CSE 11
Accelerated Intro to Programming
Lecture 12

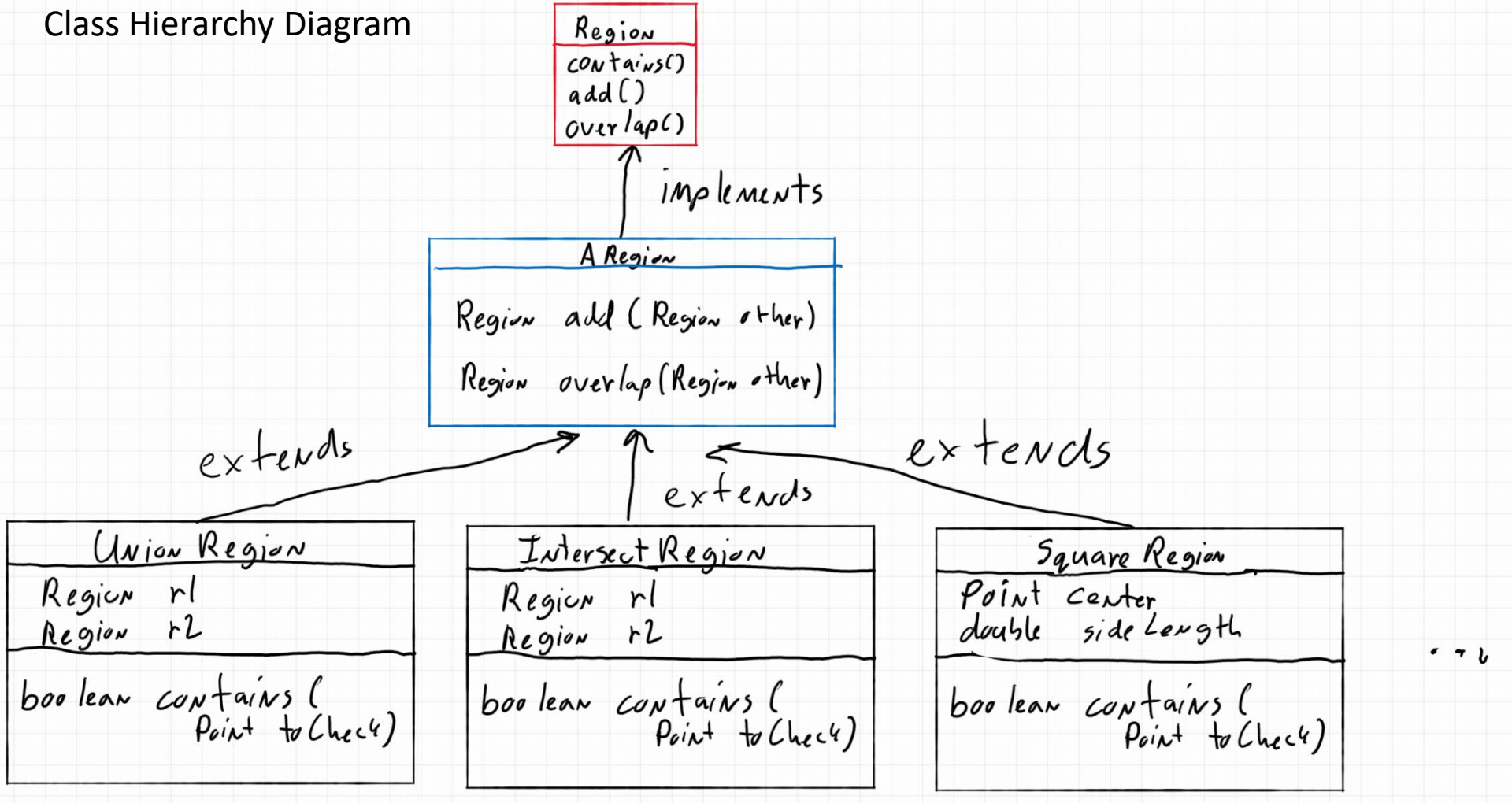
Greg Miranda, Spring 2021

This lecture is being recorded

Announcements

- Quiz 12 due Monday @ 8am
- PA4 due Wednesday @ 11:59pm
- Survey 4 due tonight @ 11:59pm
- PA1 Resubmission due tonight @ 11:59pm
- Week 6, 9, and finals week for take-home exams

Class Hierarchy Diagram



Abstract Class

- Why did we introduce abstract classes?
  - Multiple classes had the exact same method
    - Same method header (same types)
    - Same implementation
  - add() method – put into all the region classes
    - Same implementation in all of them
    - Made an abstract class
      - Had one implementation of that method
      - Used extends so that all of the implementations could share that one method

```
class Point {
  private double x, y;
  Point(double x, double y) { this.x = x; this.y = y; }
  double distance(Point other) {
    return Math.sqrt(
       Math.pow(this.x - other.x, 2) +
       Math.pow(this.y - other.y, 2));
  }
  double xDistance(Point other) { return Math.abs(other.x - this.x); }
  double yDistance(Point other) { return Math.abs(other.y - this.y); }
}
interface Region {
  boolean contains(Point p);
  Region add(Region other);
  Region overlap(Region other);
}
abstract class ARegion implements Region {
  public Region add(Region other) {
    return new UnionRegion(this, other);
  }
  public Region overlap(Region other) {
    return new IntersectRegion(this, other);
  }
}
class UnionRegion extends ARegion {
  Region region1, region2;
  UnionRegion(Region region1, Region region2) {
    this.region1 = region1;
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class SubtractRegion implements Region {
  Region region1;
  Region region2;
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class SquareRegion extends ARegion {
  Point center;
  double sideLength;
  SquareRegion(Point center, double sideLength) {
    this.center = center;
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class ExamplesARegion {
  Region circ1 = new CircleRegion(new Point(10, 5), 4.0);
  Region sq = new SquareRegion(new Point(10, 1), 8.0);
  Region ir = this.circ1.add(this.sq);
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abstract class AComboRegion                {
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class ExamplesRegion {
  Region sq = new SquareRegion(new Point(4, 5), 8);
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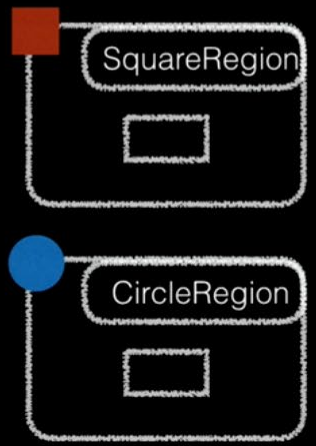

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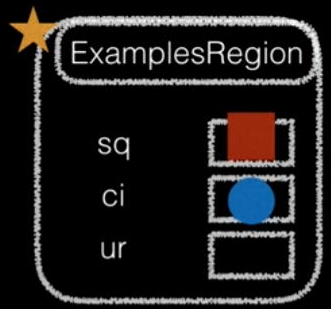

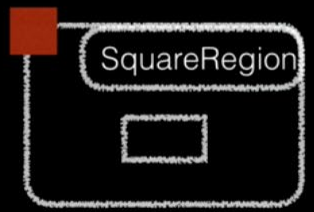

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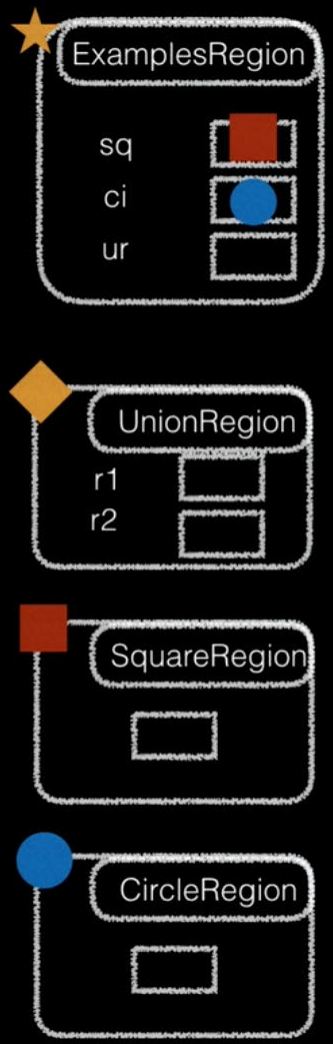

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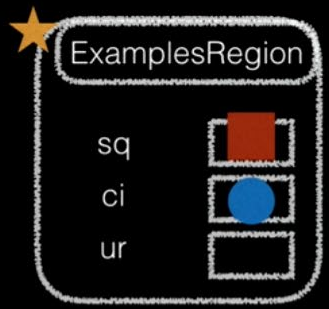

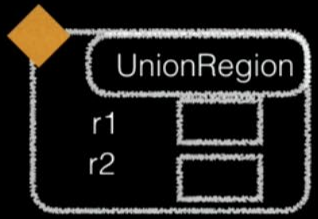

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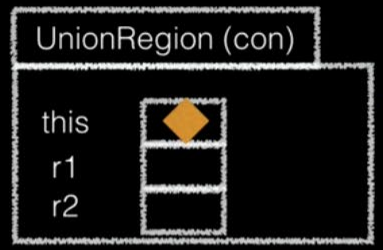

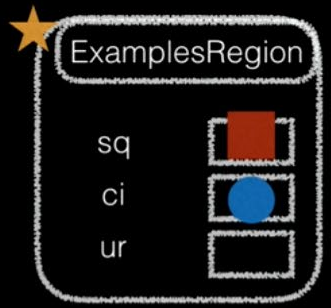

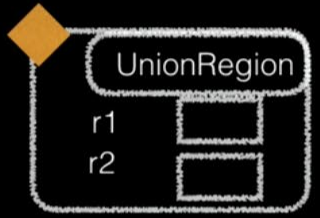

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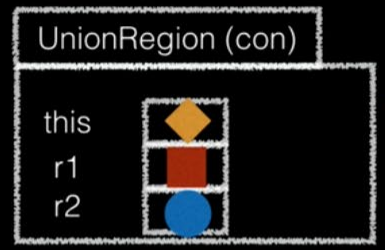

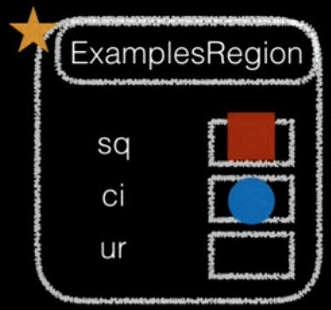

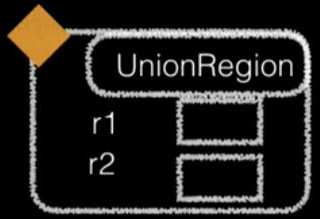

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interface Region { … }
abstract class ARegion implements Region { … }
class SquareRegion extends ARegion { … }
class CircleRegion extends ARegion { … }

abstract class AComboRegion extends ARegion {
  Region r1, r2;
  AComboRegion(Region r1, Region r2) {
    this.r1 = r1;
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  }
}

class UnionRegion extends AComboRegion {
  UnionRegion(Region r1, Region r2) {
    super(r1, r2);
  }
  public boolean contains(Point p) {
     return this.r1.contains(p) &&
            this.r2.contains(p);
  }
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class ExamplesRegion {
  Region sq = new SquareRegion(new Point(4, 5), 8);
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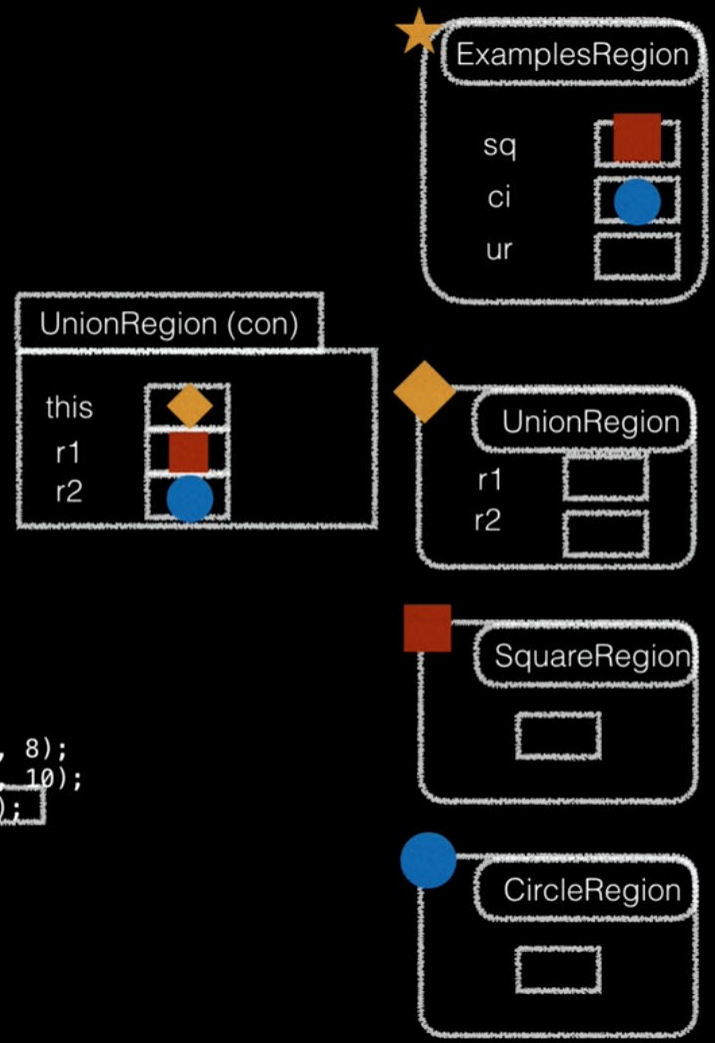

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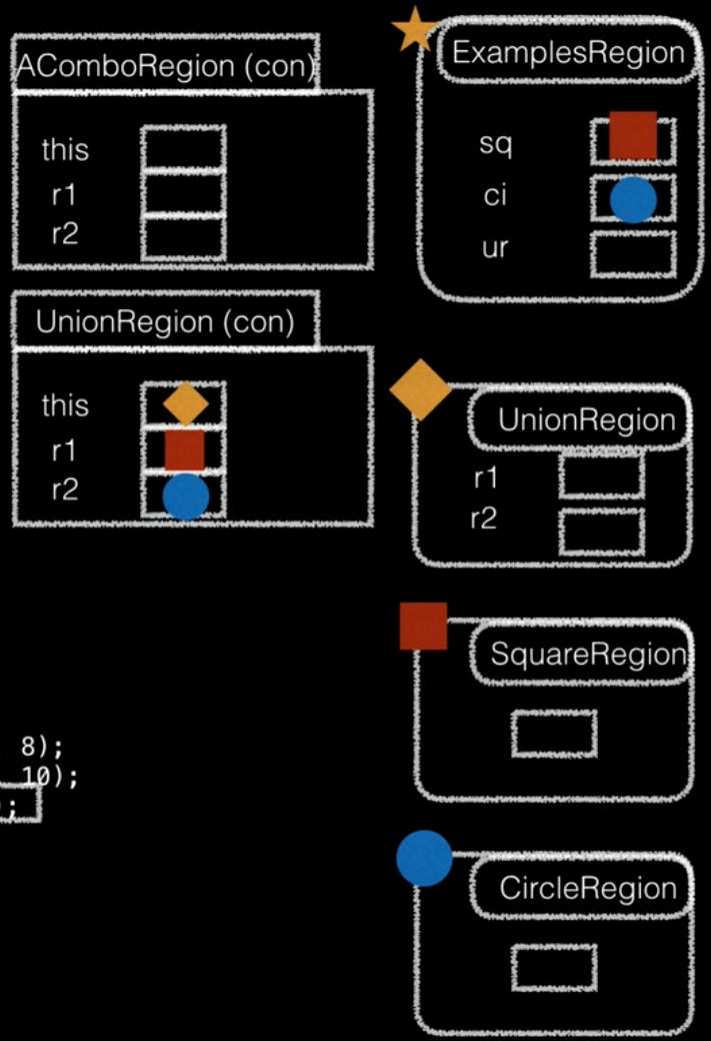

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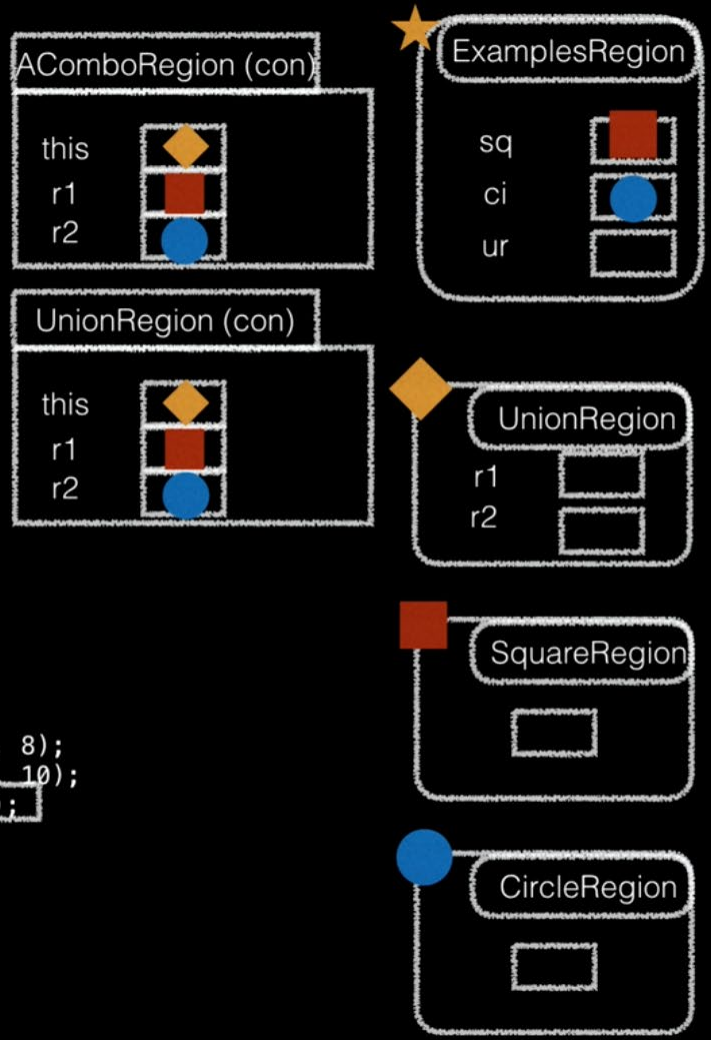

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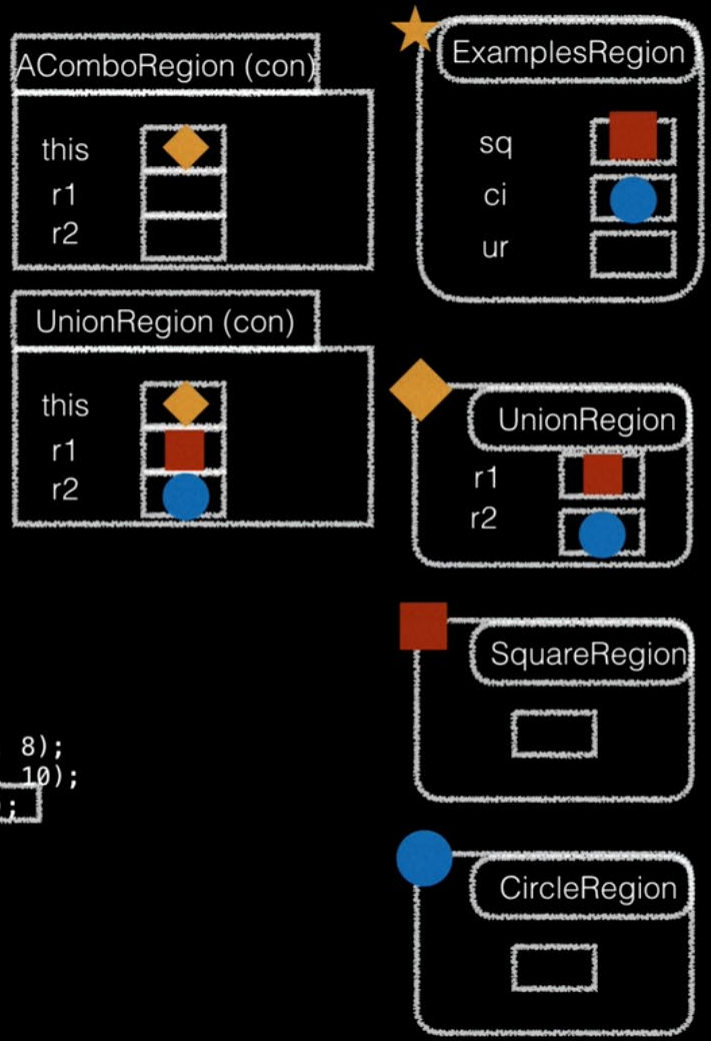
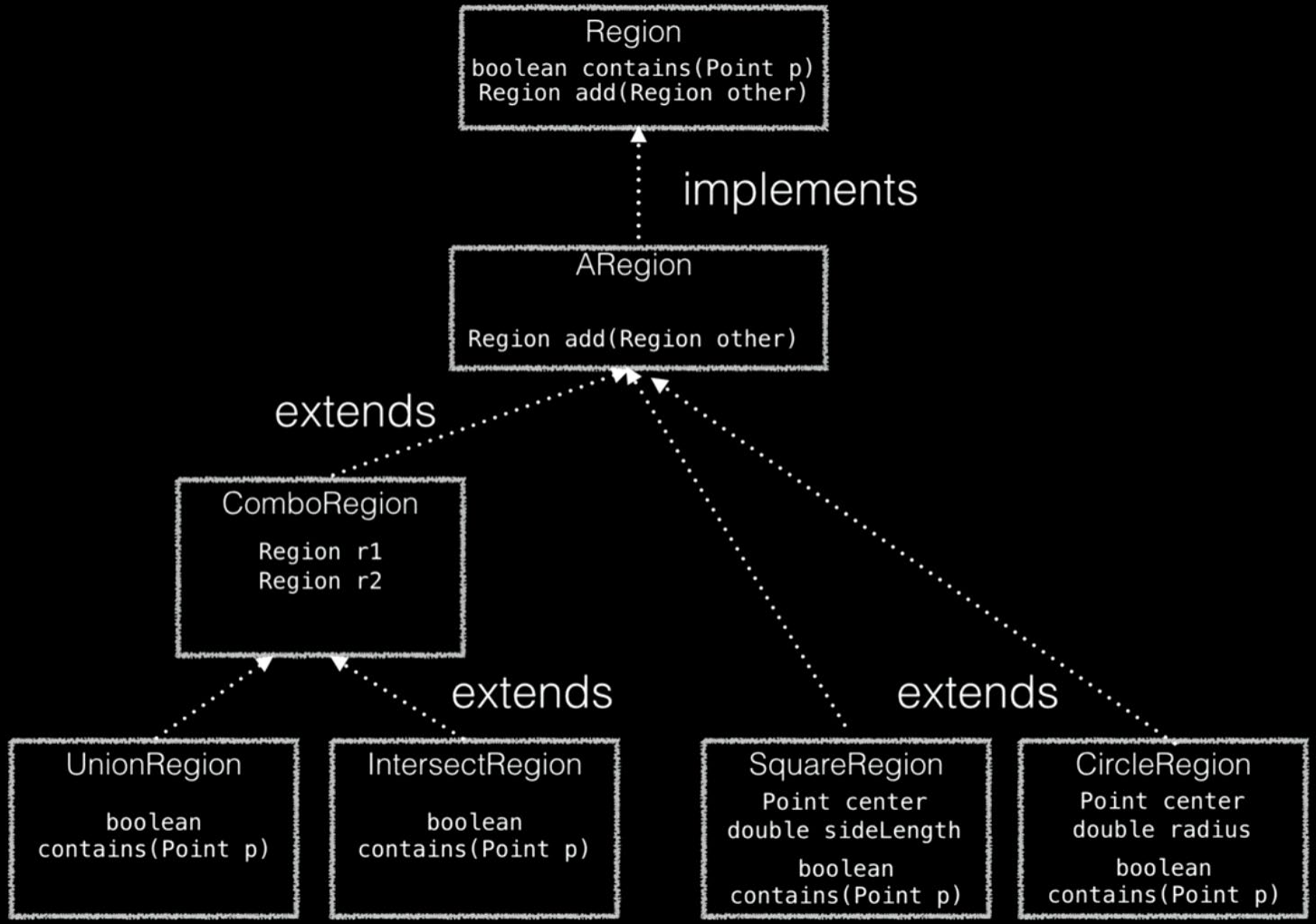
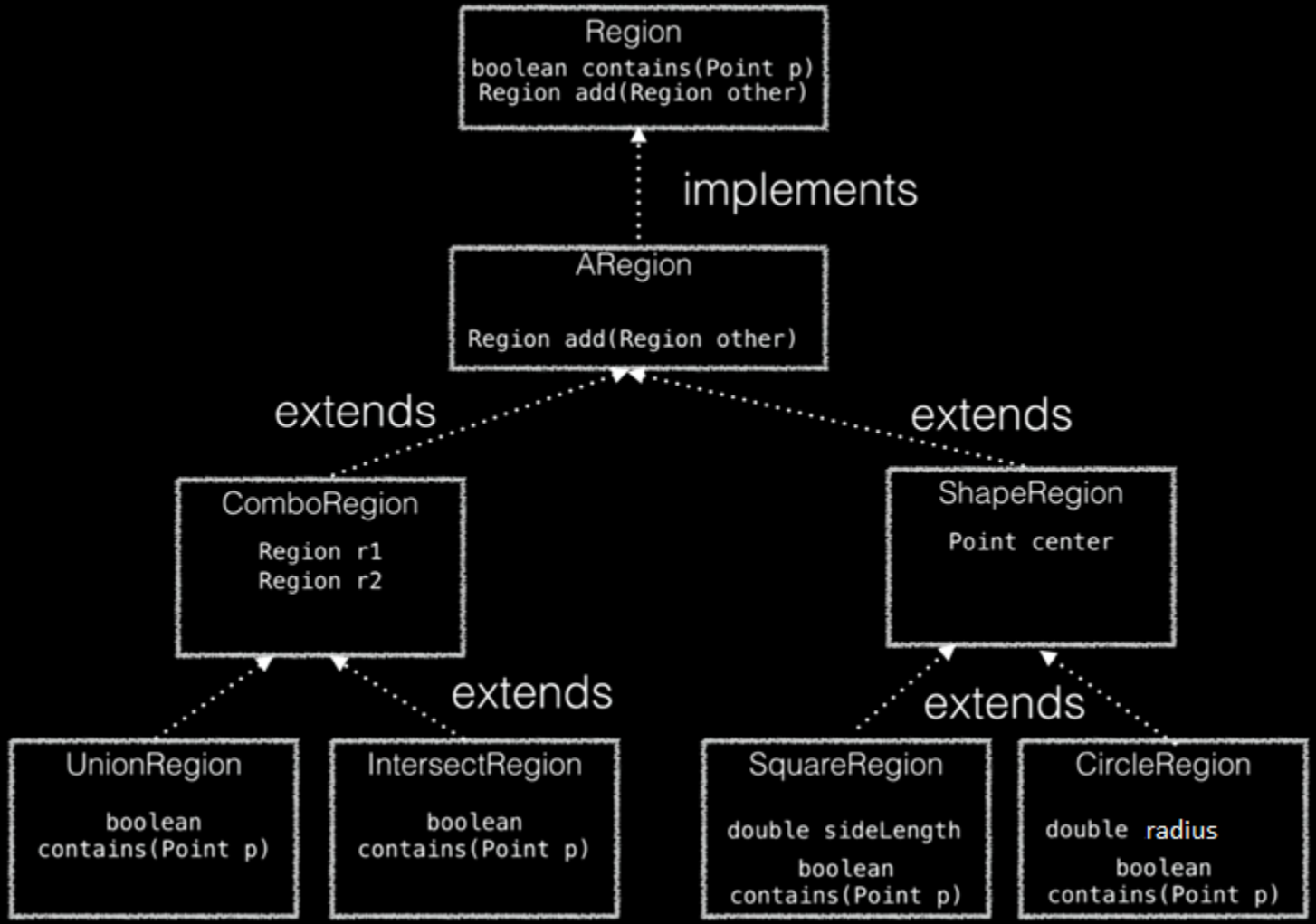



Region
boolean contains(Point p)
Region add(Region other)
implements
ARegion
Region add(Region other)
extends
ComboRegion
Region r1
Region r2
extends
extends
UnionRegion
boolean
contains(Point p)
IntersectRegion
boolean
contains(Point p)
SquareRegion
Point center
double sideLength
boolean
contains(Point p)
CircleRegion
Point center
double radius
boolean
contains(Point p)


Region
boolean contains(Point p)
Region add(Region other)
implements
ARegion
Region add(Region other)
extends
extends
ComboRegion
Region r1
Region r2
ShapeRegion
Point center
extends
extends
UnionRegion
boolean
contains(Point p)
IntersectRegion
boolean
contains(Point p)
SquareRegion
double sideLength
boolean
contains(Point p)
CircleRegion
double radius
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contains(Point p)