Abstract Classes

- Should not be instantiated (abstract in Java)
- But can defined complete methods
- Defines a protocol common to a hierarchy of classes that is independent from the representation choices.
- A class is considered as abstract as soon as one of the methods to which it should respond to is not implemented (can be a inherited one).

Abstract Classes in Smalltalk

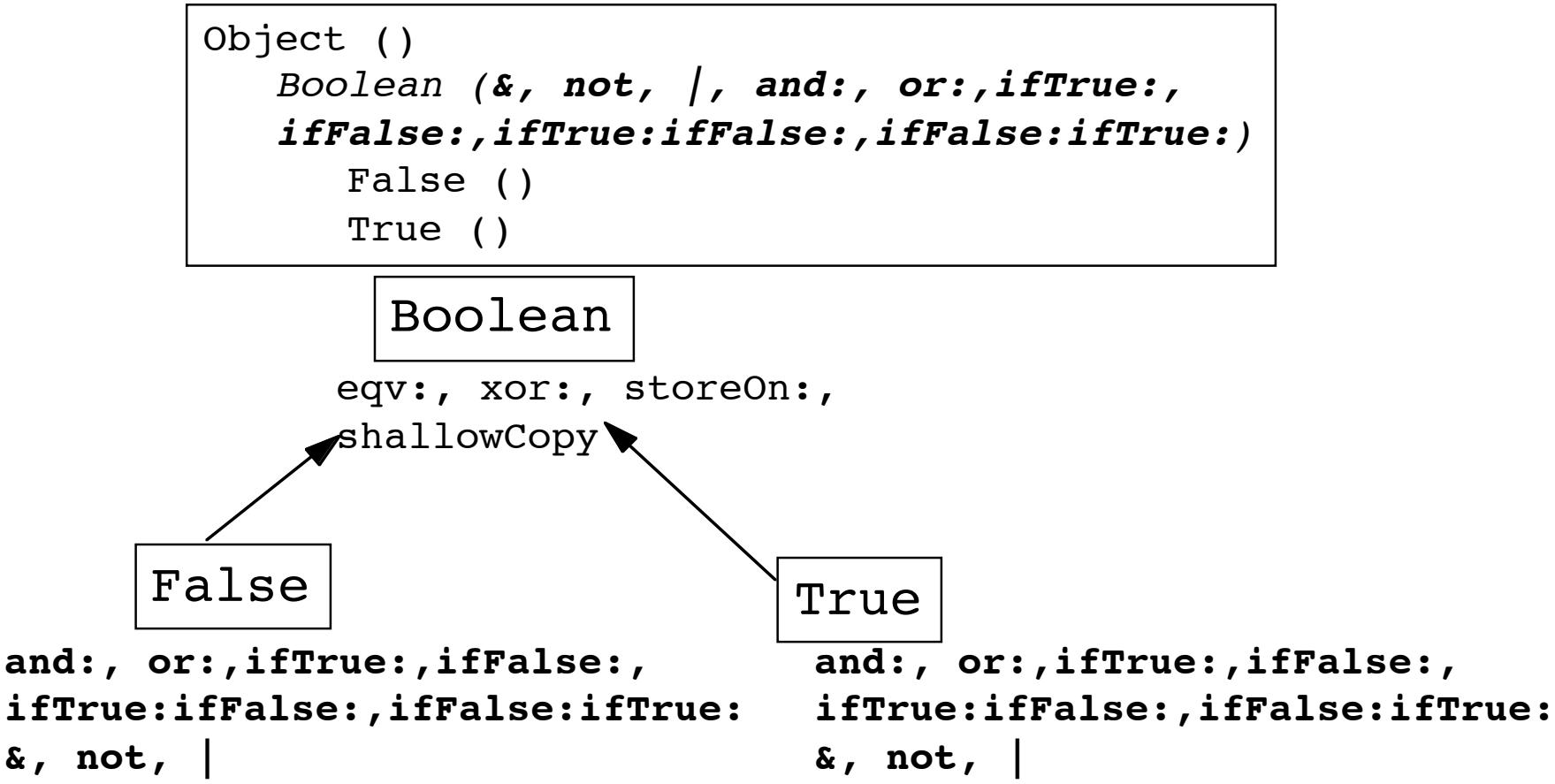
- Depending of the situation, override #new to produce an error.
- No construct: Abstract methods send the message self subclassResponsibility.
- Advanced tools check this situation and exploit it.

Example

- Abstract classes are not syntactically different from instantiable classes, BUT a common convention is to use class comments: So look at the class comment and write in the comment which methods are abstract and should be specialized.

"Class Boolean is an abstract class that implements behavior common to true and false. Its subclasses are True and False. Subclasses must implement methods for logical operations &, not, controlling and:, or:, ifTrue:, ifFalse:, ifTrue:ifFalse:, ifFalse:ifTrue:"

Case Study - Boolean, True, and False



Case Study - Boolean, True, and False (II)

- Abstract method

```
Boolean>>not
  "Negation.  Answer true if the receiver is false, answer false
  if the receiver is true."
  self subclassResponsibility
```

- Concrete method defined in terms of an abstract method

```
Boolean>>xor: aBoolean
  "Exclusive OR.  Answer true if the receiver is not equivalent to
  aBoolean."
  ^(self == aBoolean) not
```

- When #not will be defined, #xor: is automatically defined

Case Study - Boolean, True, and False (III)

```
False>>not
  "Negation -- answer true since the receiver is false."
   ^true
True>>not
  "Negation--answer false since the receiver is true."
  ^false

False>>ifTrue: trueBlock ifFalse: falseBlock
  "Answer the value of falseBlock. This method is typically not invoked
  because ifTrue:/ifFalse: expressions are compiled in-line for literal
  blocks."
  ^falseBlock value
True>>ifTrue: trueBlock ifFalse: falseBlock
  "Answer the value of trueBlock. This method is typically not invoked
  because ifTrue:/ifFalse: expressions are compiled in-line for literal
  blocks."
  ^trueAlternativeBlock value
```

Implementation Note

- Note that the Virtual Machine short cuts calls to boolean such as condition for speed reason

- Virtual machines such as VisualWorks introduced a kind of macro expansion, an optimisation for essential methods and Just In Time (JIT) compilation. A method is executed once and afterwards it is compiled into native code. So the second time it is invoked, the native code will be executed.

Case Study - Magnitude

- 1 > 2 = 2 < 1 = false

```
Magnitude>> < aMagnitude
  ^self subclassResponsibility
Magnitude>> = aMagnitude
  ^self subclassResponsibility
Magnitude>> <= aMagnitude
  ^(self > aMagnitude) not
Magnitude>> > aMagnitude
  ^aMagnitude < self
Magnitude>> >= aMagnitude
  ^(self < aMagnitude) not
Magnitude>> between: min and: max
  ^self >= min and: [self <= max]
```

```
1 <= 2   = (1 > 2) not
         = false not
         = true
```

Case Study - Date

```
Date>>< aDate
  "Answer whether the argument, aDate, precedes the date of
  the receiver."
  year = aDate year
        ifTrue: [^day < aDate day]
        ifFalse: [^year < aDate year]

  Date>>= aDate
   "Answer whether the argument, aDate, is the same day as the
    receiver. "
   self species = aDate species
        ifTrue: [^day = aDate day & (year = aDate year)]
        ifFalse: [^false]

Date>>hash
        ^(year hash bitShift: 3) bitXor: day
```

Date

- Subclass of Magnitude

```
Date today > Date newDay: 15 month: 10 year:
  1998
-> false
```

What you should know

- What is an abstract class?
- What can we do with it?