicycle("Pinarello", 15);
MountainBicycle mountainBicycle = new MountainBicycle("BMC", 42, 2);

System.out.println(bicycle);
System.out.println(mountainBicycle);
```

Console output

```
Bicycle{brand='Pinarello', speed=15}
MountainBicycle{gear=2, brand='BMC', speed=42}
```

INHERITANCE EXAMPLE

Code

```
System.out.println("Pedal to the metal!");
mountainBicycle.accelerate();

System.out.println(bicycle);
System.out.println(mountainBicycle);
```

Console output

```
Pedal to the metal!
 Bicycle{brand='Pinarello', speed=15}
 MountainBicycle{gear=2, brand='BMC', speed=43}
```

JAVA INHERITANCE – RULES AND LIMITATIONS

- Every class has default implicit Object superclass
  - In the absence of any other explicit superclass, every class is implicitly a subclass of Object class
  - Object class has no superclass
- Single inheritance principle
  - A superclass can has any number of subclasses, but a subclass can have only one superclass
  - Multiple inheritance with interfaces is permitted, even though java does not support multiple inheritance with classes

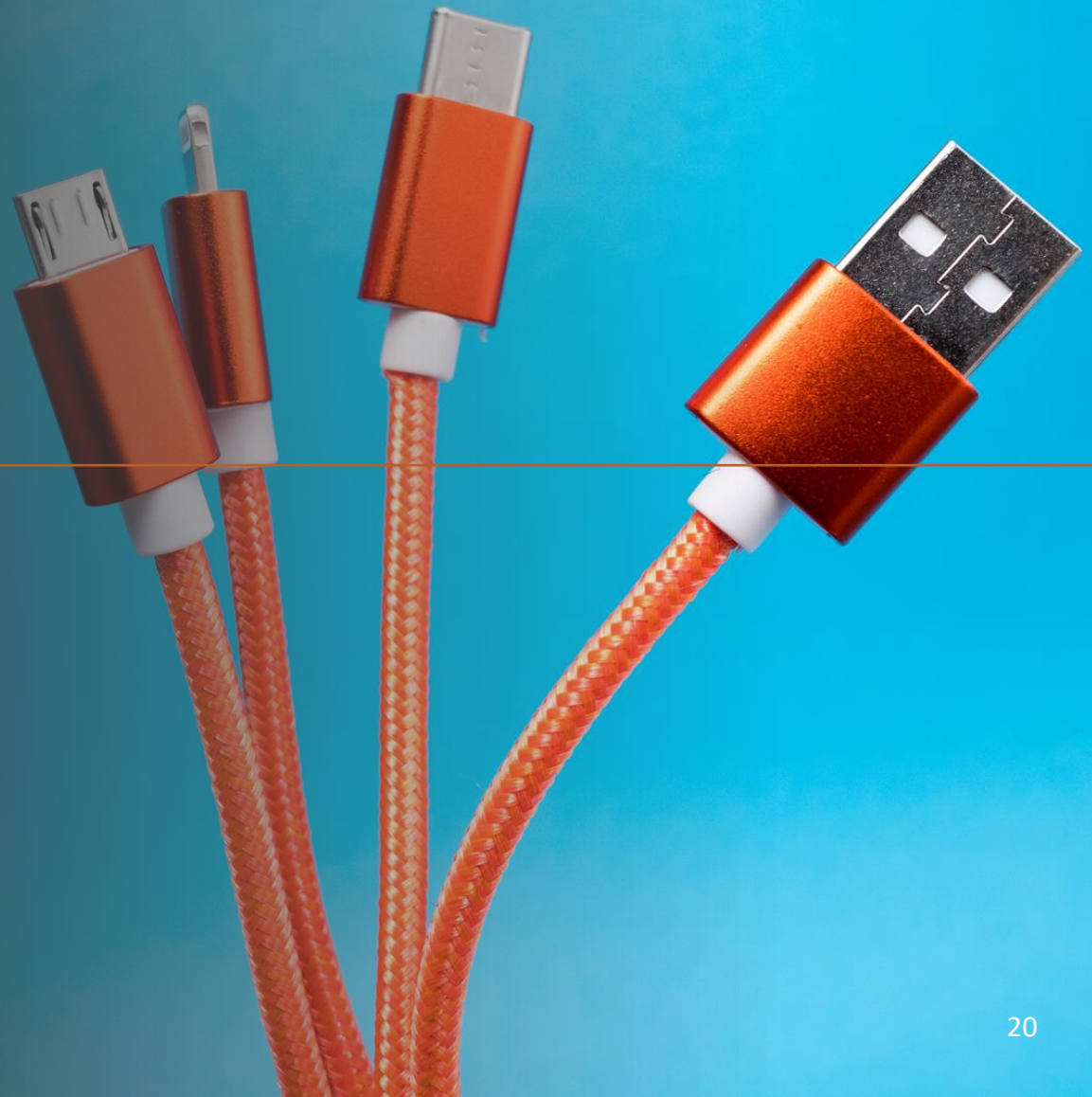
JAVA INHERITANCE – RULES AND LIMITATIONS

- Constructors are not inherited
- A subclass inherits all members (fields, methods, and nested classes) from its superclass
- Constructors are not members, so they are not inherited by subclasses, but the constructor of the superclass can be invoked from the subclass
- Private members inheritance
- A subclass does not inherit the private members of its parent class
- If superclass has public or protected methods (e.g. getters and setters) for accessing its private fields, these can also be used by subclass

JAVA INHERITANCE – RECAP

- In subclasses we can inherit members as is, modify them, hide them, or supplement them with new members:
  - Use inherited fields directly, just like any other fields
  - Declare new fields in the subclass that are not in the superclass
  - Write a new method in the subclass that has the same signature as the one in the superclass, thus overriding it (e.g. equals(), toString())
  - Declare new methods in the subclass that are not in the superclass
  - Write a subclass constructor that invokes the superclass constructor, either implicitly or by using the keyword super

ABSTRACTION



ABSTRACTION OVERVIEW

- The process where you show only relevant data and hide unnecessary details of an object from user
- Allows you to abstract from usage and rather outline generic object functionality
- Defines what object does instead of how

JAVA ABSTRACTION

- Abstraction is achieved by two mechanisms:
  - Interfaces
    - Allows to achieve complete abstraction
  - Abstract classes
    - Allows to achieve partial abstraction

JAVA INTERFACES

- A bit like class, except:
  - Interface can only contain method signatures and fields
- Methods defined in interfaces cannot contain the implementation of method, only signature (return type, name, parameters, exceptions)
- Describes an object by actions it can perform
- Sometimes interface names end with '-able' postfix (e.g. comparable)

JAVA INTERFACE EXAMPLE

Interface name

Interface keyword instead of class

```
public interface Singer {

    void sing();

}
```

Singers can sing, but we don’t care how they do so

JAVA INTERFACE EXAMPLE

```
public class ElvisPresley implements Singer{

    @Override
    public void sing() {
        System.out.println("Love me tender, baby...");
    }

}
```

Special keyword to guarantee that we support interface specified behavior

Concrete implementation of singers behavior

JAVA INTERFACE EXAMPLE

```
public class MichaelJackson implements Singer {

    @Override
    public void sing() {
        System.out.println("Billie Jean is not my lover...");
    }

}
```

JAVA INTERFACE EXAMPLE

```
public class BritneySpears implements Singer {

    @Override
    public void sing() {
        System.out.println("Hit me baby one more time...");
    }

}
```

JAVA ABSTRACT CLASSES

- Mostly like a class, except:
  - Can contain method signatures without implementation among other methods
  - Cannot be instantiated

JAVA ABSTRACT CLASS EXAMPLE

```
public abstract class Shape {

    private String color;

    public Shape(String color) {
        this.color = color;
    }

    public String getColor() {
        return color;
    }

    abstract double area();

}
```

Keyword making class abstract

Subclasses must use constructor of parent class

Method signature that all children are forced to implement

JAVA ABSTRACT CLASS EXAMPLE

```java
public class Circle extends Shape {

    private int radius;

    public Circle(String color, int radius) {
        super(color);
        this.radius = radius;
    }

    @Override
    double area() {
        return 3.14 * radius * radius;
    }
}
```

Extending shape class with concrete details

Circle specific properties

Calling parent constructor with required params

Each concrete shape knows how calculate its area

JAVA ABSTRACT CLASS EXAMPLE

```
public class Rectangle extends Shape {

    private int width;
    private int height;

    public Rectangle(String color, int width, int height) {
        super(color);
        this.width = width;
        this.height = height;
    }

    @Override
    double area() {
        return width * height;
    }
}
```

Rectangles specific properties

INTERFACE VS ABSTRACT CLASS

- Type of methods
  - Interface can have only abstract methods (since Java 8 supports static and default methods as well)
  - Abstract class can have abstract and non-abstract methods
- Final variables
  - Variables declared in a Java interface are by default final
  - Abstract class may contain non-final variables

INTERFACE VS ABSTRACT CLASS

- Type of variables
  - Interface has only static and final variables
  - Abstract class can have final, non-final, static and non-static variables
- Implementation
  - Interface can’t provide the implementation of abstract class
  - Abstract class can provide the implementation of interface

INTERFACE VS ABSTRACT CLASS

- Inheritance vs Abstraction
  - Interface can be implemented using keyword "implements”
  - Abstract class can be extended using keyword “extends”
- Multiple Implementation
  - Interface can extend another Java interface only
  - Abstract class can extend another Java class and implement multiple Java interfaces

INTERFACE VS ABSTRACT CLASS

- Accessibility of data members
  - Access modifiers of interface members are public by default and cannot be changed
  - Access modifiers of abstract class members can have any access modifiers (except private abstract methods)

POLYMORPHISM

POLYMORPHISM

- Polymorphism is the ability of an object to take on many forms
- Capability of a method to do different things based on the object that it is acting upon
- Which implementation to be used is decided at runtime depending upon the situation

POLYMORPHISM EXAMPLE

Code

```
Singer elvis = new ElvisPresley();
Singer jackson = new MichaelJackson();
Singer spears = new BritneySpears();

elvis.sing();
jackson.sing();
spears.sing();
```

Console output

```
Love me tender, baby...
Billie Jean is not my lover
Hit me baby one more time
```

POLYMORPHISM EXAMPLE

Code

```
Singer[] singers = new Singer[2];
singers[0] = new ElvisPresley();
singers[1] = new BritneySpears();

for (Singer singer : singers) {
    singer.sing();
}
```

Console output

```
Love me tender, baby...
Hit me baby one more time
```

POLYMORPHISM EXAMPLE

Code

```
Shape circle = new Circle("Red", 3);
Shape rectangle = new Rectangle("Blue", 2, 4);

System.out.println("Circle area = " + circle.area());
System.out.println("Rectangle area = " + rectangle.area());
```

Console output

```
Circle area = 28.259999999999998
Rectangle area = 8.0
```

REFERENCES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Hemingway
DON QUIXOTE
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SHELLEY'S POETICAL WORKS
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WALDEN
HARRAP
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QUESTIONS?

THANK YOU!