UNIVERSITÄT BERN

The Reflectivity

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Structural Reflection

- Structure modeled as objects
  - e.g. Classes, methods
  - Causally connected
- Uses:
  - Development environments
  - Language extensions and experiments

Methods and Reflection

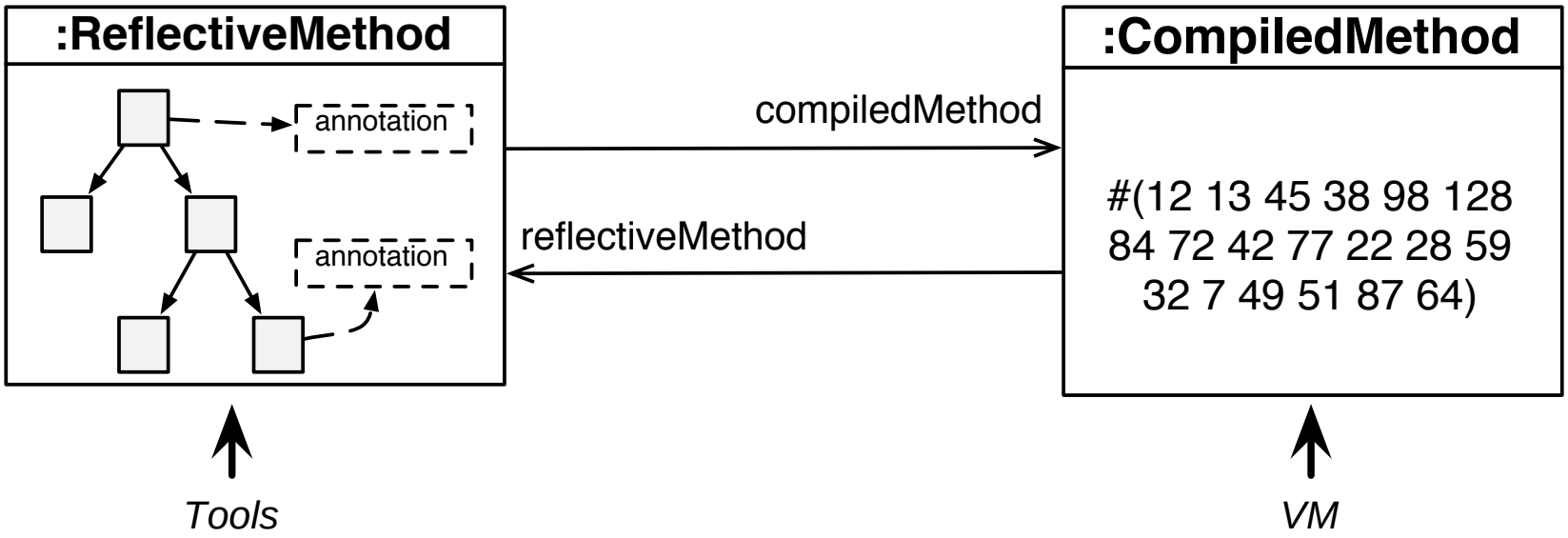
- Method are Objects
  - e.g in Smalltalk
- No high-level model for sub-method elements
  - Message sends
  - Assignments
  - Variable access
- Structural reflection stops at the granularity of methods

Sub-Method Reflection

- Many tools work on sub method level
  - Profiler, Refactoring Tool, Debugger, Type Checker
- Communication between tools needed
  - example: Code coverage
- All tools use different representations
  - Tools are harder to build
  - Communication not possible

Solution: Reflective Methods

- Annotated, persistent AST
- Bytecode generated on demand and cached



Reflectivity

- Implementation of Reflective Methods for Squeak Smalltalk
- Smalltalk Compiler generates Reflective Methods
  - Translated to Bytecode on demand
- Open Compiler: Plugins
  - Generator plugin: called before code generation
    - *Transform a copy of the AST*
  - Analysis plugin: called after name analysis

DEMO I

> Show invalidation of code

> Show assert Demo

Reflective Methods: Annotations

- Source visible annotations
  - extended Smalltalk syntax

```
(9 raisedTo: 10000) <:evaluateAtCompiletime:>
```

- Source invisible annotations
  - Reflective API
  - Can reference any object
- Every node can be annotated
- Semantics: Compiler Plugins

Example: Pluggable Type-System

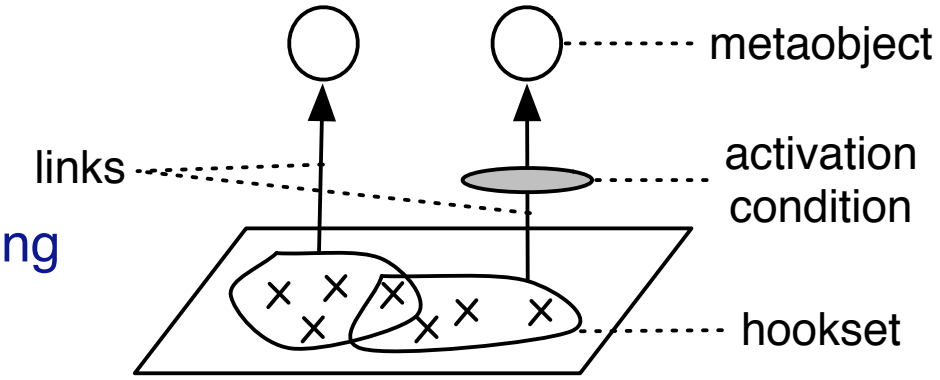
- Example for textual annotations

```
bitFromBoolean: aBoolean <:type: Boolean :>
^ (aBoolean ifTrue: [1] ifFalse: [0]) <:type: Integer :>
```

- Optional, pluggable type-system
- Types stored as annotations in the Reflective Methods

Reflex: Partial Behavioral Reflection

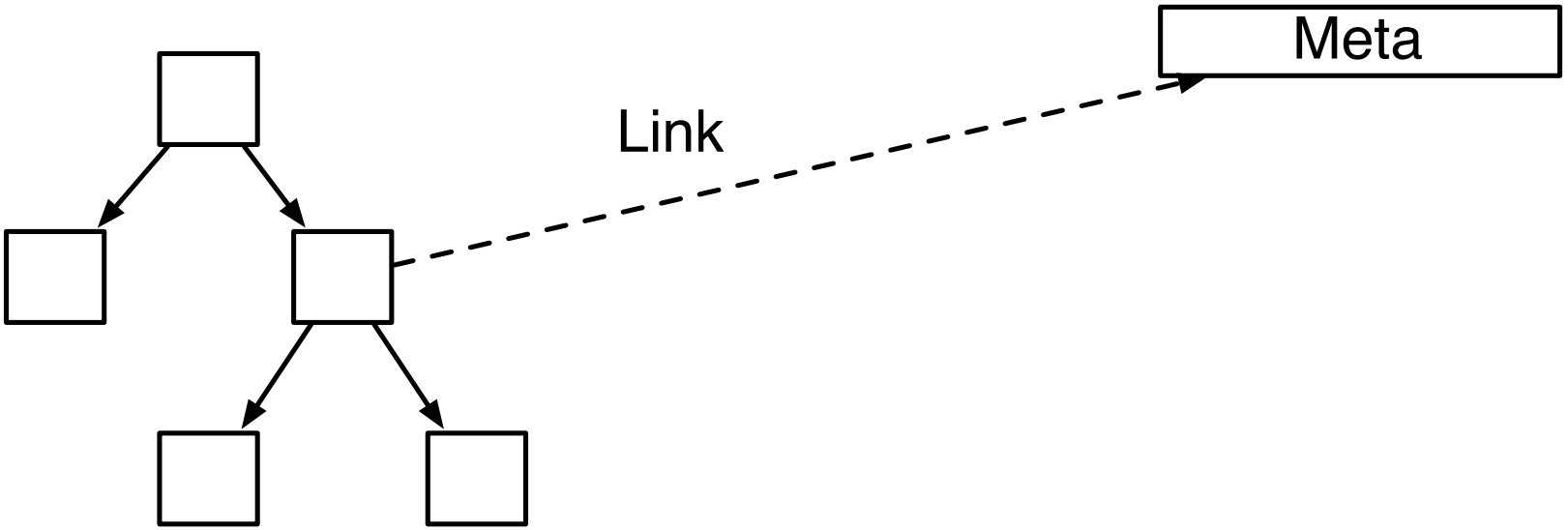
- Hooksets: collection of operation occurrences
- Links
  - Bind hooksets to metaobjects
  - Define Protocol between base and meta
- Goals
  - Highly selective reification
  - Flexiblel metalevel engineering
    - *Protocol specification*
    - *Cross-cutting hooksets*



Tanter, OOPSLA03

Links as Annotations

> Links can be annotations on the AST



Demo II: Geppetto

> Show Bounce Demo

> Show Coverage Demo

Future Work

- Optimize Size of AST Representation
  - Simpler AST
  - AST Compression
- Contextual Reifications
  - Context depended Links
- Beyond Text
  - Store only AST (no text)
  - Build text from annotated AST