OOMatch: Pattern Matching as Dispatch in Java

Background

•OOMatch combines two areas of research: dispatch and pattern matching.
•Dispatch: which method is chosen for a call.
•Aside from regular dispatch in Java, two newer, more powerful forms are **Multimethods** and **Predicate Dispatch**.

•**Multimethods**: Consider dynamic types of all arguments, and not just the class parameter.

```
void draw(Shape s) {...}
void draw(Circle c) {...}  //overrides
  //draw(Shape)
```

•The second draw overrides the first, because Circle is a subclass of Shape.
•In Java, the methods would merely be overloaded.

•**Predicate Dispatch**: Can specify arbitrary predicates or preconditions to guard entry into a method.

```
double log(double x) {...}
double log(double x)
  when x <= 0 {...}  //overrides f(double)
double log(double x)
  when x == 0 {...}  //overrides both
methods
```

•When the predicate of one method m implies that of another method n, m overrides n

•**Pattern Matching**: Allows decomposition of an expression.

```
match pair with
    (0, second) => second
| _ => ...
;;
```

•This SML code checks whether "pair" is a tuple with 2 components, the first one being 0.
•"second" is a free variable that can be used later (in this case, it is returned).
•OOMatch allows pattern matching not just on built-in values but on Java objects.

Introducing OOMatch

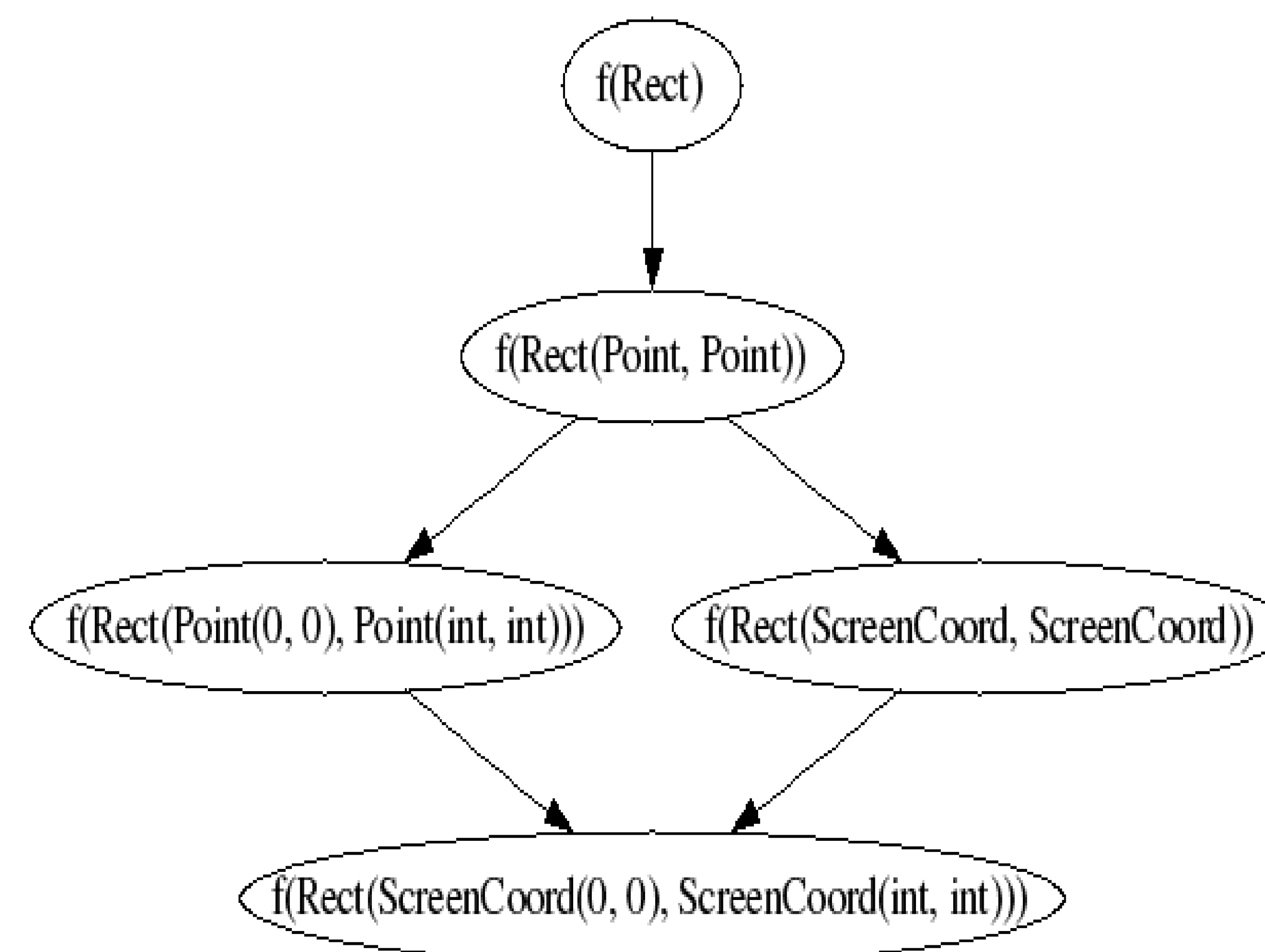
•OOMatch allows parameters to be specified as **patterns**, in addition to simple variables.

```
void f(Rect(Point(0, 0), Point p)) {}
```

•This function takes a single **parameter** of type Rect
•It only **applies** if the Rect is composed of two points, and the first point has coordinates (0, 0).
•Any **named variables** in the pattern (p in this case) can be used in the method body.
•Patterns can be **nested** to any arbitrary depth.
•Methods with more specific patterns **override** those with less specific patterns:

```
void f(Rect r) {}
void f(Rect(Point p1, Point p2)) {}
void f(Rect(Point(0, 0),
            Point(int x, int y))) {}
void f(Rect(ScreenCoord p1,
           ScreenCoord p2) r) {}
void f(Rect(ScreenCoord(0, 0),
            ScreenCoord(int x, int y))) {}
```

•This results in the following override relationships between these methods:



•For example, if a Rect with corners that are instances of ScreenCoord (a subclass of Point) were passed to f, the method f(Rect(ScreenCoord p1, ScreenCoord p2) r) would normally apply. Though f(Rect(Point p1, Point p2)) is also applicable, it is less specific, because ScreenCoord is a particular type of Point.
•If the coordinates of the first ScreenCoord parameter were (0, 0), then the last method would apply instead, as it is the most specific.

How is Pattern Matching on Objects Enabled?

•Before doing pattern matching in method parameters, objects need **deconstructors**.
•The simple way to provide one:

```
public class Rect {
    public Rect(private Point topLeft,
        private Point bottomRight){}
}
```

•The presence of access specifiers (private, protected and public are allowed) creates a **constructor** and **deconstructor** for class Rect all at once
•Enables matching with the same parameters that were passed to the constructor.

•**Explicit Deconstructors:**
- Used when more control is needed over what is considered the "components" of a class
- Also enables private data to be kept private, while allowing matching

```
public class Rect {
    private Point topLeft, bottomRight;
    public Rect(Point topLeft,
                Point bottomRight){
        this.topLeft = topLeft;
        this.bottomRight = bottomRight;
    }
    deconstructor Rect(Point topLeft,
                       Point bottomRight)
    {
        topLeft = this.topLeft;
        bottomRight = this.bottomRight;
        return true;
    }
}
```

•Deconstructors are like regular methods: they can contain arbitrary code
•Their parameters are **out parameters**, which the deconstructor **must** assign values to
•The out parameters are matched against the pattern in method bodies
•Return false from a deconstructor to explicitly prevent a match