Object Oriented Programming
CS F213

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OOP Basics

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Basic OOP concepts

- Class
- Object
- Abstraction
- Encapsulation
- Inheritance
- Polymorphism

Abstract Data Type (ADT)

- A structure that contains both data and the actions to be performed on that data.

- *Class* is an implementation of an Abstract Data Type.

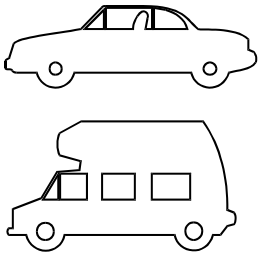
Examples

Person Objects

Abstract Into →

Person Class
Attributes: `Name, Age, Sex`
Operations: `Speak(), Listen(), Walk()`

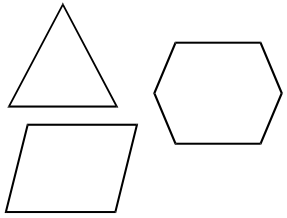
Vehicle Objects



Abstract Into →

Vehicle Class
Attributes: `Name, Model, Color`
Operations: `Start(), Stop(), Accelerate()`

Polygon Objects

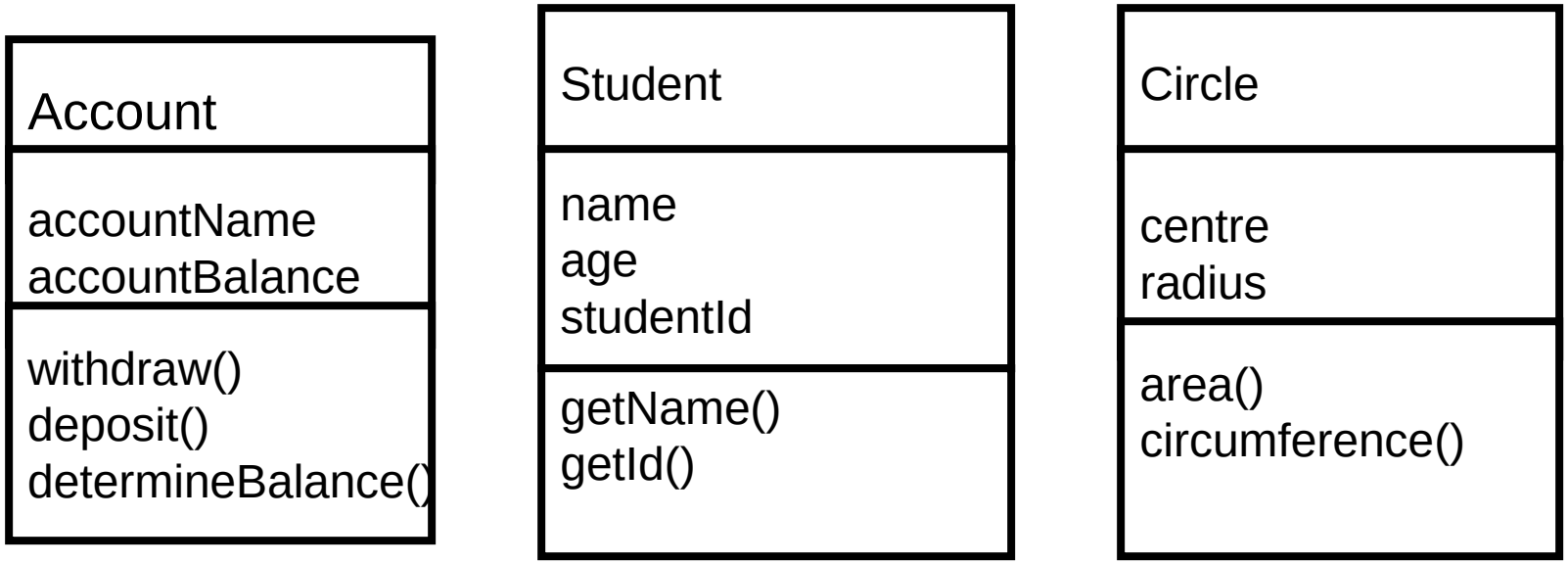


Abstract Into →

Polygon Class
Attributes: `Vertices, Border, Color, FillColor`
Operations: `Draw(), Erase(), Move()`

Class

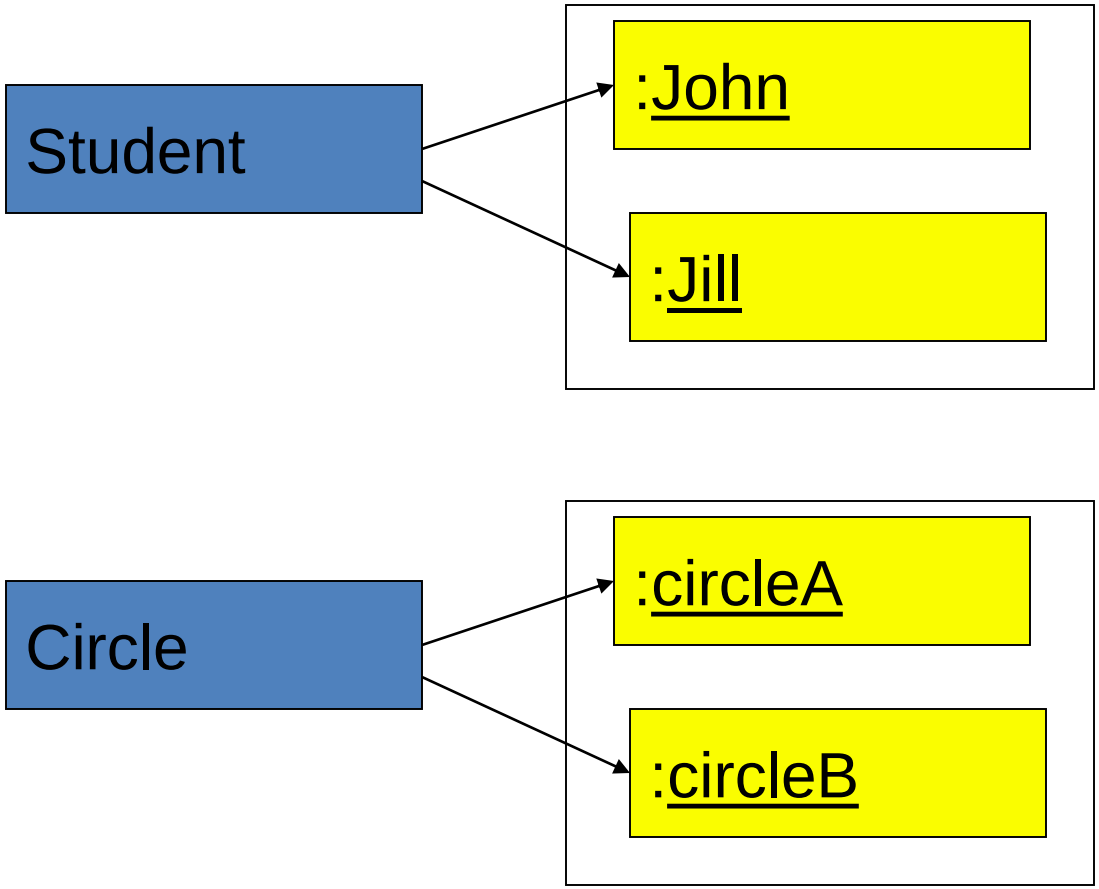
- Class is a set of *attributes* and *operations* that are performed on the attributes.
- A blueprint from which individual objects can be created.
- A class defines all the properties common to the object - *attributes* and *methods*.



Objects

- Instance of the class
- Entity that has state and behavior
- Each object has an address and takes up memory
- It can communicate without knowing other object's code or data

Classes/Objects



John and Jill are objects of class Student

circleA and circleB are objects of class Circle

Object

- Objects have state and classes don't.

  John is an object (instance) of class Student.

  name = "John", age = 20, studentId = 1236

  Jill is an object (instance) of class Student.

  name = "Jill", age = 22, studentId = 2345

  circleA is an object (instance) of class Circle.

  centre = (20,10), radius = 25

  circleB is an object (instance) of class Circle.

  centre = (0,0), radius = 10

Class/Object Example

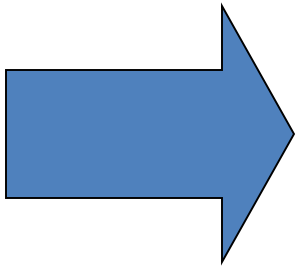
```
class Student{
 int id;
 String name;
}
class TestStudent{
 public static void main(String args[]){
//Creating object
  Student s1=new Student();
//Initializing object
  s1.id=253;
  s1.name="Sathish";
//Printing data
  System.out.println(s1.id+" "+s1.name);
   }}
```

Data Abstraction

- Abstraction is a process where you show only “relevant” data and “hide” unnecessary details of an object from the user.
- It allows the creation of user defined data types, having the properties of built in data types and more.
  - **Example:** A car in itself is a well-defined object, which is composed of several other smaller objects like a gearing system, steering mechanism, engine, which are again have their own subsystems. But for humans car is a one single object, which can be managed by the help of its subsystems, even if their inner details are unknown.

Abstraction - Example

```
class Student{
 int id;
 String name;
}
 // Class Student
```



Creates a data type Student

Student s1;

Encapsulation

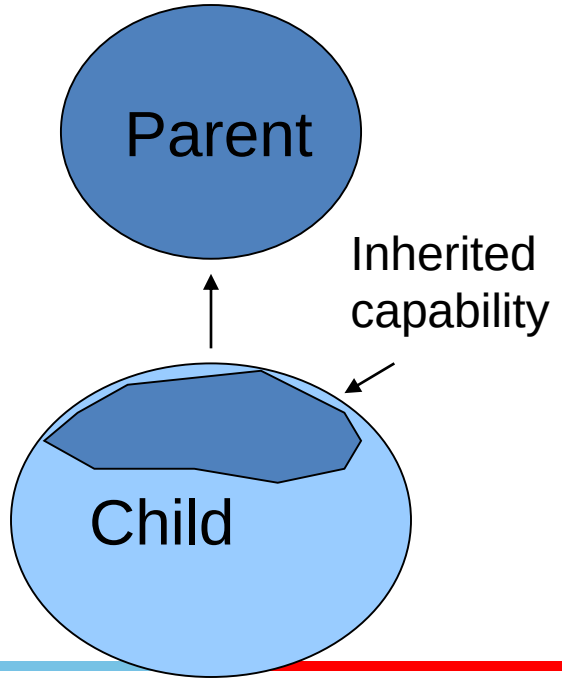
- Encapsulation is:
  - Binding the data with the code that manipulates it.
  - It keeps the data and the code safe from external interference
- All information (attributes and methods) in an object oriented system are stored within the object/class.
- Information can be manipulated through operations performed on the object/class – interface to the class. Implementation is hidden from the user.
- Object support *Information Hiding* – Some attributes and methods can be hidden from the user.

Encapsulation Example

```
class Student{
 private int rollno;
 String name;
 void insertRecord(int r, String n){
  rollno=r;
  name=n;
 }
 void displayInformation(){System.out.println(rollno+" "+name);}
}
class TestStudent{
 public static void main(String args[]){
  Student s1=new Student();
   s1.insertRecord(111,"Karan");
  s1.displayInformation();
   }
}
```

Inheritance

- New data types (classes) can be defined as extensions to previously defined types.
- Parent Class (Super Class) – Child Class (Sub Class)
- Subclass inherits properties from the parent class.

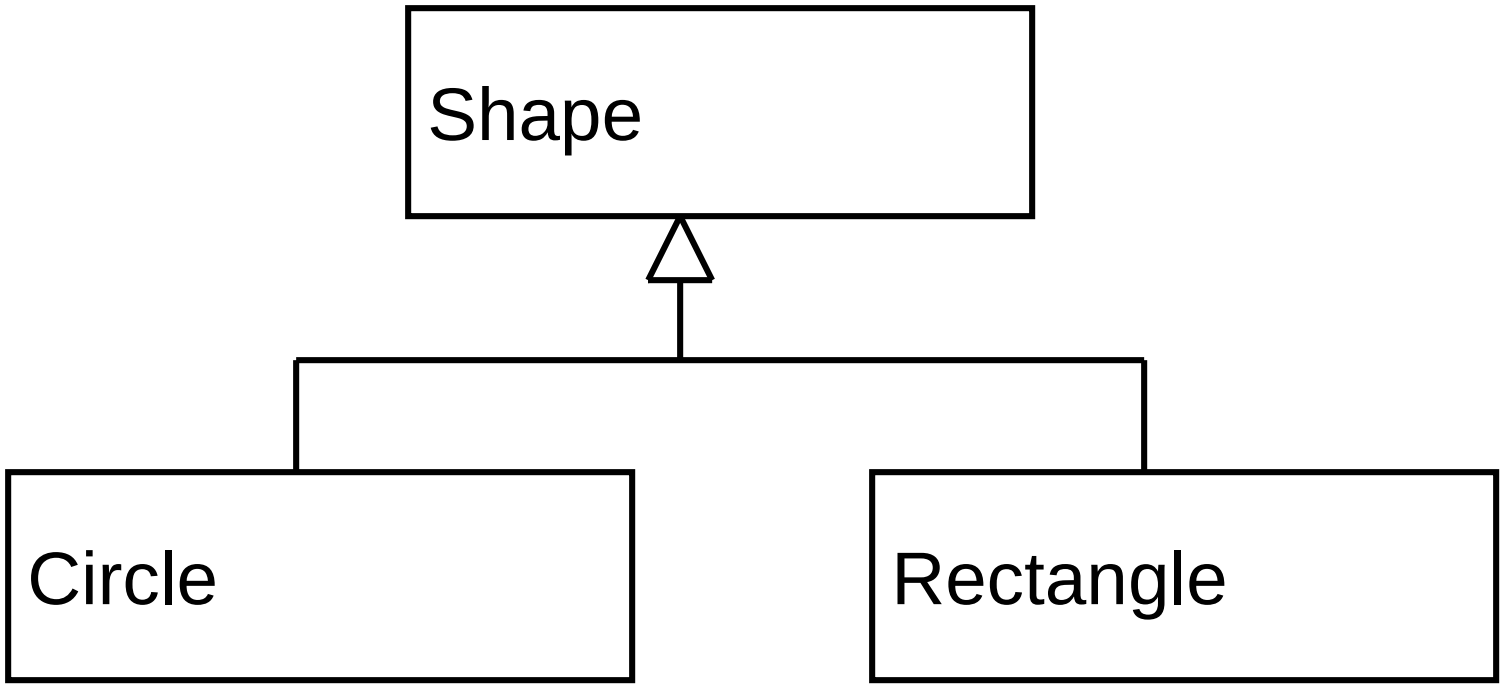


Inheritance - Example

- Example
  - Define Person to be a *class*
    - A Person has *attributes*, such as name, age, height, gender
  - Define student to be a *subclass* of Person
    - A student has all attributes of Person, plus attributes of his/her own (student no, course_enrolled)
    - A student *inherits* all attributes of Person
  - Define lecturer to be a *subclass* of Person
    - Lecturer has all attributes of Person, plus attributes of his/her own (staff_id, subjectID1, subjectID2)

Inheritance - Example

- Circle Class can be a subclass (inherited from) of a parent class - Shape

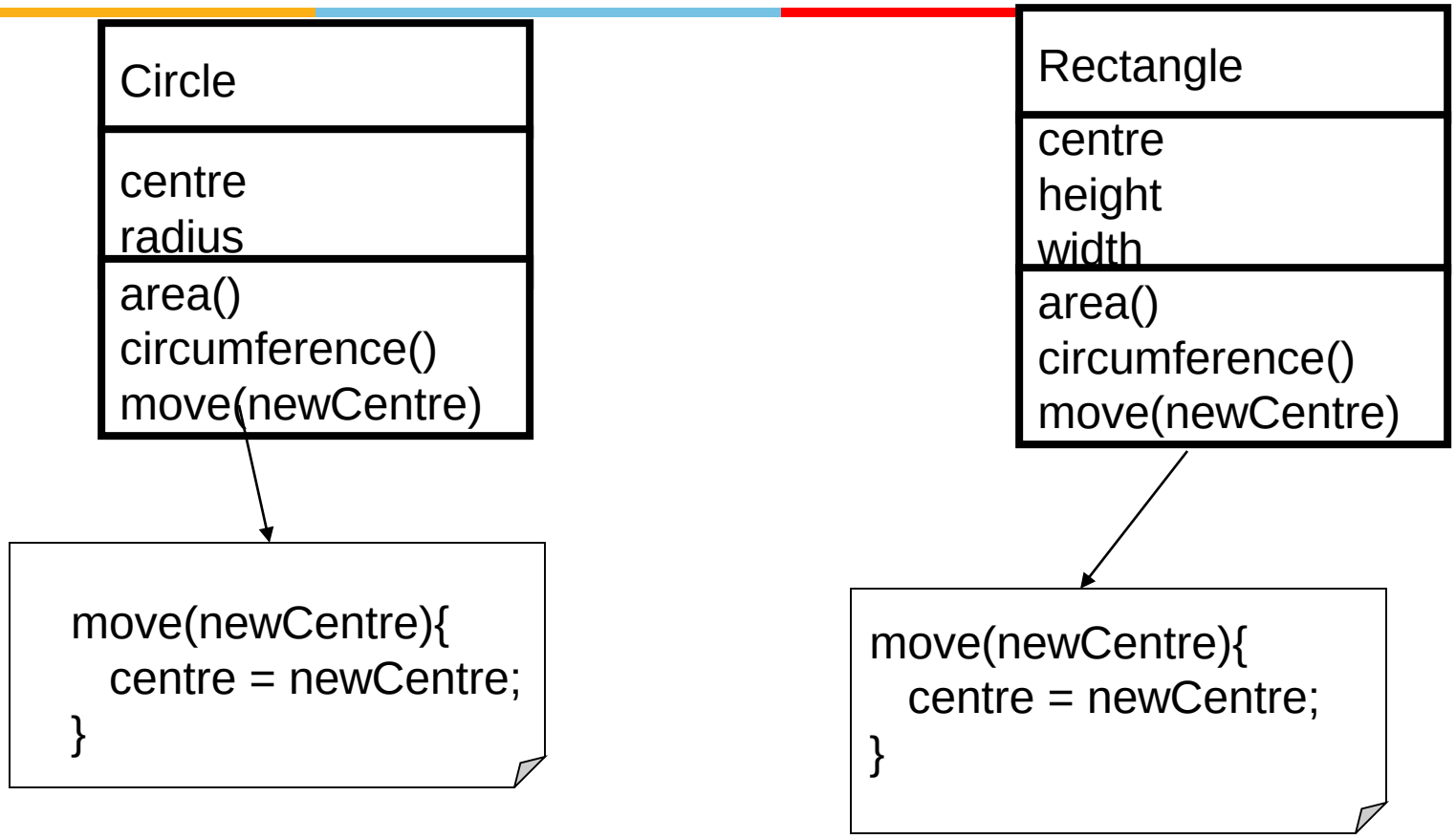


Uses of Inheritance - Reuse

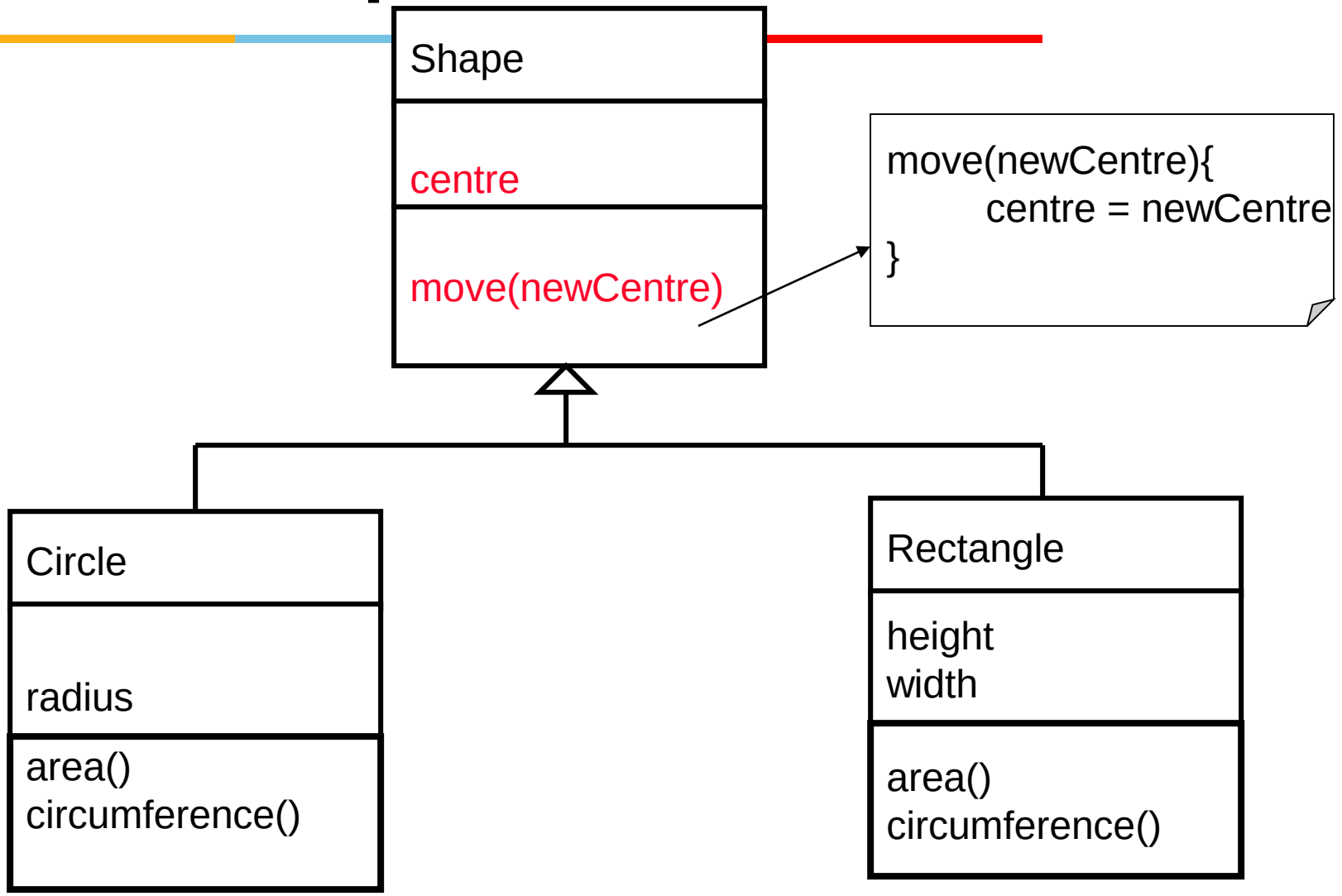
- If multiple classes have common attributes/methods, these methods can be moved to a common class - parent class.

- This allows reuse since the implementation is not repeated.

Reuse-Example



Reuse-Example



Polymorphism

- Polymorphic which means “many forms” has Greek roots.
  - Poly – many
  - Morphos - forms.
- In OO paradigm polymorphism has many forms.
- Allow a single *object, method, operator* associated with different meaning depending on the type of data passed to it.

Polymorphism – Method Overloading

- Multiple methods can be defined with the same name, different input arguments.

  Method 1 - initialize(int a)

  Method 2 - initialize(int a, int b)

- Appropriate method will be called based on the input arguments.

  initialize(2) Method 1 will be called.

  initialize(2,4) Method 2 will be called.