Interleaving of Modification and Use in Dataflow-driven Tool Development

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UCT-HPI Research School Workshop

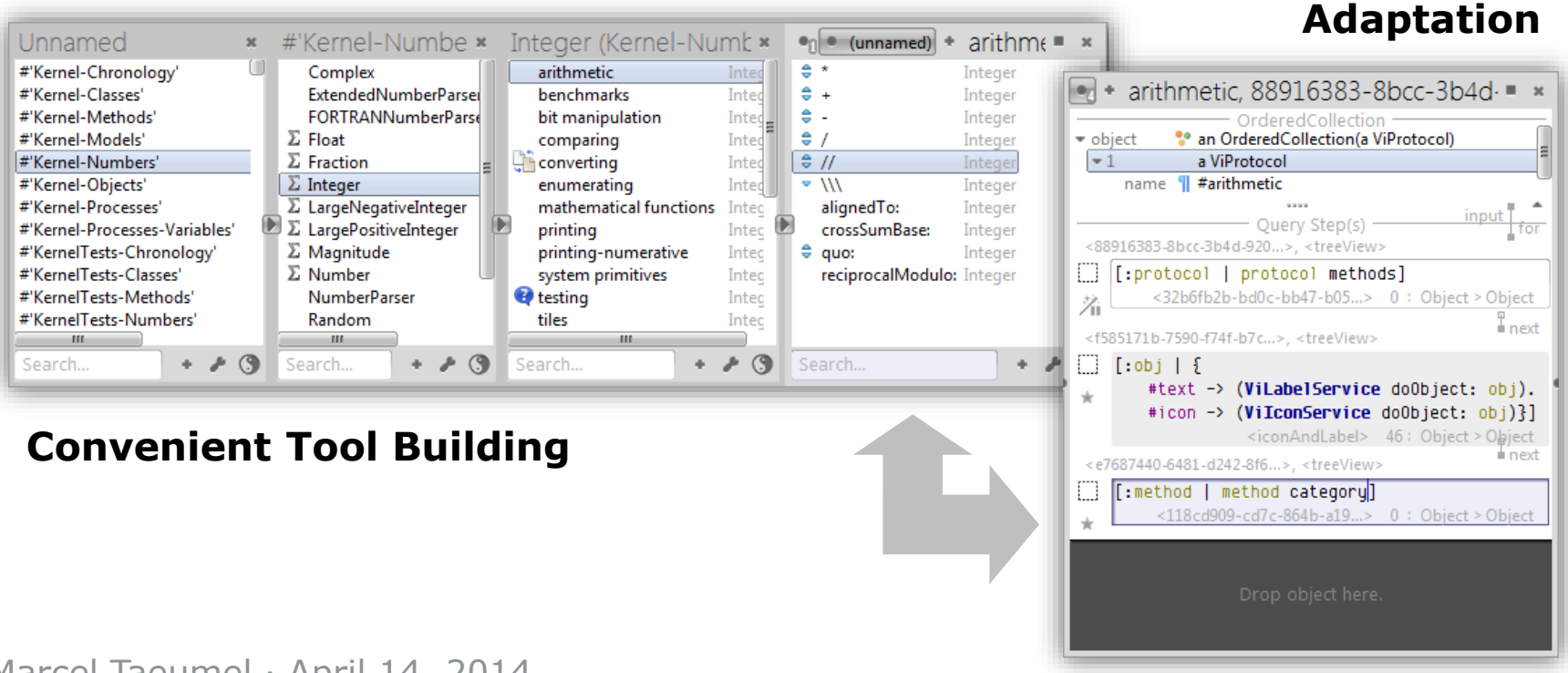
April 14, 2014

A New Programming Environment
Prototype in Squeak/Smalltalk


```
ActiveVivide openQueries: {
  [SystemOrganization categories] asQuery.
  [:category | SystemOrganizer default
    classesInCategory: cat] asQuery.
  [:class | ViProtocol protocolsForClass: class] asQuery.
  [:protocol | protocol methods] asQuery.
}.
```

OO Dataflow Programming

Live Adaptation



Convenient Tool Building

Iterative Tool Building

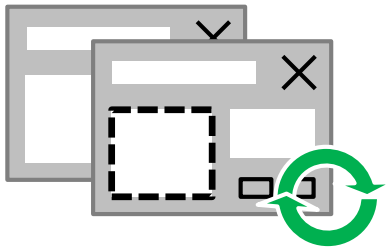
- Exploration tools support program comprehension tasks
- Programmers are capable of building such tools
- Tools in use entail visual impressions that trigger change requests

Example changes

How to realize?

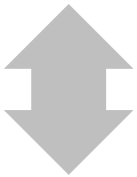
1. Localize view-related source code
2. Express changes concisely
3. Update run-time components

Challenges
of Iterative Tool Building



Updates inconsistent due to mismatch of expected and actual code execution times

Localization difficult due to indirect or missing links from run-time components to code



Modifications verbose due to implicit or explicit duplication or redundancy of unspecific concepts

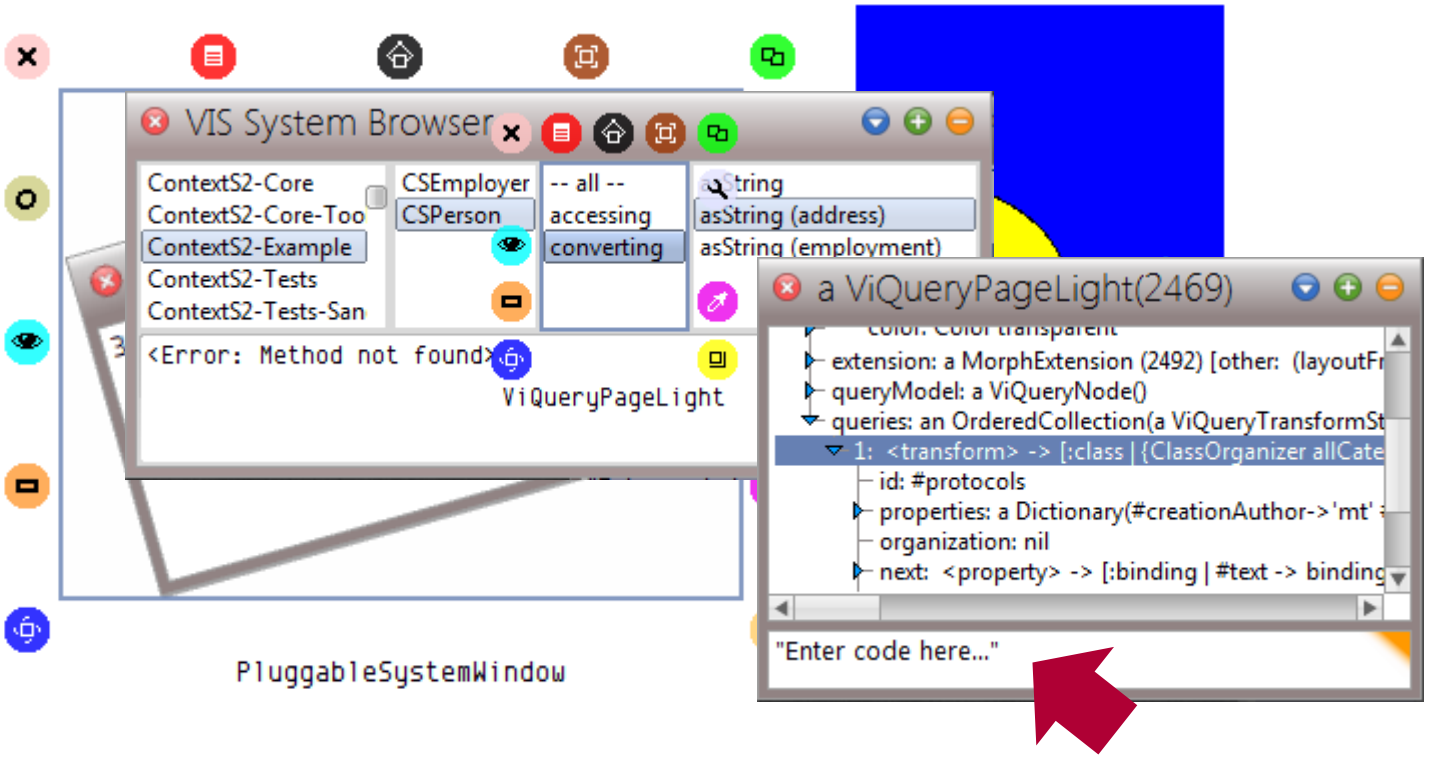
Research Question

How can we support programmers to build programming tools whose specific source code parts can be localized directly and modified concisely while tool instances update consistently?

- Inspect visual elements; localize code
- Adapt code to specific domains, tasks, or users
- Immediately see changes; keep on using the tool

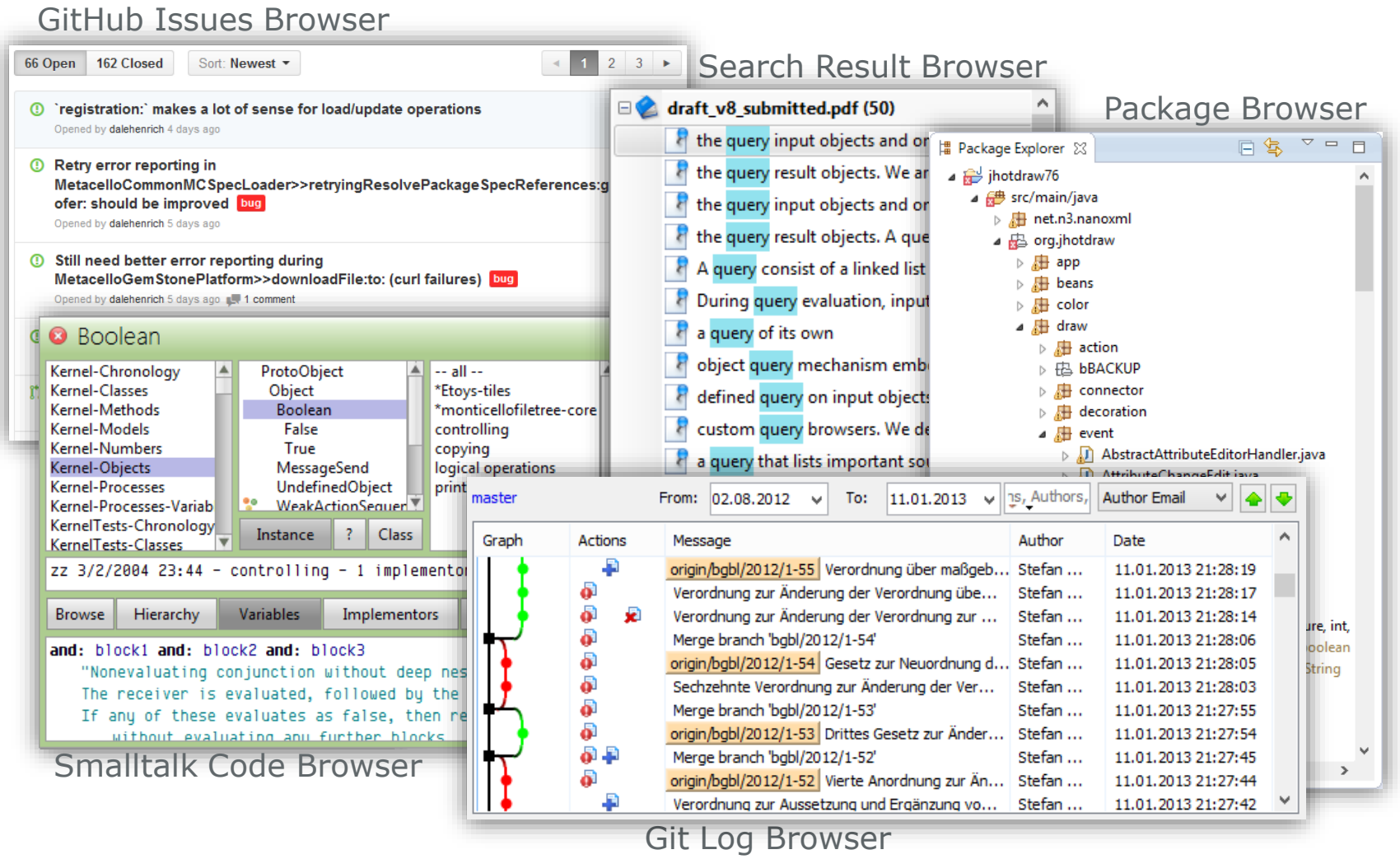
- **Impact?** Support iterative tool building, try out ideas, prototype

Inspecting Visual Elements

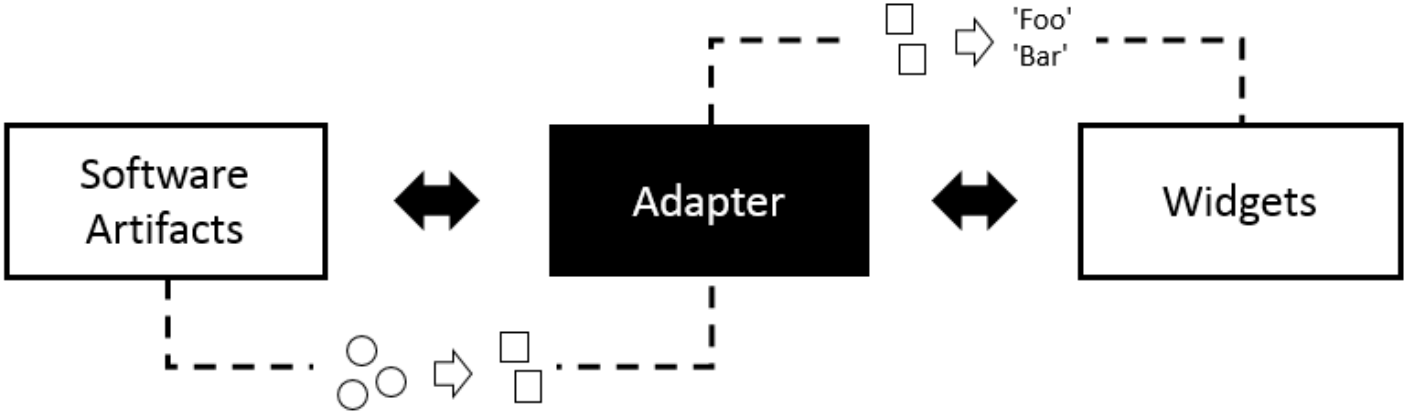


- Works for, e.g., Smalltalk/Morphic, F-Script for Cocoa, …

Our Focus: Exploration Tools

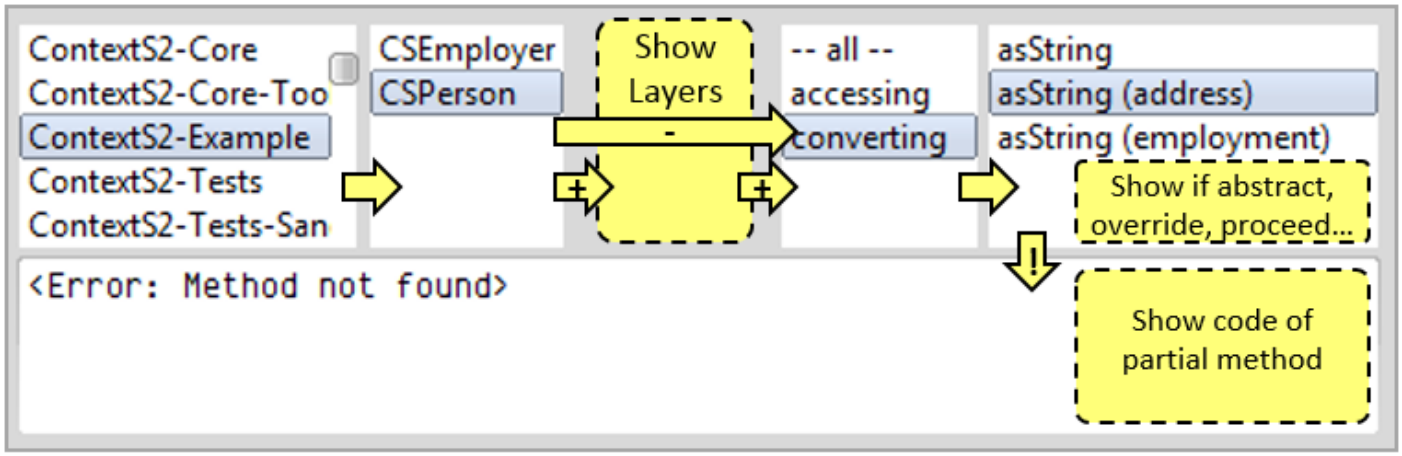


Design of Exploration Tools



- Traditional adapters range from monolithic to composite designs often with a declarative language for tool initialization
- Lessons learned
  - Make specific code declarative (what not how) and reachable
  - Avoid hidden redundancy in declarative code
  - Modularize run-time components to support modular updates

Our Approach: Expose Dataflow in Tools



Specific Code in Exploration Tools

- Find software artifacts, e.g. all methods of a class:

```
String methodDict values
```

- Read relevant properties of artifacts, e.g. method information:

```
(String >> #findTokens:) selector
```

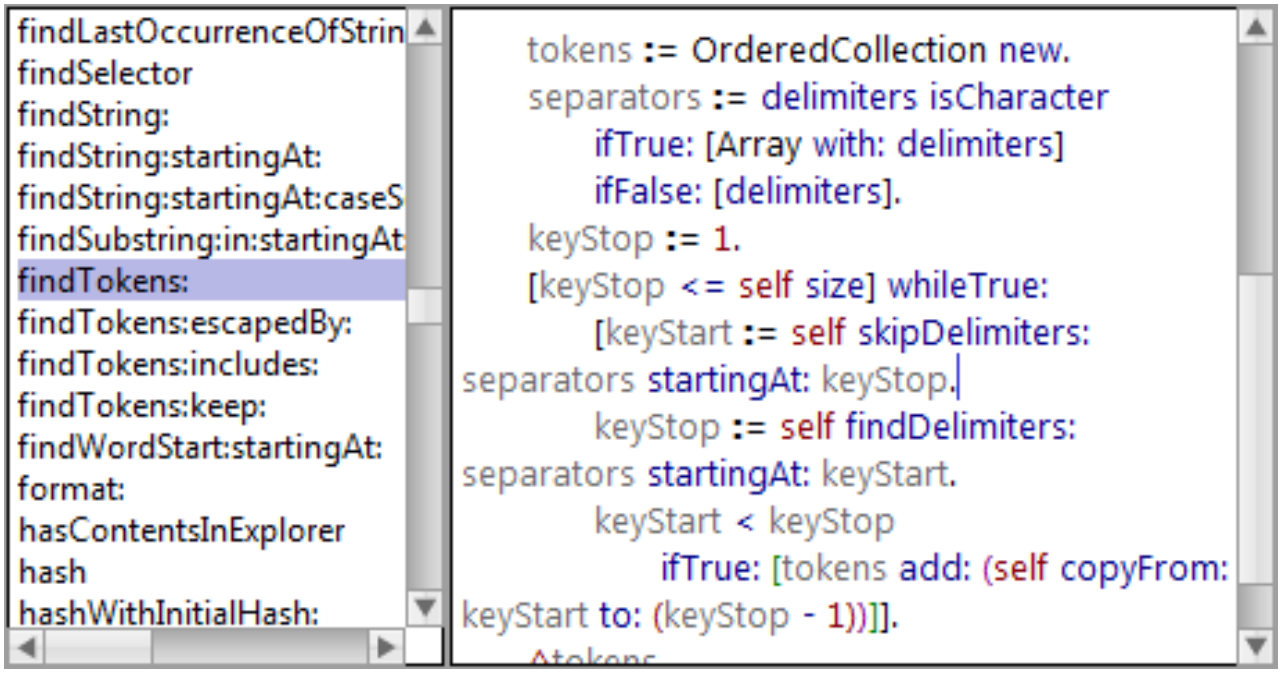
```
(String >> #findTokens:) getSource
```

- Show information on screen, e.g. in a text box:

```
ListView position: 0@0 extent: 160@240
```

```
TextBox position: 160@0 extent: 300@240
```

Specific Code in **Exploration Tools**



- Write back changed properties to software artifacts, e.g. code:

```
String compile: 'findTokens: delimiter ...'.
```

"Unspecific" Code to Avoid

- Required support structures in frameworks or libraries
  - Subclasses
  - Callback functions
  - …
- Initialization code
  - Glue callbacks
  - Layout graphical widgets upfront
  - …

Encapsulate Specific Code

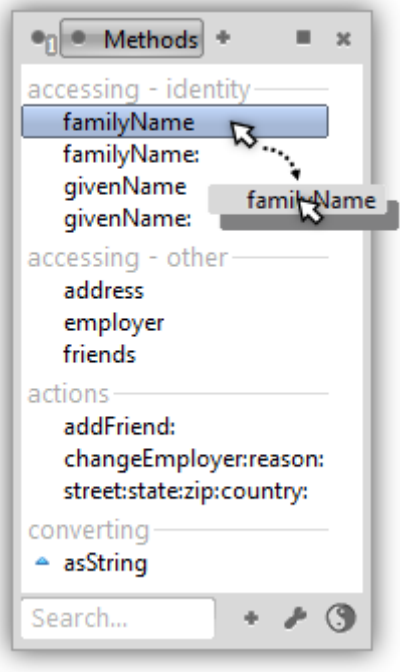
- **What** information? → Query code

```
[:class | class methodDict values collect: [:method | {
   #text -> method selector.
   #object -> method }]]
```

- **What** graphical output? → View code

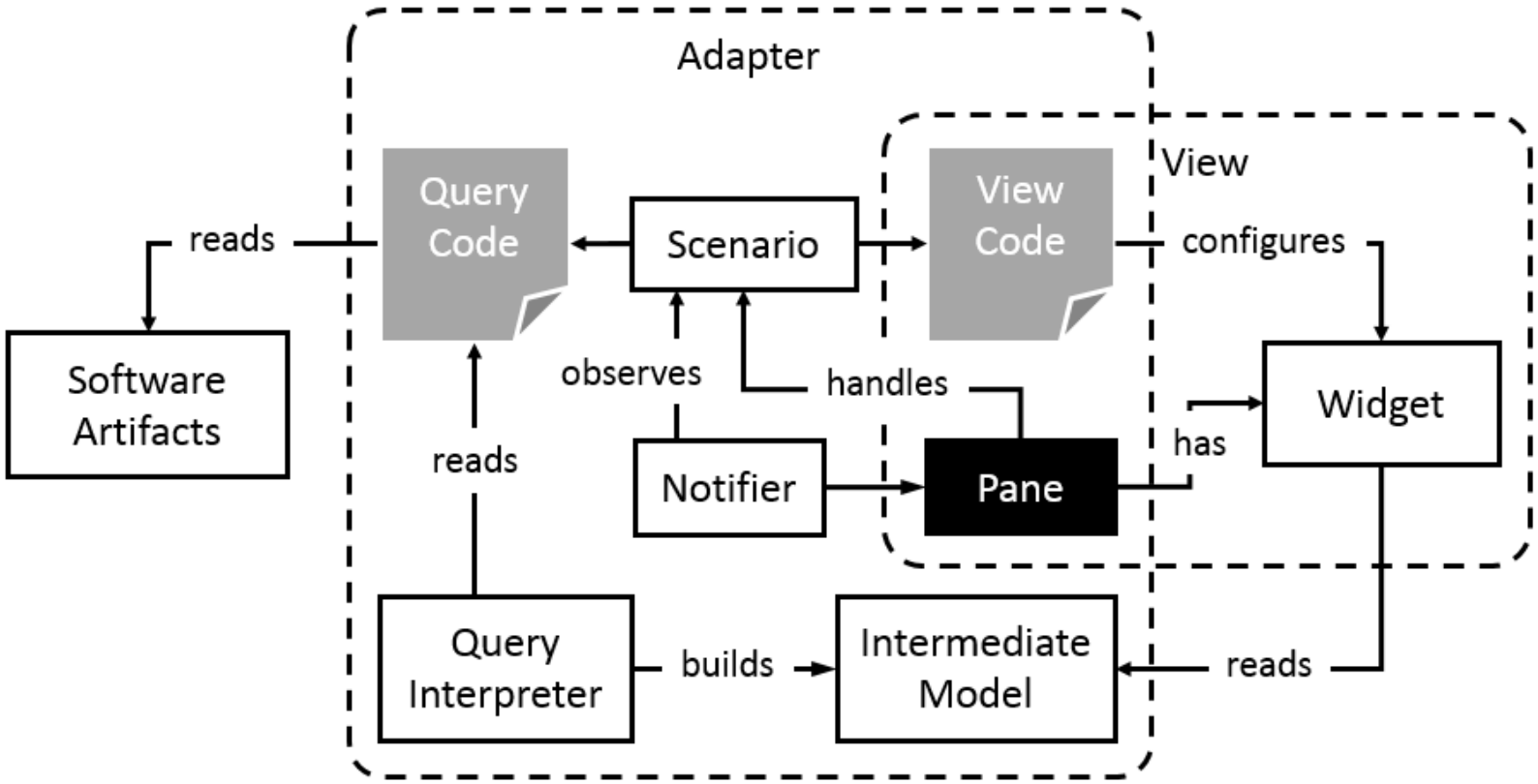
```
[:model | ListView new
   model: model;
   textSelector: #text;
   dragSelector: #object]
```

Position and extent to be modified interactively in the programming environment.



- **How** update? → Framework evaluates query code and view code with concrete artifacts automatically.

Our Design for Exploration Tools



Modularize Query Code


```
[:class | class methodDict values collect: [:method | {
   #text -> method selector.
   #object -> method }]]
```

```
[:class | class methodDict values].
```

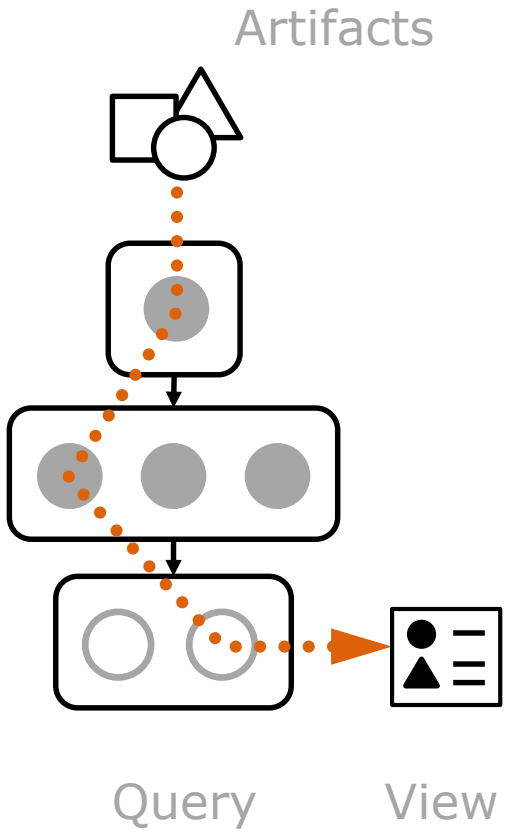
```
[:method | #text -> method selector].
```

- Provide semantics for handling lists of artifacts
- Decouple artifact transformations from property extractions

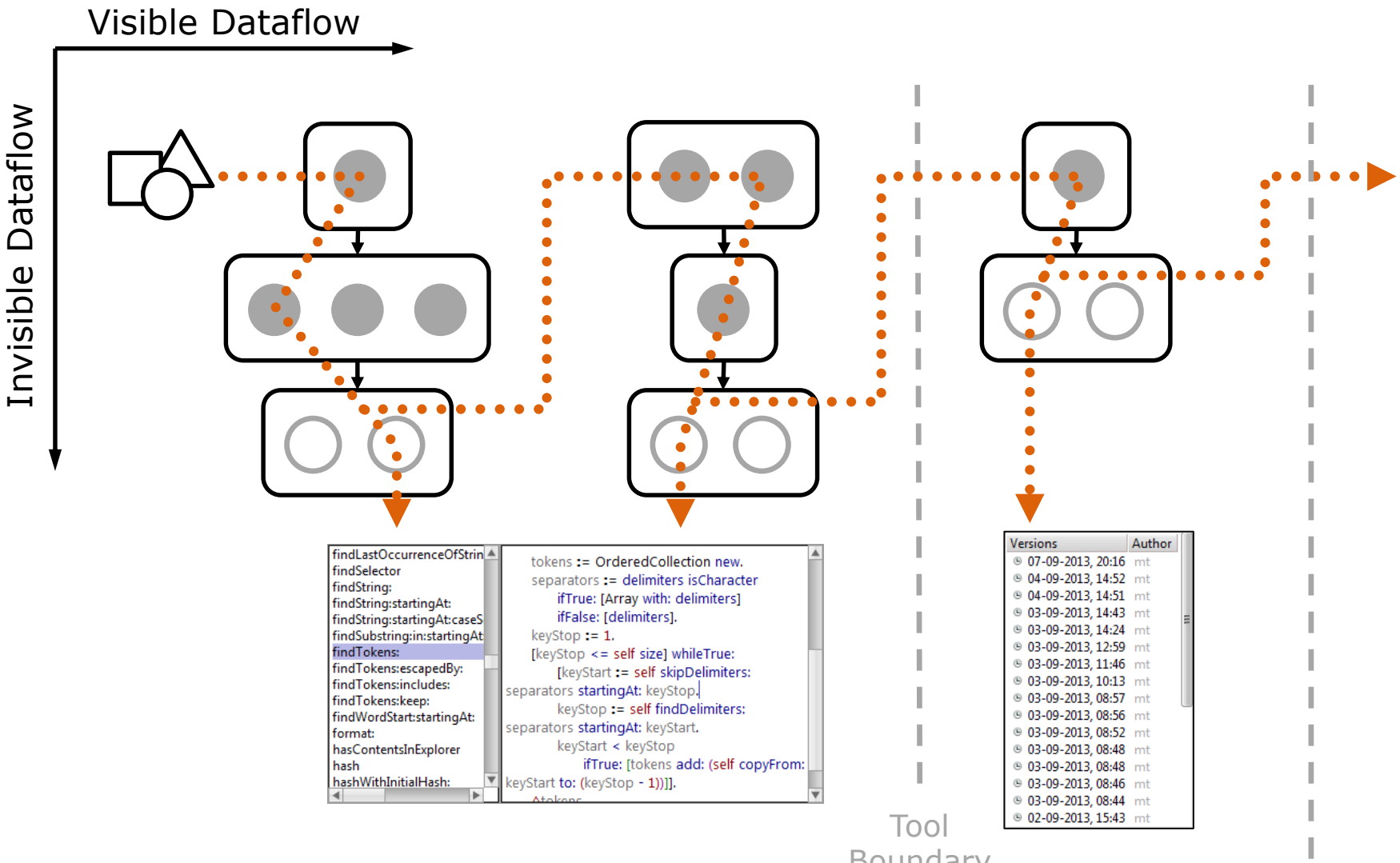
Extend Dataflow Metaphor

Decouple specific code

- Domain-specific artifact transformation
- Domain-specific property extraction
- Task-specific compositions



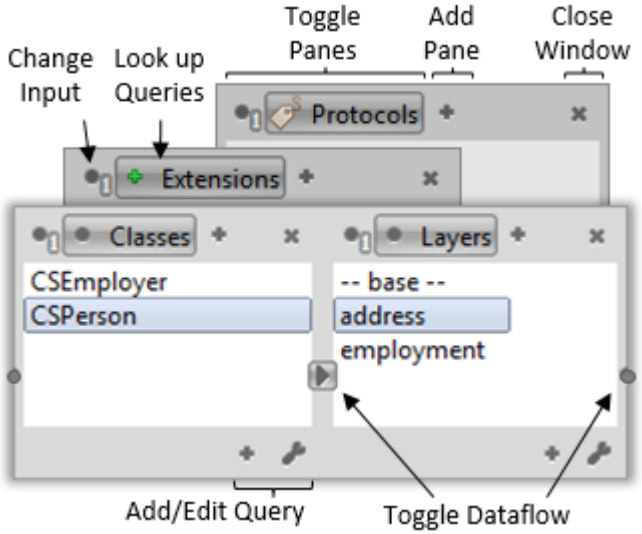
Extend Dataflow Metaphor

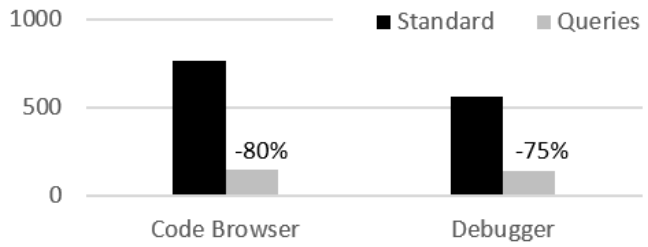


Current and Next Steps

Extend dataflow metaphor

- Create, update, and delete software artifacts
- Compose, decompose, recommend queries





Squeak 4.4

Evaluate dataflow metaphor

- Build programming tools
- Quantify and compare efforts

Conclusion

- Programmers are able to iteratively build their own tools
- How can we support localization and modification of code so that tools can be changed in use?
- We employ a dataflow metaphor on programming tools

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