# §9.10-9.22: Polymorphism

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CMPT167
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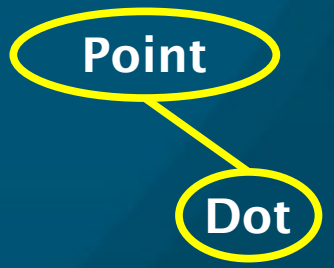
# Review last time

- Inheritance for software reusability
  - "has a" vs. "is a kind of"
- Subclass/superclass constructors
  - super()
- Subclass/superclass references
  - Downcasting

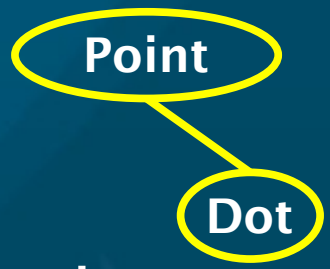


# What's on for today

- Polymorphism
  - Dynamic method binding
  - final keyword for classes and methods
  - Abstract and concrete classes
    - abstract keyword for classes and methods
- Interfaces
  - vs. abstract superclasses
- Type-wrapper classes for the primitive types

# Polymorphism

- Think carefully about class hierarchy in program design
- Write programs/algorithms to operate on superclass objects
  - As generic as possible
- Instances of subclasses can be operated on by the algorithms without need for modification
- Dynamic method binding:
  - Java chooses correct method (e.g., toString() ) from subclass



# final: methods/classes

- We've seen final on variables: set as constant
- final on a method prevents subclasses from overriding
- final on a class means it cannot be extended
  - (Other classes cannot inherit from it)

# Abstract vs. concrete classes

- Abstract classes:
  - Too generic to define a real object
    - e.g., TwoDimensionalShape
  - Not intended to be directly instantiated
    - Java can enforce this: use abstract keyword
    - abstract classes can have abstract methods:
      - No body defined; each subclass must implement
- Concrete classes:
  - Subclass of an abstract class, meant to be instantiated
    - e.g., Square, Circle, Triangle

# Example: TwoDimensionalShape

- Abstract superclass: TwoDimensionalShape
  - Abstract method: draw()

```
abstract public class TwoDimensionalShape {
    abstract public void draw();        // no body
```

- Concrete subclasses: Circle, Square, Triangle
  - Each provide own implementation of draw()

```
public class Circle extends TwoDimensionalShape {
    public void draw() { drawOval( x, y, r, r ); }
}
public class Square extends TwoDimensionalShape {
    public void draw() { drawRect( x, y, w, h ); }
}
```

# Interfaces

- Define a set of abstract methods

```
public interface drawableShape {
    public abstract void draw();
    public abstract double area();
}
```

- Classes implement these methods

```
public class Circle implements drawableShape {
    public void draw() { drawOval( x, y, r, r ); }
    public double area() { return 2 * Math.PI * r * r; }
```

- We've already been using the actionListener interface

# Abstract classes vs. interfaces

- Abstract superclasses declare identity:
  - "Circle is a kind of TwoDimensionalShape"
  - Each class can have only one superclass
    - No multiple inheritance in Java
  - Inherit methods, attributes; get protected access
- Interfaces declare capability:
  - "Circles know how to be drawableShapes"
  - May implement multiple interfaces
  - Interfaces are not ADTs (abstract data types)

# Primitive type-wrapper classes

- Eight primitive types in Java
  - Primitives are not really objects
- Type-wrapper classes for each of the eight:
  - Character, Byte, Integer, Boolean, etc.
  - Enable us to represent primitives as Object
  - Can then process them polymorphically
- Type-wrapper classes declared final
  - Many methods declared static
    - e.g., Integer.parseInt( String )

# TODO

- Lab4 due next week Wed 14Mar
  - OO concepts (sets and vectors)