POLYMORPHISM

CS302 – Introduction to Programming
University of Wisconsin – Madison
Lecture 25

By Matthew Bernstein – matthewb@cs.wisc.edu

What is Polymorphism?

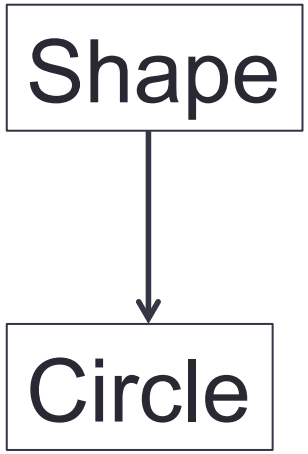
- The definition of **polymorphism** is:

  The ability to treat objects of different classes in a uniform way.

- What does this mean?
- It is best explained with an example.

Consider the following example:

- Let's say we are implementing a drawing program that allows the user to draw shapes to a canvas. We have the following inheritance hierarchy:



Each class has a **draw** method

- Let's say each class in the previous slide has a method called **draw** that draws its shape to a canvas:

```
public void draw()
{
        // Draws itself
}
```

- The **Circle**'s **draw** method draws a circle What does the **Shape**'s **draw** method draw? Let's implement **Shape** so that by default it simply draws a square.

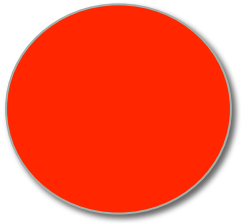
Example

```
Shape shape = new Shape();
shape.draw();
```

Produces:

```
Circle circle= new Circle();
circle.draw();
```

Produces:



Okay, so far so good

- So far we have two classes: **Shape** and **Circle**
- Circle override's its superclass's **draw**
- That is, each class's **draw** method draws a different shape

Let's Implement a method called **DrawShape**

- Now let's say we define a method called **DrawShape** that accepts a single **Shape** object and draws it:

```
public static void drawShape(Shape shape)
{
        shape.draw();
}
```

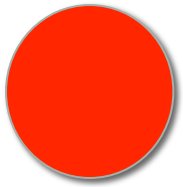
What actual shape will drawn in the following example?

- Let's say in our main method, we implement the following code:

```
Circle circle = new Circle();

drawShape( circle );
```

- What actual shape will be drawn to the canvas?
- Answer: a circle!

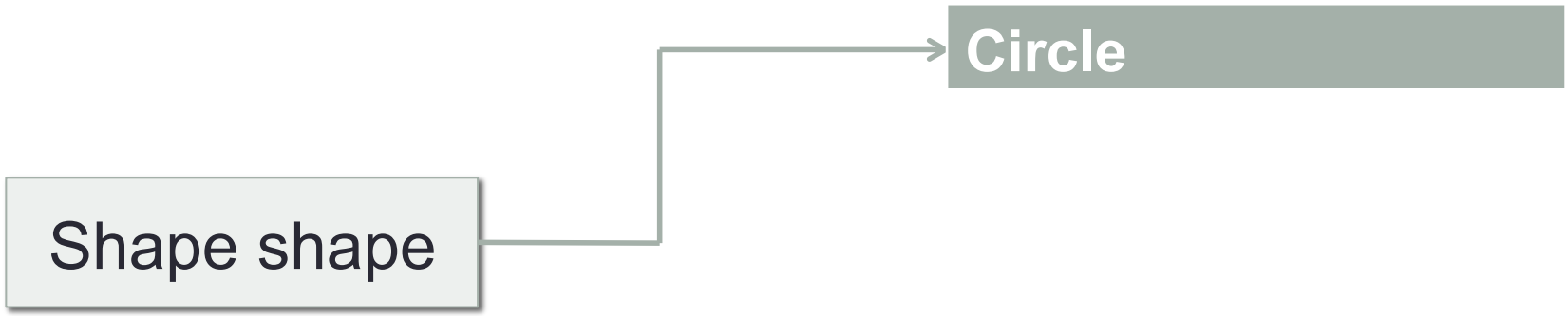


This is what is actually drawn to the canvas

What Happened?

- Even though inside the **drawShape** method we call **draw** on a reference variable of type **Shape**, Java knows that the object being referenced by this variable is actually an instance of Circe:

```
shape.draw();
```



How does Java determine which method to call?

- Why did Java call **Circle.draw** instead of **Shape.draw** even though the reference variable "shape" was type **Shape**?
- In Java, method calls *are always determined by the type of the actual object*, not on the type of the variable containing the object reference
- This is called **dynamic method lookup**
- Dynamic method lookup allows us to treat objects of different classes in a uniform way. This ability is called **Polymorphism**