Aquarium: Aspect-Oriented Programming for Ruby

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What is AOP?
Is it necessary for Ruby?

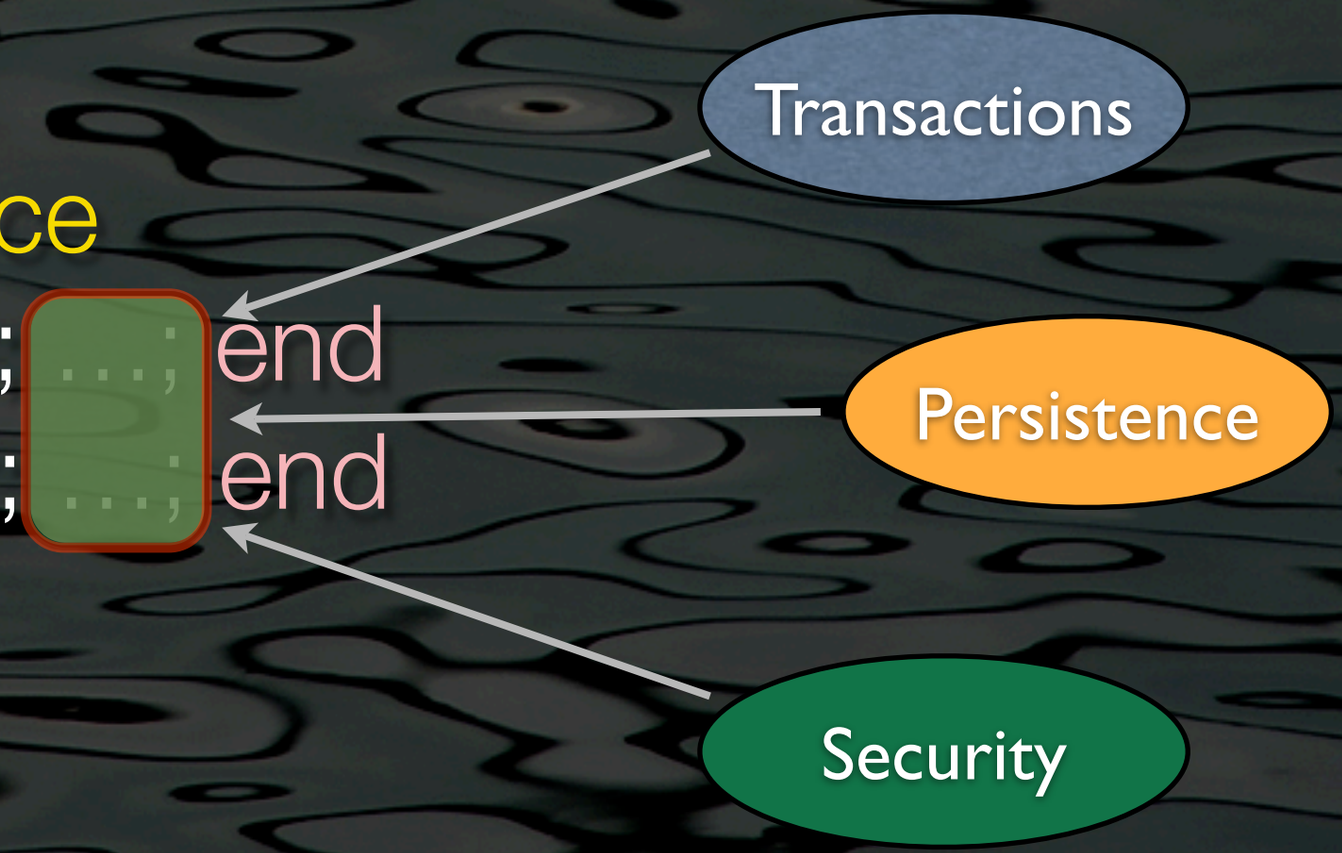
Aquarium in action

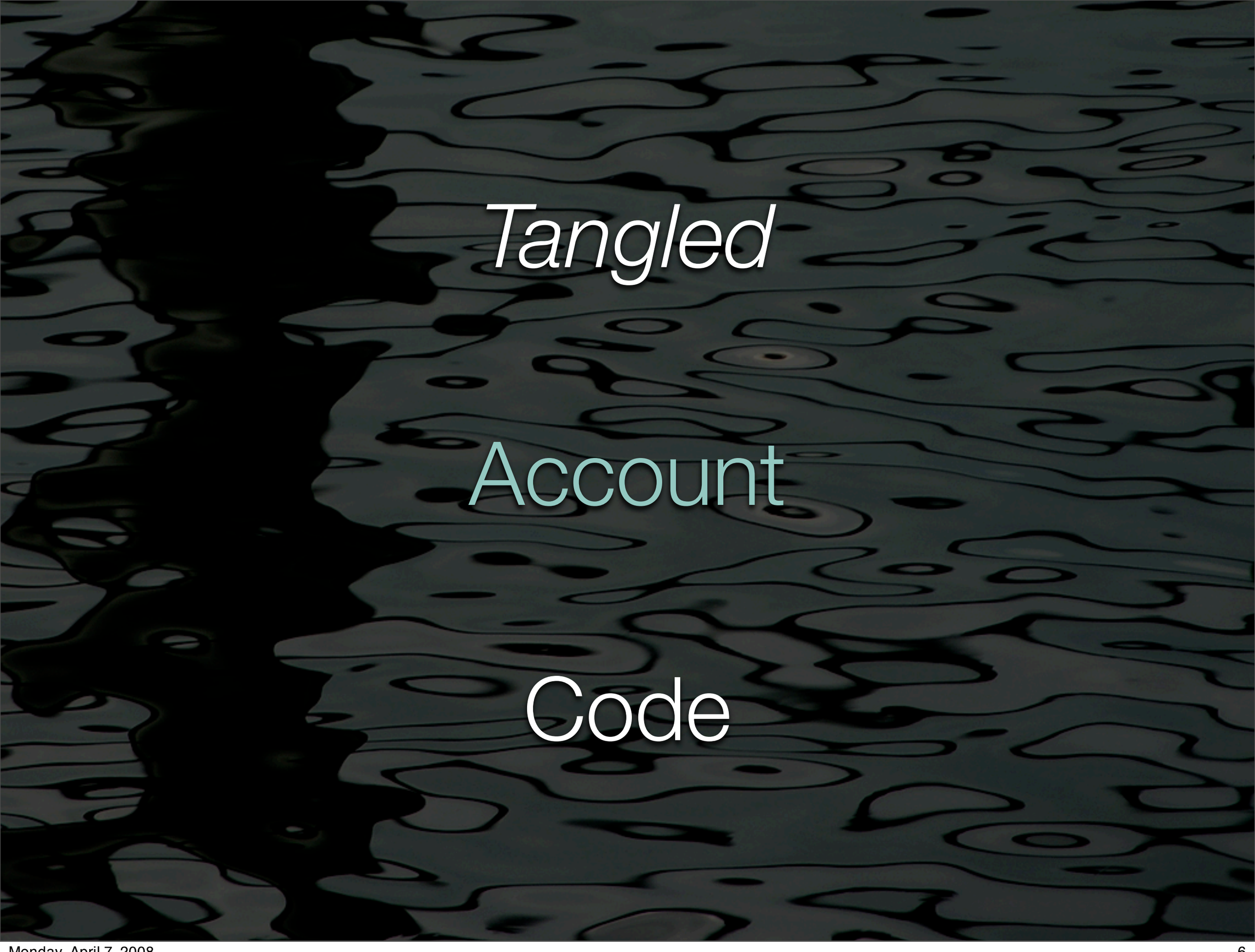
```ruby
class Account
  attr_reader :balance

  def credit amount
    raise "..." unless amount >= 0
    @balance += amount
  end

  def debit amount
    raise "..." unless amount < @balance
    @balance -= amount
  end
end
```

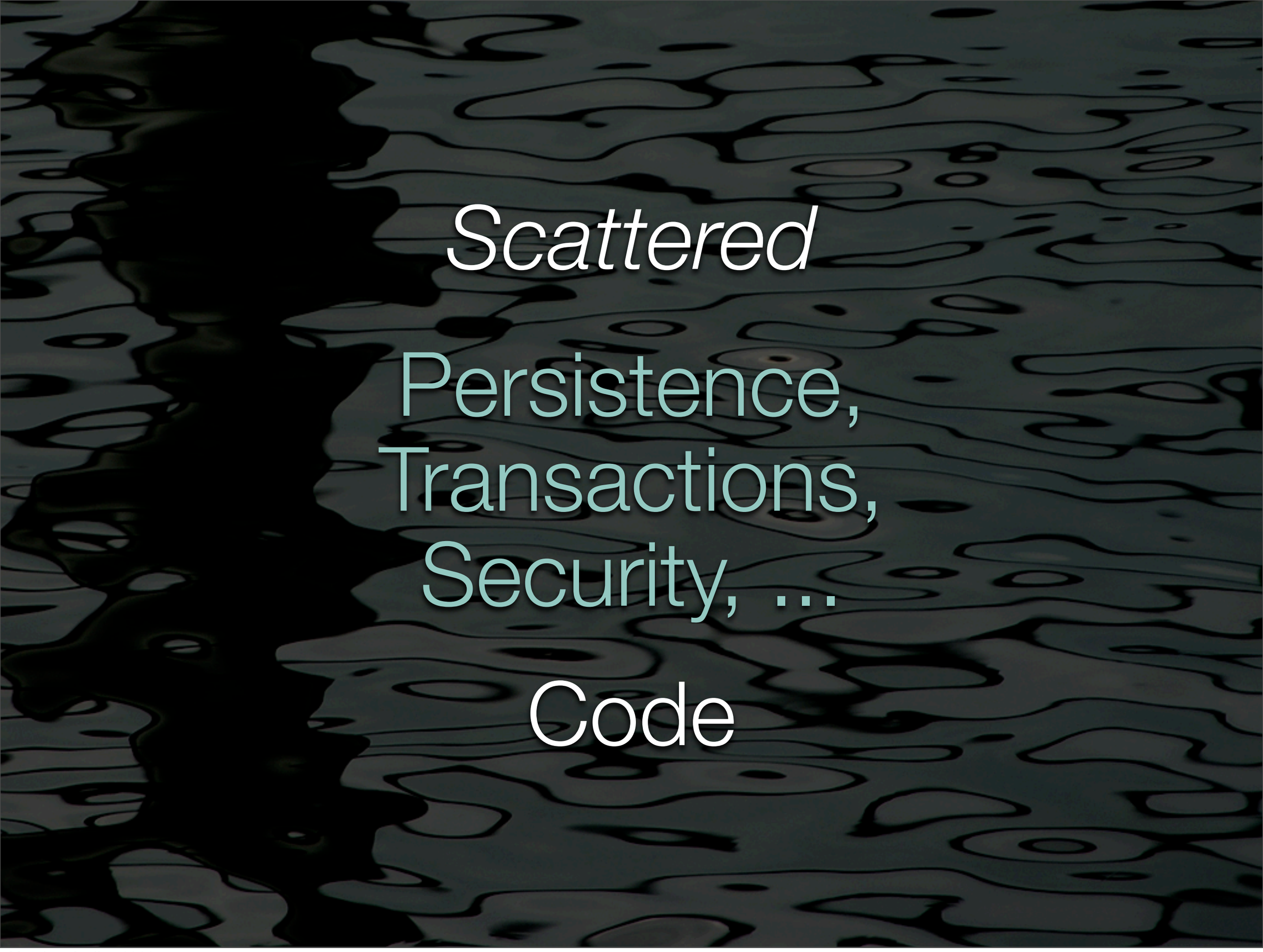

Clean
and
Simple

But, Real Applications Need:

```
class Account
  attr_reader :balance
  def credit amount; ...; end
  def debit  amount; ...; end
end
```




Tangled
Account
Code


Scattered
Persistence,
Transactions,
Security, ...
Code

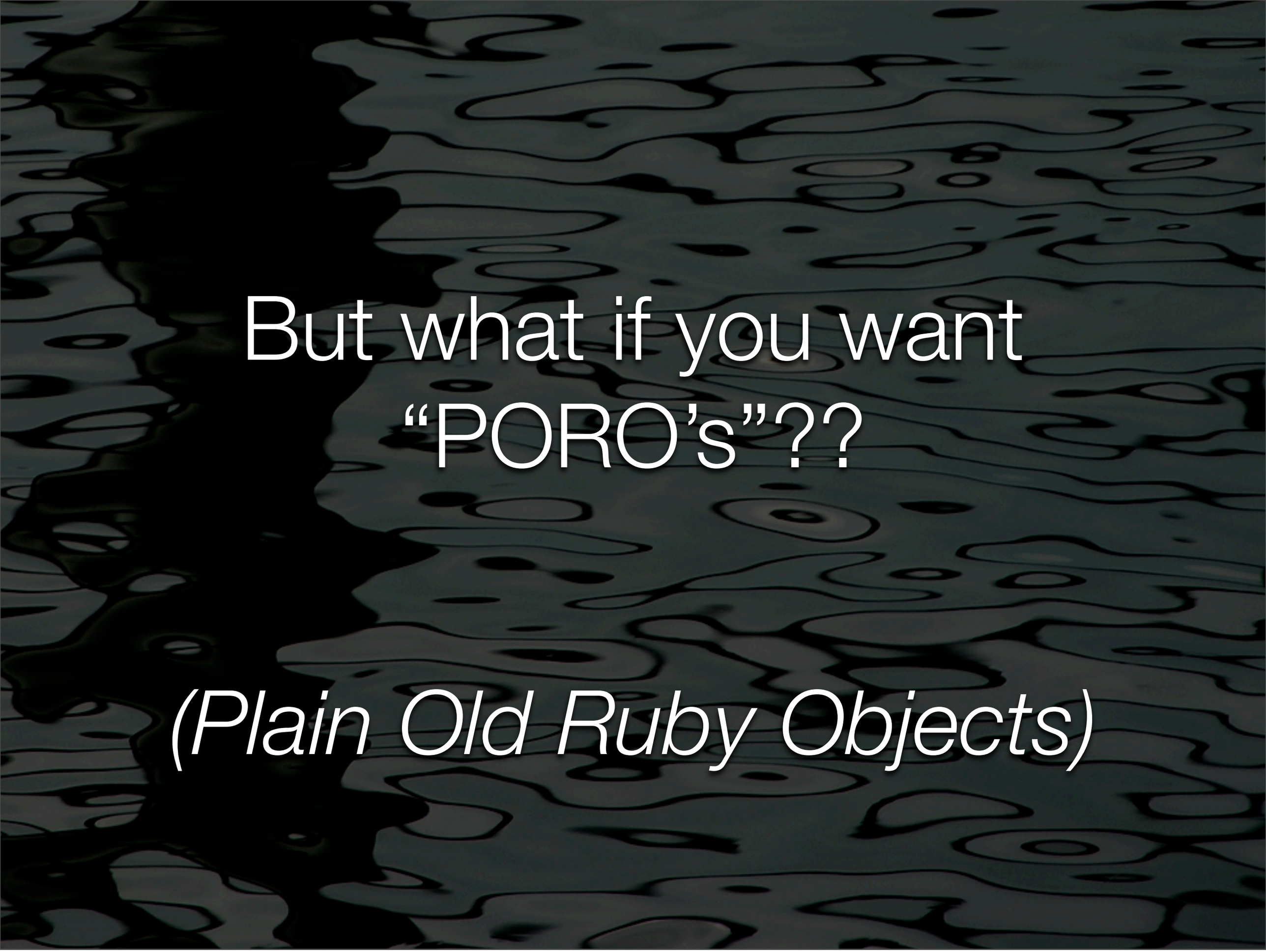
Modularity

is

Compromised.

Rails Solution

```
class Account < ActiveRecord::Base
  ...
end
```


But what if you want
“PORO’s”??
(Plain Old Ruby Objects)

I would like to say...

Before returning the Account balance, read the current balance from the persistence store.

After the Account balance changes, update the new balance in the persistence store.

Before changing the Account balance, authenticate and authorize the user.

```
require 'aquarium'
class Account                    # reopen Account
  include Aquarium::DSL          # add "DSL" methods

  before :calls_to => [:credit, :debit] \
      do |join_point, object, *args|

    object.balance = read_from_database ...
  end
  ...
```

The type the aspect acts on is inferred to be Account

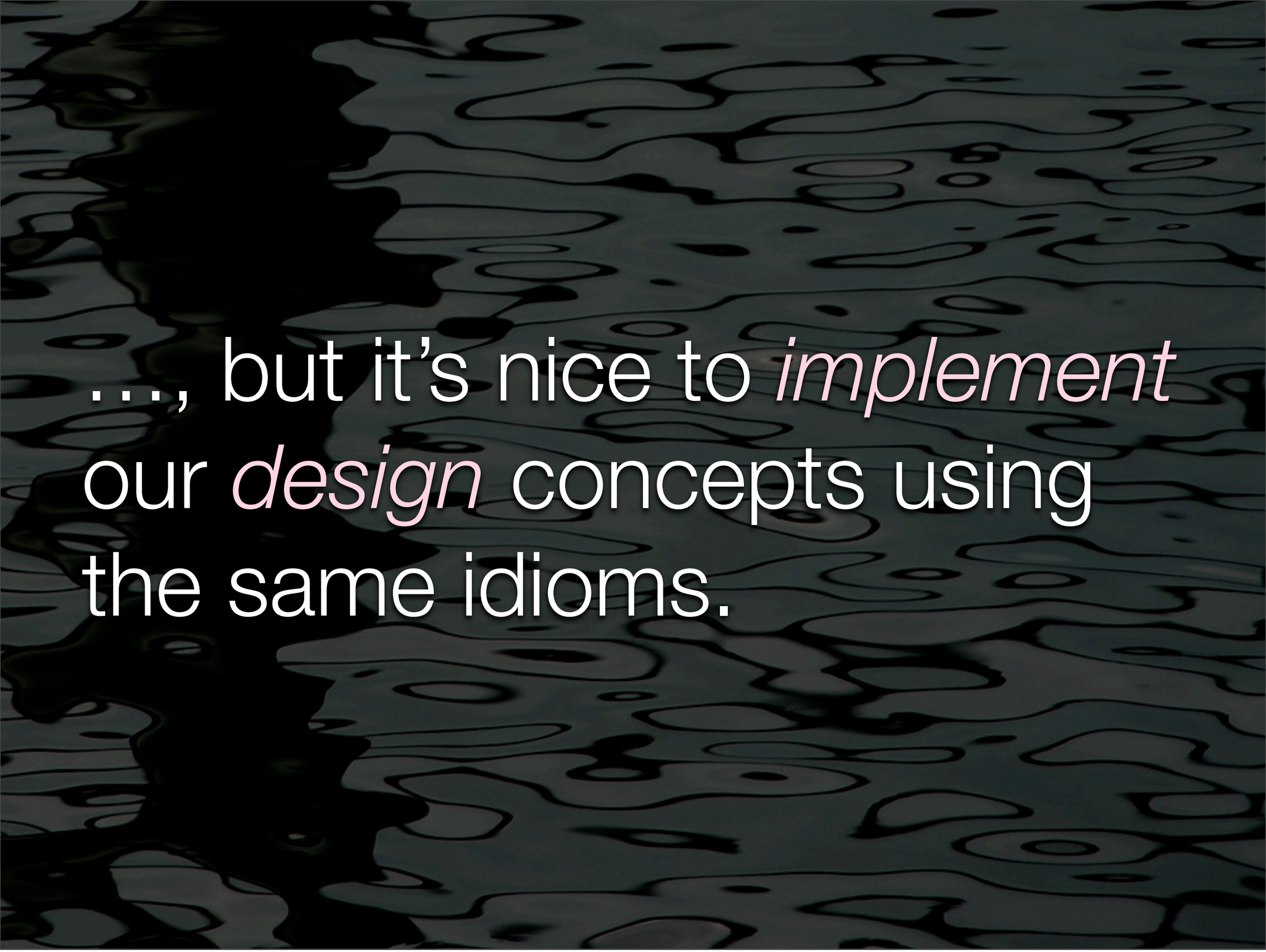
```
...
after_returning_from :calls_to=>[:credit, :debit] \
    do |join_point, object, *args|
        update_in_database (object.balance,...)
end
...
```

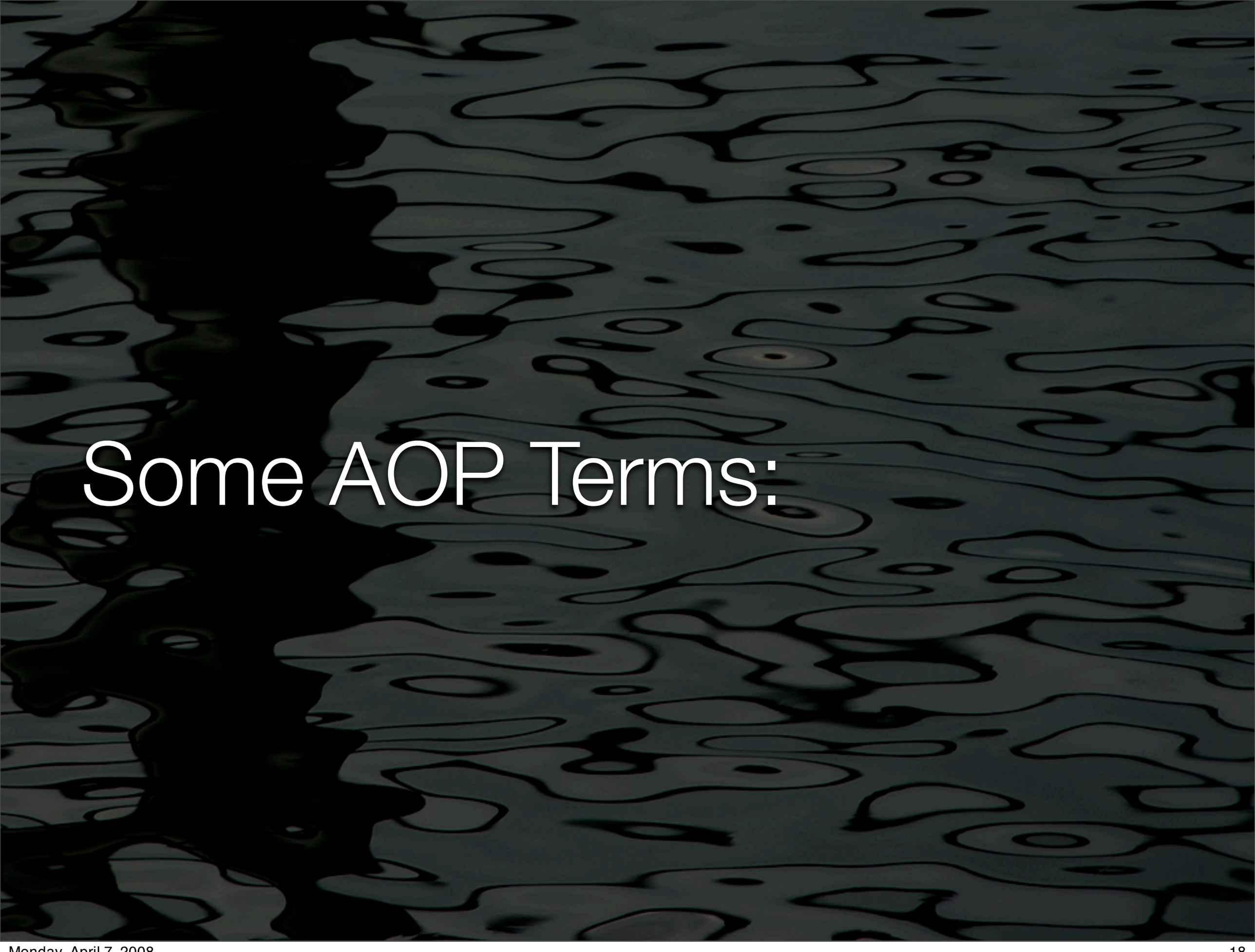
```
...
  before :calls_to => [:credit, :debit] do |jp, *args|
    raise "..." unless user_authorized
  end
end
```

Can’t we just use

Metaprogramming?

Ruby's metaprogramming gives us the *mechanisms* we need...


…, but it's nice to *implement*
our *design* concepts using
the same idioms.



Some AOP Terms:

Aspect

A modularity construct that incorporates
Pointcuts *and* Advice.

Alternative to before *method used before.*

```
Aspect.new :before, :calls_to => :credit, \
        :in_type => Account  do |jp, obj, *args|
  # do something
end
```

Aspect

Can advise individual objects

```
Aspect.new :before, :calls_to => :credit, \
    :in_object => my_account do |jp, obj, *args|
  # do something
end
```

Aspect

```
Aspect.new :before, :calls_to => :credit, \
    :in_object => my_account , \
    :advice => proc
```

Use a Proc instead of a block

Join Point

A single execution point.

```
JoinPoint.new :type => Account,
              :method => :credit

JoinPoint.new :object => account1,
              :method => :credit
```

:type *is one of many synonyms for* :in_types

:method *is one of many synonyms for* :calls_to

Pointcut†

A "query" over all Join Points.

```
Pointcut.new  :types => /.*Account$/,
              :calls_to => [:credit, :debit]

Pointcut.new  :in_object => account1,
              :calls_to => /it$/
```

†Yes, no space, unlike *Join Point*

Advice:

- Before
- After returning
- After raising
- After (… returning or raising)
- Around

Before Advice

*Do something **before** the Join Point.*

```
Aspect.new :before, :pointcut => … do |jp,o,*a|
  log “Entering: #{jp.inspect}”
end

include Aquarium::DSL
before :pointcut => … do |jp, object, *args|
  log “Entering: #{jp.inspect}”
end
```

After Returning Advice

*Do something **after returning from** the Join Point.*

Or :after_returning

```
Aspect.new :after_returning_from, … do |jp,o,*a|
  log “Leaving: #{jp}”
end

include Aquarium::DSL
after_returning_from :pointcut => … do |jp,o,*args|
  log “Leaving: #{jp}”
end
```

After Raising Advice

*Do something **iff** the Join Point **raises**.*

```
Aspect.new :after_raising, … do |jp, obj, *args|
  log “ERROR: #{jp.context.raised_exception}”
end

include Aquarium::DSL
after_raising :pointcut => … do |jp, obj, *args|
  log “ ERROR: #{jp.context.raised_exception}”
end
```

After Advice

*Do something **after** a **return** or **raise**...*

```
Aspect.new :after, … do |jp, obj, *args|
  log “Escaped from: #{jp}”
end

include Aquarium::DSL
after :pointcut => … do |jp, obj, *args|
  log “Escaped from: #{jp}”
end
```

Around Advice

"Wrap" a Join Point.

```
Aspect.new :around, ... do |jp, obj, *args|
  log "before: #{jp}"
  jp.proceed      # You decide to invoke join point
  log "after: #{jp}"
end
include Aquarium::DSL
around :pointcut => ... do |jp, obj, *args|
  ...
end
```

A Few Other AOP Terms:

Introduction†

Adding new attributes, methods to a class.
We already have it with Ruby!!

```
class MyClass
  def do_this; …; end
end

class MyClass      # reopen MyClass
  def do_that; …; end
end
```

†a.k.a *Inter-Type Declaration*

Cross-Cutting Concerns

When the natural boundaries of different domains *cut across* each-other's natural boundaries.

Example: Refactor Rails

~175 uses of alias_method in Rails

```
module ActiveRecord::Associations::ClassMethods
  def has_and_belongs_to_many (assoc_id,
          options => {}, &extension)
    reflection =
      create_has_and_belongs_to_many_reflection (
          assoc_id, options, &extension)
    ...
    old = "destroy_without_habtm_shim_for_
          #{reflection.name}"
    class_eval <<-END
      # next slide...
    END
  end
```

```
alias_method #{old}, destroy_without_callbacks
def destroy_without_callbacks
  #{reflection.name}.clear
  #{old}
end
```

Refactoring with Aquarium

```
...
  reflection =
    create_has_and_belongs_to_many_reflection (
        assoc_id, options, &extension)
  ...
  before :calls_to => :destroy_without_callbacks \
    do |jp, obj, *args|
      class_eval "#{reflection.name}.clear"
    end
  end
```

Refactoring Account

Handle “overdraft” requirements as an aspect, so we can vary it independently, possibly per client, per type of account, *etc*.

```ruby
class Account
  attr_reader :balance

  def credit amount
    raise "..." unless amount >= 0
    @balance += amount
  end

  def debit amount
    raise "..." unless amount < @balance
    @balance -= amount
  end
end
```

Move this logic to an aspect

```ruby
class Account
  attr_reader :balance

  def credit amount
    raise "..." unless amount >= 0
    @balance += amount
  end

  def debit amount
    @balance -= amount
  end
end
```

```
class Account    # Reopen class
  attr_accessor :max_overdraft
  before :calls_to=> :debit, :in_type=> :Account \
  do |jp, account, *args|
    if (account.balance - args[0]) < -max_overdraft
      raise "..."
    end
  end
end
```

Exercises

- aspectprogramming.com/papers/
  - Aquarium_RubyAOP_exercises.zip

1. Method tracing
2. Advising method_missing
3. AO design - safer pointcuts

References

- This presentation:
  - aspectprogramming.com/papers
  - aquarium.rubyforge.org
  - aosd.net