

CSCI 334:  
Principles of Programming Languages

Lecture 18-2: OOP II

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**Williams**

Topics

OO vs FP

Rectangle Test

Dynamic Dispatch

OO vs Functional Tradeoff

- OO offers a different kind of extensibility than functional (or function-oriented) languages.
- Suppose you're modeling a hospital.

<b>Operation</b>	Doctor	Nurse	Orderly
Print	Print Doctor	Print Nurse	Print Orderly
Pay	Pay Doctor	Pay Nurse	Pay Orderly

- FP makes it easy to add operations (rows).
- OOP makes it easy to add data (columns).

Dynamic Dispatch

(the secret to understanding how  
Java, Python, Ruby, etc. work)

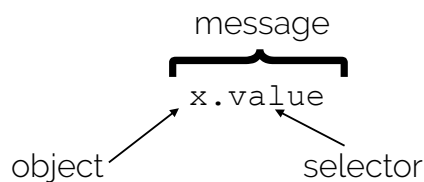
## Ingalls Test for Extensibility

- The test is about *the ability to extend software after it has already been designed and written.*
- E.g., suppose you have a class for a `ColoredRectangle`.
- Can you **define** a new kind of number (e.g., fractions), **use** your new numbers to **redefine (subtype) rectangle**, and then ask the system to **color the rectangle**?
- If so, you have an OO system.

## Ruby Passes the Rectangle Test

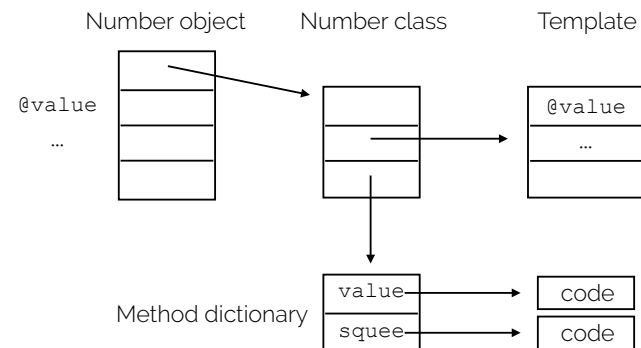
## Dynamic Dispatch

- Dynamic dispatch is the OO mechanism for polymorphism.
- Functions ("methods") are always bound to an object (or class).
- A method is called ("dispatched") by sending a "message" to the "selector" of an object.

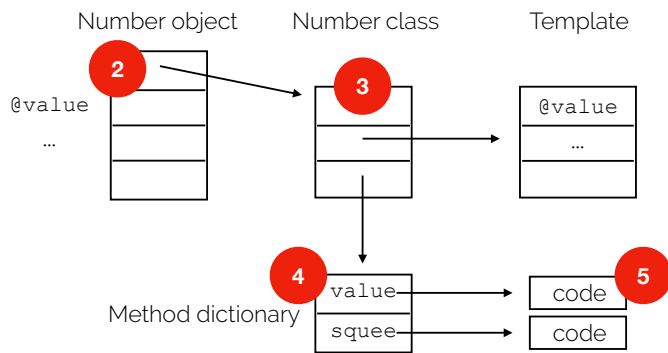


## Dynamic Dispatch

- Dynamic dispatch is an algorithm for finding an object's method corresponding to a given selector name.

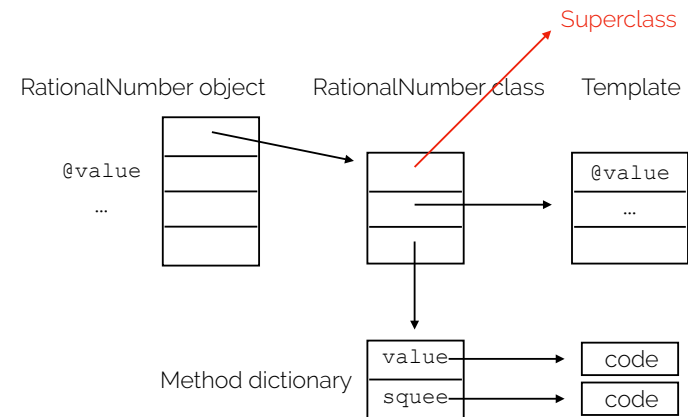


- 1 Call `x.value`
- 2 `value` message dispatched to `x`
- 3 `value` message forwarded to `Number`
- 4 `value` message lookup in method dictionary
- 5 `value` executed.

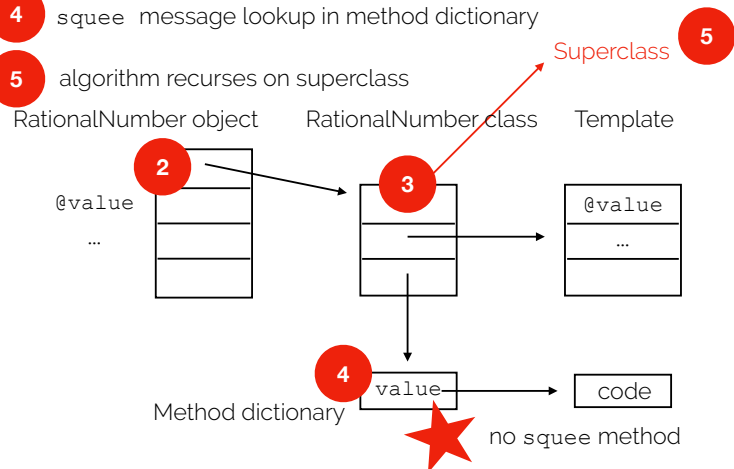


## Inheritance

- One small change enables inheritance.



- 1 Call `x.squee`
- 2 `squee` message dispatched to `x`
- 3 `squee` message forwarded to `RationalNumber`
- 4 `squee` message lookup in method dictionary
- 5 algorithm recurses on superclass



## Question

How expensive is dynamic dispatch?

## Cost

- 1.dereference object
- 2.deference class
- 3.dereference method dictionary
- 4.dereference method

## Cost

- 1.dereference object
  - 2.deference class
  - 3.dereference method dictionary
  - 4.dereference method
- } for each class or superclass

**O(n)** method lookup, where **n** is the number of superclasses.

## Recap & Next Class

### This lecture:

OO vs FP

Rectangle Test

Dynamic Dispatch

### Next lecture:

How C++ does OOP