

Reflection



Episode II

The return of the Java virtual machine



Summary

- Remainder

- Structural / Behavioural
- Comparison between Smalltalk and Java

- Remainder

- Pierre's exercises

- More

- Proxy
- HotSwap
- Blocks
- ...



Structural vs. Behavioural

■ Structural reflection

- Reification of the program being executed
- Reification of the program abstract data types

■ Behavioural reflection

- Reification of the language semantics (its interpreter)
- Reification of the data used to execute the program

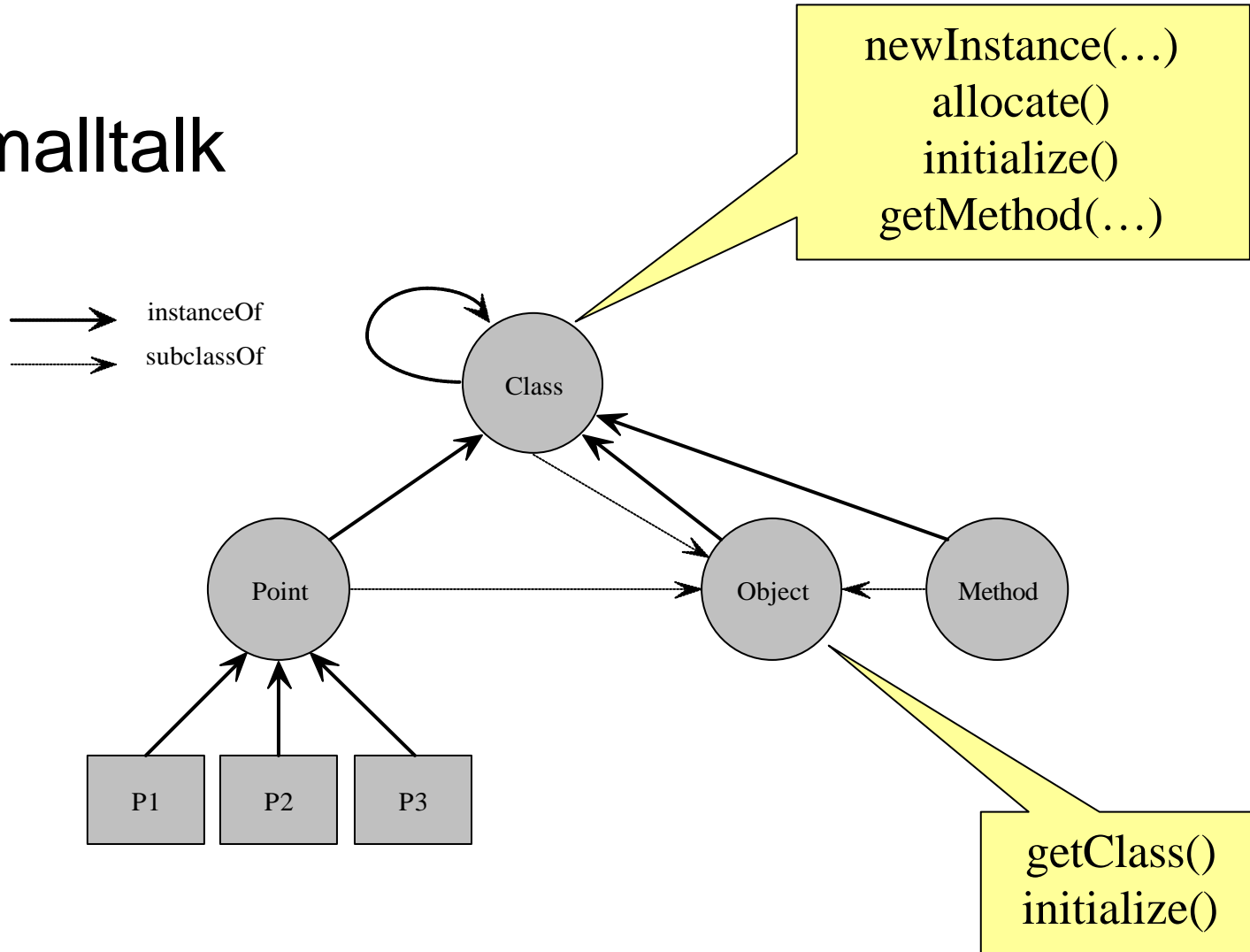


Structural vs. Behavioural

Structural and behavioural
reflection are strongly
coupled!

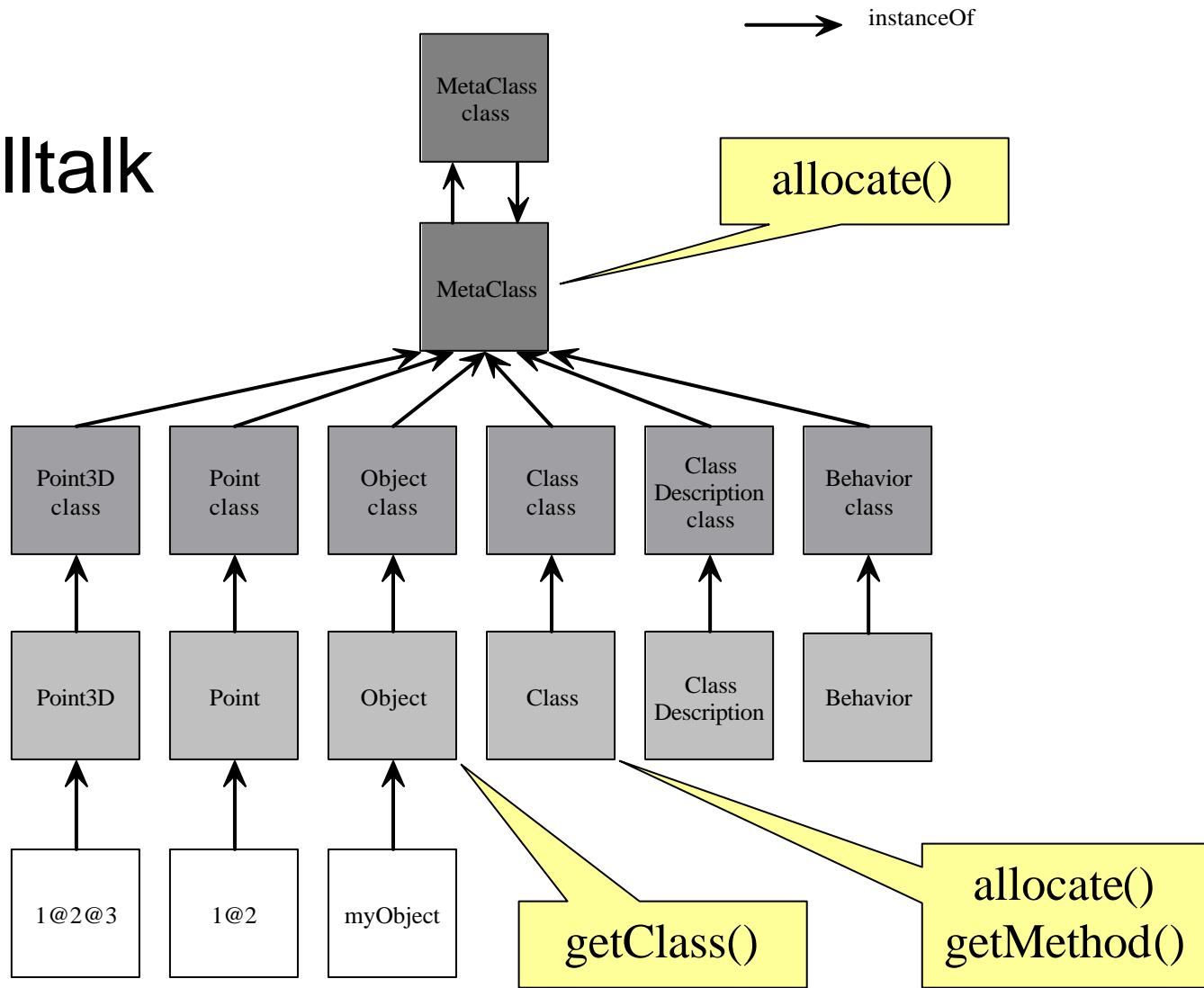
Structural reflection

■ Smalltalk



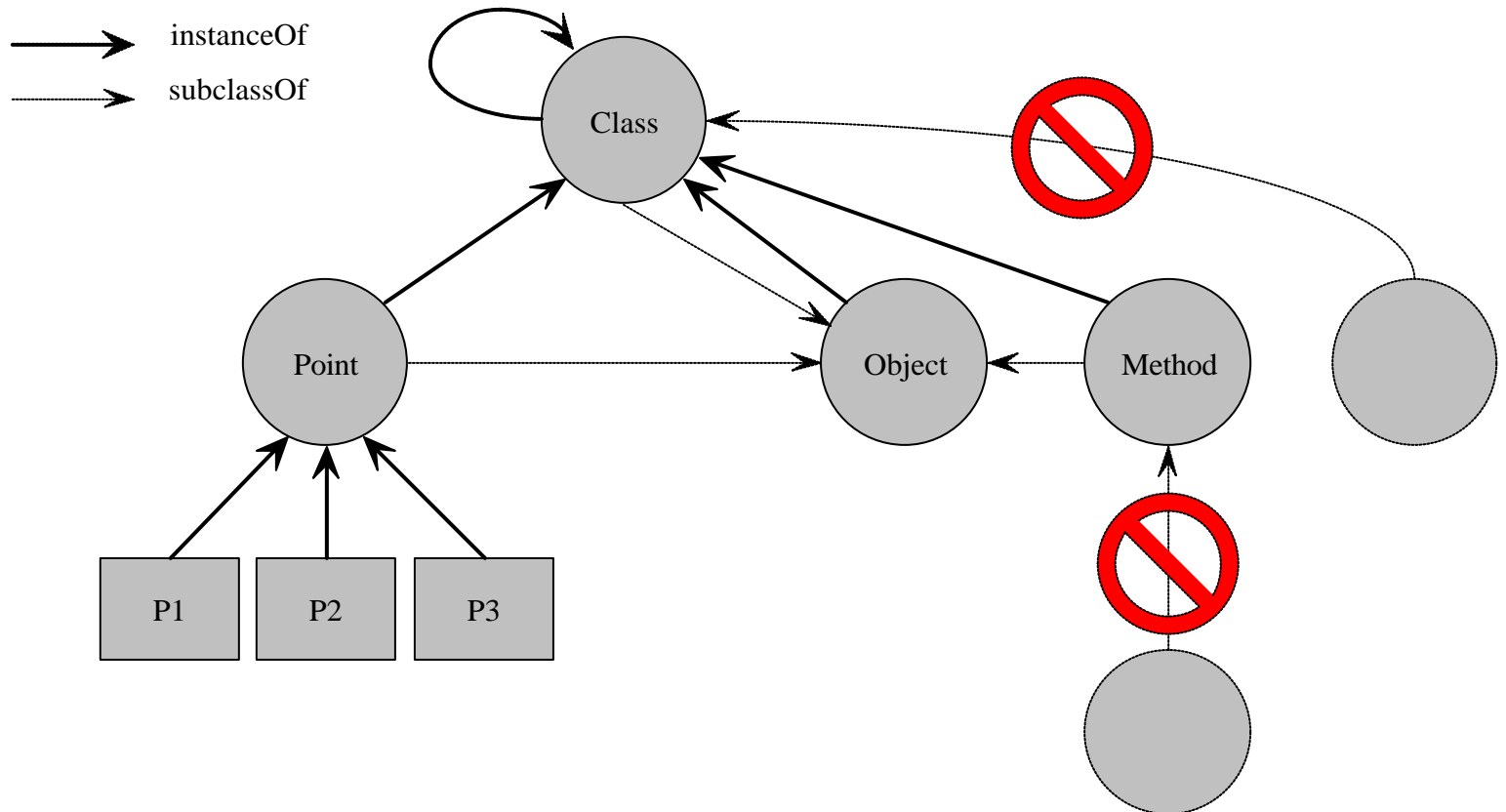
Structural reflection

■ Smalltalk



Structural reflection

■ Java





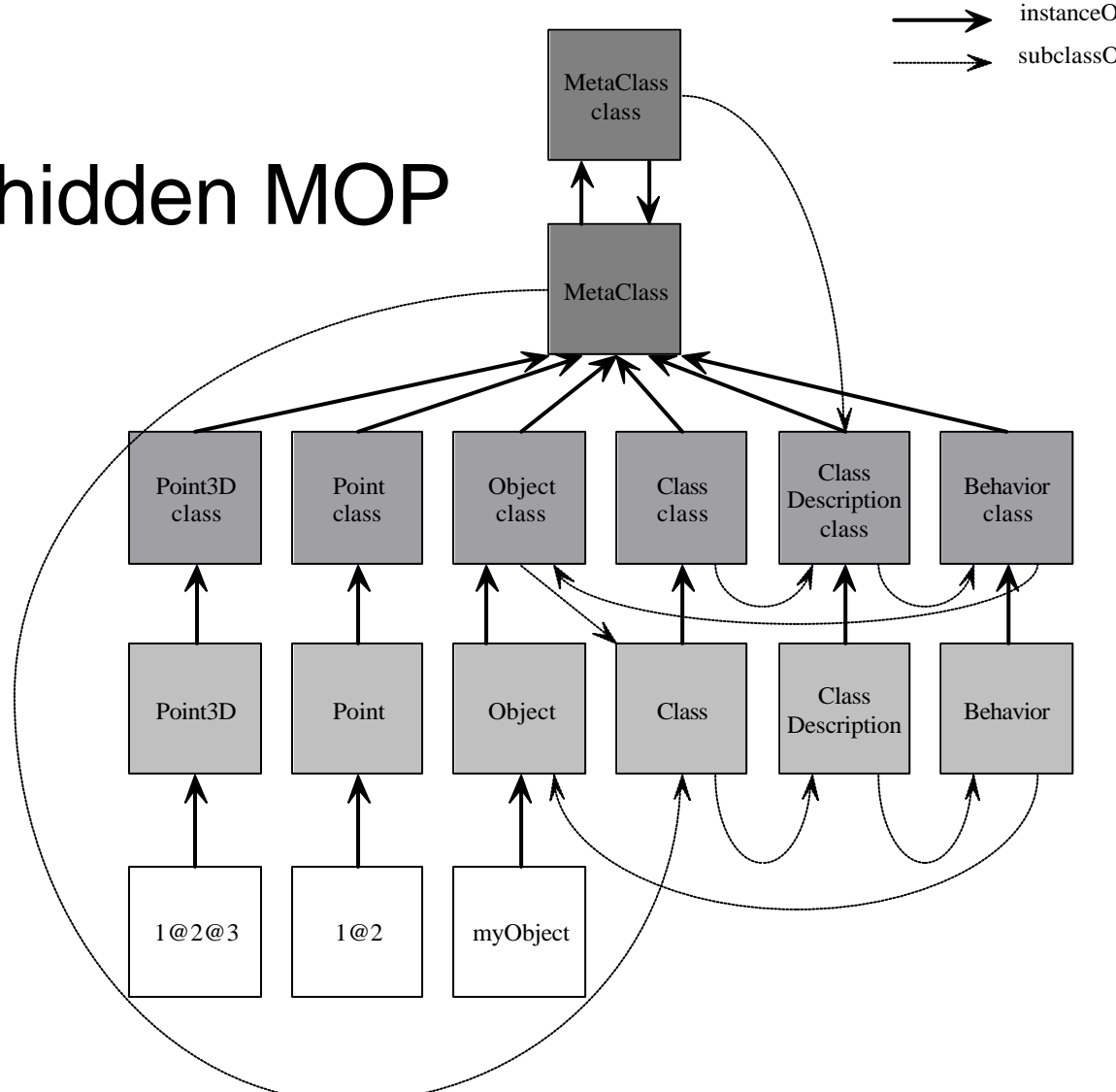
Behavioural reflection

- Smalltalk

- Meta-object
- Meta-object protocol (MOP)

Behavioural reflection

■ Smalltalk hidden MOP





Behavioural reflection

■ Java

- New?
- Message send?
- Finalization?



Behavioural reflection

■ Java

- ExtendedObject
- ClassDescription
- MetaObject
- Proxy
- Blocks
- HotSwap

ExtendedObject

System Browser: Object			
Yann-Tests	Boolean	-- all --	asOop
Kernel-Objects	EventModel	accessing	becomeForward:
Kernel-Classes	False	testing	className
Kernel-Methods	MessageSend	comparing	creationStamp
Kernel-Processes	Model	copying	instVarAt:
Kernel-Magnitudes	MorphObjectOut	dependents access	instVarAt:put:
Kernel-Numbers	Object	updating	instVarNamed:
Kernel-ST80 Remnants	ObjectOut	printing	instVarNamed:put:
Collections-Abstract	ObjectTracer	class membership	oopString
Collections-Unordered	ObjectViewer	message handling	rootStubInImageSegment:
Collections-Sequenceable	ProtoObject	error handling	someObject
Collections-Text	True	user interface	tryNamedPrimitive
Collections-Arrayed	UndefinedObject	system primitives	tryNamedPrimitive:
Collections-Streams		private	tryNamedPrimitive:with:
Collections-Weak		associating	tryNamedPrimitive:with:
Collections-Support		converting	tryNamedPrimitive:with:
Graphics-Primitives		casing	tryNamedPrimitive:with:
Graphics-Display Objects		binding	tryNamedPrimitive:with:
Graphics-Transformation		macpal	tryNamedPrimitive:with:
Graphics-Files		flagging	tryNamedPrimitive:with:
Graphics-Text		translation support	tryNamedPrimitive:with:
Graphics-FXBlt		objects from disk	tryPrimitive:withArgs:
Graphics-External		finalization	
Sound-Synthesis		filter streaming	
Sound-Scores		events	
Sound-Interface		scripting	
Speech-TTS		drag and drop	
Speech-Support		world hacking	
Speech-Gestures		logging	
Speech-Klatt		undo	
Speech-Phonetics		viewer	
	instance	?	class
instVarAt: index			
<p>"Primitive. Answer a fixed variable in an object. The numbering of the variables corresponds to the named instance variables. Fail if the index is not an Integer or is not the index of a fixed variable. Essential. See Object documentation whatIsAPrimitive."</p>			
<pre><primitive: 73> "Access beyond fixed variables." ↑self basicAt: index - self class instSize</pre>			

ClassDescription

System Browser: ClassDescription

Kernel-Classes

ProtoObject			-- all --	allSubclasses
Object			initialize-release	classesThatImplementAllOf:
Behavior			accessing	printSubclassesOn:level:
ClassDescription			copying	removeUninstantiatedSubclassesSilently
Class			printing	subclasses
Metaclass			instance variables	subclassesDo:
			method dictionary	withAllSubclasses
			organization	
			compiling	
			fileIn/Out	
instance	?	class	private	
			accessing class hierarchy	

allSubclasses

"Answer a Set of the receiver's and the receiver's descendent's subclasses."

```

| scan scanTop |
scan ← OrderedCollection withAll: self subclasses.
scanTop ← 1.
[scanTop > scan size] whileFalse:
    [scan addAll: (scan at: scanTop) subclasses.
    scanTop ← scanTop + 1].
↑ scan asSet
    
```



MetaObject

- Reification of the message send



Proxy

- Interception of the message send

Blocks

System Browser: BlockContext			
Yann-Tests	AbstractInstructionPrinter	-- all --	value
Kernel-Objects	BlockContext	initialize-release	value:
Kernel-Classes	CompiledMethod	accessing	value:ifError:
Kernel-Methods	ContextPart	evaluating	value:value:
Kernel-Processes	InstVarRefLocator	controlling	value:value:value:
Kernel-Magnitudes	InstructionPrinter	scheduling	value:value:value:value
Kernel-Numbers	InstructionStream	instruction decoding	valueError
Kernel-ST80 Remnants	Message	printing	valueUninterruptably
Collections-Abstract	MethodContext	private	valueWithArguments:
Collections-Unordered	MethodDictionary	system simulation	valueWithPossibleArgs:
Collections-Sequenceable	MethodFinder	exceptions	valueWithWorld:
Collections-Text	PseudoContext	private-exceptions	whileFalse
Collections-Arrayed	TranslatedMethod	private-debugger	whileFalse:
Collections-Streams		Worlds	whileTrue
Collections-Weak	instance ? class	tiles	whileTrue:

value

"Primitive. Evaluate the block represented by the receiver. Fail if the block expects any arguments or if the block is already being executed. Optional. No Lookup. See Object documentation whatIsAPrimitive."

```
<primitive: 81>
↑self valueWithArguments: #()
```




HotSwap

- Re-definition of a class without stopping the virtual machine