Learning Object-Oriented Programming and Design with TDD

About Double Dispatch

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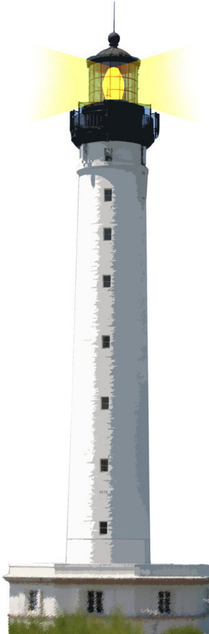

http://www.pharo.org

W8S02

Outline

- Some fun exercises
- Thinking about them
- Discovering double dispatch
- Stepping back

Exercise 1

Given

```
primitive addi(i,j) returns i + j
primitive addf(f1,f2) returns f1 + f2
i.asFloat() returns a float
```

Adding Integer and Float

```
1 + 2
>>> 3
```

```
1.1 + 2
>>> 3.1
```

```
2 + 1.3
>>> 3.3
```

```
1.1 + 2.2
>>> 3.3
```

Implement +
But with

- Not a single explicit conditional
- No static type support

A First Hint

- Two classes Integer and Float

Let Us See

```
Integer >> + aNumber
  "fill me up :)"





Float >> + aNumber




  "fill me up :)"
```

Another Key Hint

When you execute a method you know that the receiver is from the class of the method!

Even More Hints

- Remember the Boolean implementation
- Sending a message to an object is a choice operator

Let Us Get Started

Imagine that we add one method sumWithInteger: anInteger

```
Integer >> + aNumber


Integer >> sumWithInteger: anInteger







Float >> + aNumber


"fill me up :)"
```

Look Like An Easy Definition

```
Integer >> + aNumber

Integer >> sumWithInteger: anInteger
  ^ addi(self, anInteger)


Float >> + aNumber

  "fill me up :)"
```

How Do We Connect Them?

```
Integer >> + aNumber
  ^ aNumber sumWithInteger: self

Integer >> sumWithInteger: anInteger
  ^ addi(self, anInteger)


Float >> + aNumber

  "fill me up :)"
```

On Float Too

```
Integer >> + aNumber
  ^ aNumber sumWithInteger: self

Integer >> sumWithInteger: anInteger
  ^ addi(self, anInteger)



Float >> + aNumber


Float >> sumWithInteger: anInteger
  "fill me up :)"
```

On Float Too

```
Integer >> + aNumber
  ^ aNumber sumWithInteger: self

Integer >> sumWithInteger: anInteger
  ^ addi(self, anInteger)



Float >> + aNumber


Float >> sumWithInteger: anInteger
  ^ addf(self, asFloat(anInteger))
```

Supporting 1.2 + 2

```
Integer >> + aNumber
  ^ aNumber sumWithInteger: self
Integer >> sumWithInteger: anInteger
  ^ addi(self , anInteger)



Float >> + aNumber
  ^ aNumber sumWithFloat: self

Float >> sumWithInteger: anInteger
  ^ addf(self, asFloat(anInteger))
```

Supporting 1.2 + 2

```
  Integer >> + aNumber
    ^ aNumber sumWithInteger: self
  Integer >> sumWithInteger: anInteger
    ^ addi(self , anInteger)

> Integer >> sumWithFloat: aFloat
>   ^ addf(aFloat, asFloat(self))

  Float >> + aNumber
    ^ aNumber sumWithFloat: self
  Float >> sumWithInteger: anInteger
    ^ addf(self, asFloat(anInteger))

> Float >> sumWithFloat: aFloat
>   ^ addf(self, aFloat)
```

Ok now Relax!

- Take a pen and follow the calls to the following expressions
- Follow with your fingers if necessary :)

```
1 + 2
1.1 + 2
2 + 1.3
1.1 + 2.2
```

Key Point

```
Integer >> + aNumber
  ^ aNumber sumWithInteger: self
```

Two choices/messages:

- one for +
- one for sumWithInteger:

Exercise2: How to Add Fraction?

```
f := Fraction num: 1 denum: 2.

f num
>>> 1
f denum
>>> 2
f asFloat
>>> 0.5
```

```
  1/2 + 3
  3 + 3.3
  1.3 + 2/5
  1/3 + 4/3
```

Introducing Fraction

```
Fraction >> + aNumber
  ^ aNumber sumWithFraction: self
...
```

Introducing Fraction

```
Fraction >> + aNumber
  ^ aNumber sumWithFraction: self
Fraction >> sumWithFraction: aFrac
  ...
```

Introducing Fraction

```
Fraction >> + aNumber
  ^ aNumber sumWithFraction: self
Fraction >> sumWithFraction: aFrac
  ^ Fraction num: (self num * aFrac denum) + (aFrac num * self denum)
    denum: aFrac denum * self denum
...
```

Taking Care of Integer and Float

```
Fraction >> + aNumber
 ^ aNumber sumWithFraction: self
Fraction >> sumWithFraction: aFrac
 ^ Fraction num: (self num * aFrac denum) + (aFrac num * self denum)
   denum: aFrac denum * self denum

Integer >> sumWithFraction: aFrac
 ...
Float >> sumWithFraction: aFrac
 ...
```

Introducing Fraction

```
Fraction >> + aNumber
 ^ aNumber sumWithFraction: self
Fraction >> sumWithFraction: aFrac
 ^ Fraction num: (self num * aFrac denum) + (aFrac num * self denum)
  denum: aFrac denum * self denum
...
Integer >> sumWithFraction: aFrac
 ^ Fraction num: (self * aFrac denum) + aFrac num denum: aFrac denum
Float >> sumWithFraction: aFrac
 ^ addf(self, aFrac asFloat)
```

Full Code for Fraction

```
Fraction >> + aNumber
  ^ aNumber sumWithFraction: self
Fraction >> sumWithFraction: aFrac
  ^ Fraction num: (self num * aFrac denum) + (aFrac num * self denum)
    denum: aFrac denum * self denum
Fraction >> sumWithInteger: anInteger
  ^ Fraction num: (self num + anInteger * aFrac denum) denum: aFrac denum
Fraction >> sumWithFloat: aFloat
  ^ addf(self aFloat, aFloat)
Integer >> sumWithFraction: aFrac
  ^ Fraction num: (self * aFrac denum) + aFrac num denum: aFrac denum
Float >> sumWithFraction: aFrac
  ^ addf(self, aFrac asFloat)
```

Ok Now Relax

- Take a pen and follow the calls to the following expressions
- Follow with your fingers if necessary :)

```
1/2 + 3
3 + 3.3
1.3 + 2/5
1/3 + 4/3
```

Stepping Back

- We can add Fraction without changing any previous method
- Another example of "Sending a message is making a choice"
- We send two messages
    - + to select Integer, Float, Fraction
    - then the message sumWith... to reselect the correct definition in Integer, Float, Fraction

Different kinds of messages

- Primary operations
- Double dispatching methods

Double Dispatch

- Essence of Visitor Design Pattern (see Lecture)
- Double dispatch is a clear illustration of **Do not ask, Tell** OOP tenet
- Used really frequently for event, drawing, ...

When not using Double Dispatch

- No class to dispatch on!
- We need an different instance of dispatch to

What about Overloading

- Double dispatch is also useful in statically typed languages
- Avoid overloading for double dispatch - some type systems do not work well

Conclusion

- Powerful
- Modular
- Just sending an extra message to an argument and using late binding

A course by Stéphane Ducasse

http://stephane.ducasse.free.fr

Reusing some parts of the Pharo Mooc by

Damien Cassou, Stéphane Ducasse, Luc Fabresse

http://mooc.pharo.org