The Building Blocks of Modularity

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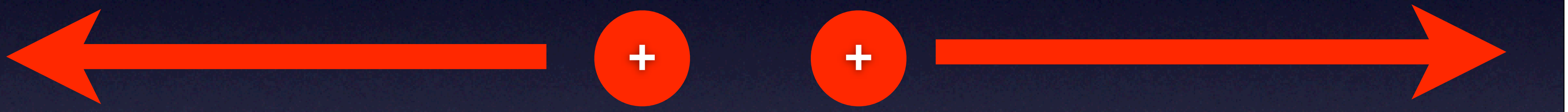
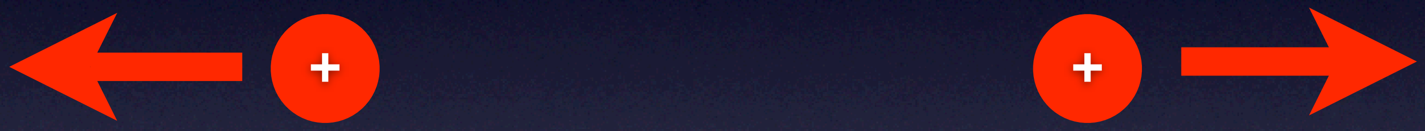
EdgeCase
software artisans

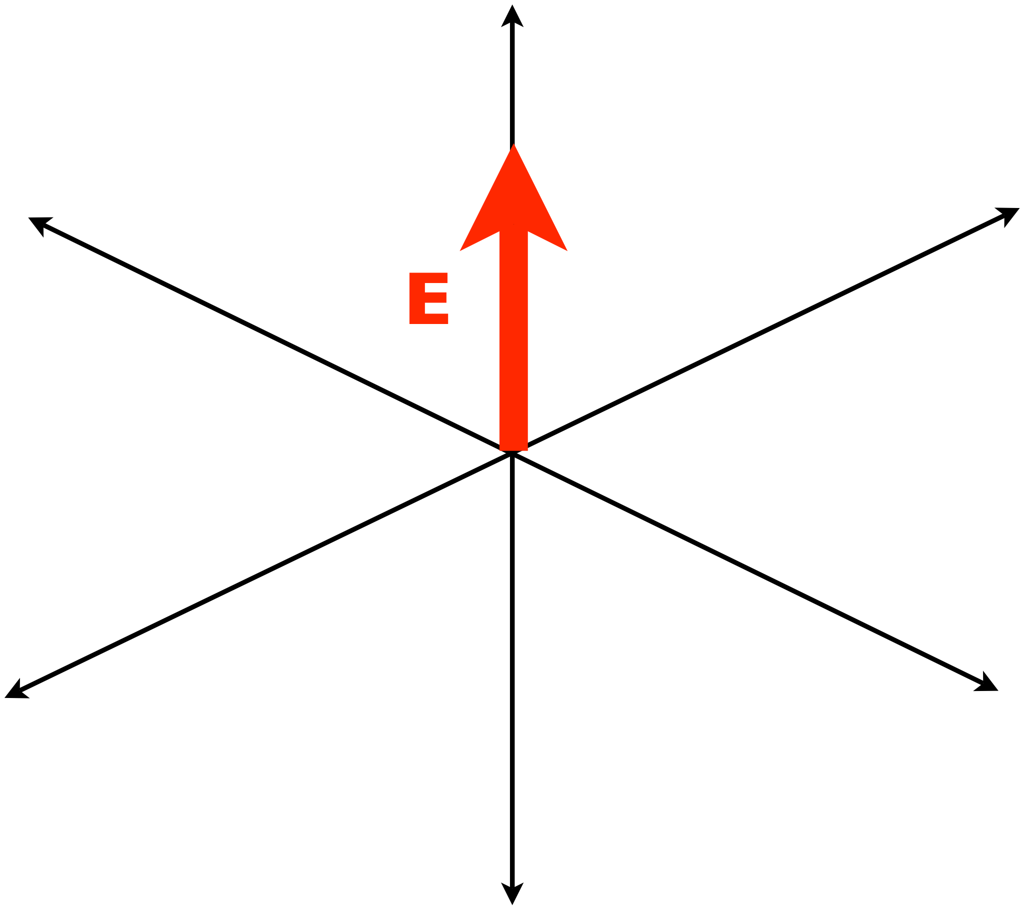
Tech Interview

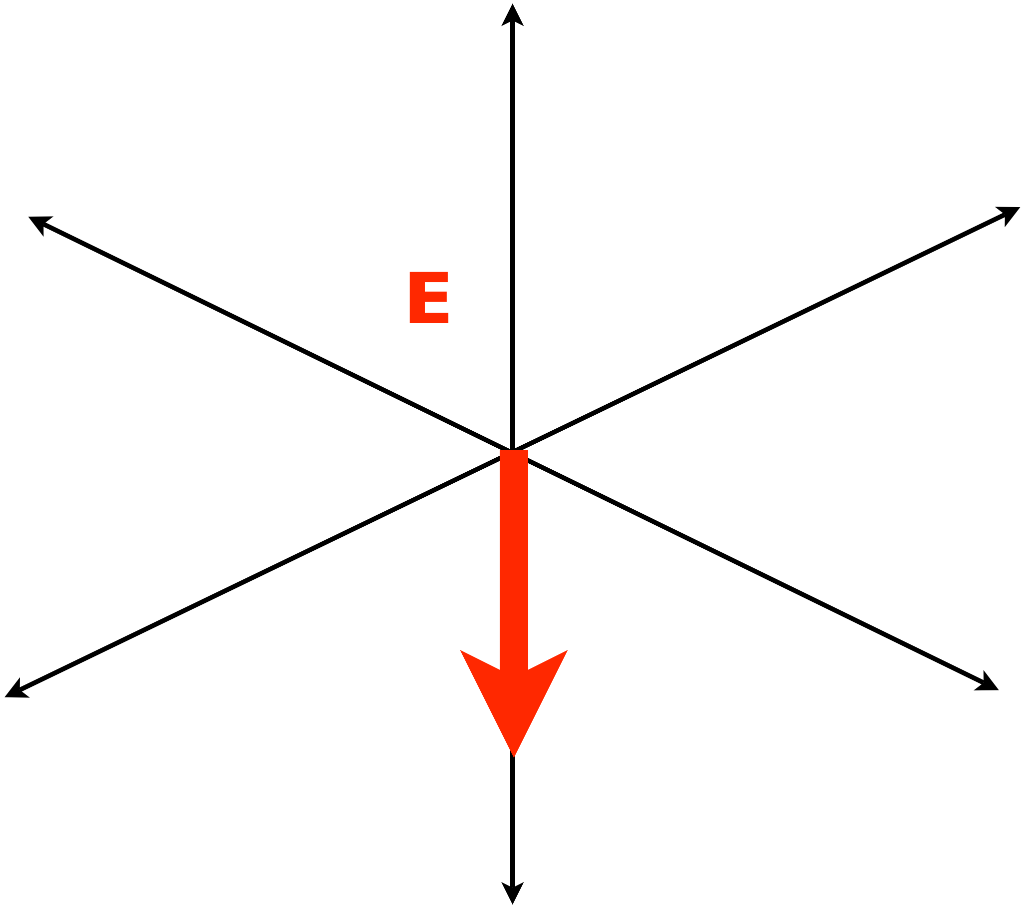
“What do you look for in a good design?”

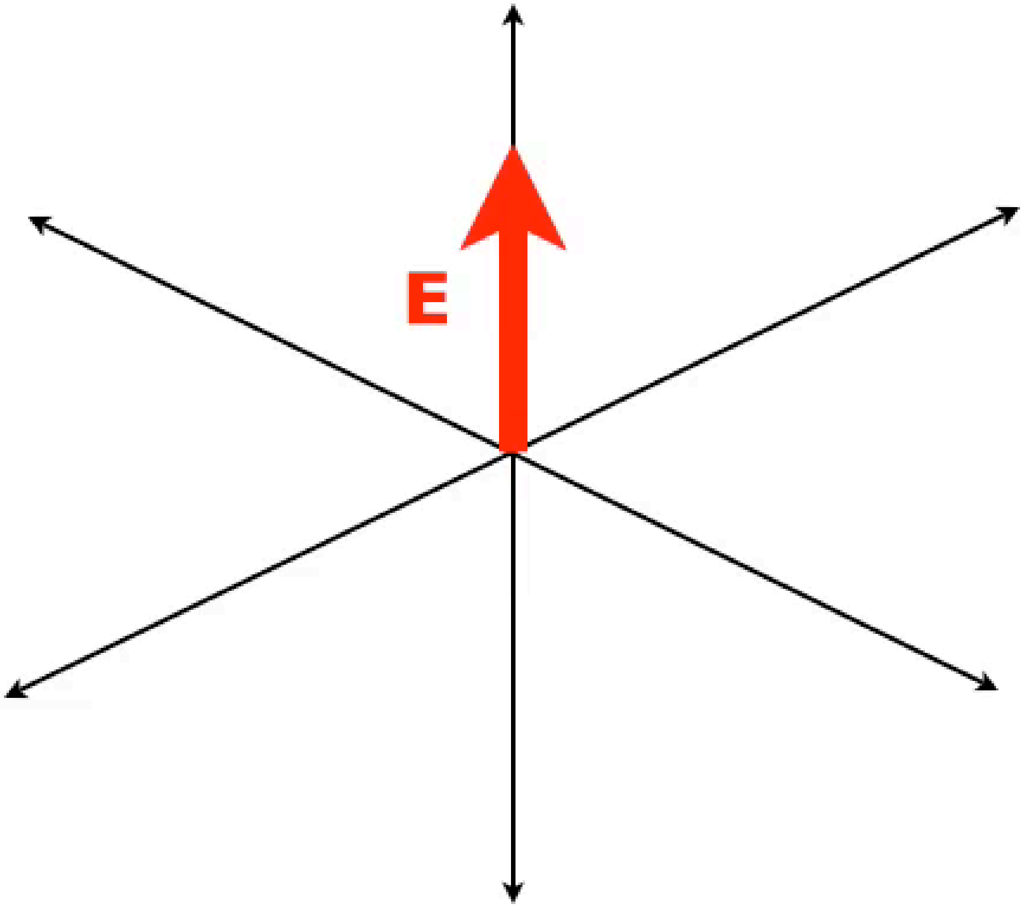
Ummm?

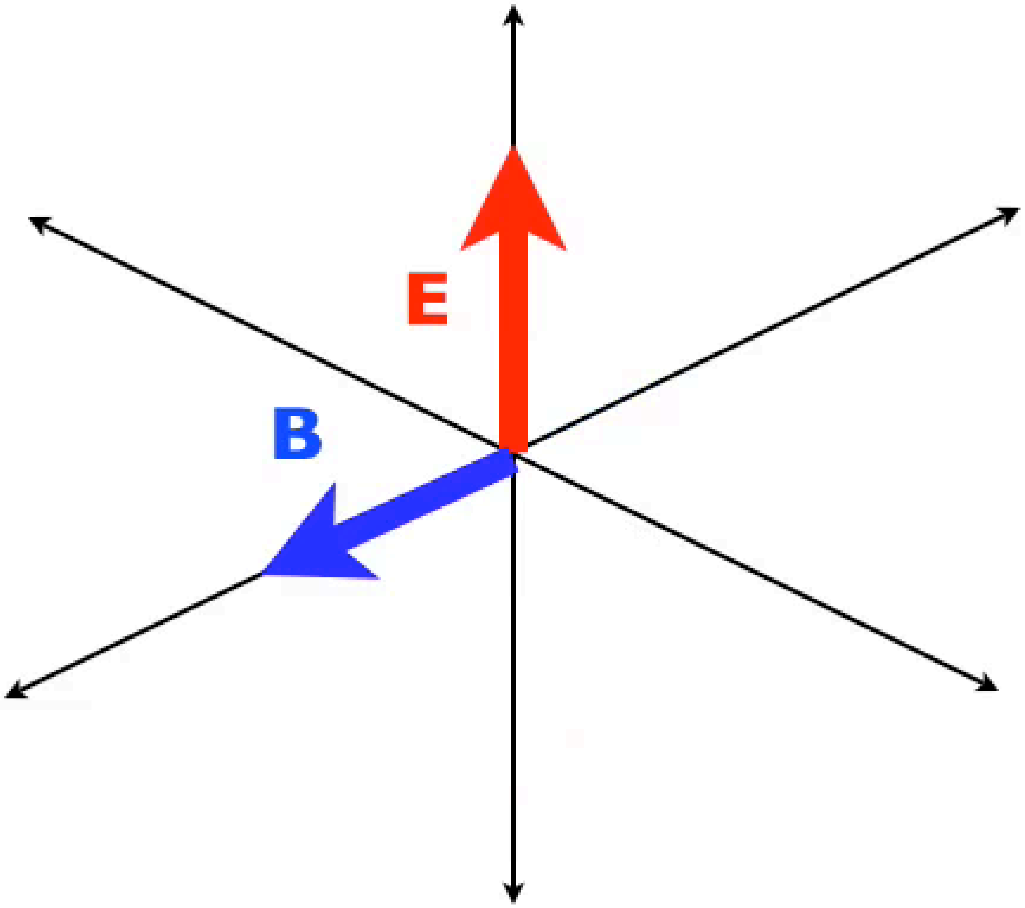




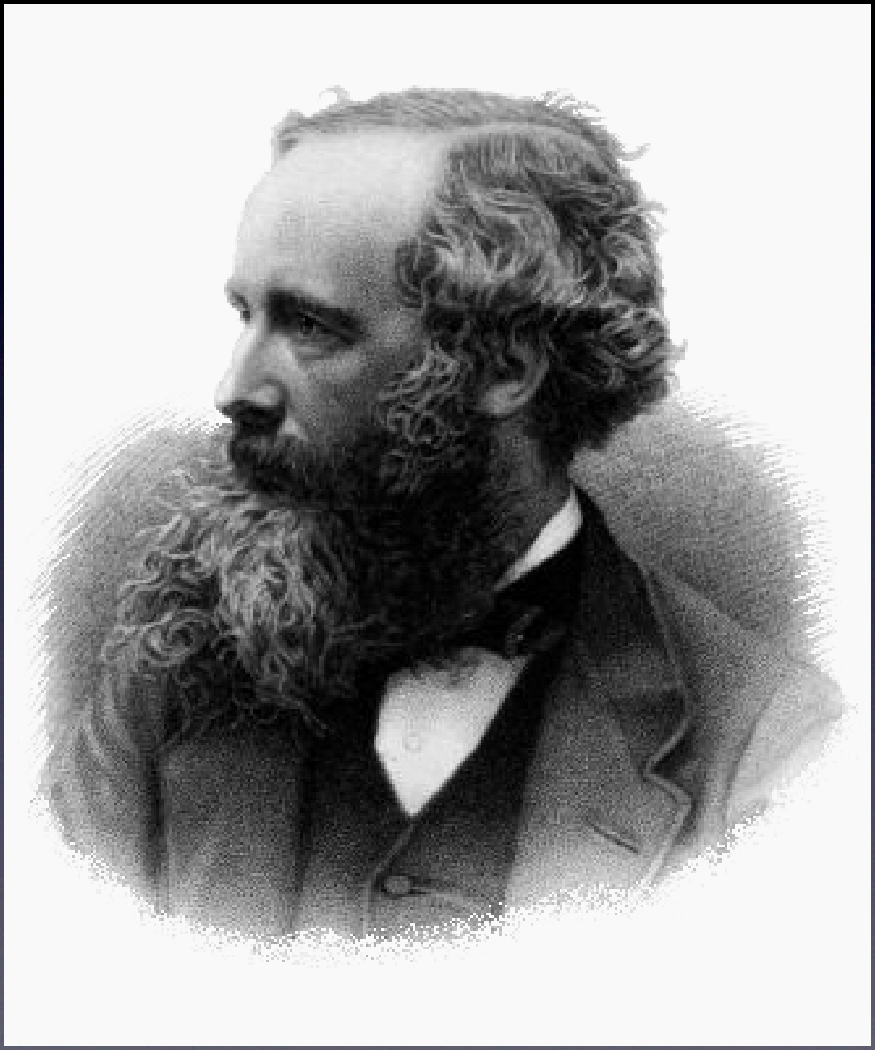

E


E

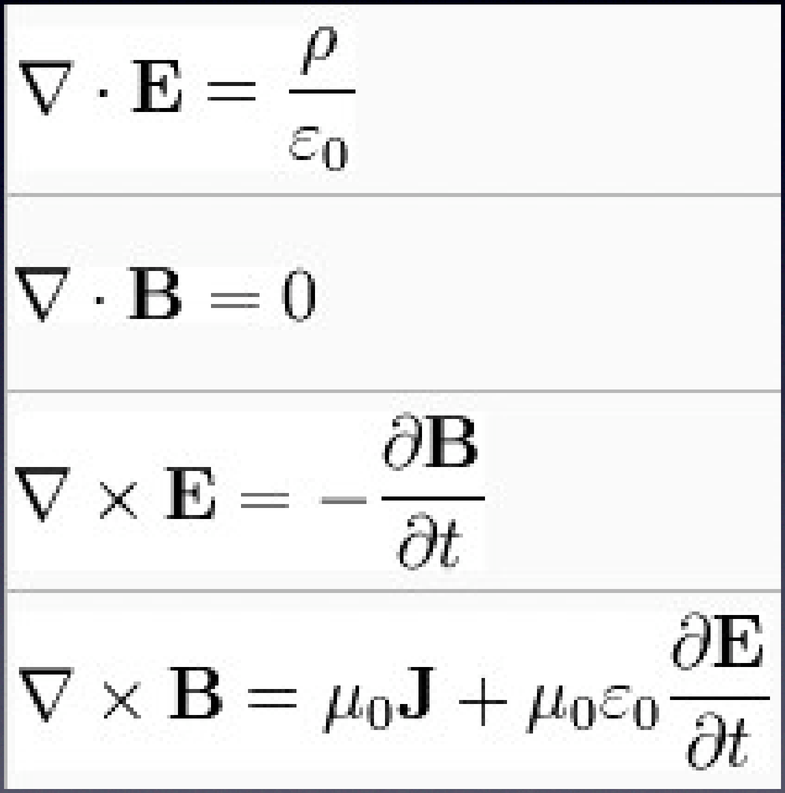

E


E
B

James Clerk Maxwell
1831 - 1879



Maxwell's Equations

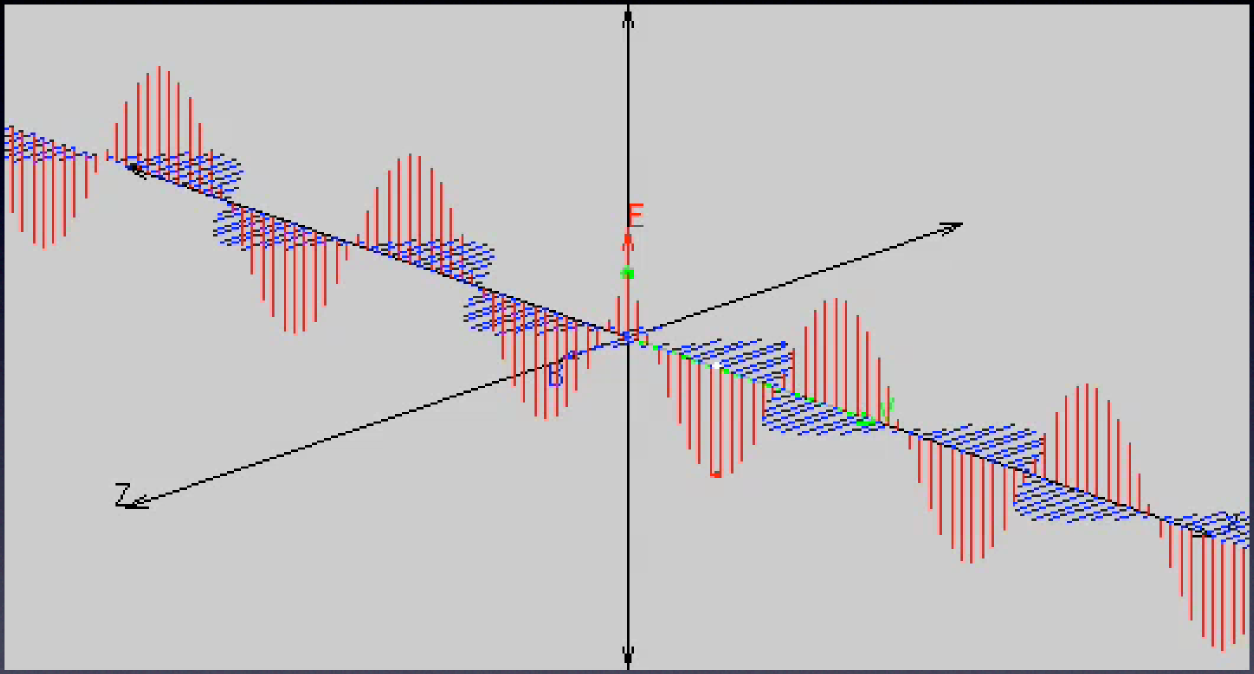


$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t}$$


E
B
V
Z
X

Unified!

Electric Fields
+
Magnetic Fields

=

Electromagnetism

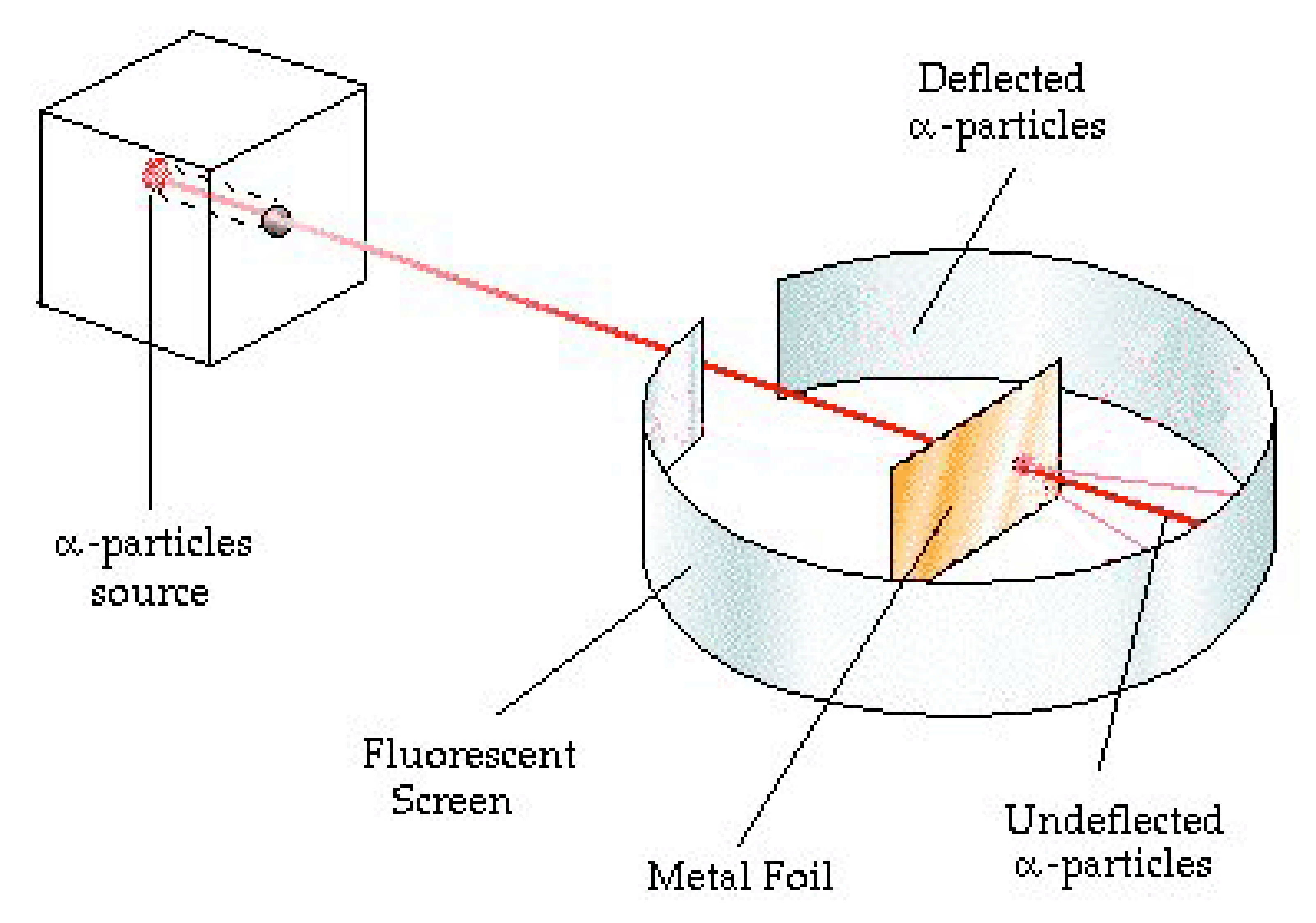
His [Maxwell's] work in producing a unified model of electromagnetism is considered to be one of the greatest advances in physics.
-- Wikipedia

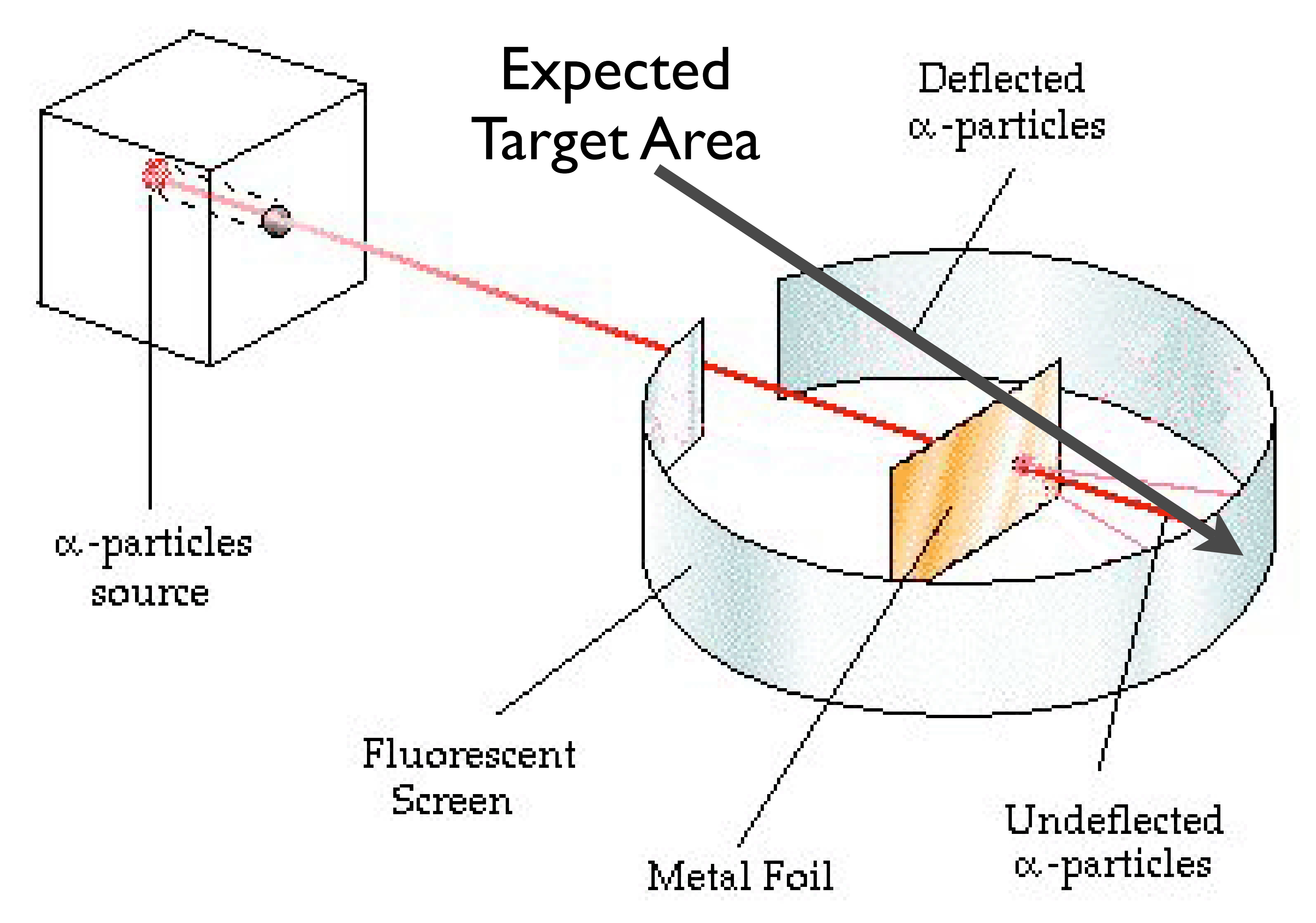
†Natural and artificial flav

†Natural and artificial flav

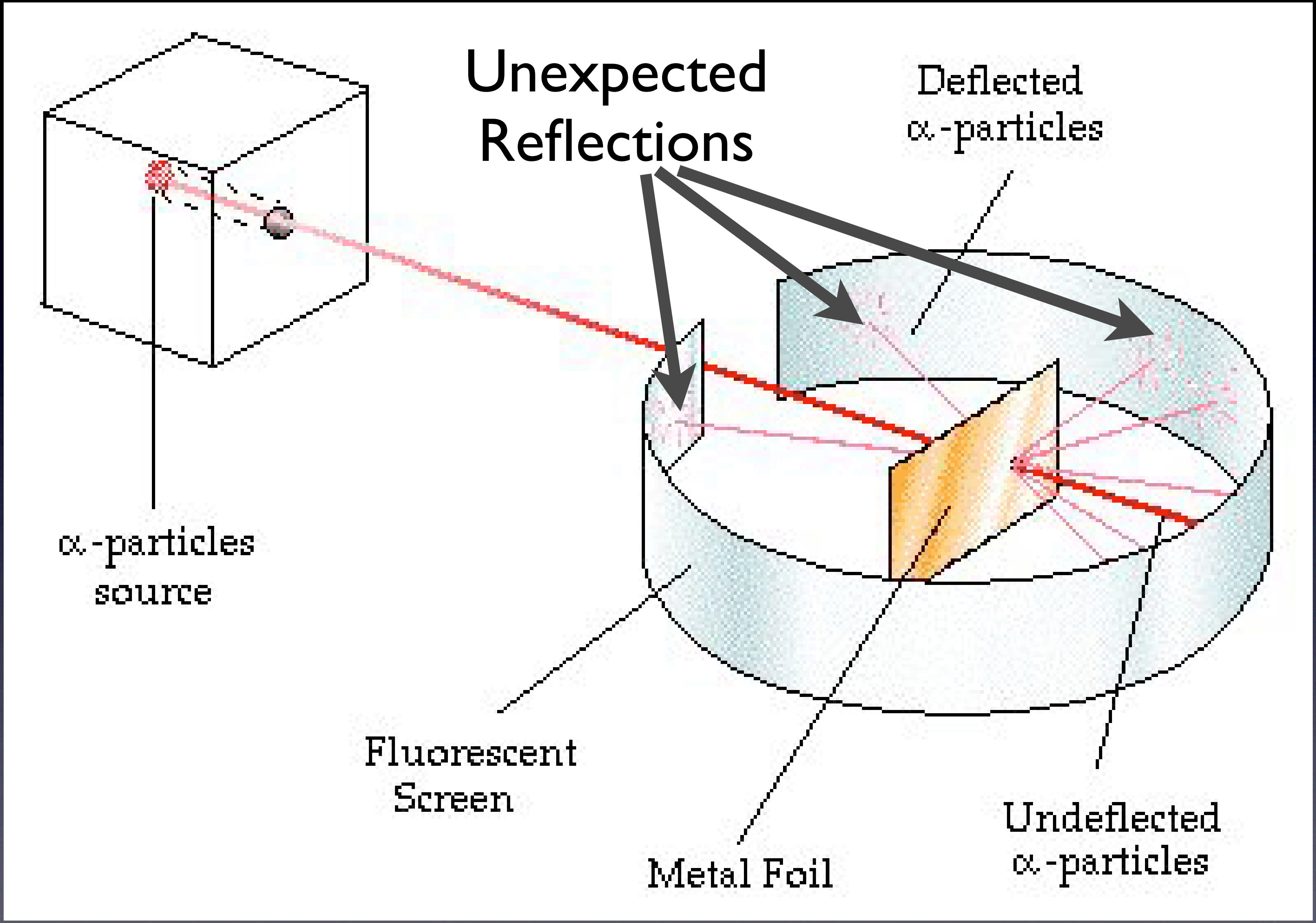
Ernest Rutherford

1909

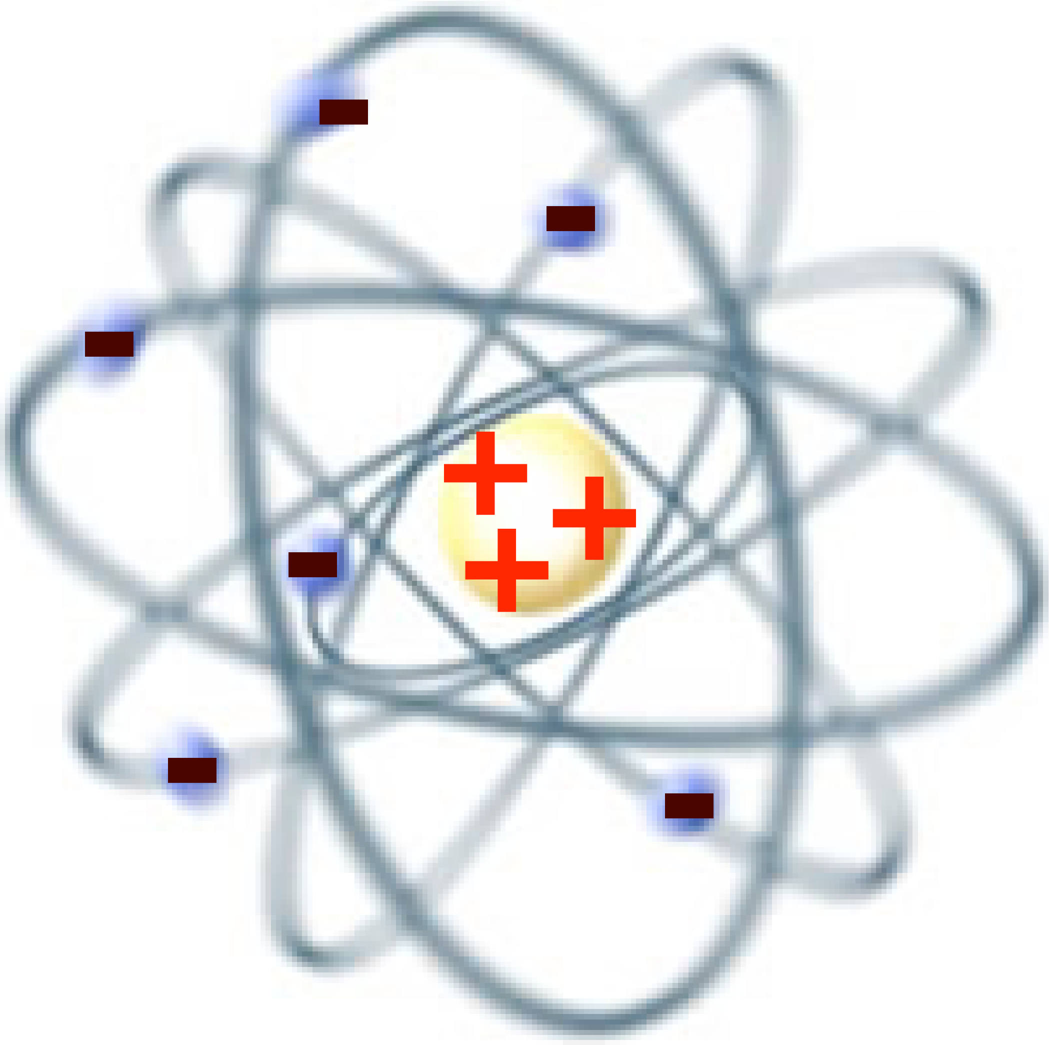

Deflected
α-particles
α-particles
source
Fluorescent
Screen
Metal Foil
Undeflected
α-particles



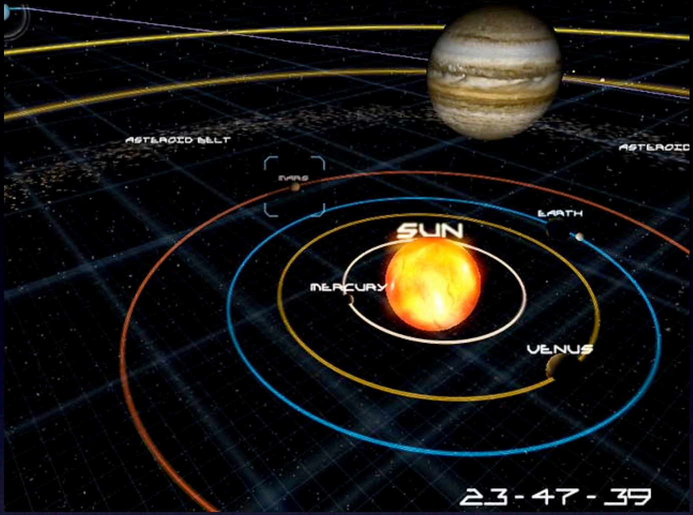
Expected Target Area



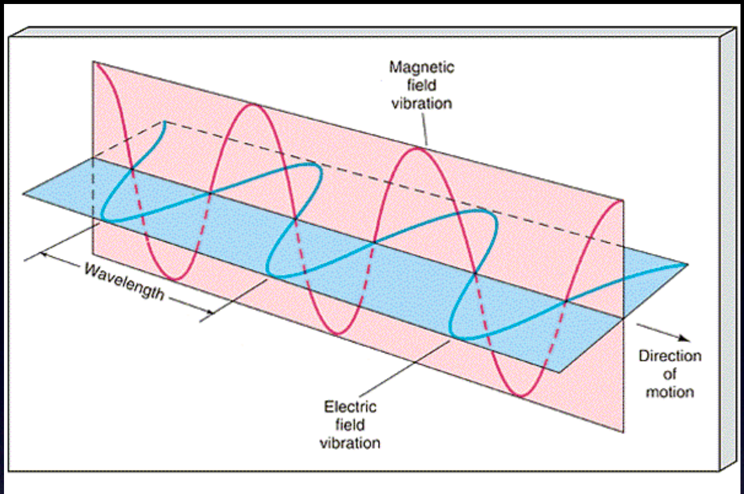
Unexpected Reflections

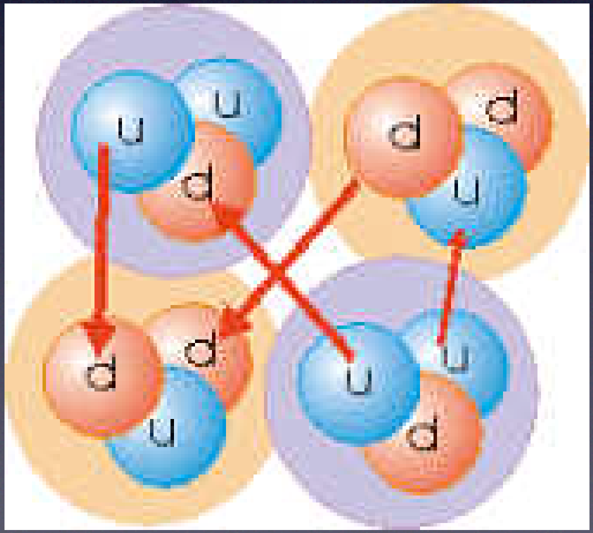


Gravity

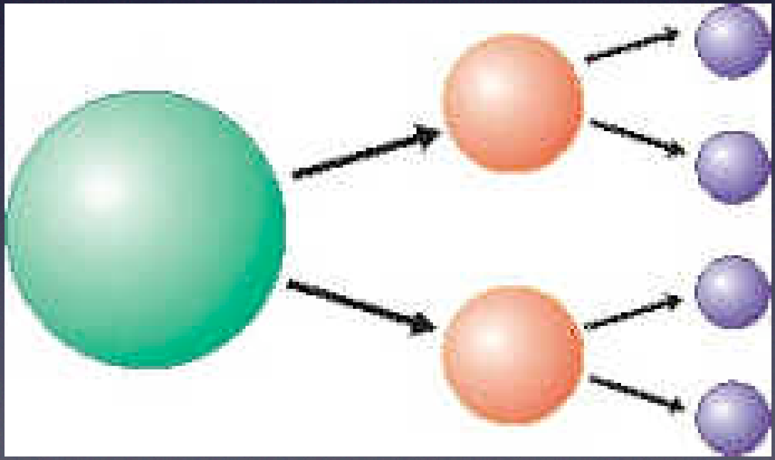


Electromagnetism





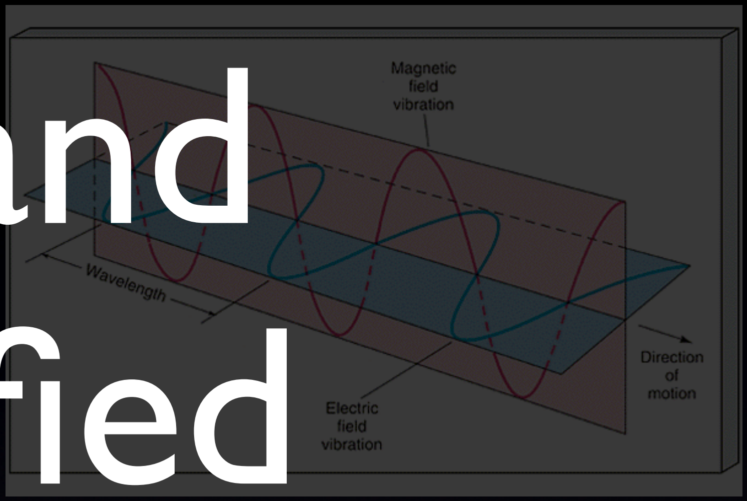
Strong Nuclear



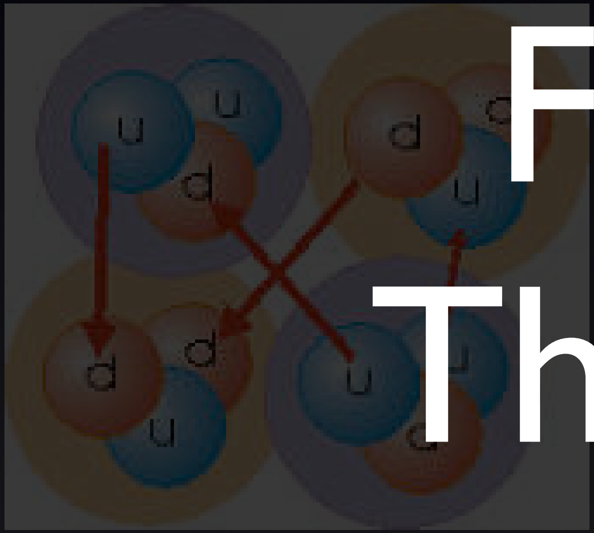
Weak Nuclear

Gravity

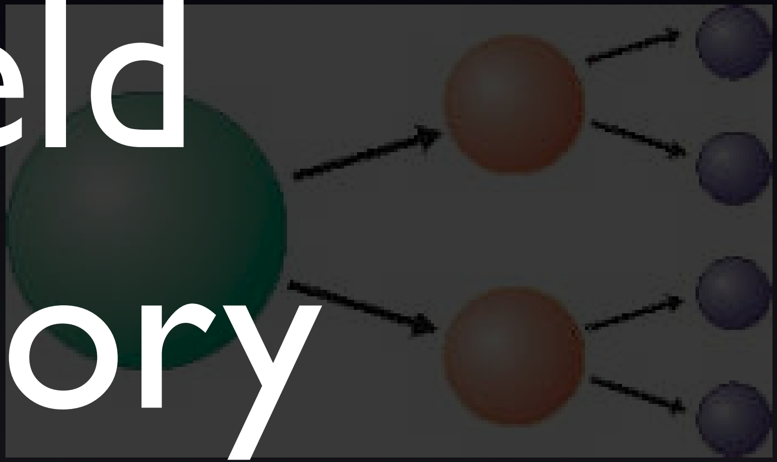
Electromagnetism



Grand Unified Field Theory



Strong Nuclear



Weak Nuclear

Some Principles ...

- SOLID
- Law of Demeter
- DRY
- Small Methods
- Design by Contract

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- SOLID
- Law of Demeter
- DRY
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Grand Unified Theory
of
Software Development

The Grand Unified Theory of Software Development

Jim Weirich
Chief Scientist
EdgeCase LLC
@jimweirich

EdgeCase
software artisans

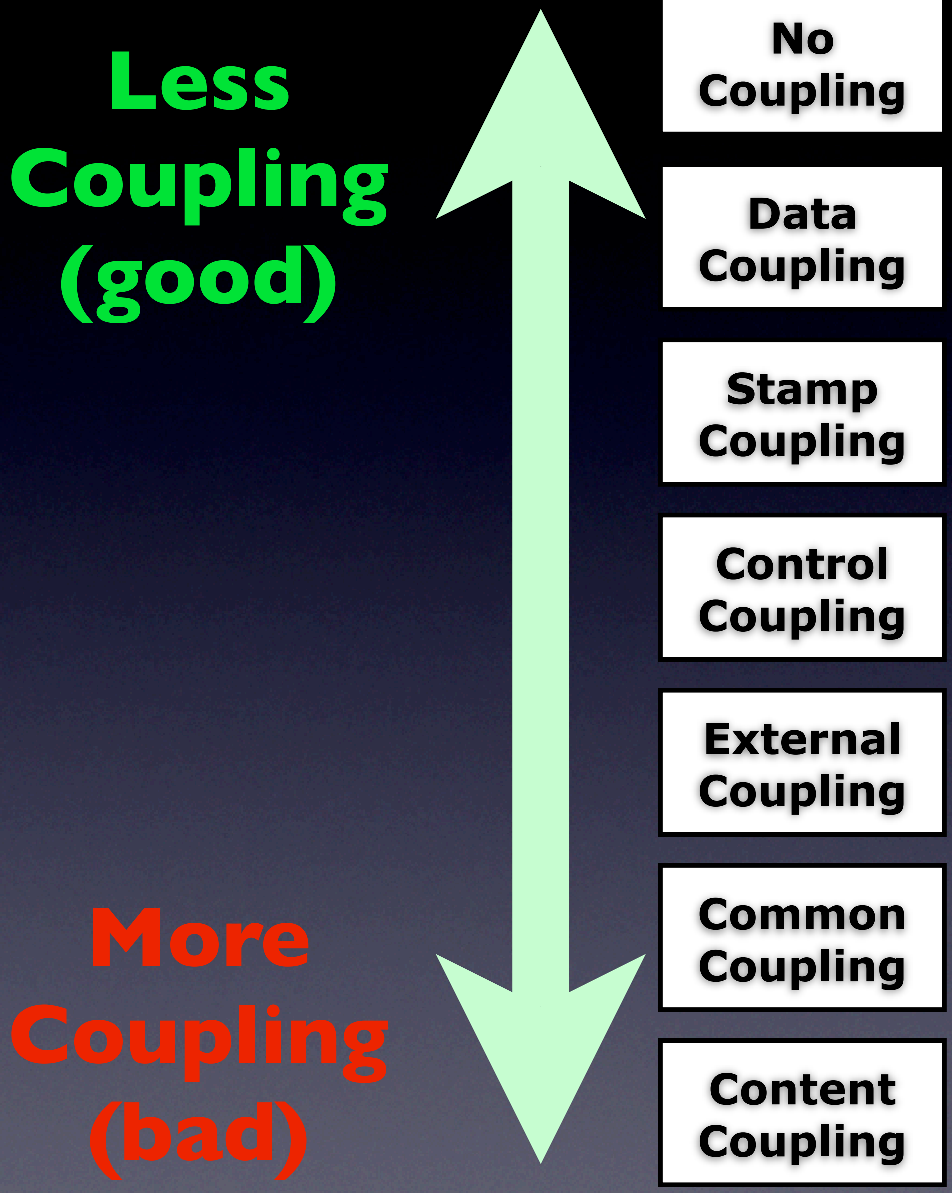
1978

Coupling & Cohesion

Types of Coupling

- No Coupling
- Data Coupling
- Stamp Coupling
- Control Coupling
- External Coupling
- Common Coupling
- Content Coupling

Types of Coupling



Less Coupling (good)

No Coupling

Data Coupling

Stamp Coupling

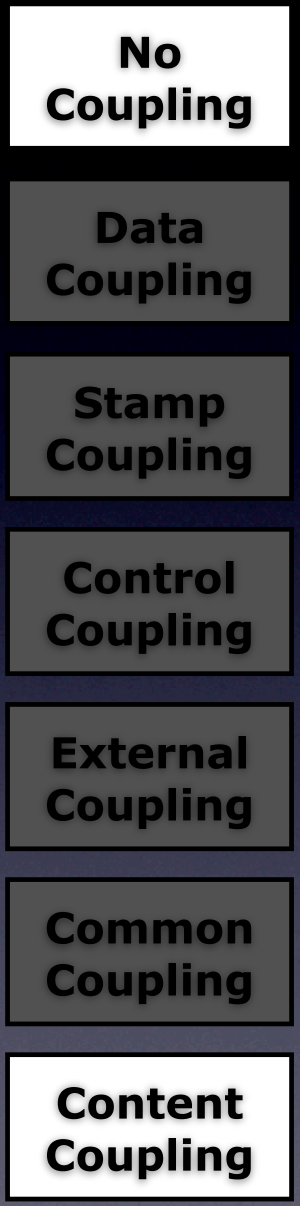
Control Coupling

External Coupling

Common Coupling

Content Coupling

More Coupling (bad)



No Coupling

Data Coupling

Stamp Coupling

Control Coupling

External Coupling

Common Coupling

Content Coupling

No Coupling

Data Coupling

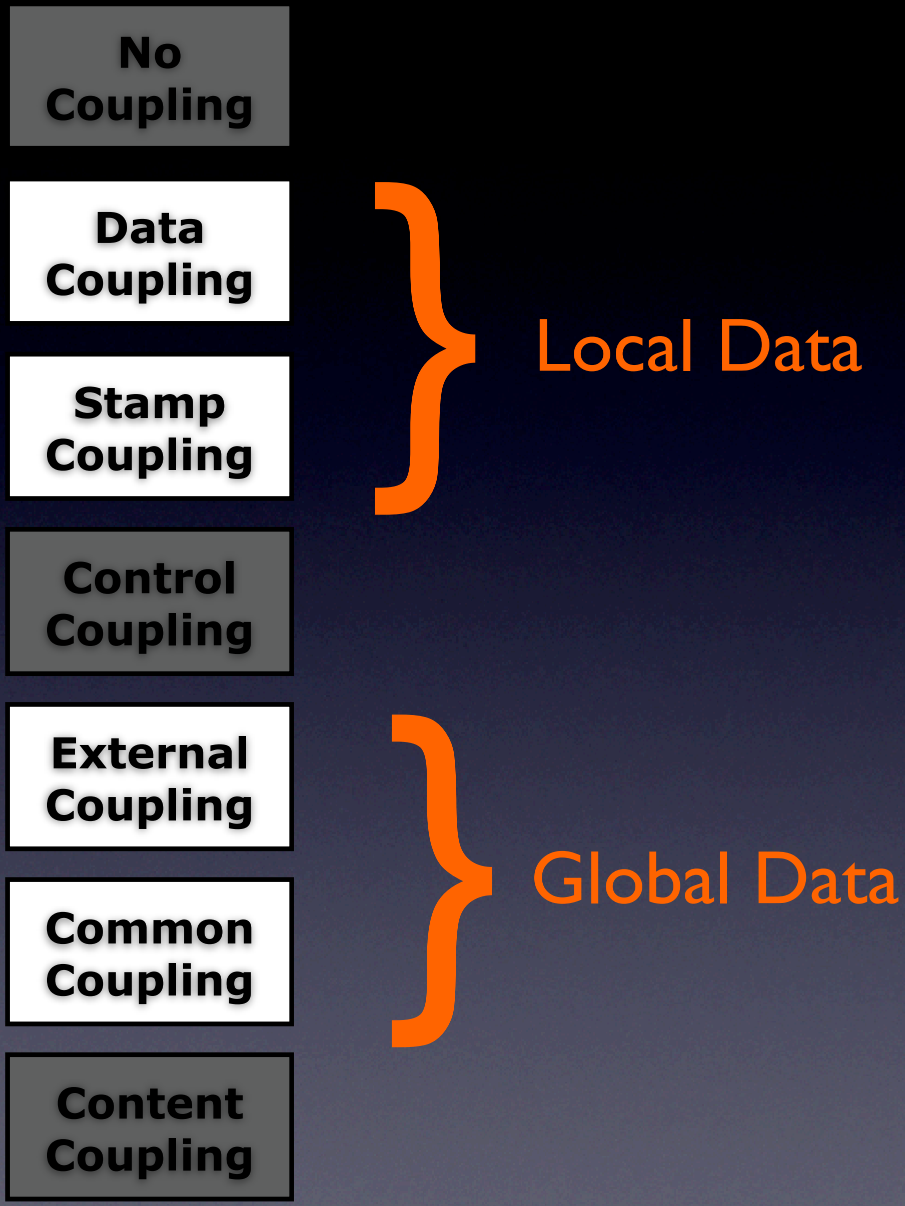
Stamp Coupling

Control Coupling

External Coupling

Common Coupling

Content Coupling



No Coupling

Data Coupling

Stamp Coupling

Local Data

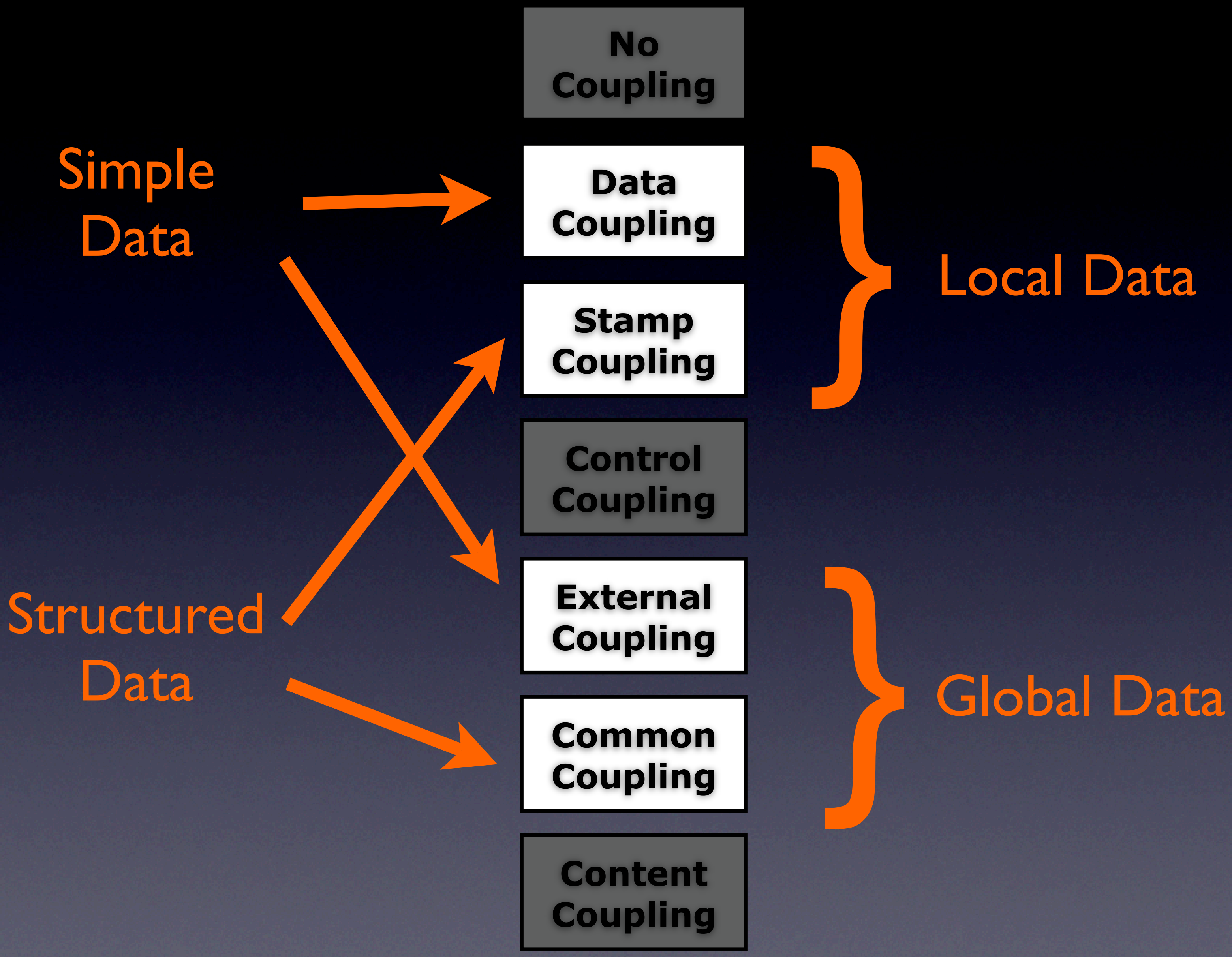
Control Coupling

External Coupling

Common Coupling

Global Data

Content Coupling



No Coupling

Data Coupling

Stamp Coupling

Control Coupling

External Coupling

Common Coupling

Content Coupling

Simple Data

Structured Data

Local Data

Global Data

No Coupling

Data Coupling

Stamp Coupling

Control Coupling

External Coupling

Common Coupling

Content Coupling

Control Coupling

- Method has a “flag” parameter
- The flag controls which algorithm to use

Control Coupling

  - Method has a “flag” parameter
  - The flag controls which algorithm to use

- **Symptoms**
  - The word “OR” in description
  - Flag value is arbitrary and not related to problem domain.

Control Coupling

```
Array.instance_methods
```

Control Coupling

```
Array.instance_methods
Array.instance_methods(true)
Array.instance_methods(false)
```

Control Coupling

```
Array.instance_methods
Array.instance_methods(true)
Array.instance_methods(false)
```

... the instance methods in *mod* are returned, otherwise the methods in *mod* and *mod*'s superclasses are returned.

Control Coupling

```
Array.instance_methods
Array.instance_methods(true)
Array.instance_methods(false)
```

... the instance methods in *mod* are returned, **otherwise** the methods in *mod* and *mod*'s superclasses are returned.

Another Example?

Control Coupling

```
Customer.find(:first, ...)
Customer.find(:all, ...)
```

Control Coupling

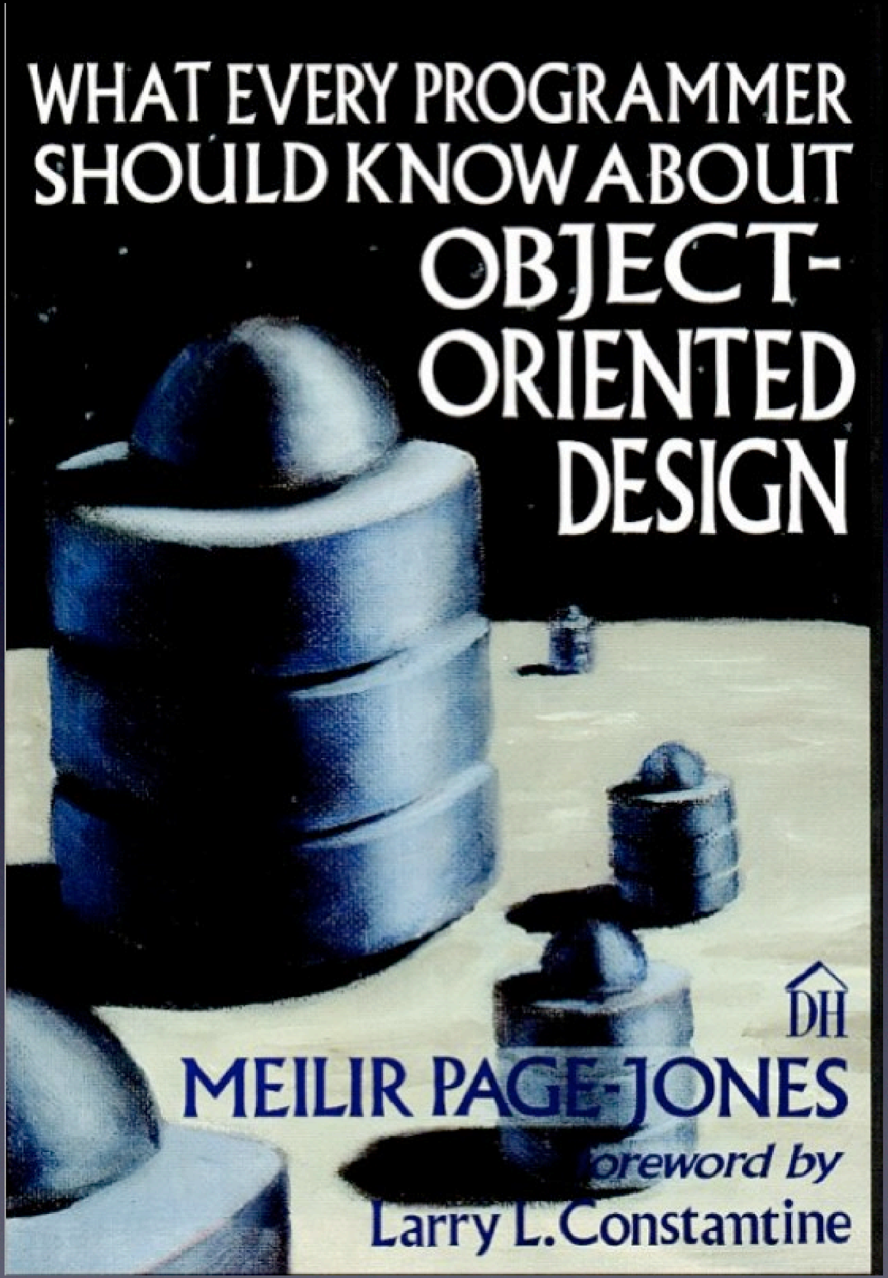
Returns object

```
Customer.find(:first, ...)
Customer.find(:all, ...)
```

Returns list of objects

Myer’s Classifications were ‘OK’

Failed to extend
well to Objects and
Dynamic Languages


WHAT EVERY PROGRAMMER
SHOULD KNOW ABOUT
OBJECT-
ORIENTED
DESIGN
DH
MEILIR PAGE-JONES
oreword by
Larry L. Constamtine

1996

Connascence

1. The common birth of two or more at the same time; production of two or more together.
2. That which is born or produced with another.
3. The act of growing together.

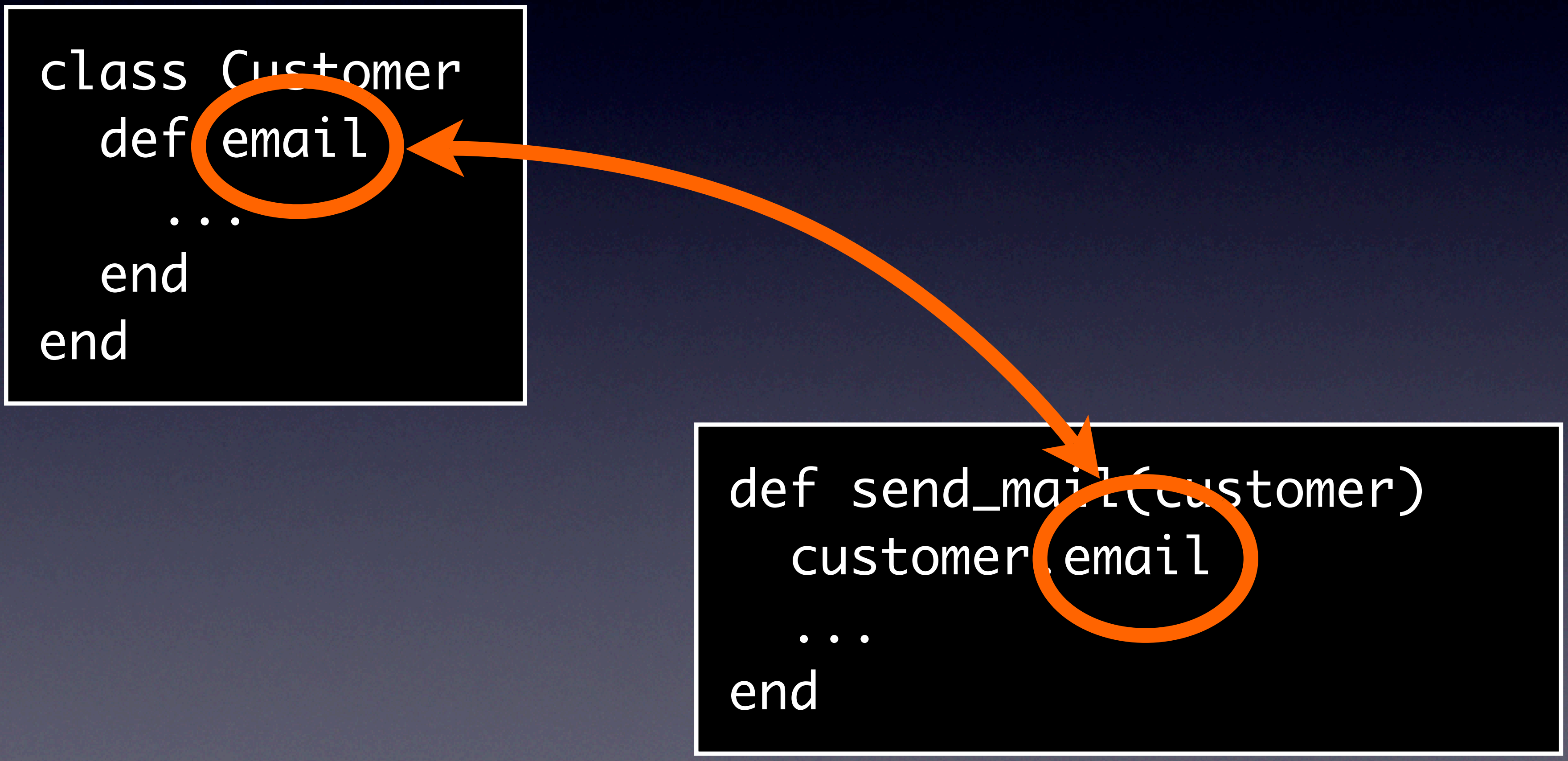
Connascence

Two pieces of software share *connascence* when a changes in one requires a corresponding change in the other.

CoN

```
class Customer
  def email
    ...
  end
end
```

```
def send_mail(customer)
  customer.email
  ...
end
```



```
class Customer
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end
```

```
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```
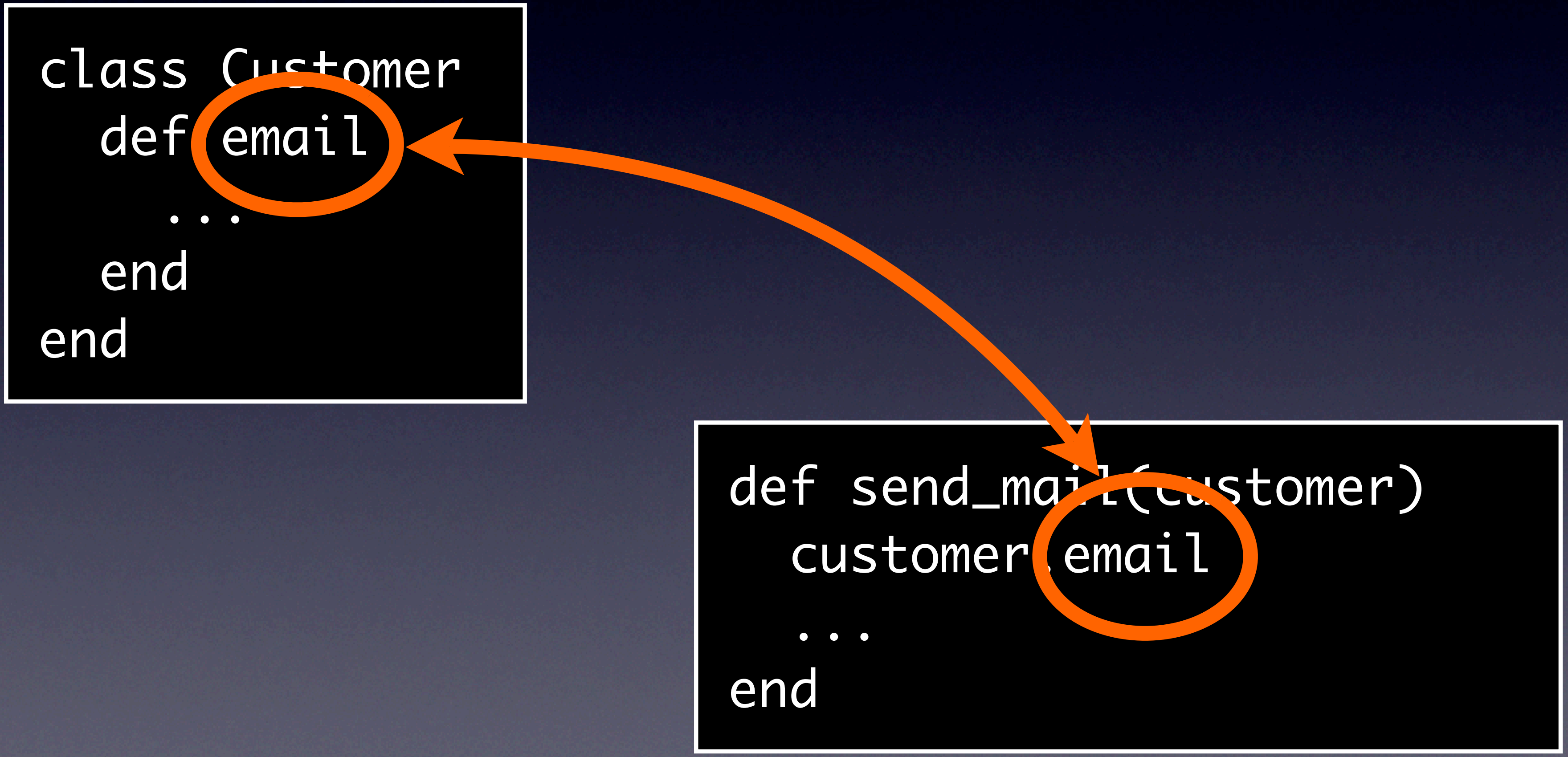

Connascence of Name



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  end
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def send_mail(customer)
  customer.email
  ...
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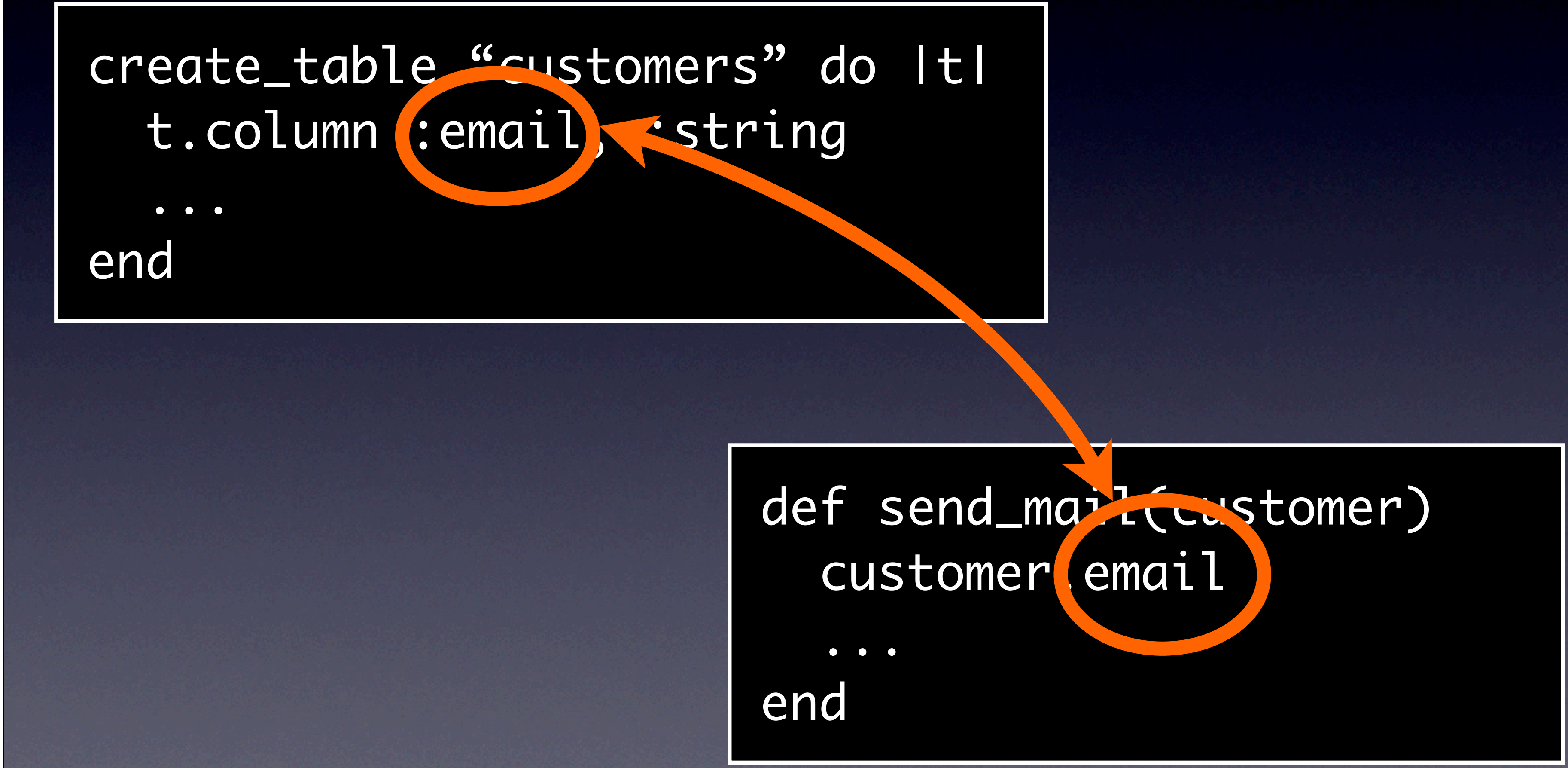
```

Connascence of Name



```
create_table “customers” do |t|
  t.column :email, :string
  ...
end
```

```
def send_mail(customer)
  customer.email
  ...
end
```

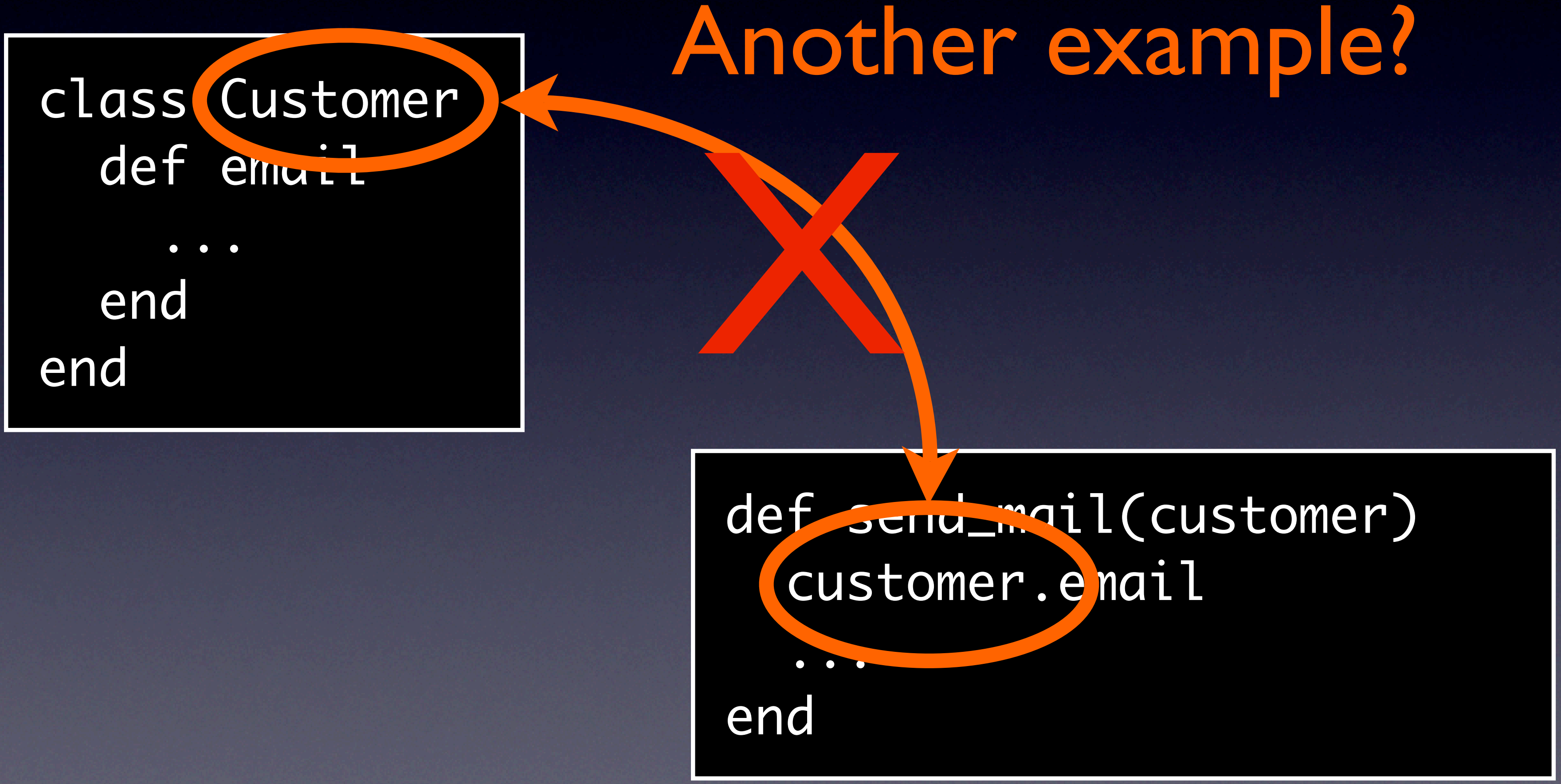
Connascence of Name

```
class Customer
  def email
    ...
  end
end
```

Another example?

```
def send_mail(customer)
  customer.email
  ...
end
```

Connascence of Name



Another example?

```
class Customer
  def email
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end
```

```
def send_mail(customer)
  customer.email
  ...
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```

Connascence of Name

Another example?

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```
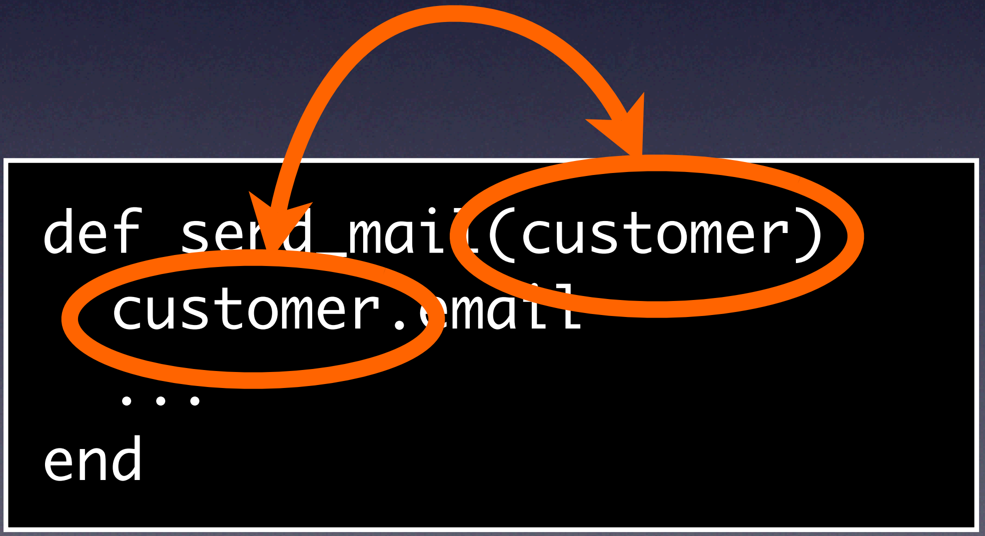
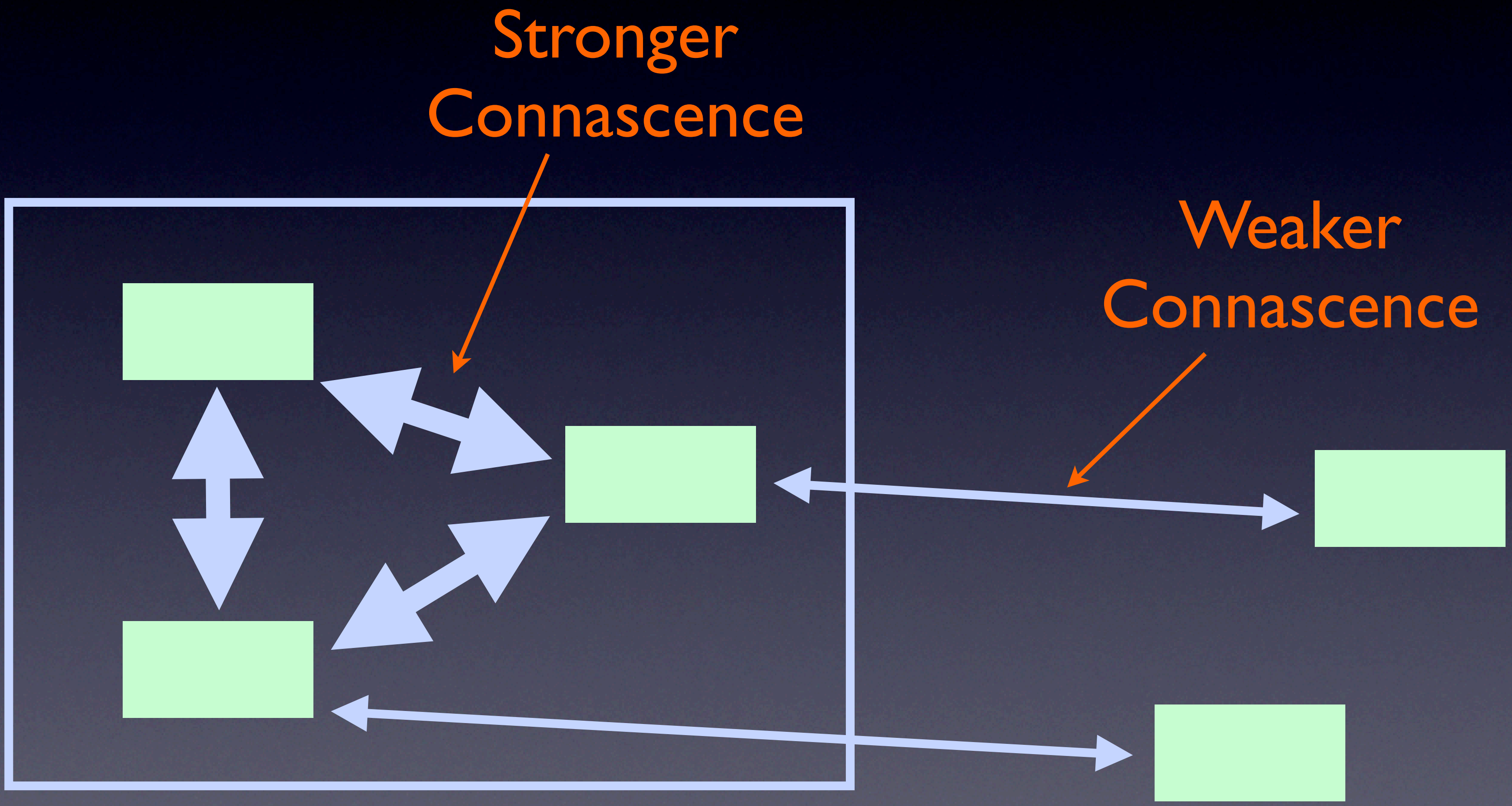



```
def send_mail(customer)
  customer.email
  ...
end
```

Locality Matters

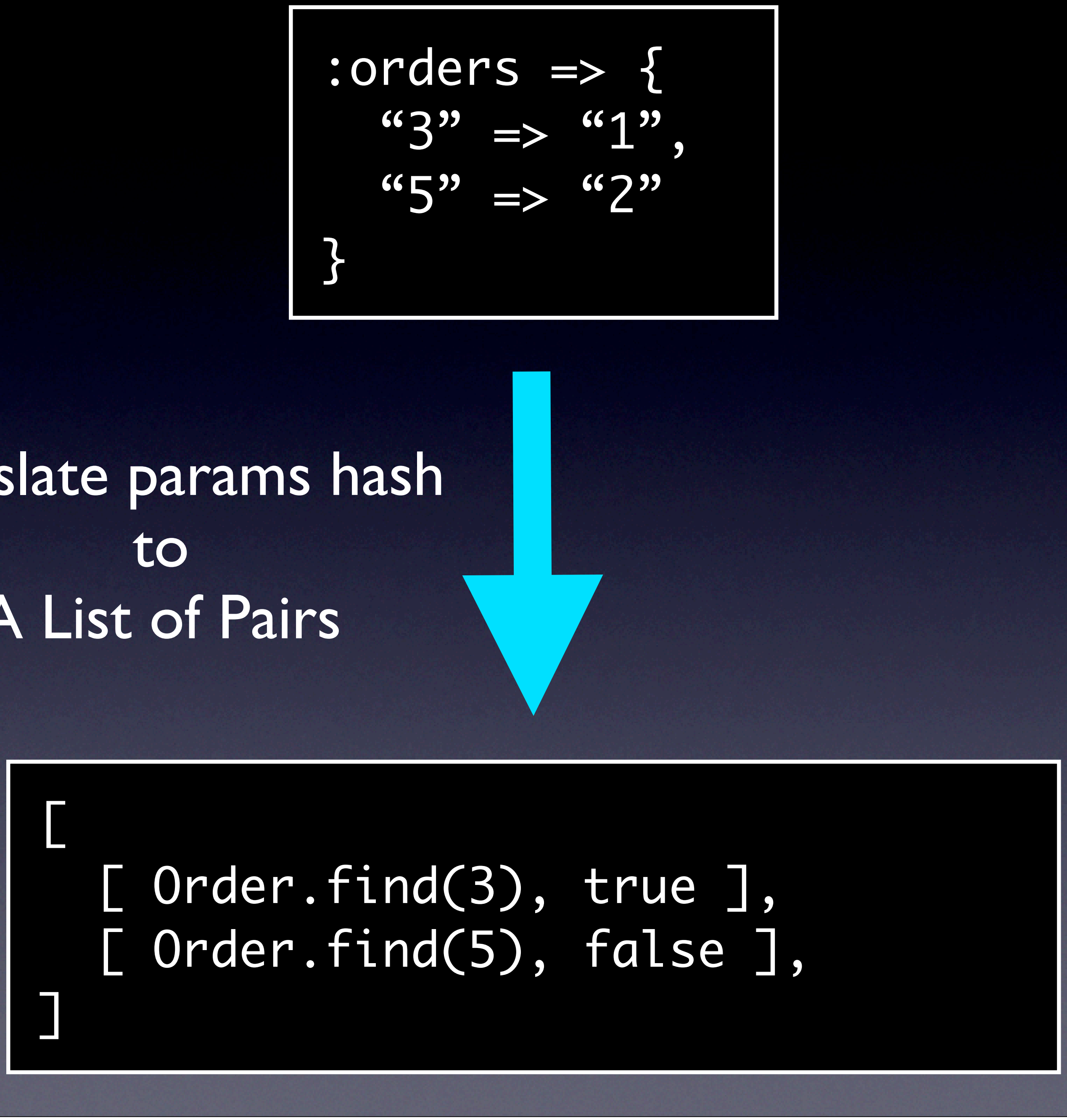
Rule of Locality



Rule of Locality

As the distance between software elements increases, use weaker forms of connascence.

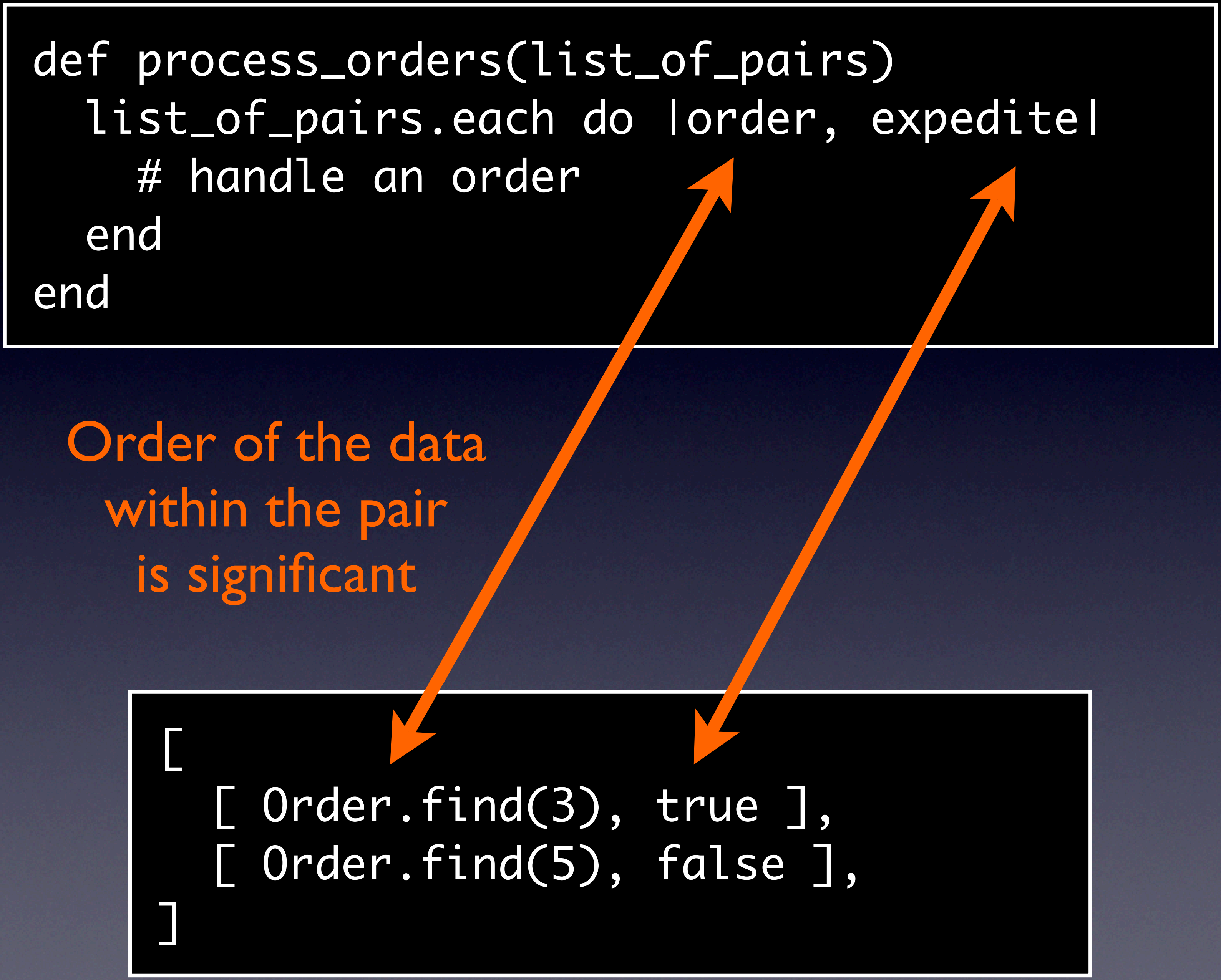
CoP



```
:orders => {
  “3” => “1”,
  “5” => “2”
}
```

Translate params hash
to
A List of Pairs

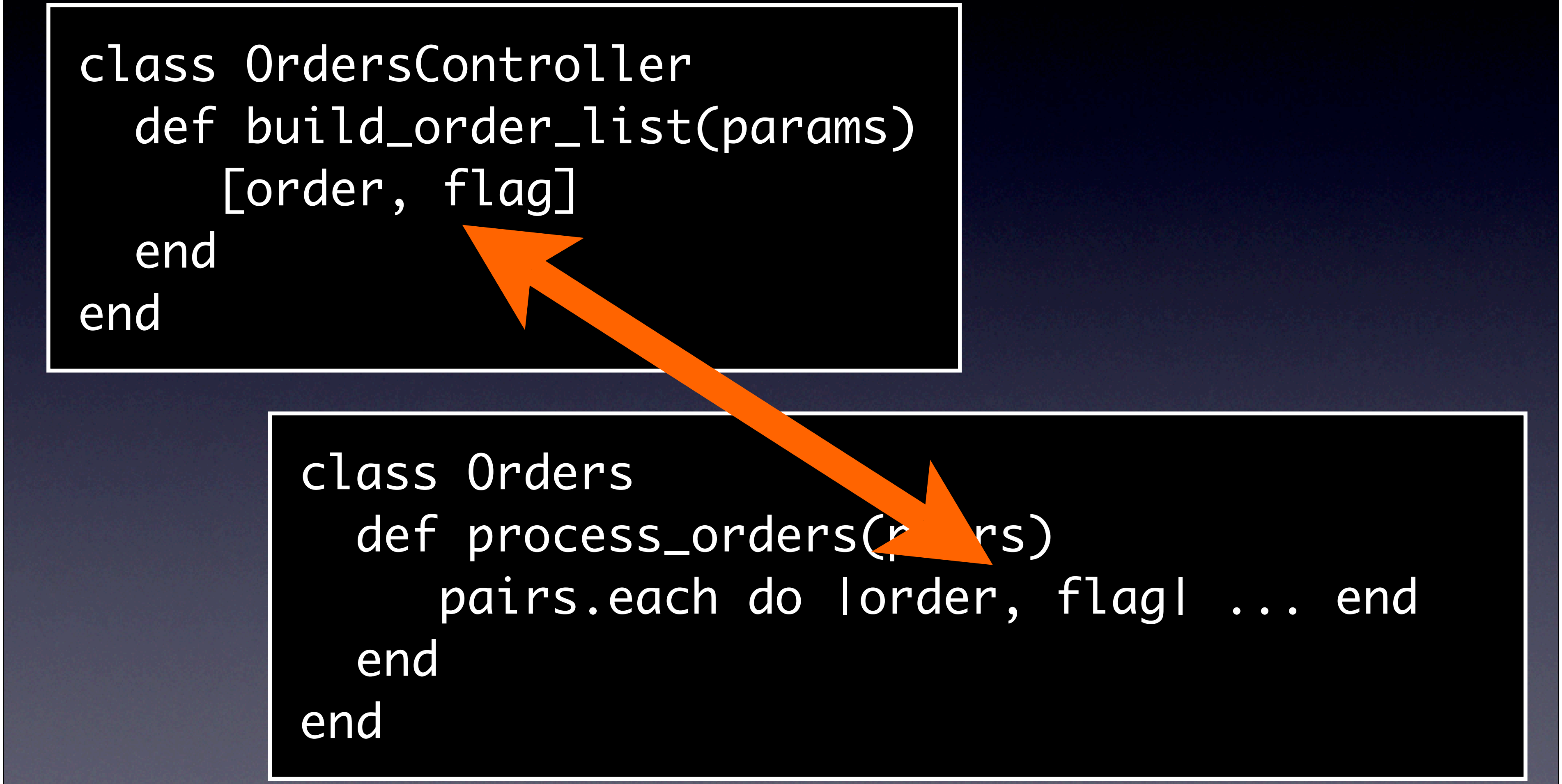
```
[
  [ Order.find(3), true ],
  [ Order.find(5), false ],
]
```



```
def process_orders(list_of_pairs)
  list_of_pairs.each do |order, expedite|
    # handle an order
  end
end
```

Order of the data
within the pair
is significant

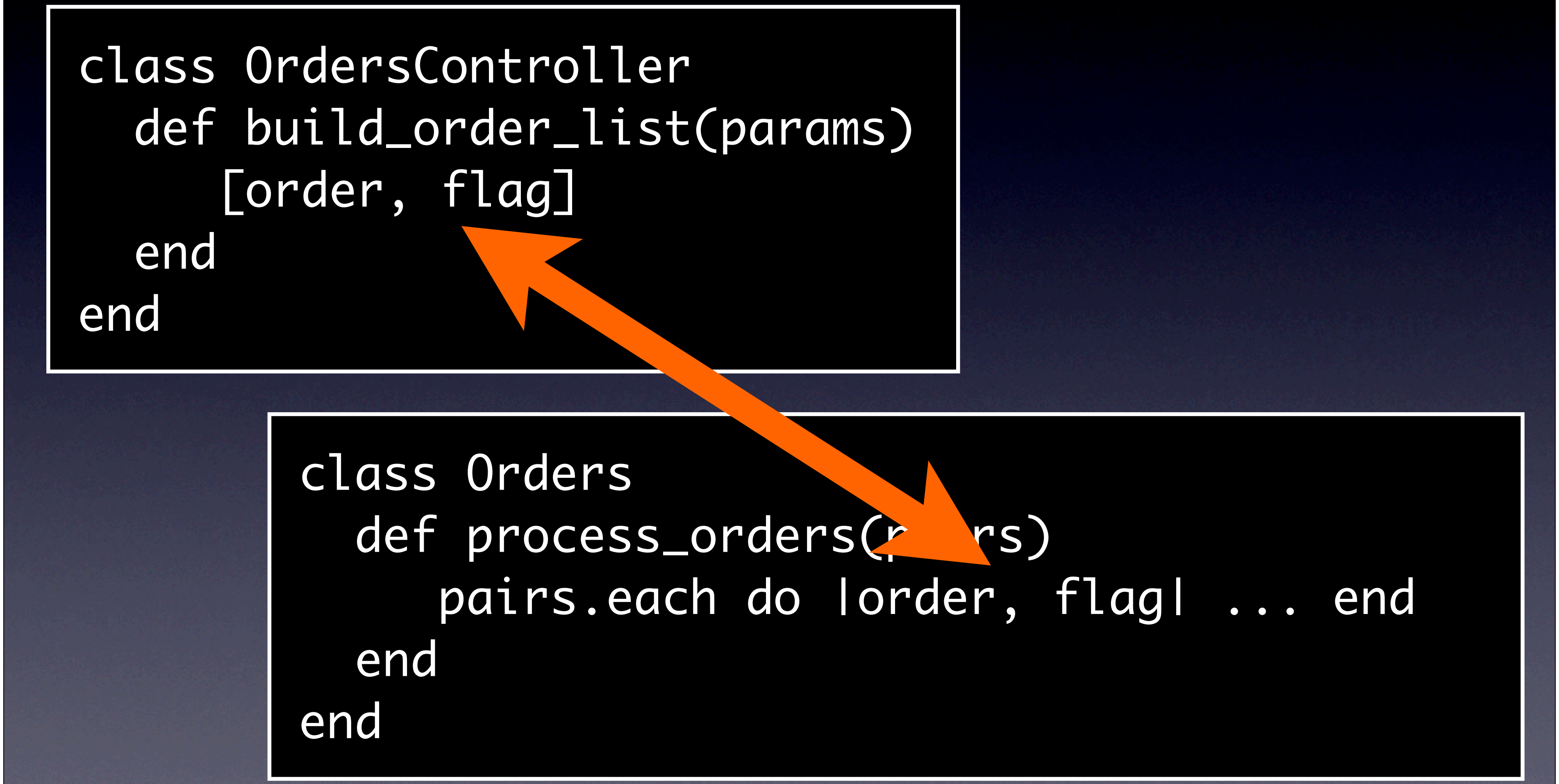
```
[
  [ Order.find(3), true ],
  [ Order.find(5), false ],
]
```



```
class OrdersController
  def build_order_list(params)
     [order, flag]
  end
end
```

```
class Orders
  def process_orders(pairs)
     pairs.each do |order, flag| ... end
  end
end
```

Connascence of Position



```
class OrdersController
  def build_order_list(params)
     [order, flag]
  end
end
```

```
class Orders
  def process_orders(pairs)
     pairs.each do |order, flag| ... end
  end
end
```

Consider

Low Degree of CoP

```
[ order, expedite ]
```

High Degree of CoP

```
[
  order, expedite, confirmation_number,
  ordered_date, expiration, special
]
```

CoP → CoN

```
class OrderDisposition
  attr_reader :order,
    :expedite,
    :confirmation_number,
    :ordered_date,
    :expiration,
    :special
  ...
end
```

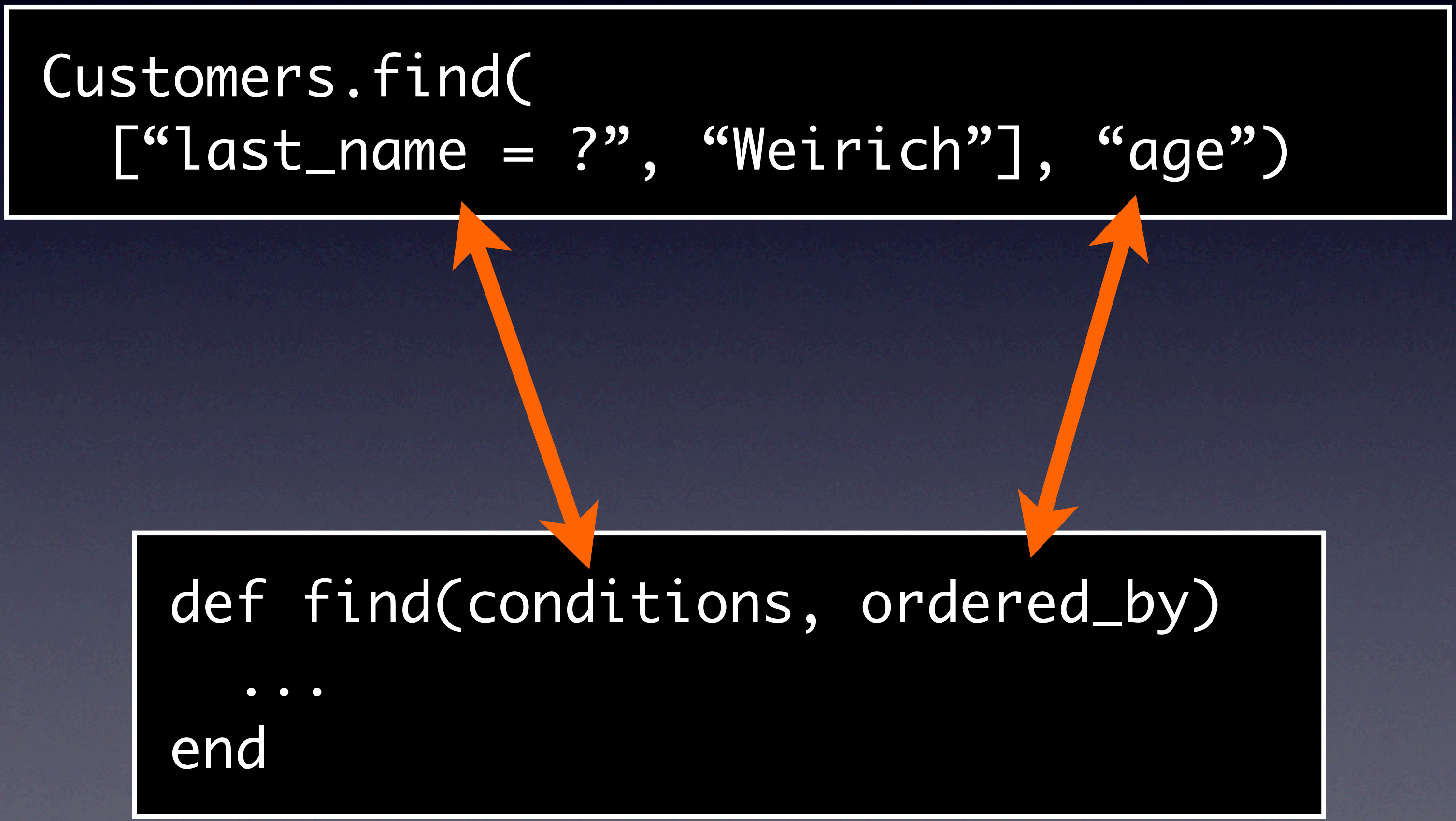
Degree Matters

CoN < CoP

Rule of Degree

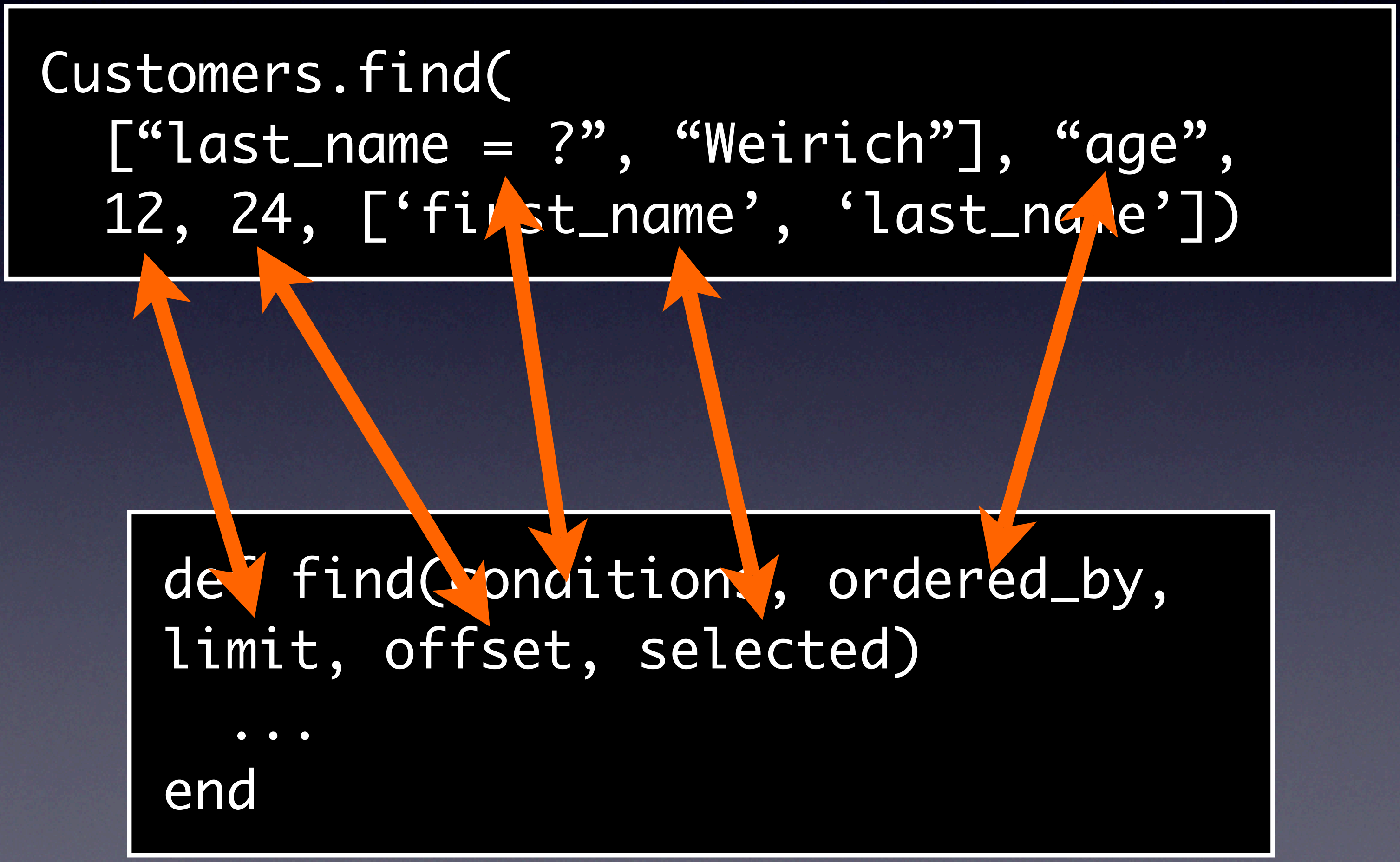
Convert high degrees of connascence
into
weaker forms of connascence

Another Example?



```
Customers.find(
  [“last_name = ?”, “Weirich”], “age”)
```

```
def find(conditions, ordered_by)
  ...
end
```



```
Customers.find(
  [“last_name = ?”, “Weirich”], “age”,
  12, 24, [‘first_name’, ‘last_name’])
```

```
def find(conditions, ordered_by,
limit, offset, selected)
  ...
end
```

CoP → CoN

```
Customers.find(
  :conditions => [“last_name = ?”, “Weirich”],
  :order_by => “age”,
  :limit => 12,
  :offset => 24,
  :select => [‘first_name’, ‘last_name’])
```

```
def find(options={})
  ...
end
```

Another Example?

Connascence of Position

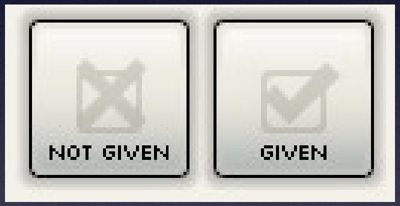
```
def test_user_can_do_something_interesting
  user = User.find(:first)
  ...
end
```

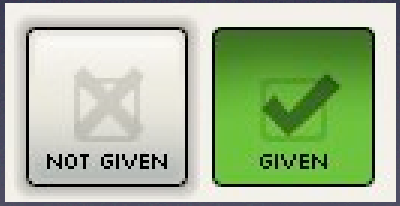
Connascence of Position

```
def test_user_can_do_something_interesting
  user = User.find_by_name(“Jim”)
  ...
end
```

CoM

```
<input type="checkbox" value="2" />
<input type="checkbox" value="1" />
```


NOT GIVEN
GIVEN


NOT GIVEN
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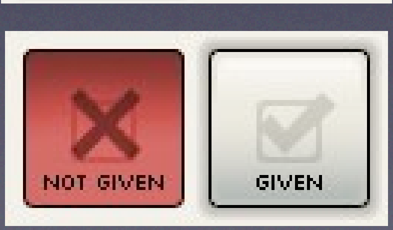
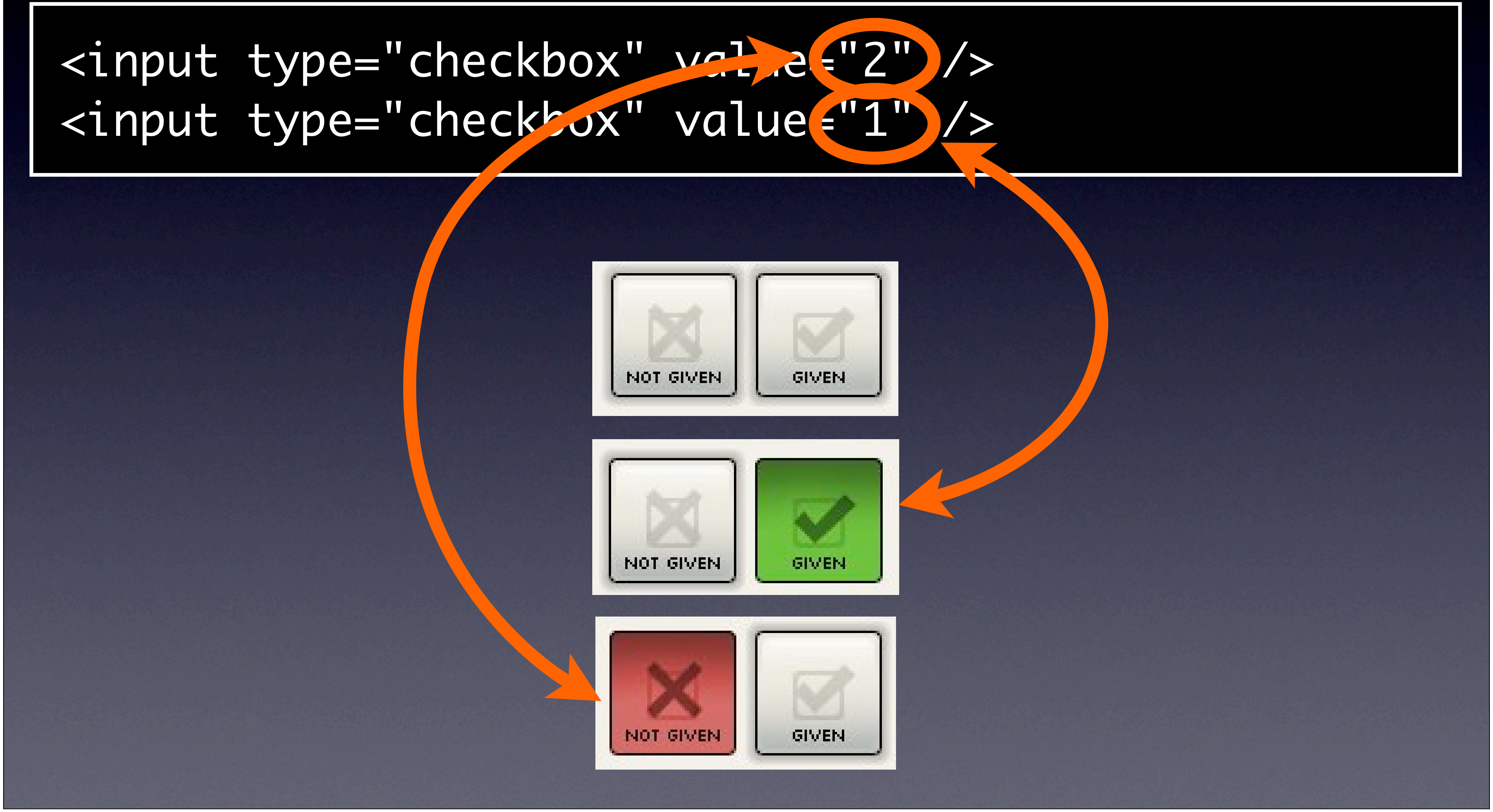
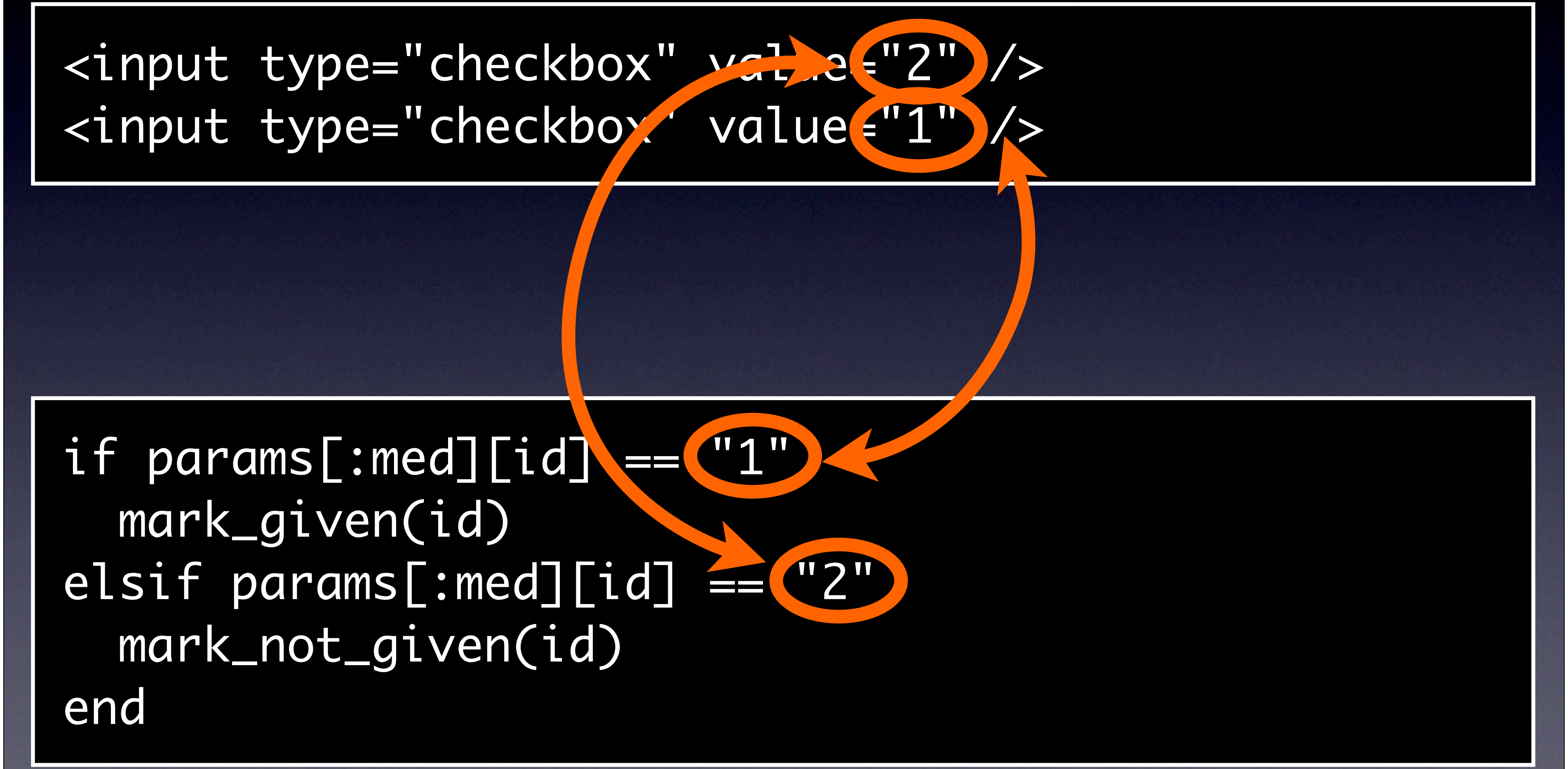

NOT GIVEN
GIVEN



```
<input type="checkbox" value="2" />
<input type="checkbox" value="1" />
```

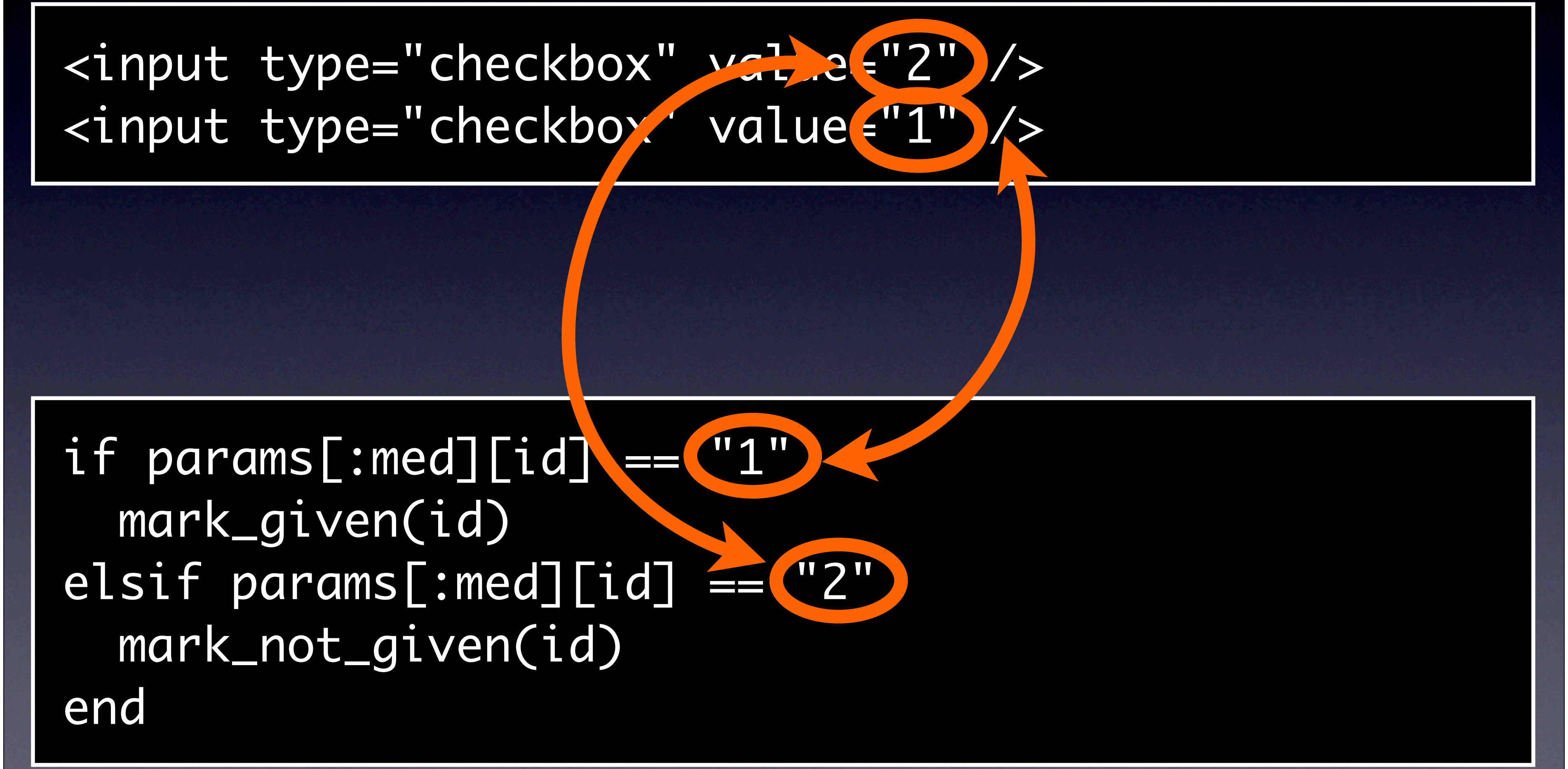
NOT GIVEN
GIVEN
NOT GIVEN
GIVEN
NOT GIVEN
GIVEN



```
<input type="checkbox" value="2" />
<input type="checkbox" value="1" />
```

```
if params[:med][id] == "1"
  mark_given(id)
elsif params[:med][id] == "2"
  mark_not_given(id)
end
```

Connascence of Meaning



```
<input type="checkbox" value="2" />
<input type="checkbox" value="1" />
```

```
if params[:med][id] == "1"
  mark_given(id)
elsif params[:med][id] == "2"
  mark_not_given(id)
end
```

Connascence of Meaning

```
MED_GIVEN = "1"
MED_NOT_GIVEN = "2"
```

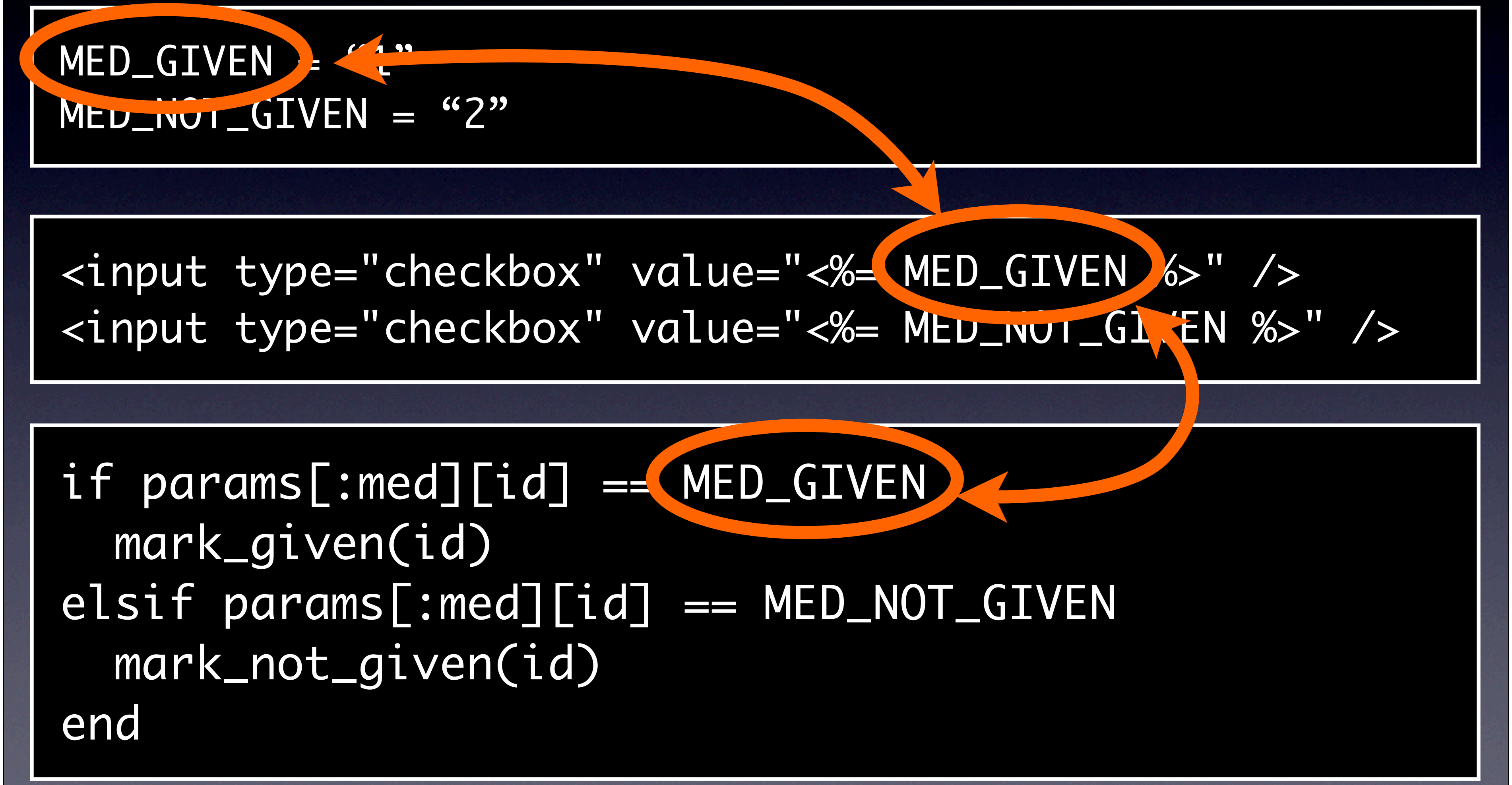
CoM → CoN

```
MED_GIVEN = "1"
MED_NOT_GIVEN = "2"
```

```
<input type="checkbox" value="<%= MED_GIVEN %>" />
<input type="checkbox" value="<%= MED_NOT_GIVEN %>" />
```

```
if params[:med][id] == MED_GIVEN
  mark_given(id)
elsif params[:med][id] == MED_NOT_GIVEN
  mark_not_given(id)
end
```

CoM → CoN



```
MED_GIVEN = “1”
MED_NOT_GIVEN = “2”
```

```
<input type="checkbox" value="<%= MED_GIVEN %>" />
<input type="checkbox" value="<%= MED_NOT_GIVEN %>" />
```

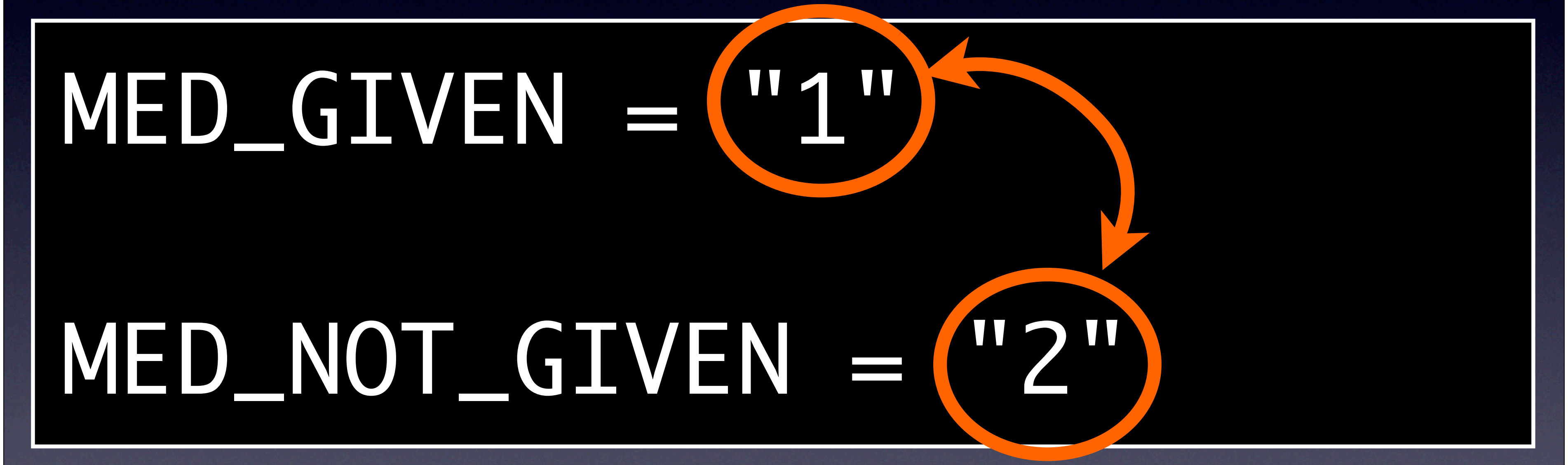
```
if params[:med][id] == MED_GIVEN
  mark_given(id)
elsif params[:med][id] == MED_NOT_GIVEN
  mark_not_given(id)
end
```

CN

Revisit

```
MED_GIVEN = "1"

MED_NOT_GIVEN = "2"
```



```
MED_GIVEN = "1"

MED_NOT_GIVEN = "2"
```

```
MED_GIVEN = "1"

MED_NOT_GIVEN = "1"
```

Contranascence

```
MED_GIVEN = "1"

MED_NOT_GIVEN = "1"
```

Another Example?

Contranascence

My XML Library

```
class Node
  ...
end
```

Contranascence

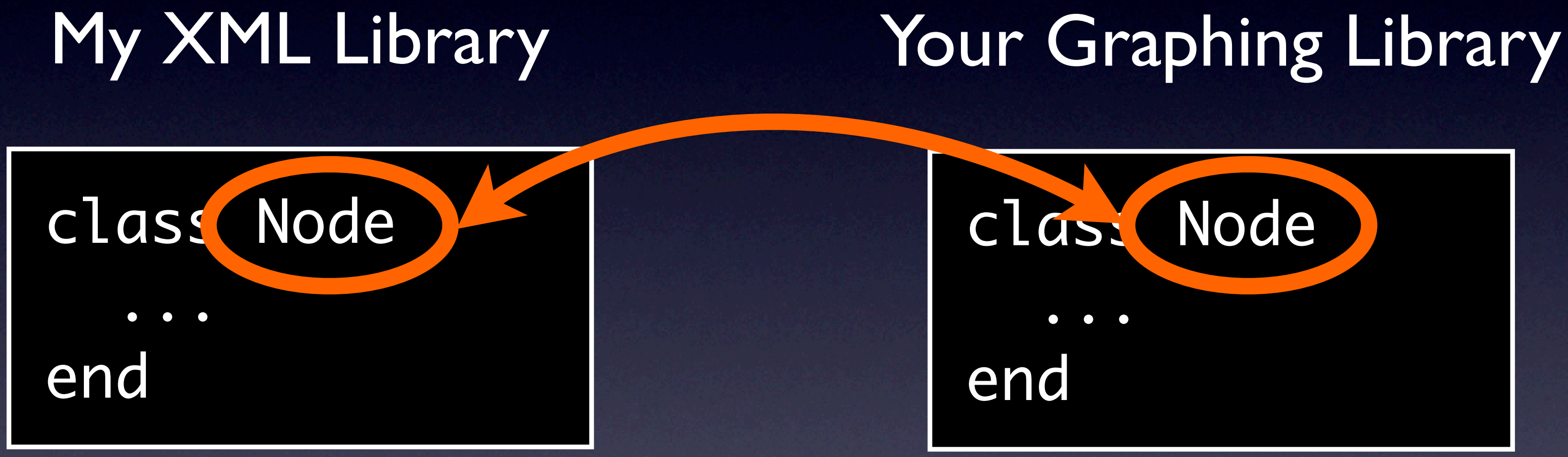
My XML Library

```
class Node
  ...
end
```

Your Graphing Library

```
class Node
  ...
end
```

Contranascence



My XML Library

```
class Node
  ...
end
```

Your Graphing Library

```
class Node
  ...
end
```

Contranascence

My XML Library

```
module MyXml
  class Node
    ...
  end
end
```

Your Graphing Library

```
module YourGraphing
  class Node
    ...
  end
end
```

Contranascence

```
irb/slex.rb:92:               class Node
tkextlib/blt/tree.rb:15:      class Node < TkObject
tkextlib/blt/treeview.rb:18:  class Node < TkObject
tkextlib/blt/treeview.rb:966: class Node < TkObject
tkextlib/bwidget/tree.rb:13:  class Node < TkObject
tkextlib/bwidget/tree.rb:262: class Node
xmlrpc/parser.rb:17:          class Node
yaml/syck.rb:14:              class Node
```

Another Example?

Contranascence

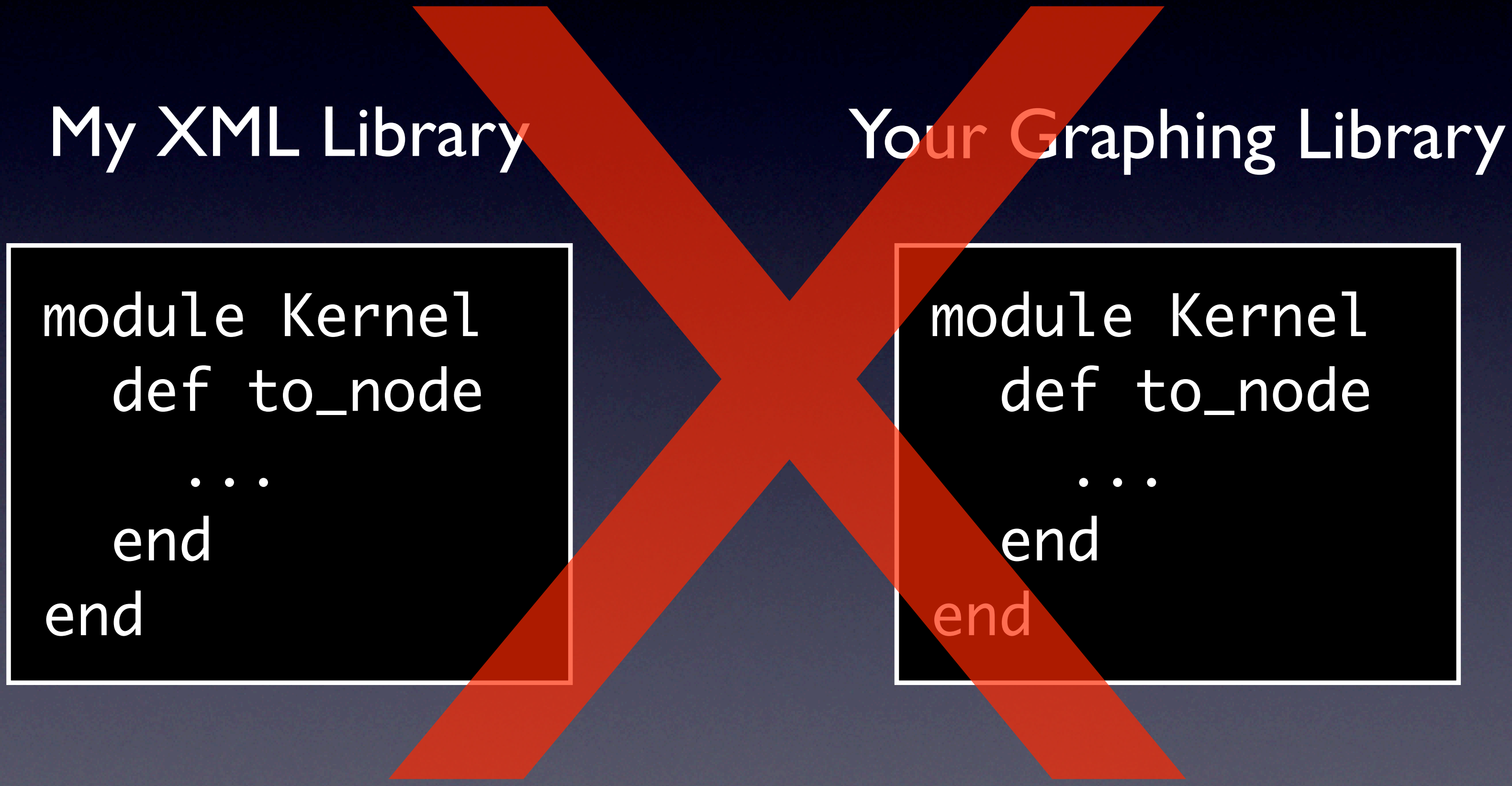
My XML Library

```
module Kernel
  def to_node
    ...
  end
end
```

Your Graphing Library

```
module Kernel
  def to_node
    ...
  end
end
```

Contranascence



My XML Library

```
module Kernel
  def to_node
    ...
  end
end
```

Your Graphing Library

```
module Kernel
  def to_node
    ...
  end
end
```

Contranascence

Selector Namespaces

(Ruby 2 ?)

CoA

add_check_digit(“31415972”) → “314159728”

check?(“ 314159728”) → true

check?(“ 314159723”) → false

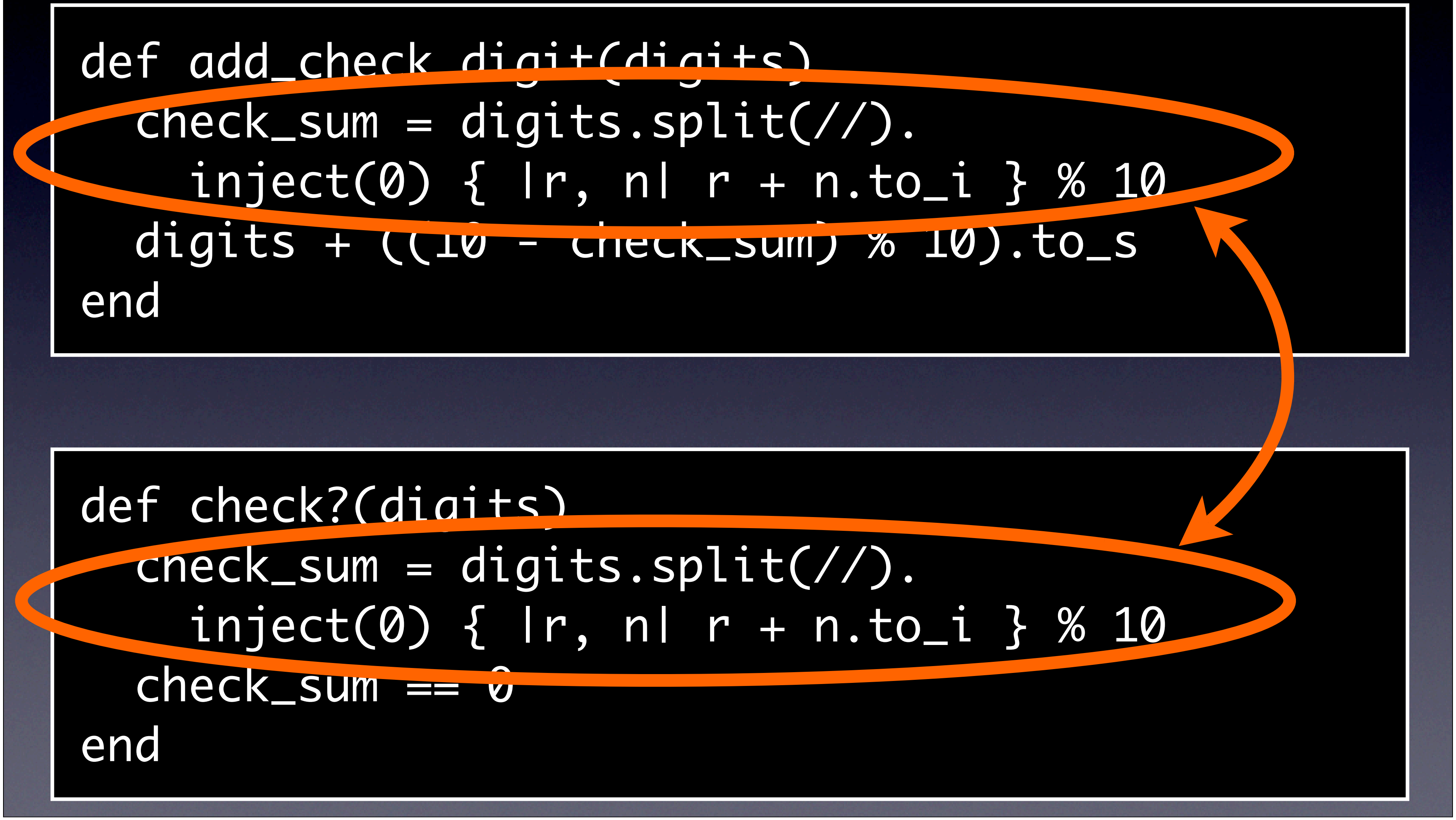
```
def add_check_digit(digits)
  check_sum = digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
  digits + ((10 - check_sum) % 10).to_s
end
```

```
def check?(digits)
  check_sum = digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
  check_sum == 0
end
```

```
def add_check_digit(digits)
  check_sum = digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
  digits + ((10 - check_sum) % 10).to_s
end
```

```
def check?(digits)
  check_sum = digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
  check_sum == 0
end
```

Connascence of Algorithm



```
def add_check_digit(digits)
  check_sum = digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
  digits + ((10 - check_sum) % 10).to_s
end
```

```
def check?(digits)
  check_sum = digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
  check_sum == 0
end
```

CoA → CoN

```
def add_check_digit(digits)
  digits + ((10 - check_sum(digits)) % 10).to_s
end
```

```
def check?(digits)
  check_sum(digits) == 0
end
```

```
def check_sum(digits)
  digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
end
```

DRY

```
def add_check_digit(digits)
  digits + ((10 - check_sum(digits)) % 10).to_s
end
```

```
def check?(digits)
  check_sum(digits) == 0
end
```

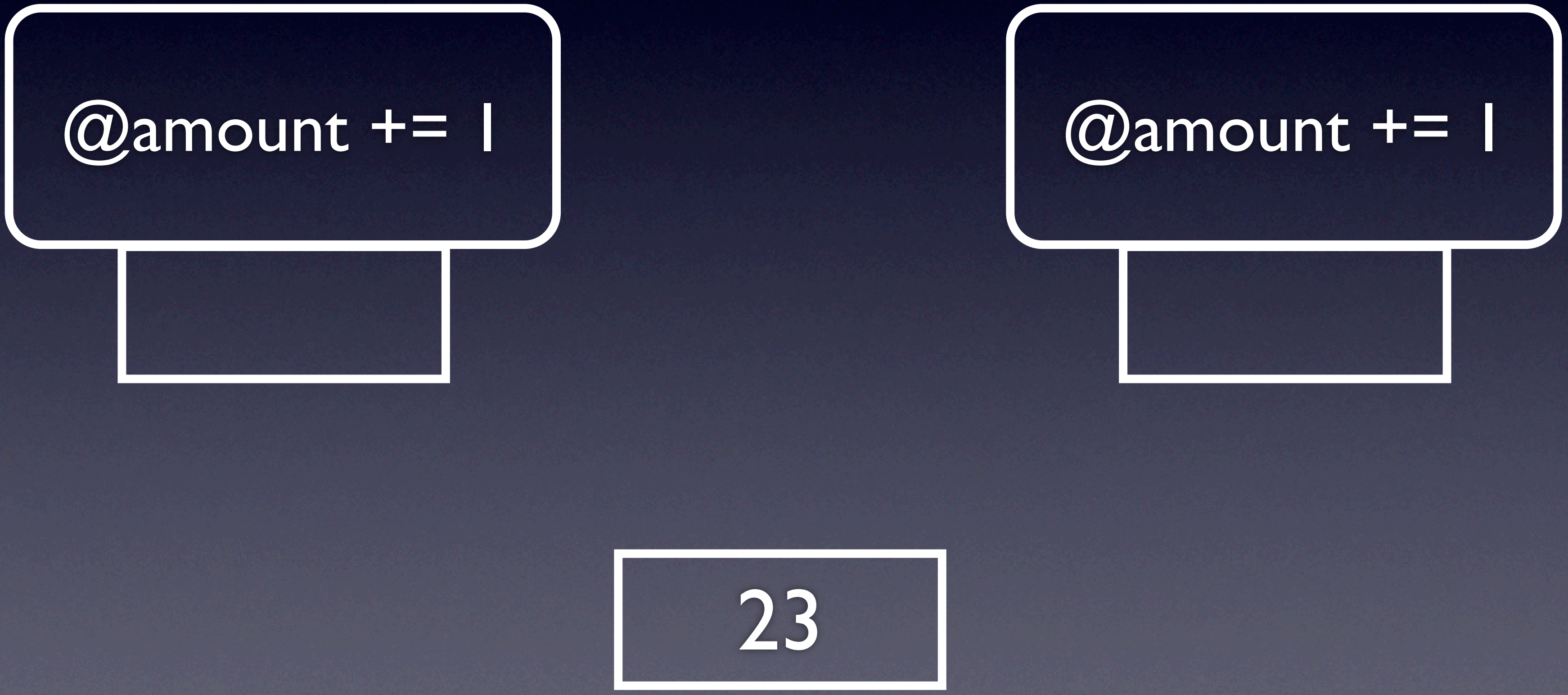
```
def check_sum(digits)
  digits.split(//).
    inject(0) { |r, n| r + n.to_i } % 10
end
```

CoT

```
class Account
  def credit(amount)
    @amount += amount
  end
end
```

```
threads = (0...Threads).map {
  Thread.new do
    A.credit(1)
  end
}
```

The Setup

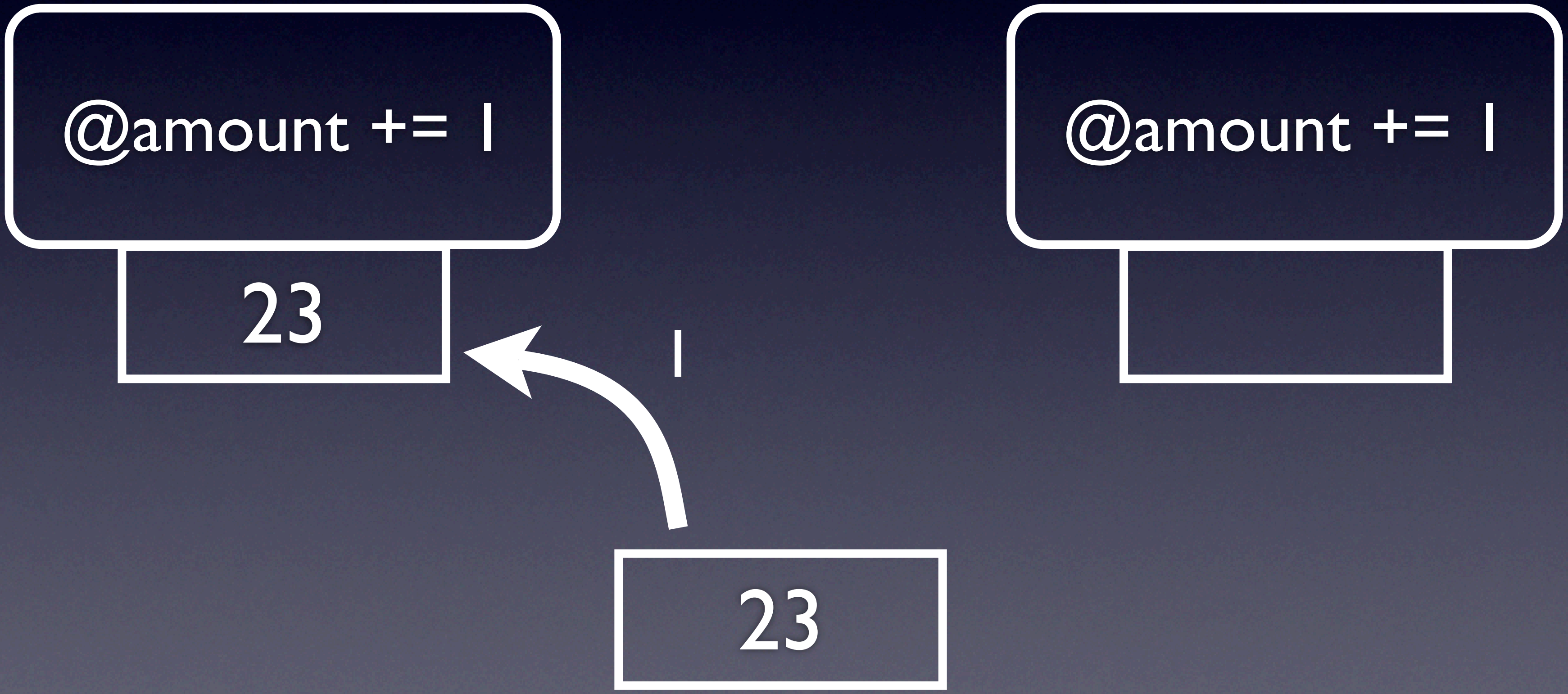


@amount += 1

@amount += 1

23

Step 1



@amount += 1

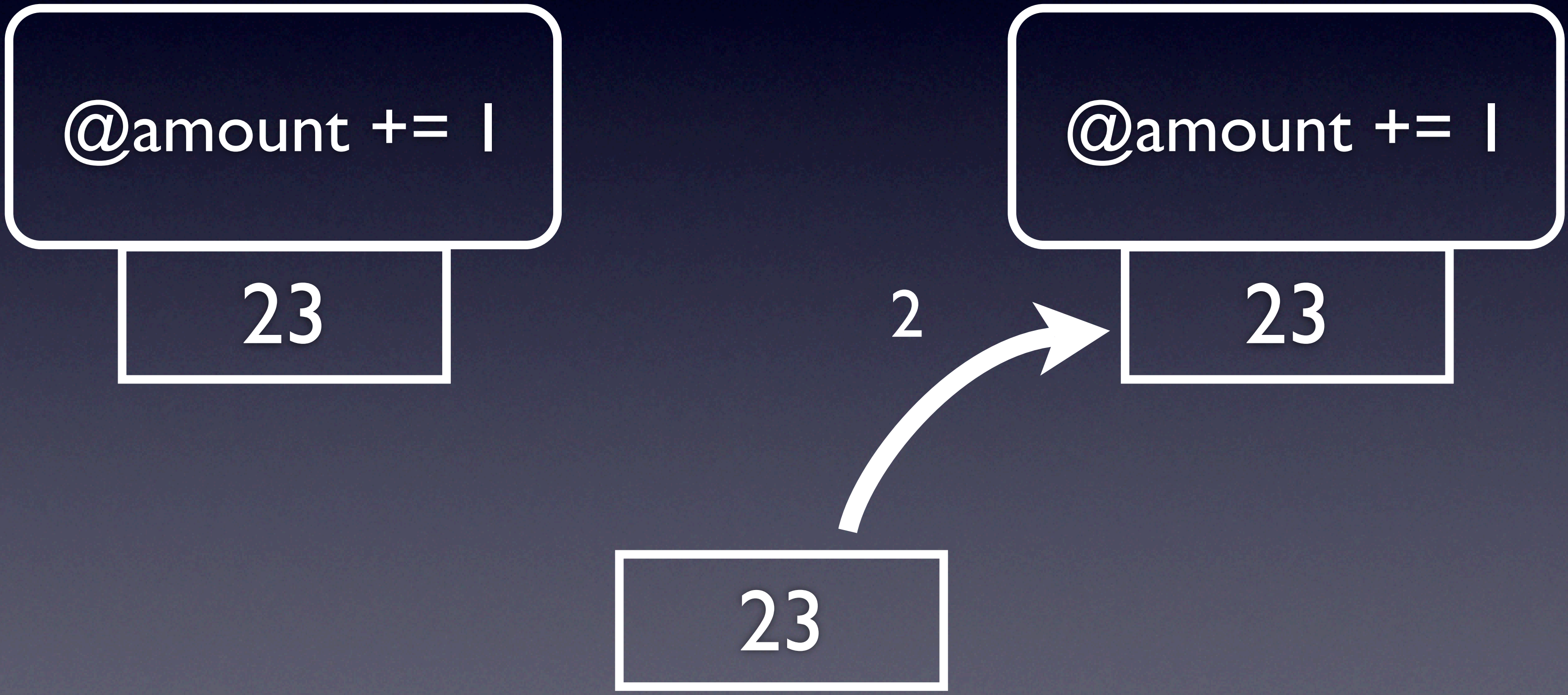
23

1

@amount += 1

23

Step 2



@amount += 1

23

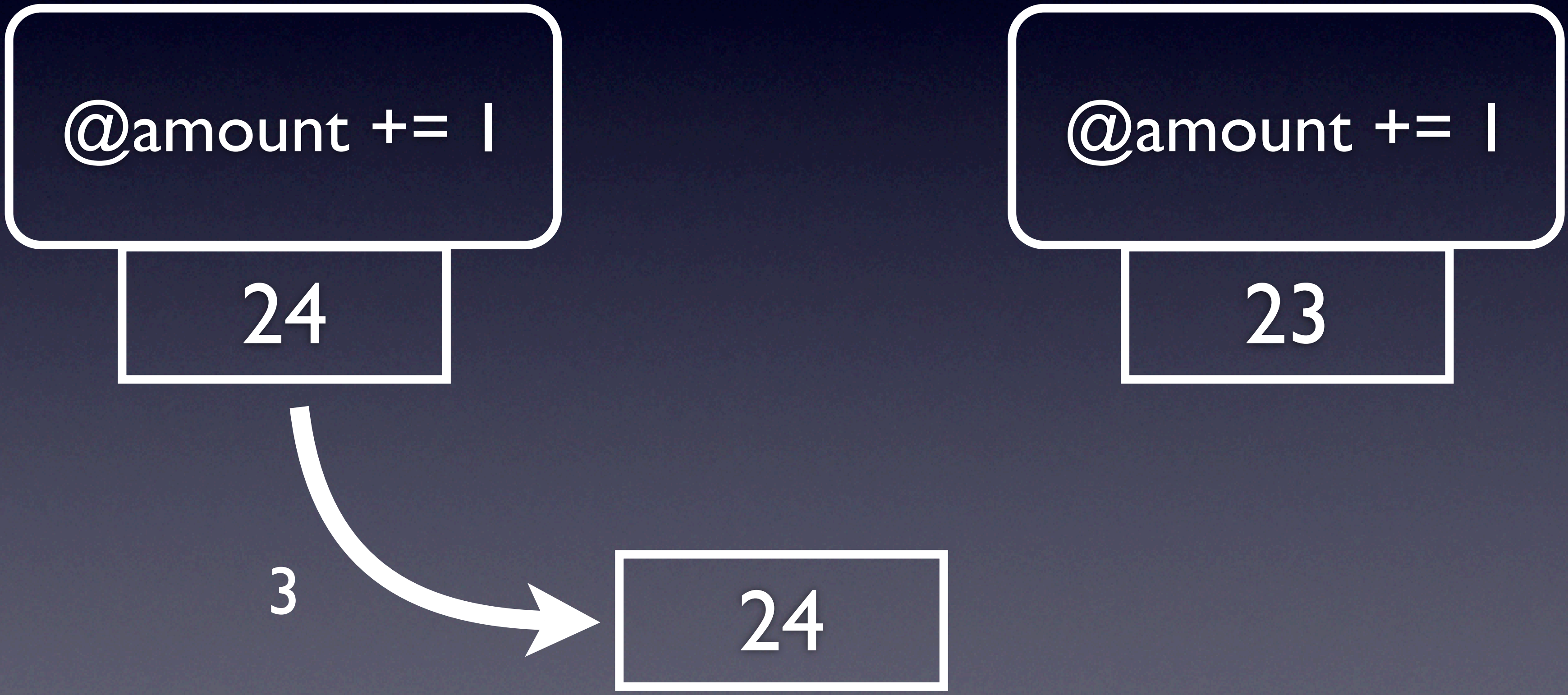
@amount += 1

2

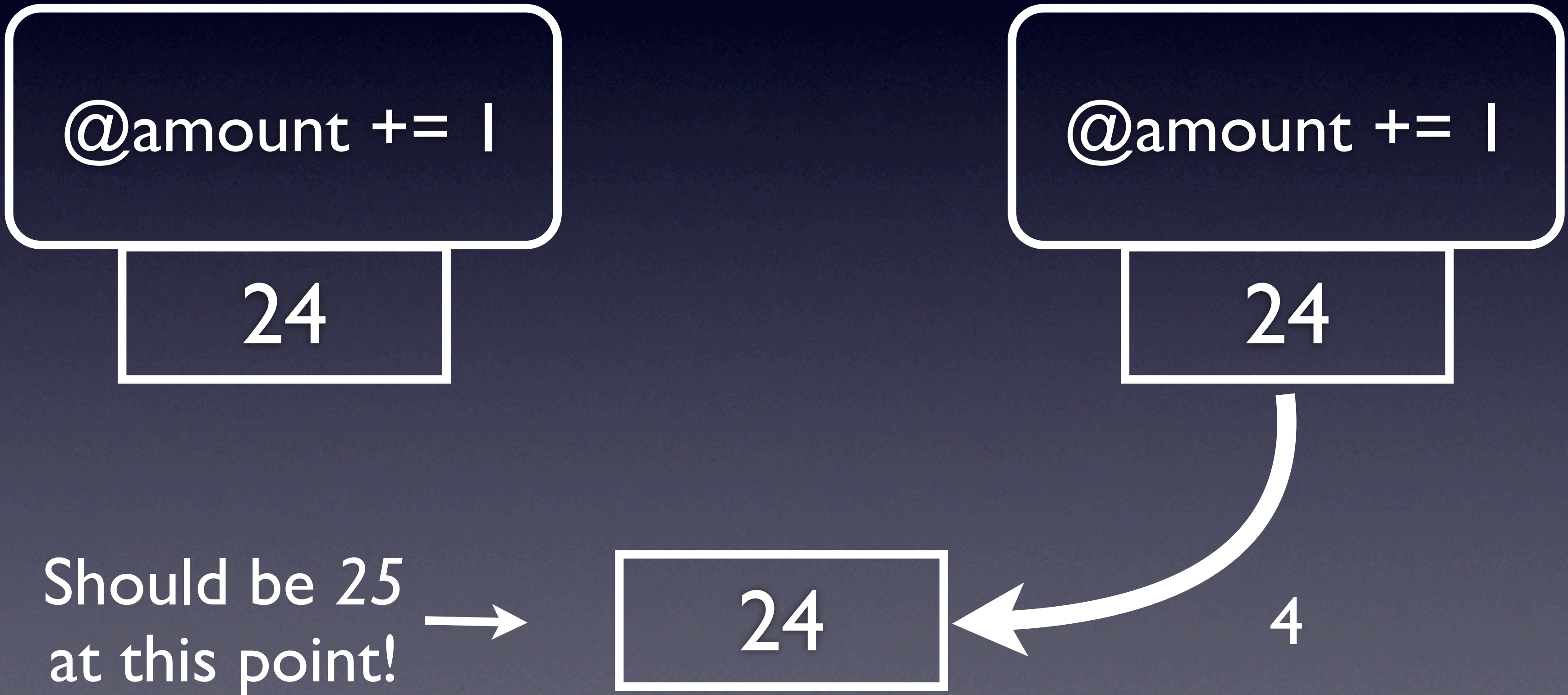
23

23

Step 3



Step 4



@amount += 1

24

@amount += 1

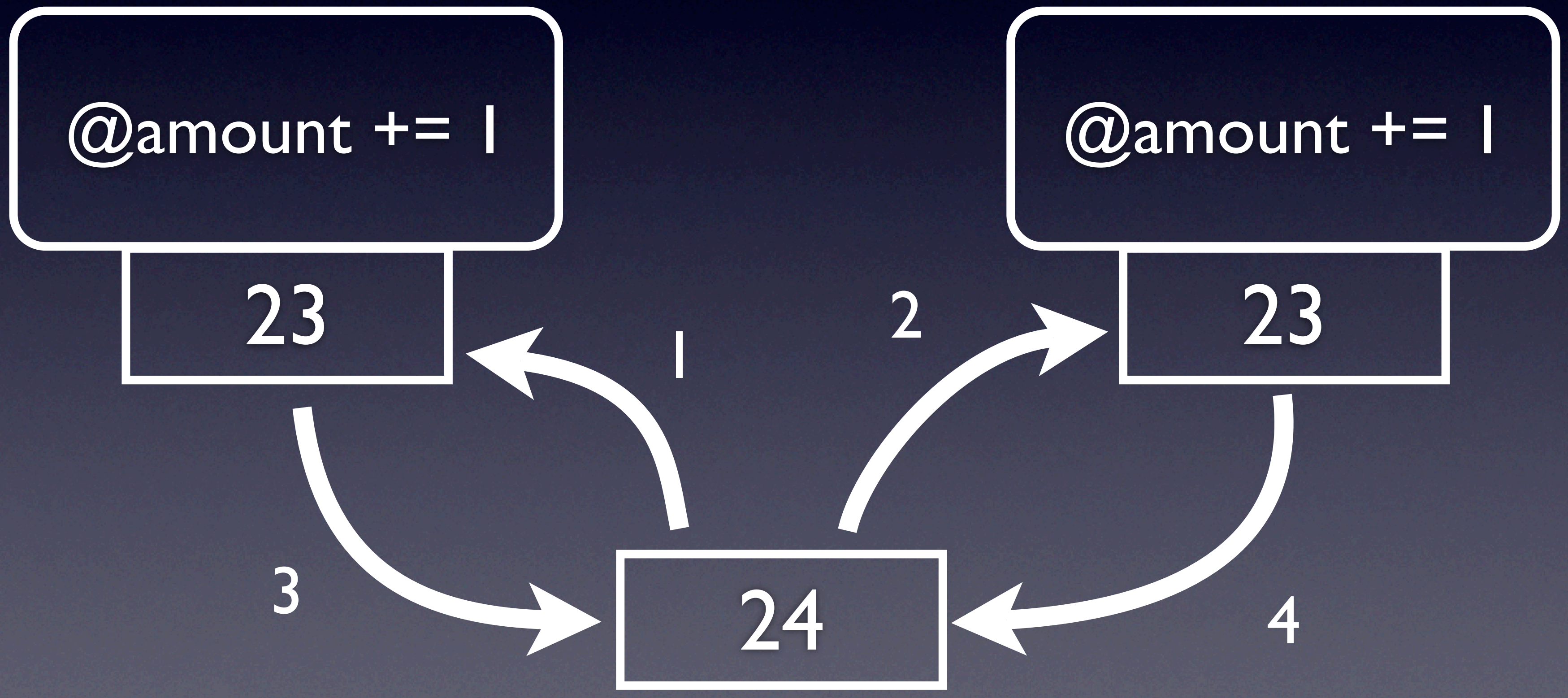
24

Should be 25 at this point!

24

4

Race Condition



@amount += 1

@amount += 1

23

23

1

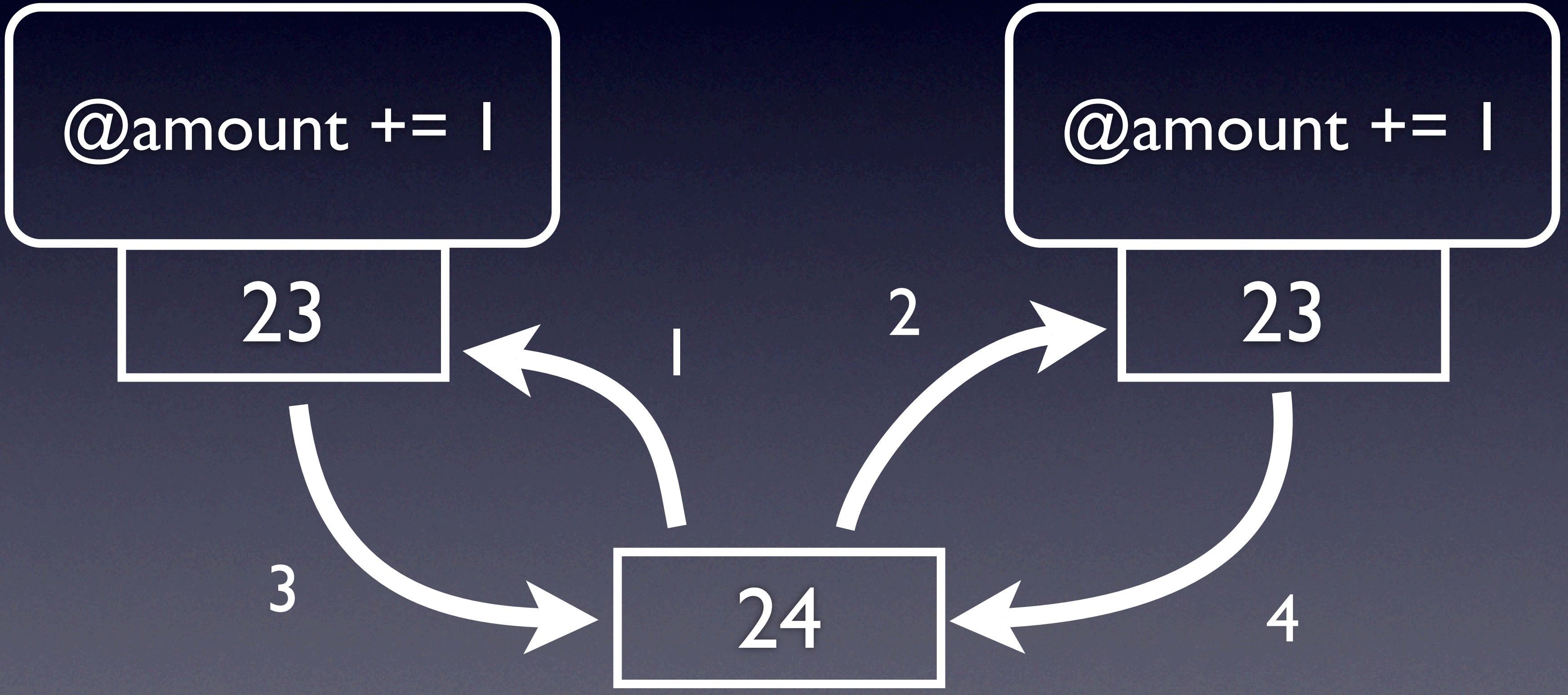
2

3

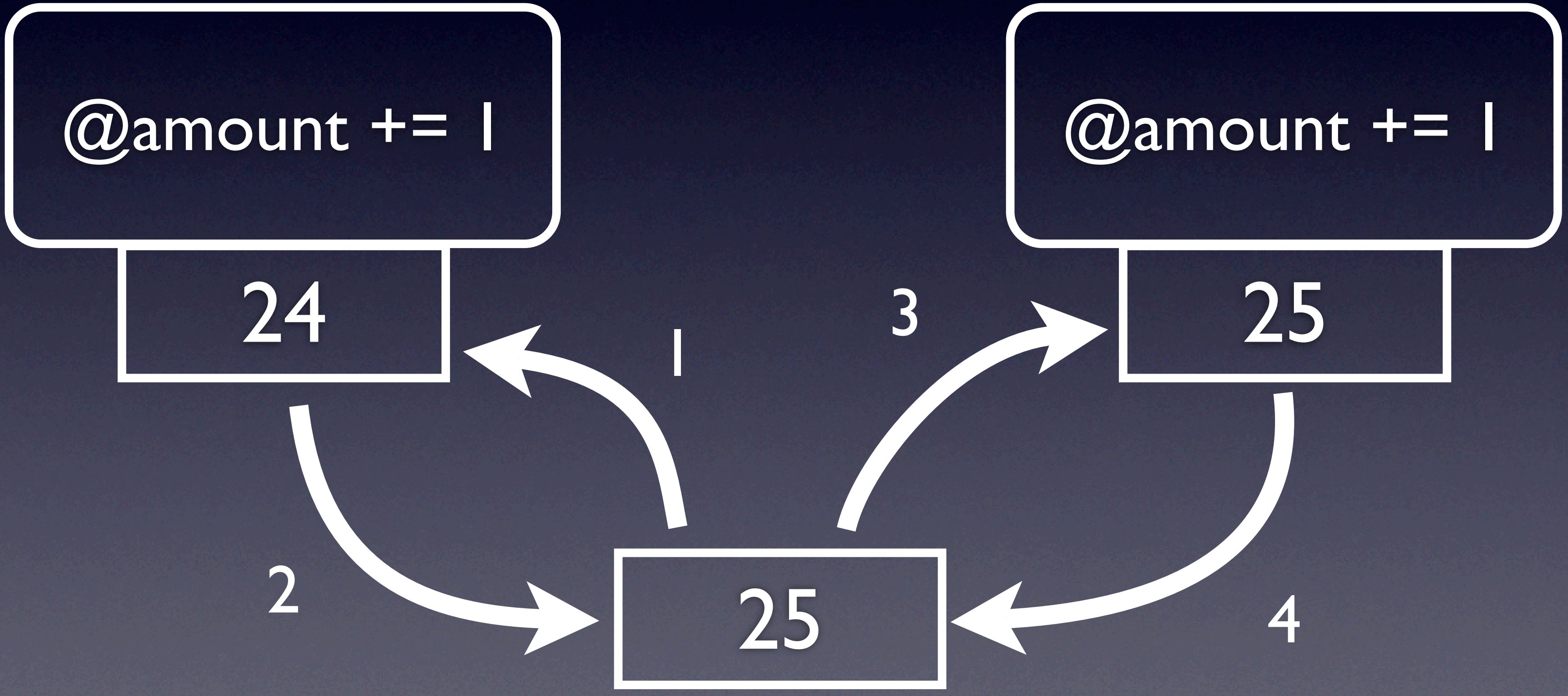
24

4

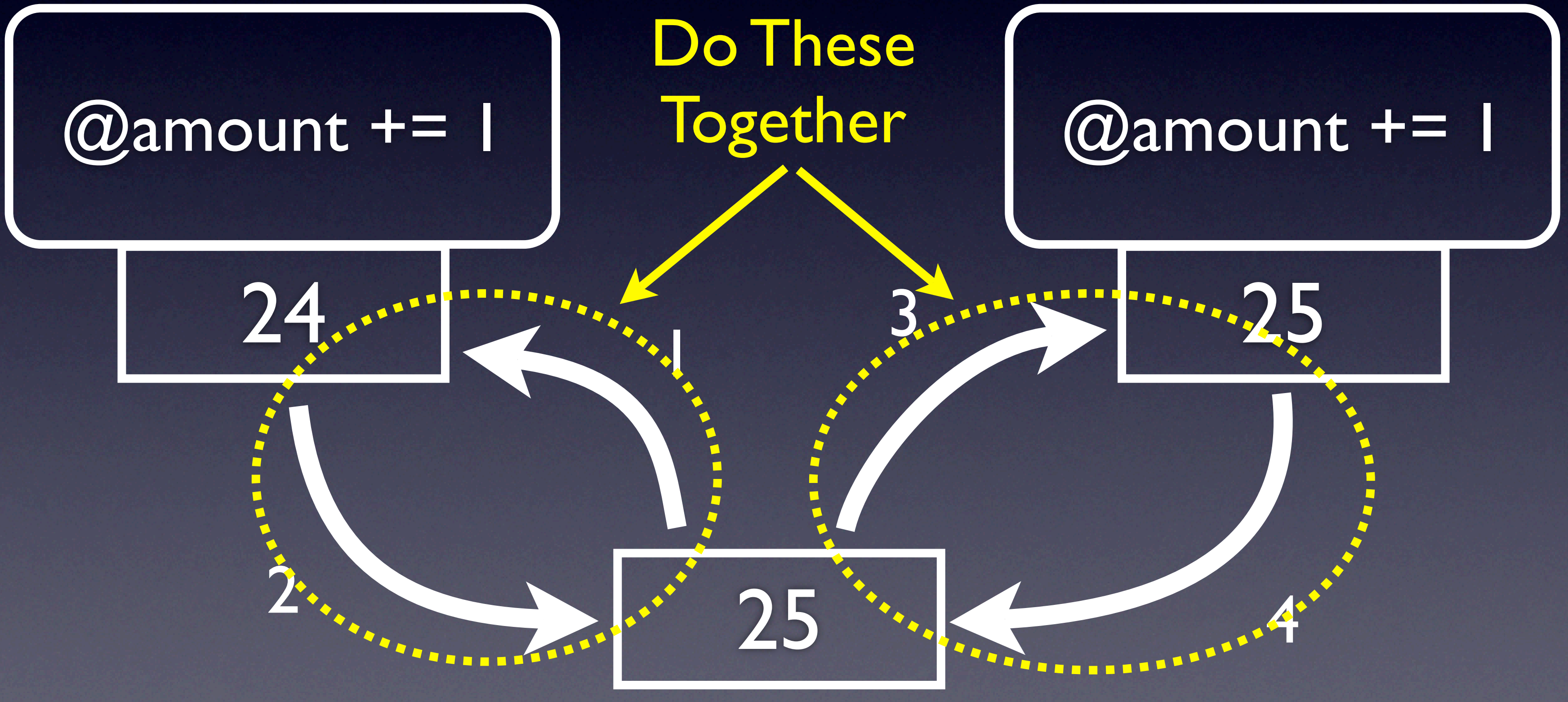
Connascence of Timing



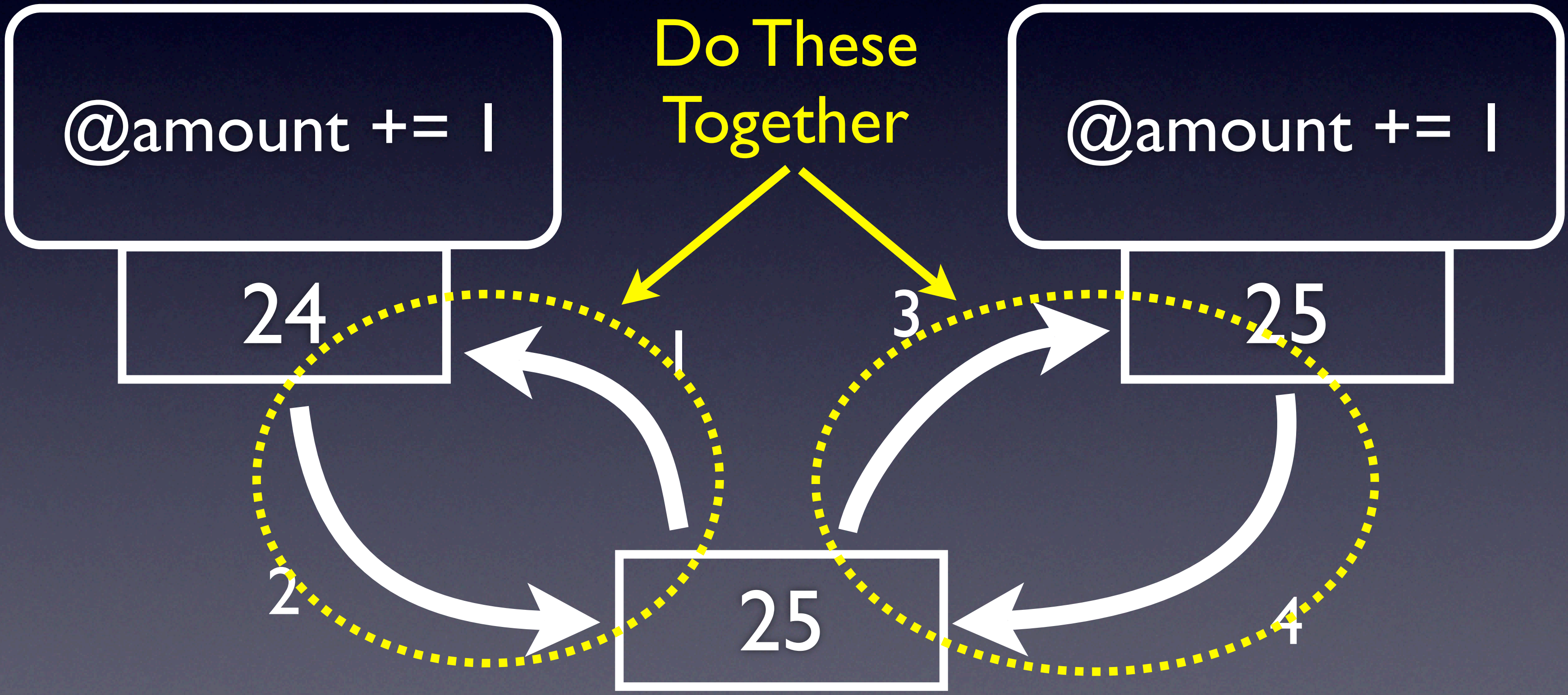
Reordering Steps



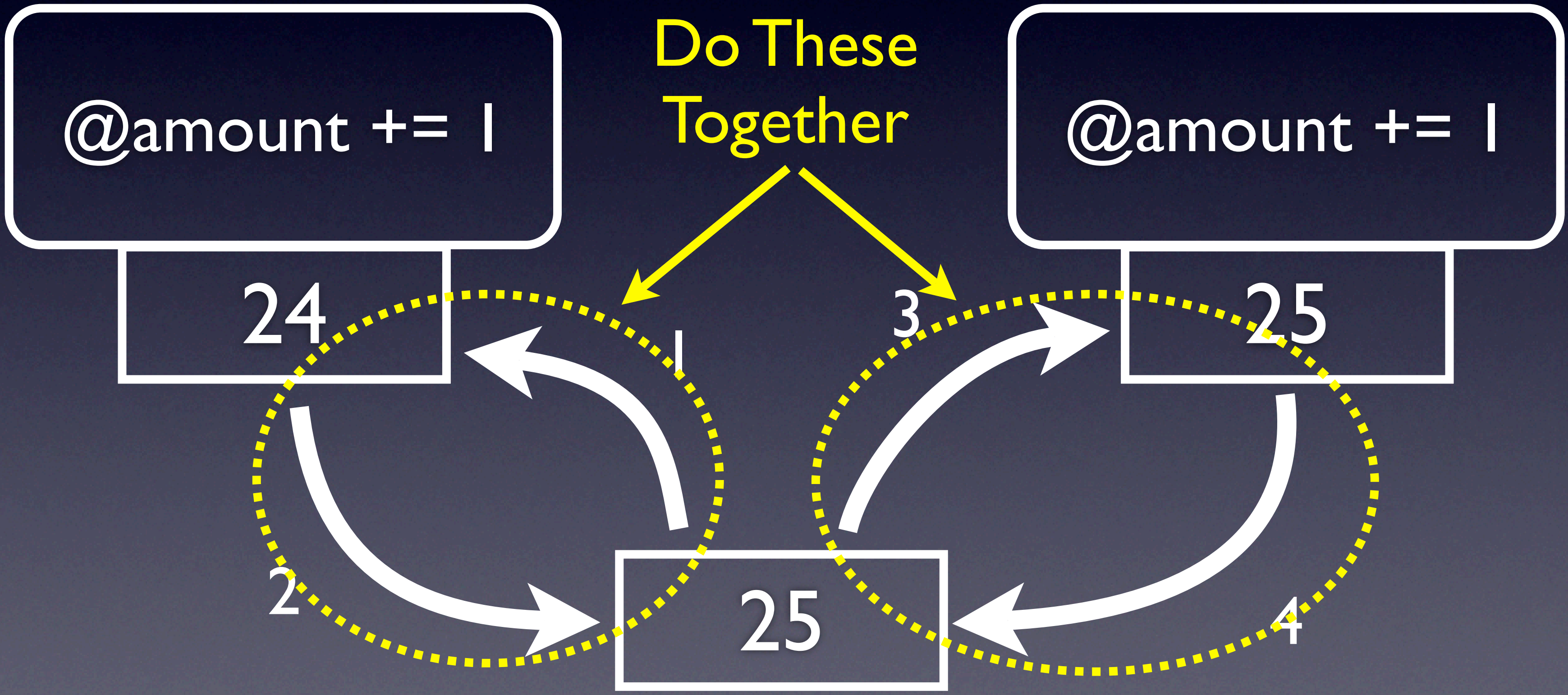
Mutual Exclusion



Connascence of Timing



Connascence of Timing



@amount += 1

Do These Together

@amount += 1

24

25

25

1

2

3

4

```
m = Mutex.new
threads = (0...Threads).map {
  Thread.new do
    m.synchronize do
      A.credit(1)
    end
  end
}
```

Summary

Connascence

- Static
  - Connascence of Name
  - Connascence of Type
  - Connascence of Meaning
  - Connascence of Algorithm
  - Connascence of Position

- Dynamic
  - Connascence of Execution
  - Connascence of Timing
  - Connascence of Value
  - Connascence of Identity
- Contranascence

Rules

- Rule of Locality
- Rule of Degree

References

- *What Every Programmer Should Know About Object Oriented Design*, Meilir Page-Jones
- *Fundamentals of Object-Oriented Design in UML*, Meilir Page-Jones
- *Composite/Structured Design*, Glenford Myers
- *Reliable Software Through Composite Design*, Glenford Myers
- *Agile Software Development, Principles, Patterns, and Practices*, Robert Martin
- *Object-Oriented Software Construction*, Bertrand Meyer
- *The Pragmatic Programmer: From Journeyman to Master*, Andy Hunt & Dave Thomas

Questions?

Thank You!

git://github.com/jimweirich/presentation_connascence.git