Inheritance Semantics and Method Lookup

Stéphane Ducasse
stephane.ducasse@inria.fr
http://stephane.ducasse.free.fr/

Goal

Inheritance
Method lookup
Self/super difference

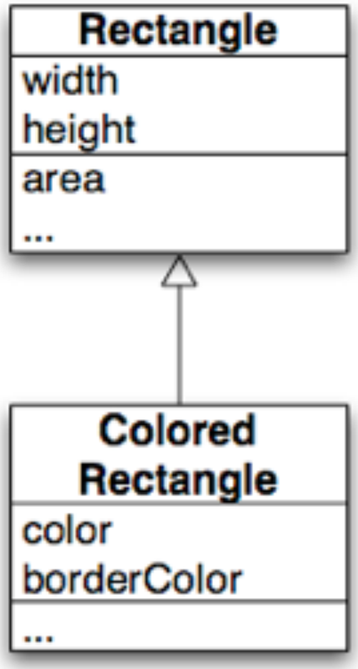
RMod

Inheritance

Do not want to rewrite everything!
Often we want small changes
We would like to reuse and extend existing behavior

Solution: class inheritance

Each class defines or refines the definition of its ancestors



Inheritance

- New classes
  - Can add state and behavior:
    - color, borderColor, borderWidth, totalArea
  - Can specialize ancestor behavior
    - intersect:
  - Can use ancestor’s behavior and state
  - Can redefine ancestor’s behavior
    - area to return totalArea

Inheritance

Single inheritance

Static for the instance variables

At class creation time the instance variables are collected from the superclasses and the class. No repetition of instance variables.

Dynamic for the methods

Late binding (all virtual) methods are looked up at run-time depending on the dynamic type of the receiver.

Message Sending

receiver selector args

Sending a message = looking up the method that should be executed and executing it

Looking up a method: When a message (receiver selector args) is sent, the method corresponding to the message selector is looked up through the inheritance chain.

Method Lookup

Two steps process

1: The lookup starts in the *CLASS* of the *RECEIVER*.

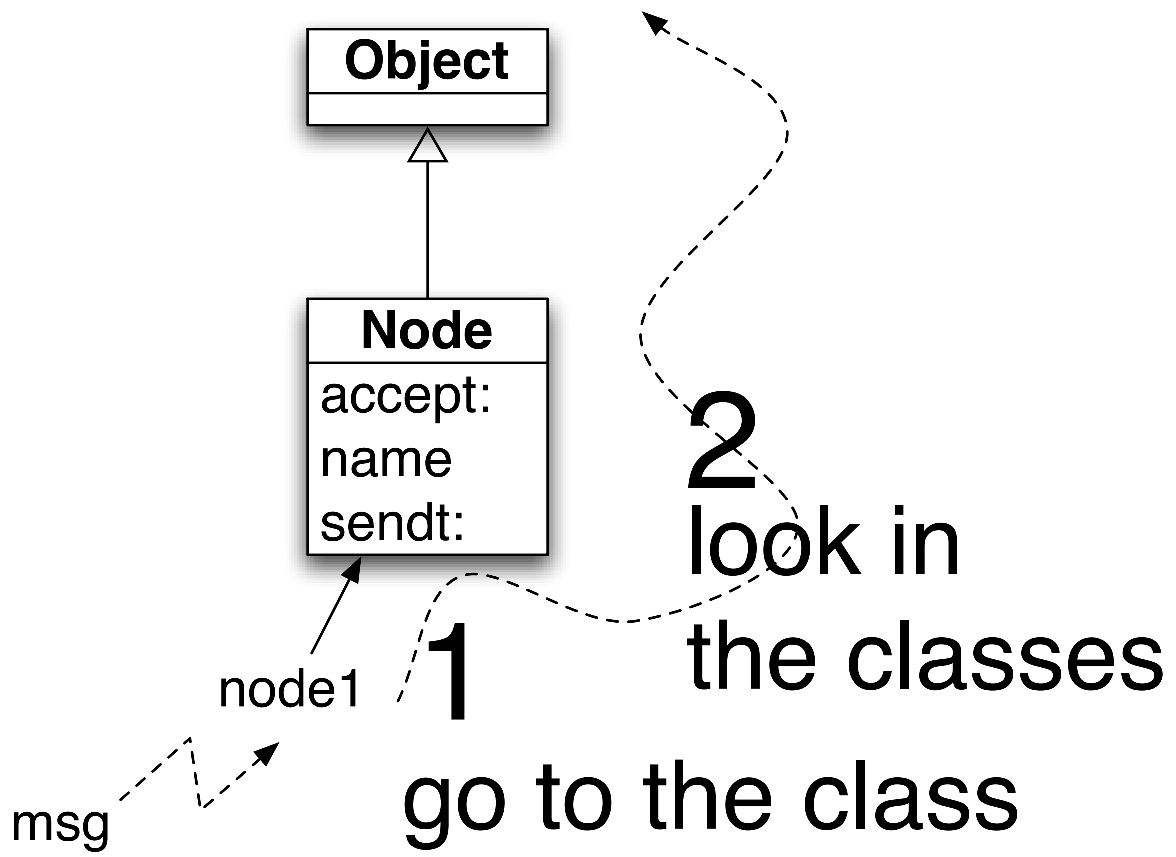
2: If the method is defined in the method dictionary, it is returned.

3: Otherwise the search continues in the superclasses of the receiver's class. If no method is found and there is no superclass to explore (class Object), this is an ERROR

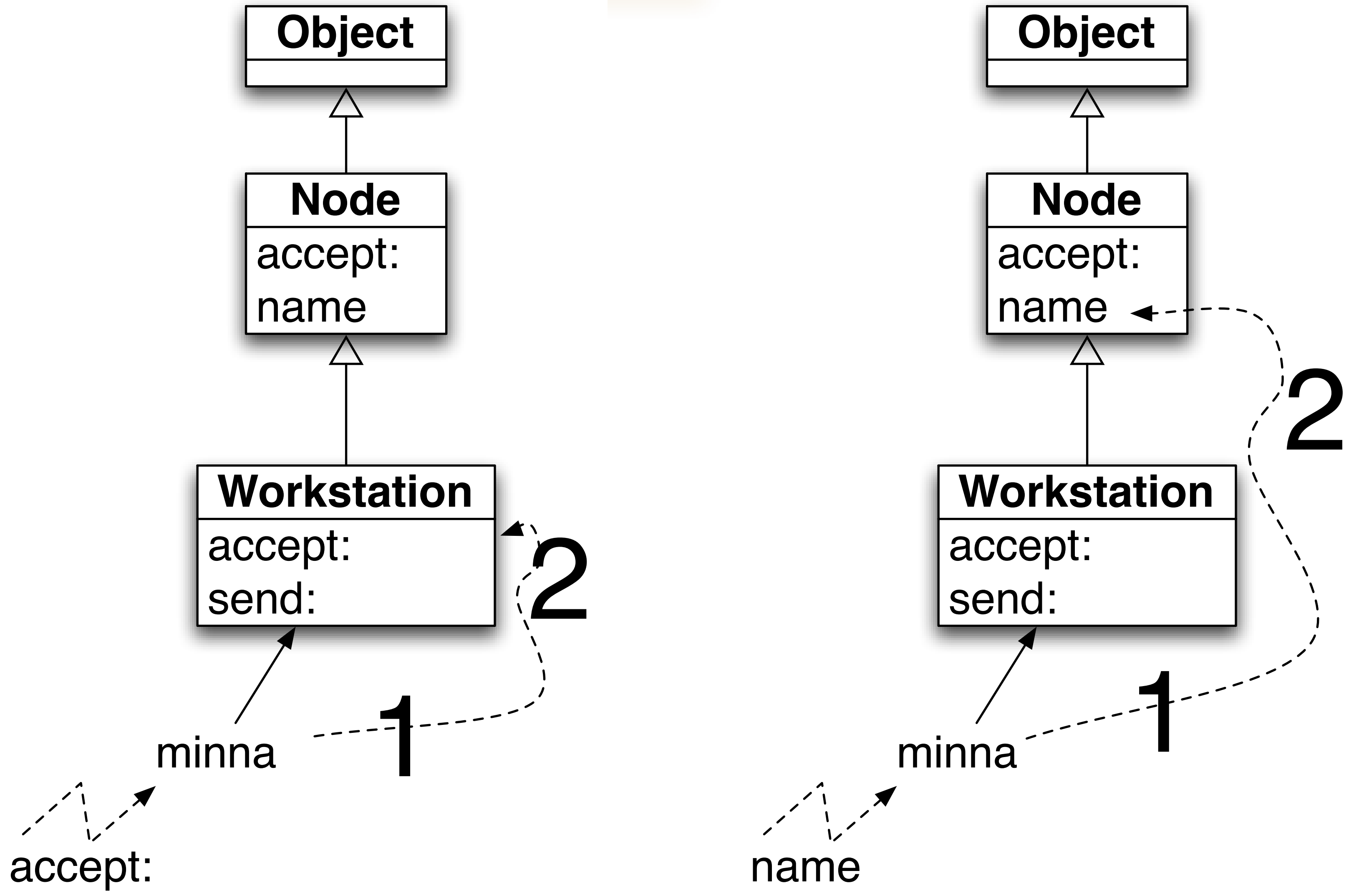
self/this

self represents the receiver of the message, the method lookup starts in the class of the receiver

Lookup: class and inheritance



Some Cases


Object
Node
accept:
name
Workstation
accept:
send:
minna
accept:
1
2
Object
Node
accept:
name
Workstation
accept:
send:
minna
name
1
2

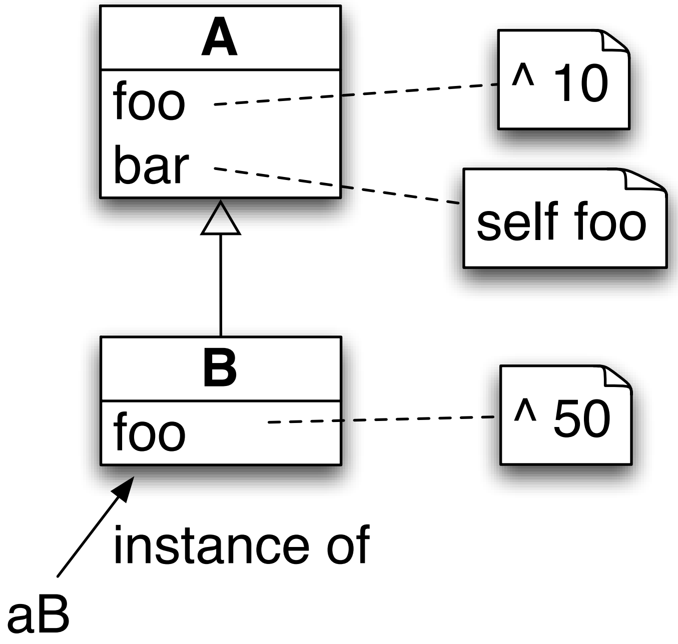
Method Lookup starts in Receiver Class

A new foo

B new foo

A new bar

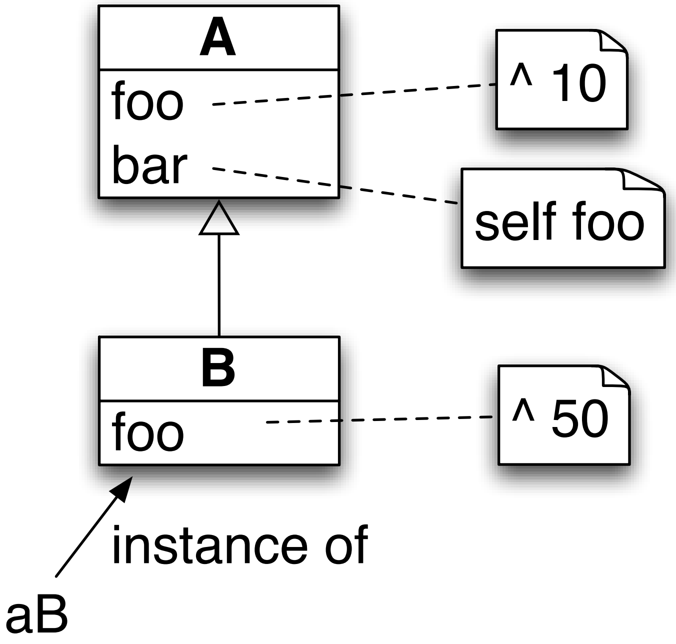
B new bar



Method Lookup starts in Receiver Class

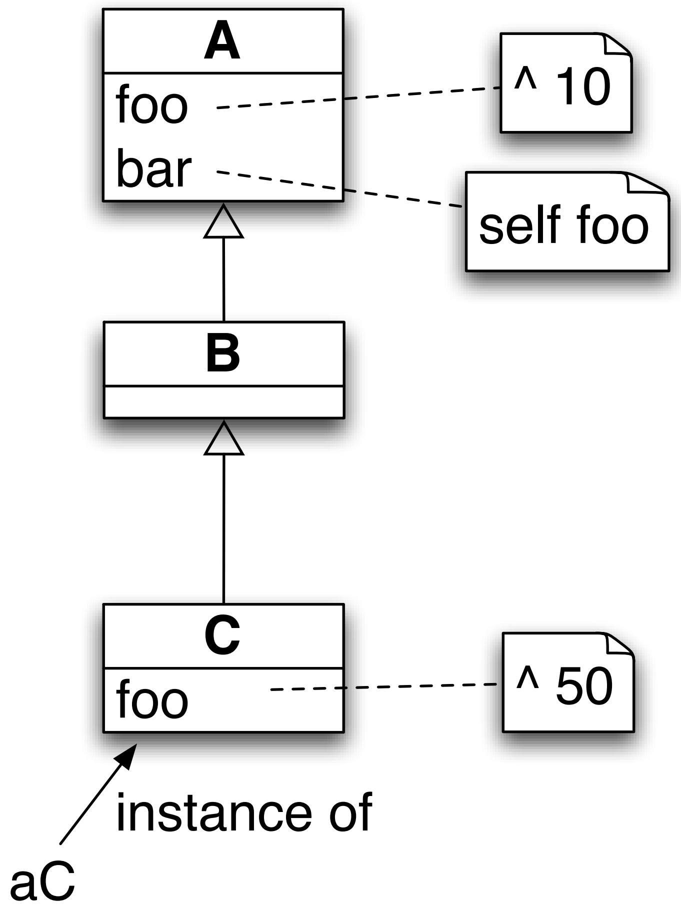
aB foo
(1) aB class => B
(2) Is foo defined in B?
(3) Foo is executed -> 50

aB bar
(1) aB class => B
(2) Is bar defined in B?
(3) Is bar defined in A?
(4) bar executed
(5) Self class => B
(6) Is foo defined in B
(7) Foo is executed -> 50



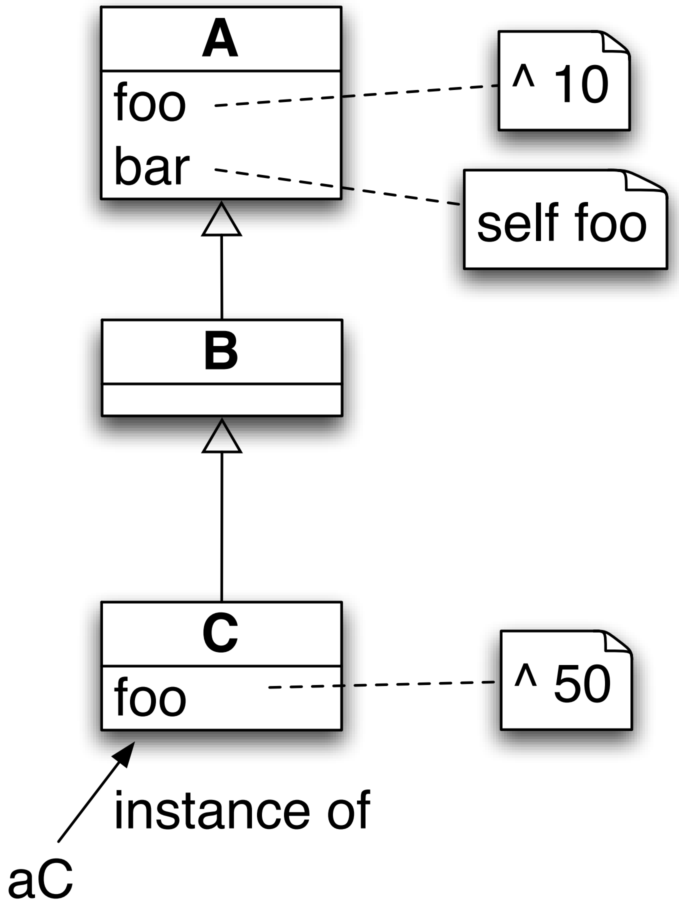
self **always** represents the receiver

- A new foo
- ->
- B new foo
- ->
- C new foo
- ->
- A new bar
- ->
- B new bar
- ->
- C new bar



self **always** represents the receiver

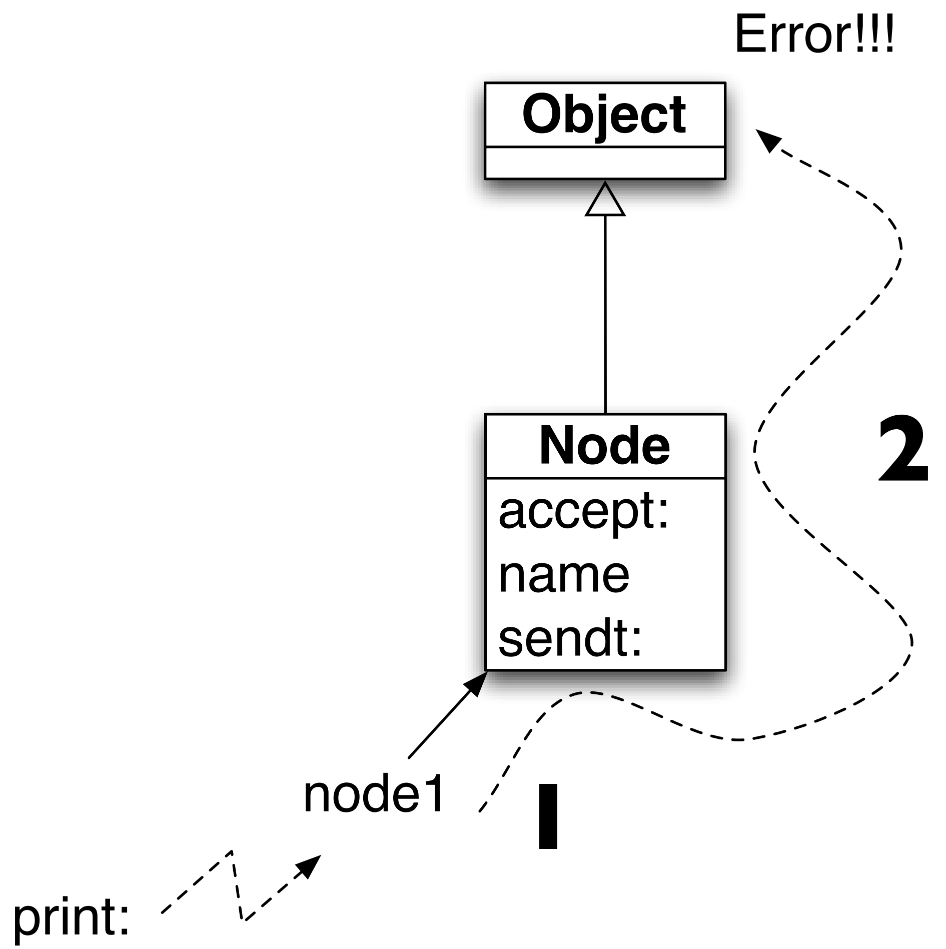
- A new foo
- -> 10
- B new foo
- -> 10
- C new foo
- -> 50
- A new bar
- -> 10
- B new bar
- -> 10
- C new bar
- -> 50



When message is not found

- If no method is found and there is no superclass to explore (class Object), a new method called #doesNotUnderstand: is sent to the receiver, with a representation of the initial message.

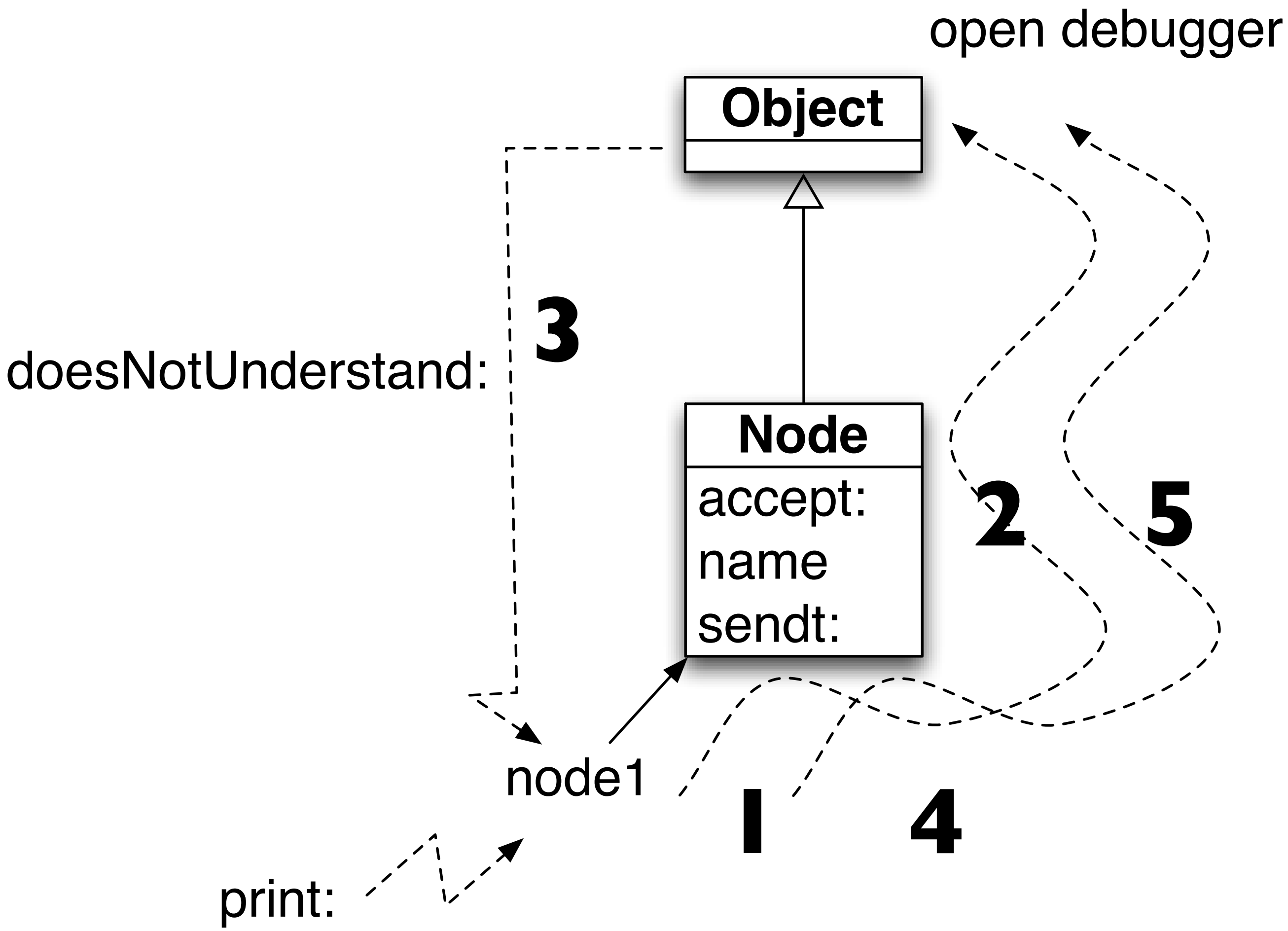
Graphically…



…in Smalltalk

- node1 print: aPacket
  - node is an instance of Node
  - print: is looked up in the class Node
  - print: is not defined in Node > lookup continues in Object
  - print: is not defined in Object => lookup stops + exception
  - message: node1 doesNotUnderstand: #(#print aPacket) is executed
  - node1 is an instance of Node so doesNotUnderstand: is looked up in the class Node
  - doesNotUnderstand: is not defined in Node => lookup continues in Object
  - doesNotUnderstand: is defined in Object => lookup stops + method executed (open a dialog box)

Graphically...



Roadmap

Inheritance
Method lookup
Self/super difference

S.Ducasse

RMod

How to Invoke Overridden Methods?

- Solution: Send messages to super

```
 Workstation>>accept: aPacket
      (aPacket isAddressedTo: self)
          ifTrue:[Transcript show: 'Accepted by the Workstation ', self name asString]
      ifFalse: [super accept: aPacket]
```

- Design Hint: Do not send messages to super with different selectors than the original one. It introduces implicit dependency between methods with different names.

The semantics of super

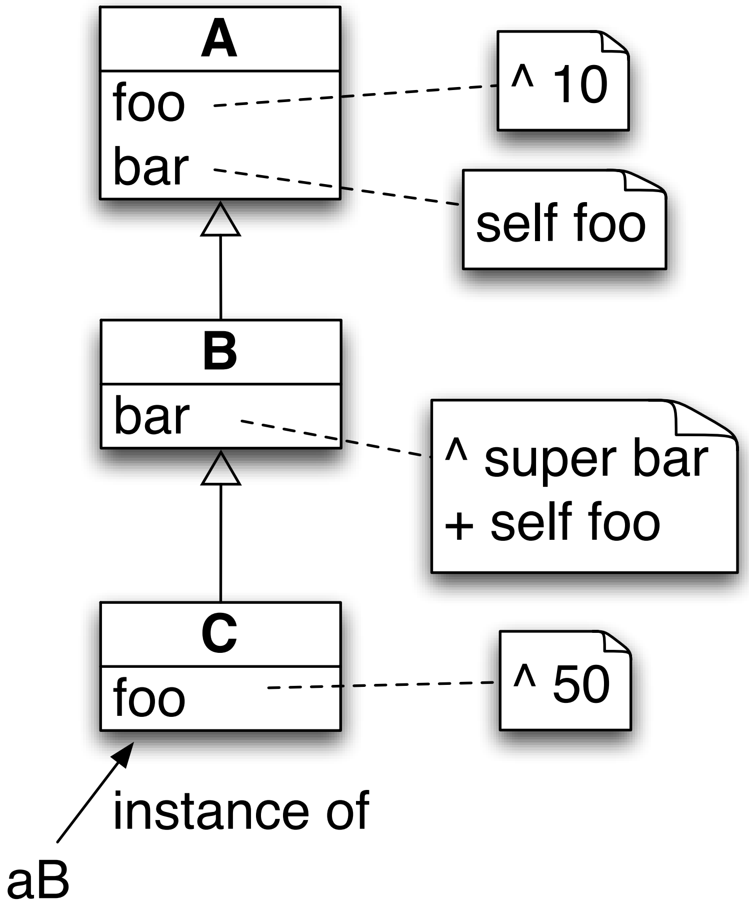
- Like self, ***super*** is a pseudo-variable that refers to the ***receiver*** of the message.
- super is used to invoke overridden methods.

- Using self, the lookup of the method begins in the class of the receiver.

- Using super, the lookup of the method begins in the ***superclass of the class of the method containing*** the super expression

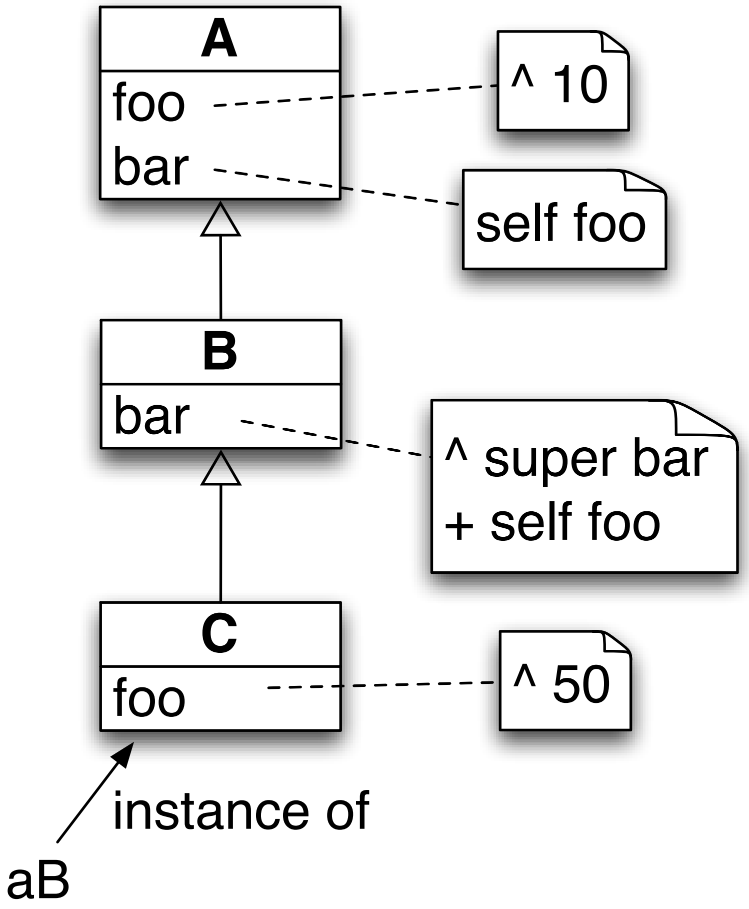
super *changes* lookup starting class

- A new foo
- A new bar
- B new foo
- B new bar
- C new foo
- C new bar

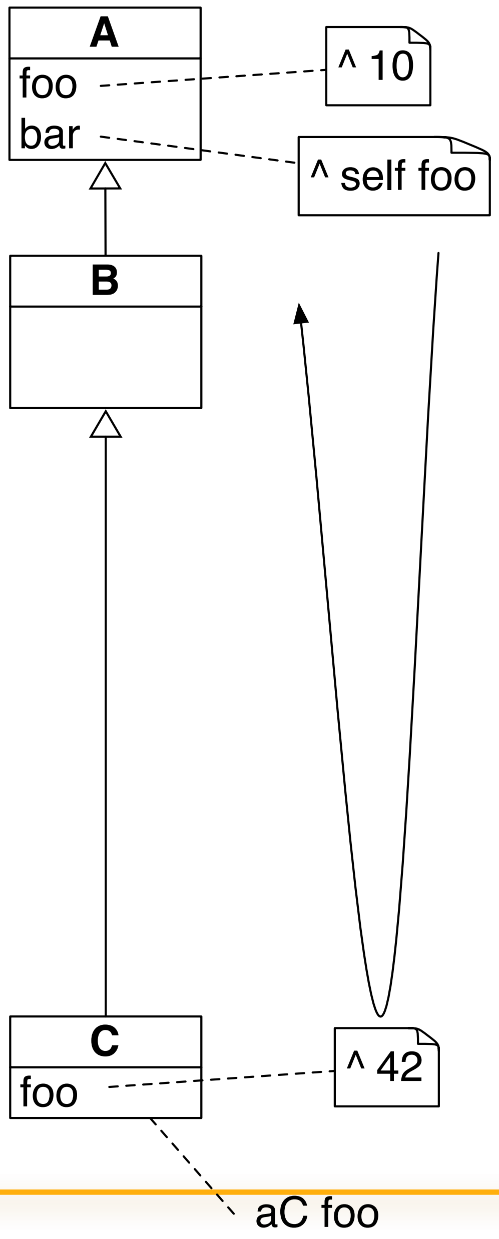


super *changes* lookup starting class

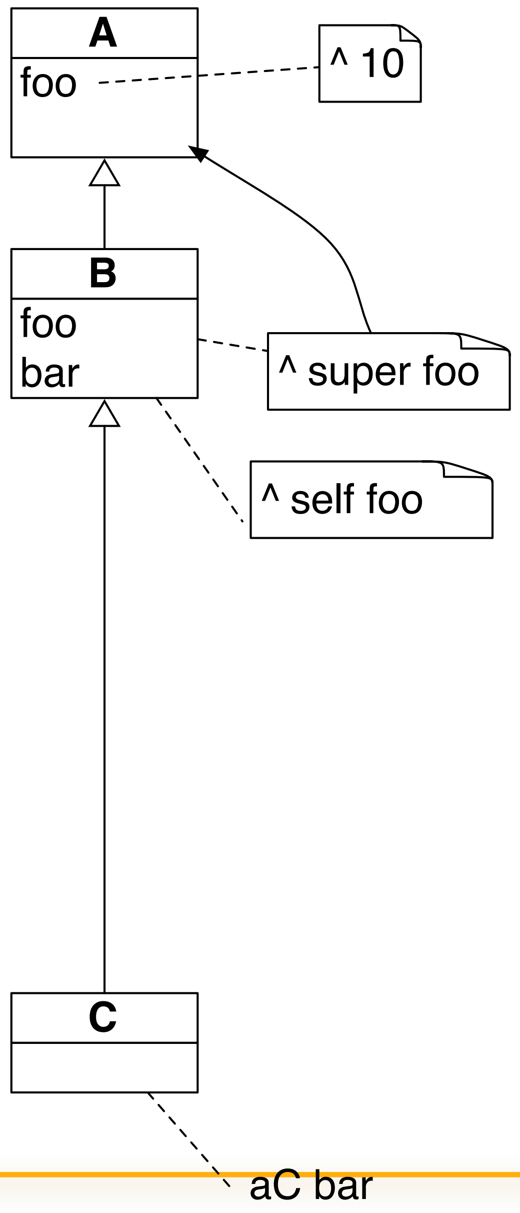
- A new bar
- -> 10
- B new bar
- -> 10 + 10
- C new bar
- -> 50 + 50



self is dynamic



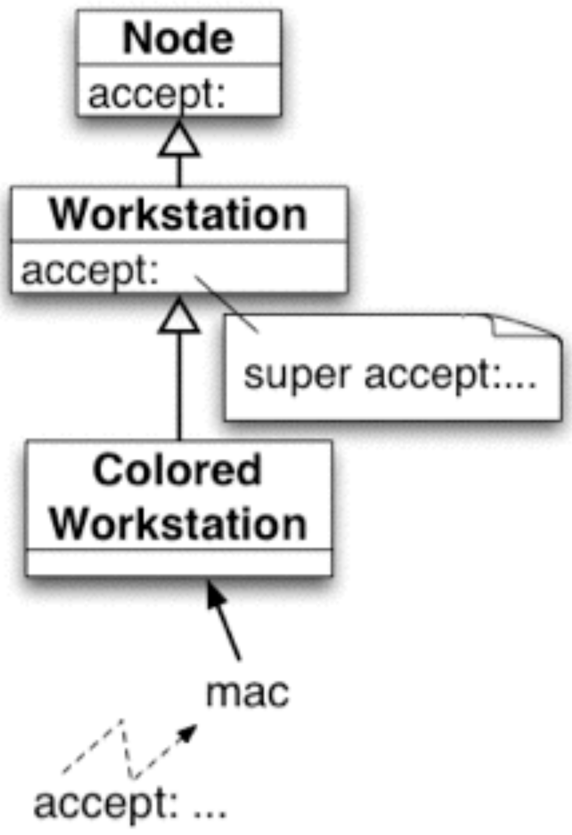
super is static



super is NOT the superclass of the receiver

RMod

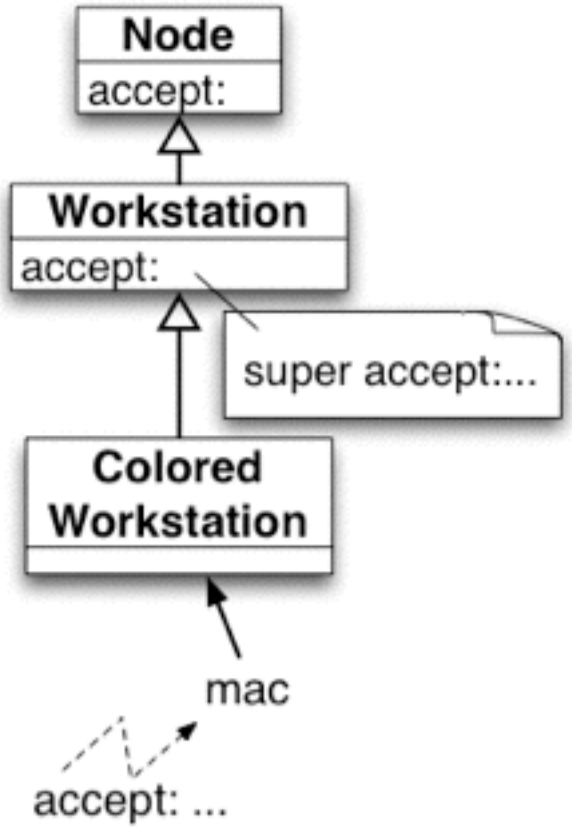
Suppose the WRONG hypothesis: "*The semantics of super is to start the lookup of a method in the superclass of the receiver class*"



super is NOT the superclass of the receiver

mac is instance of ColoredWorkStation
Lookup starts in ColoredWorkStation
Not found so goes up...

accept: is defined in Workstation
    lookup stops
    method accept: is executed
Workstation>>accept: does a super send
Our hypothesis: start in the super of the class of the receiver
=> superclass of class of a ColoredWorkstation is ... **Workstation !**



What you should know

- Inheritance of instance variables is made at class definition time.
- Inheritance of behavior is dynamic.
- self **always** represents the receiver, the method lookup starts in the class of the receiver.
- ***super*** represents the ***receiver*** but method lookup starts in the superclass of the class ***using*** it.
- ***Self is dynamic vs. super is static.***