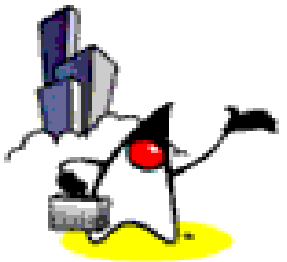
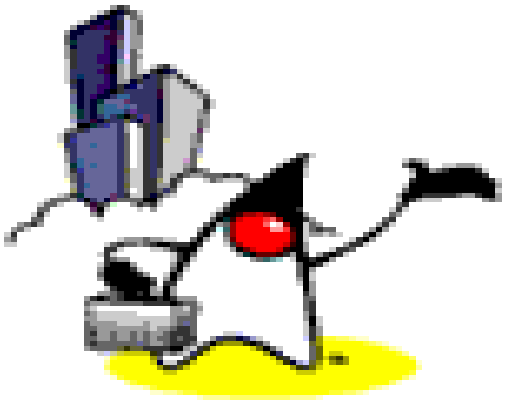
Polymorphism



Agenda

- What is and Why Polymorphism?
- Examples of Polymorphism in Java programs
- 3 forms of Polymorphism



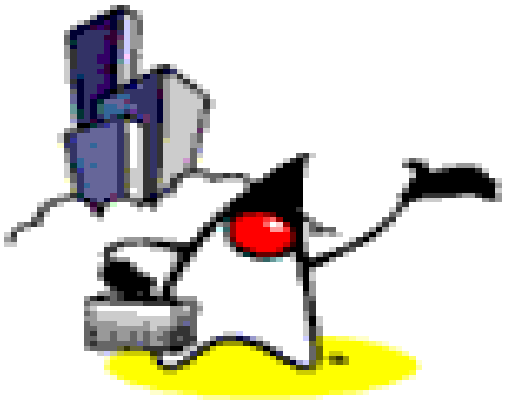
What is & Why Polymorphism?

What is Polymorphism?

- Generally, polymorphism refers to the ability to appear in many forms
- Polymorphism in a Java program
  - The ability of a reference variable to change behavior according to what object instance it is holding.
  - This allows multiple objects of different subclasses to be treated as objects of a single super class, while automatically selecting the proper methods to apply to a particular object based on the subclass it belongs to

Polymorphism Example

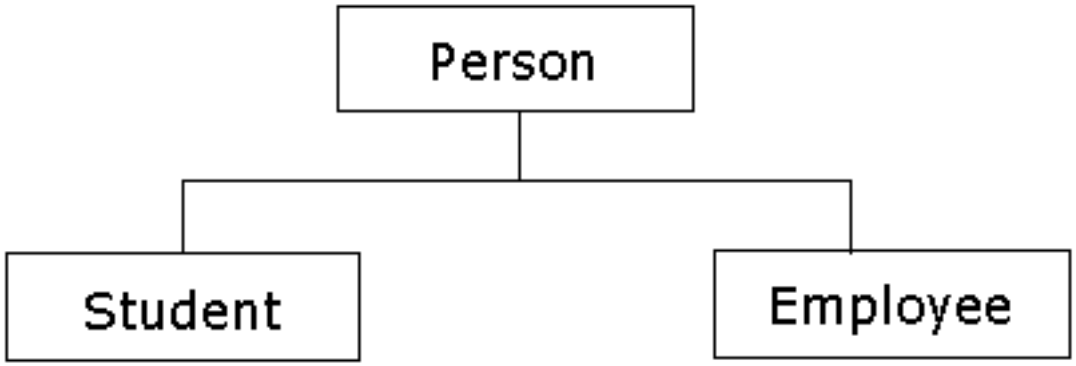
- For example, given a base class *shape*, polymorphism enables the programmer to define different *area* methods for any number of derived classes, such as *circles*, *rectangles* and *triangles*.
- No matter what shape an object is, applying the *area* method to it will return the correct results.



Examples of Polymorphic Behavior in Java Programs

Example #1: Polymorphism

- Given the parent class **`Person`** and the child class **`Student`**, we add another subclass of **`Person`** which is **`Employee`**.
- Below is the class hierarchy



Example #1: Polymorphism

- In Java, we can create a reference that is of type super class, *Person*, to an object of its subclass, *Student*.

```
public static main( String[] args ) {

    Student studentObject = new Student();
    Employee employeeObject = new Employee();

    Person ref = studentObject; // Person reference points
                                // to a Student object

    // Calling getName() of the Student object instance
    String name = ref.getName();
}
```

Example #1: Polymorphism

- Now suppose we have a getName method in our super class Person, and we override this method in both Student and Employee subclass's

```
public class Student {
   public String getName(){
      System.out.println("Student Name:" + name);
      return name;
   }
}

public class Employee {
   public String getName(){
      System.out.println("Employee Name:" + name);
      return name;
   }
}
```

Example #1: Polymorphism

- Going back to our main method, when we try to call the `getName` method of the reference Person ref, the `getName` method of the `Student` object will be called.

- Now, if we assign ref to an `Employee` object, the `getName` method of `Employee` will be called.

Example #1: Polymorphism

```
1   public static main( String[] args ) {
2
3       Student studentObject = new Student();
4       Employee employeeObject = new Employee();
5
6       Person ref = studentObject; //Person ref. points to a
7                                   // Student object
8
9       // getName() method of Student class is called
10      String temp= ref.getName();
11      System.out.println( temp );
12
13      ref = employeeObject; //Person ref. points to an
14                            // Employee object
15
16      //getName() method of Employee class is called
17      String temp = ref.getName();
18      System.out.println( temp );
19  }
```

Example #2: Polymorphism

- Another example that illustrates polymorphism is when we try to pass a reference to methods as a parameter

- Suppose we have a static method printInformation that takes in a Person reference as parameter.

```
public static printInformation( Person p ){
    // It will call getName() method of the
    // actual object instance that is passed
    p.getName();
}
```

Example #2: Polymorphism

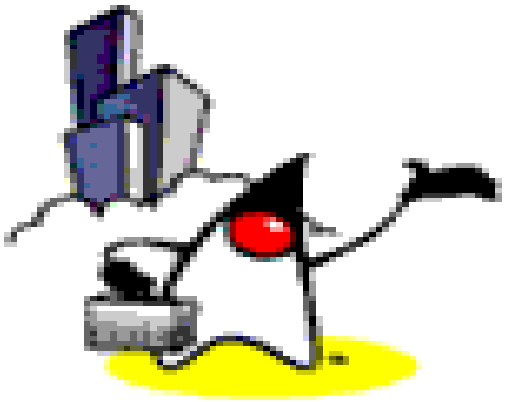
- We can actually pass a reference of type Employee and type Student to the printInformation method as long as it is a subclass of the Person class.

```
public static main( String[] args ){

        Student   studentObject = new Student();
        Employee  employeeObject = new Employee();

        printInformation( studentObject );

        printInformation( employeeObject );
}
```



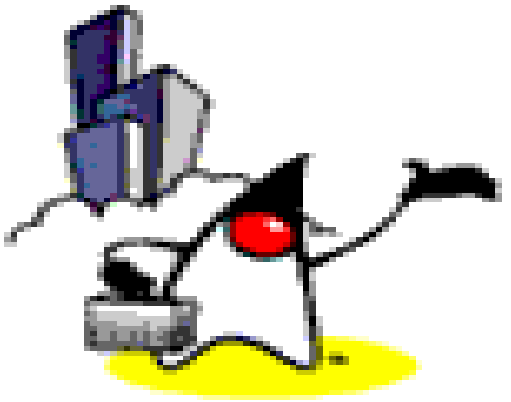
Benefits of Polymorphism

Benefits of Polymorphism

- Simplicity
  - If you need to write code that deals with a family of types, the code can ignore type-specific details and just interact with the base type of the family
  - Even though the code thinks it is using an object of the base class, the object's class could actually be the base class or any one of its subclasses
  - This makes your code easier for you to write and easier for others to understand

Benefits of Polymorphism

- Extensibility
  - Other subclasses could be added later to the family of types, and objects of those new subclasses would also work with the existing code



3 Forms of Polymorphism

3 Forms of Polymorphism in Java program

- Method overriding
  - Methods of a subclass override the methods of a superclass
- Method overriding (implementation) of the abstract methods
  - Methods of a subclass implement the abstract methods of an abstract class
- Method overriding (implementation) through the Java interface
  - Methods of a concrete class implement the methods of the interface

Polymorphism