



Research in Coding and IDEs

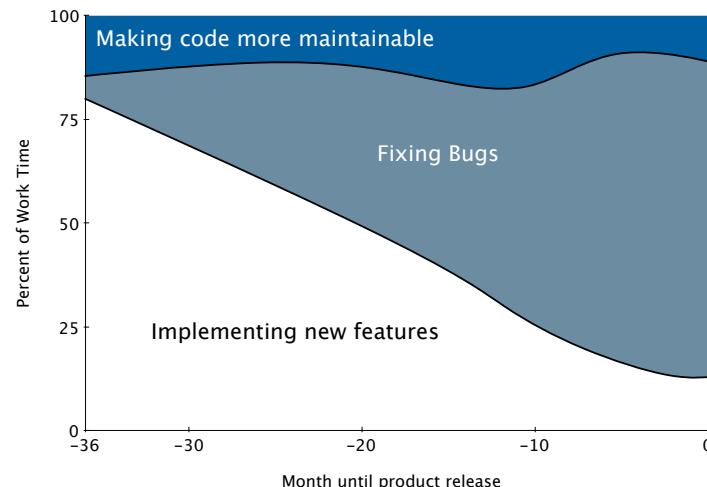
Jan-Peter Krämer
Media Computing Group
RWTH Aachen University

<http://hci.rwth-aachen.de/cthci>

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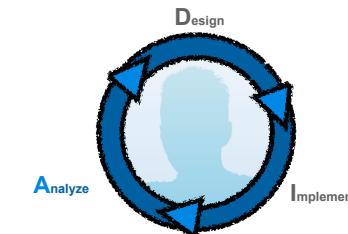
Time in Software Development

[LaToza2006, Maintaining mental models: a study of developer work habits]

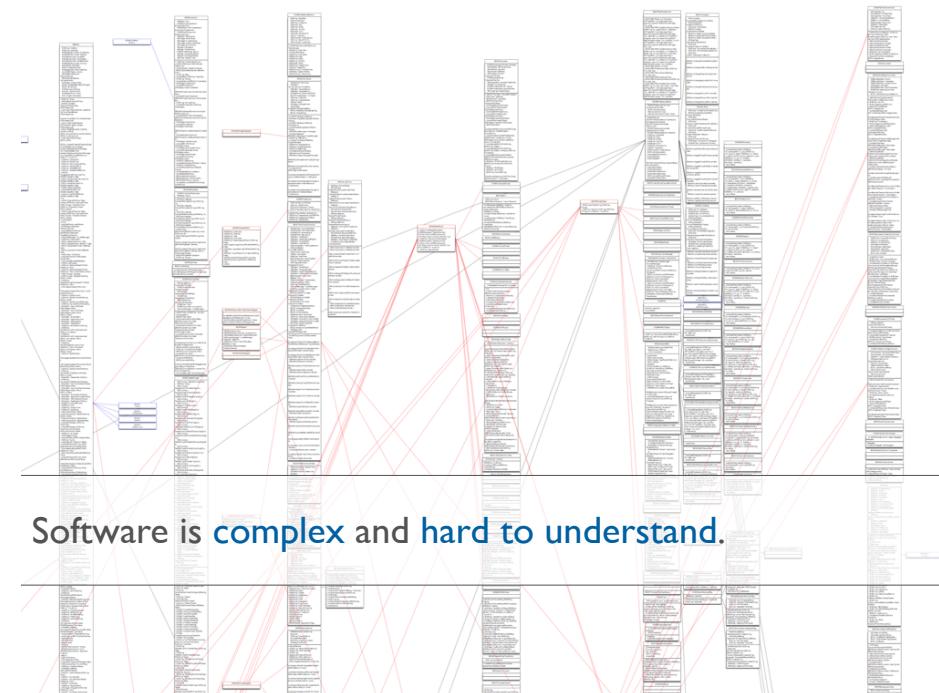


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Status Quo



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Task context

• What is relevant information?
• What strategies are applied to find information?

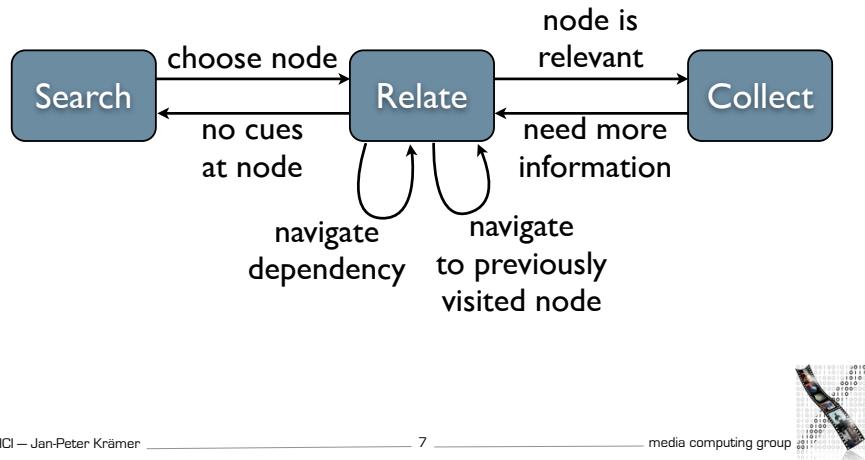
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Models for Developer Strategies

[Ko2006, An Exploratory Study of How Developers Seek, Relate, and Collect Relevant Information during Software Maintenance Tasks]



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Models for Developer Strategies

[Ko2006, An Exploratory Study of How Developers Seek, Relate, and Collect Relevant Information during Software Maintenance Tasks]



31 Professional Java Developers



5 Maintenance tasks
(3 Bugs, 2 Enhancements)



500 SLOC Java Paint
Application



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Models for Developer Strategies

[Sillito2008, Asking and Answering Questions during a Programming Change Task]



9 experienced
developers (pair
programming)



1 of 5 maintenance
tasks per session



ArgoUML
60k SLOC



16 developers from
industry



Real world change
task



Real world sour code

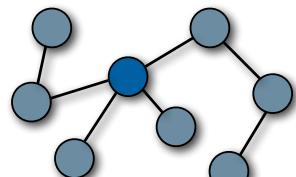
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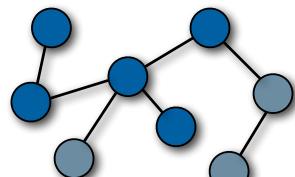
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Models for Developer Strategies

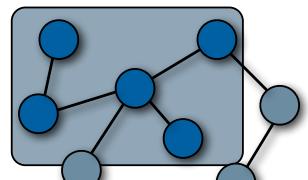
[Sillito2008, Asking and Answering Questions during a Programming Change Task]



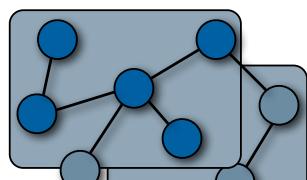
Finding focus points



Expanding focus points



Understanding a subgraph



Questions over groups of subgraphs

```
java - jHotDraw/src/org/jhotdraw/contrib/DesktopEvent.java - Eclipse SDK - /Users/jpkraemer/Downloads/jhotdraw60b1
```

```
package org.jhotdraw.contrib;
```

```
import org.jhotdraw.framework.DrawingView;
```

```
/*
```

```
 * Author: C.L.Gilbert <noyvah@users.sourceforge.net>
```

```
 * Version: $CURRENT_VERSION$
```

```
 */
```

```
public class DesktopEvent extends EventObject {
```

```
    private DrawingView myDrawingView;
```

```
    /*
```

```
     * Some events require the previous DrawingView (e.g. when a new DrawingView
```

```
     * is selected).
```

```
     */
```

```
    private DrawingView myPreviousDrawingView;
```

```
    public DesktopEvent(Desktop newSource, DrawingView newDrawingView, DrawingView newPrevious) {
```

```
        this(newSource, newDrawingView, null);
```

```
    }
```

```
    public DesktopEvent(Desktop newSource, DrawingView newDrawingView, DrawingView newPreviousD) {
```

```
        super(newSource);
```

```
        setDrawingView(newDrawingView);
```

```
        setPreviousDrawingView(newPreviousD);
```

```
    }
```

```
    private void setDrawingView(DrawingView newDrawingView) {
```

```
        myDrawingView = newDrawingView;
```

```
    }
```

```
    public DrawingView getDrawingView() {
```

```
        return myDrawingView;
```

```
    }
```

```
    private void setPreviousDrawingView(DrawingView newPreviousDrawingView) {
```

```
        myPreviousDrawingView = newPreviousDrawingView;
```

```
    }
```

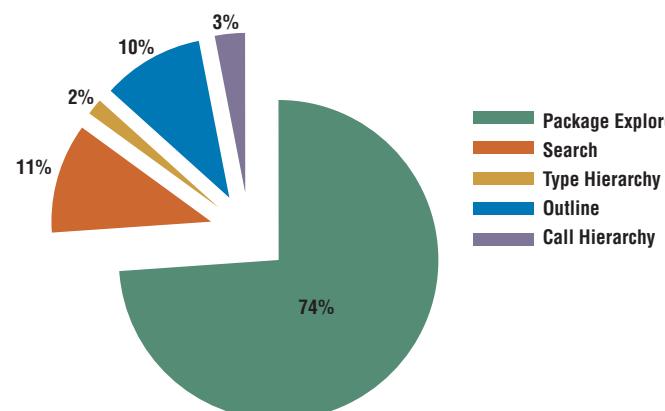
```
    public DrawingView getPreviousDrawingView() {
```

```
        return myPreviousDrawingView;
```

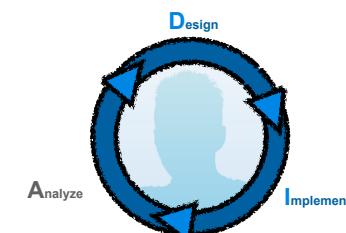
```
    }
```

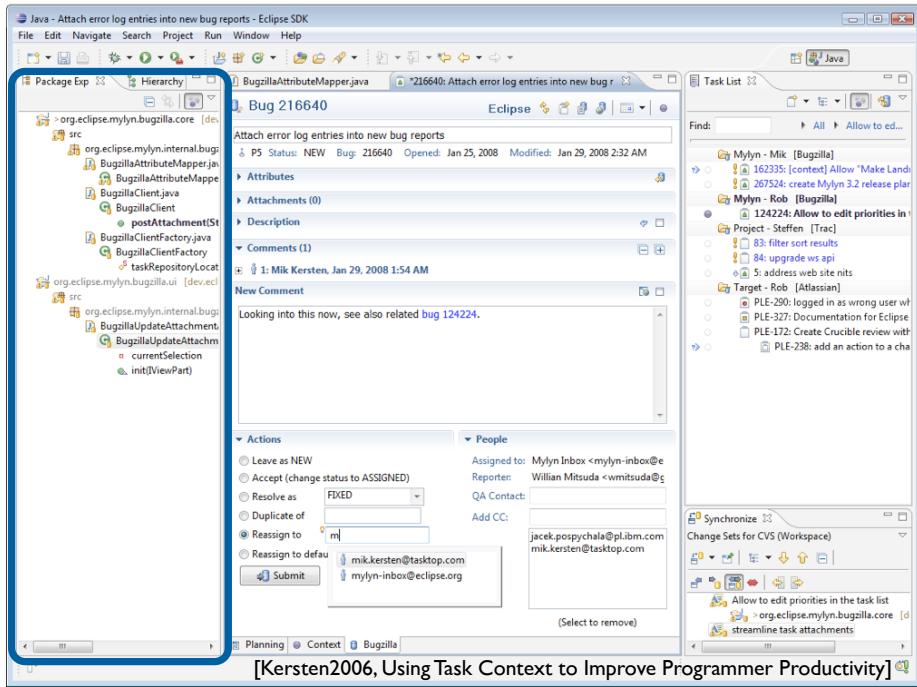
Tools Used in Eclipse

[Murphy2006, How Are Java Software Developers Using the Eclipse IDE?]



Easing Access to Task Context





Recommender Tools

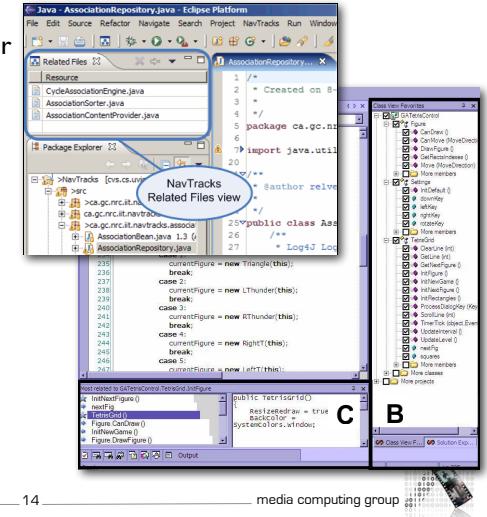
[Singer2005, NavTracks: supporting navigation in software maintenance]
 [DeLine2005, Easing program comprehension by sharing navigation data]
 [Cubranic'2005, Hipkat: recommending pertinent software development artifacts]

• Calculate a Degree of Interest for source code elements based on:

- reading history
- editing history
- history of other team members
- information from version control systems

• Remaining Problems:

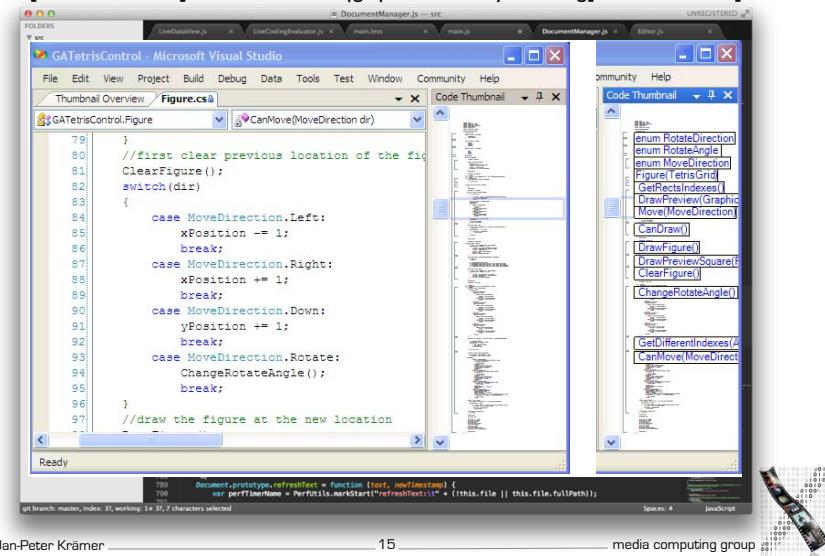
- Still only text-based visualization
- Recommendations for irrelevant code are still irrelevant



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Changing the Presentation

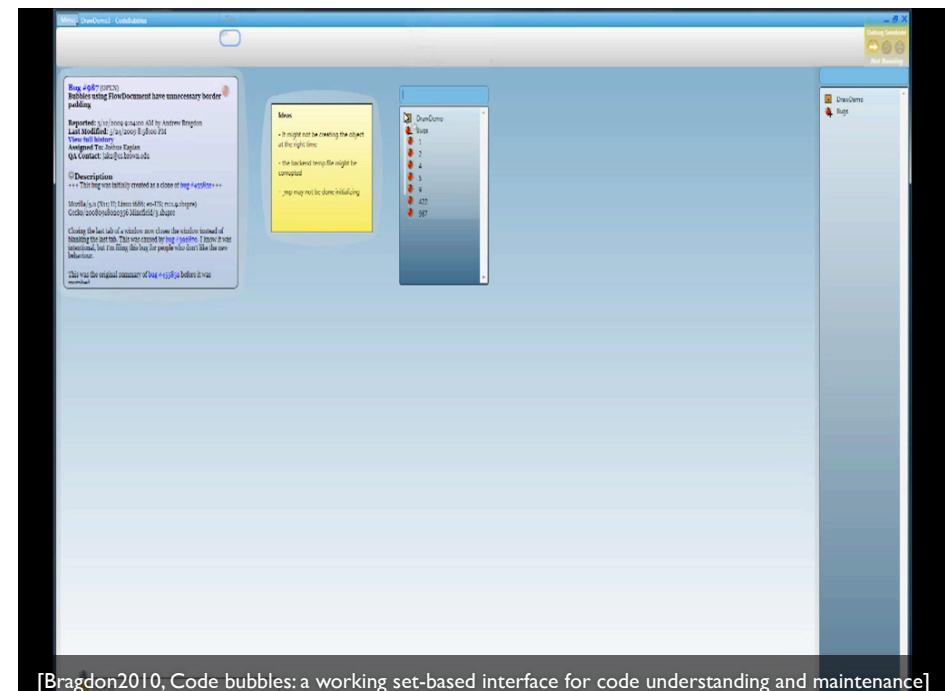
[DeLine2006, CodeBubbles: Using Spatial Memory to Show Source Code]



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Bragdon2010, Code bubbles: a working set-based interface for code understanding and maintenance]

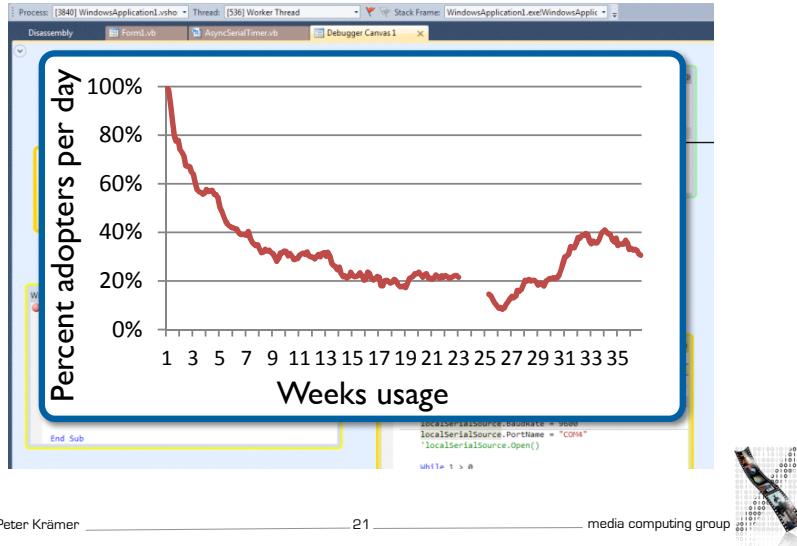
Bragdon2010, Code bubbles: a working set-based interface for code understanding and maintenance]

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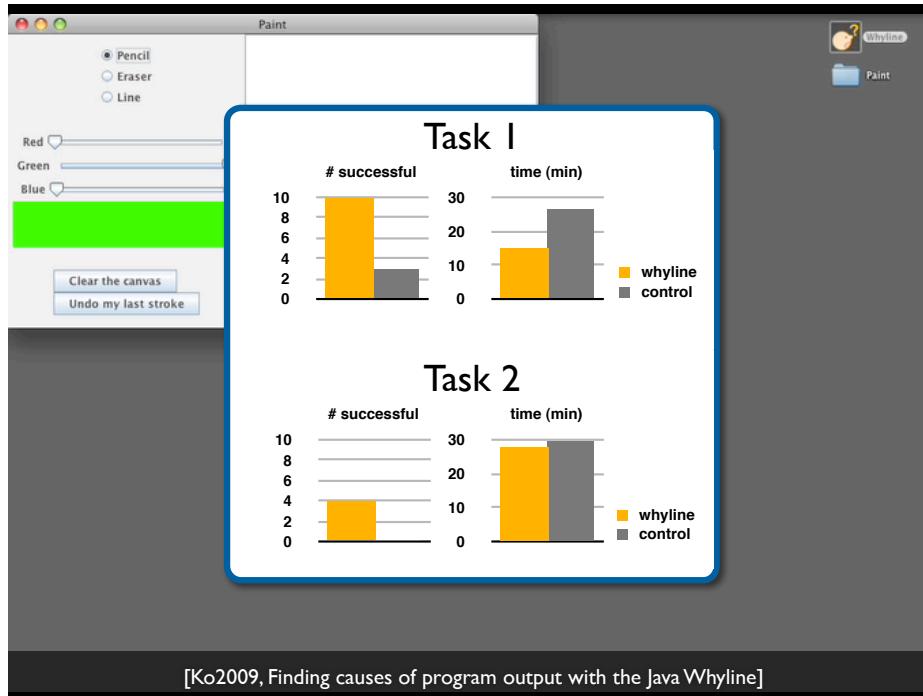
Bragdon2010, Code bubbles: a working set-based interface for code understanding and maintenance]

Canvas Interfaces in the Wild

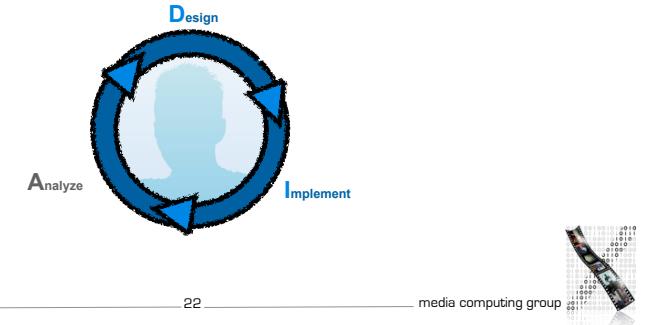
[DeLine2012, Debugger Canvas: Industrial experience with the code bubbles paradigm]



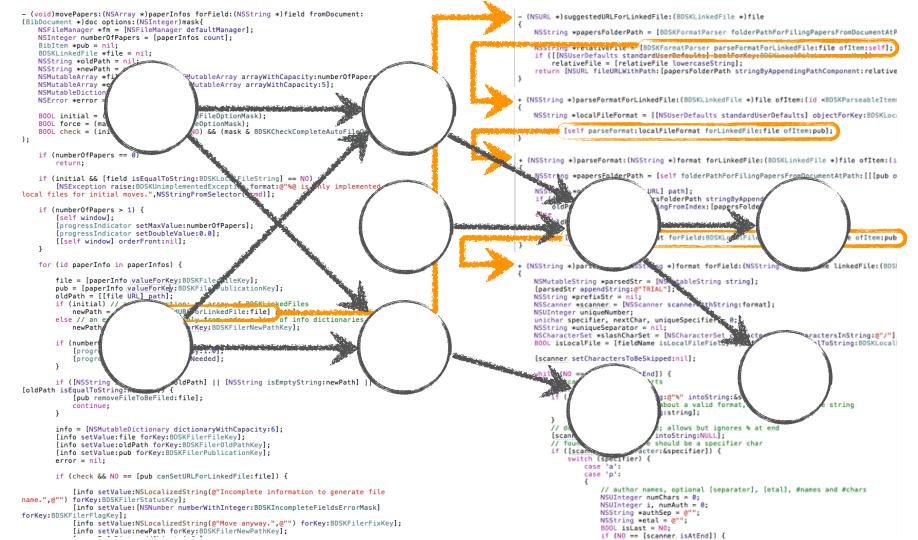
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Utilizing the Call Graph



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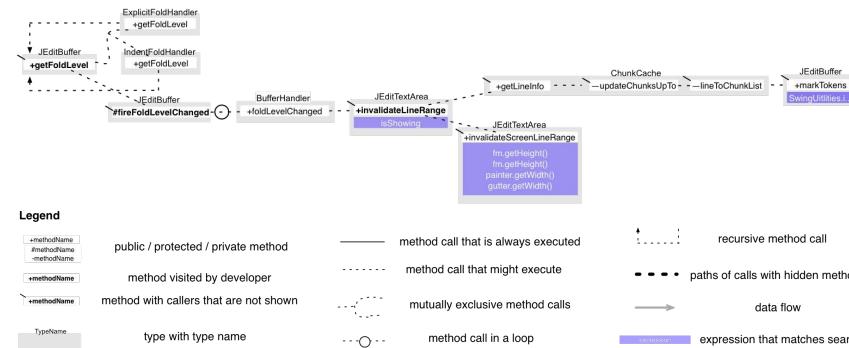


In practice: Feasible paths most interesting
[LaToza2010, Developers ask reachability questions]

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Utilizing Call Graph Information

[LaToza2010, Searching Across Paths]



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Static Analysis in the Wild

[Clang Static Analyzer, <http://clang-analyzer.llvm.org/>]

A screenshot of the Clang Static Analyzer interface. It shows a code editor with Objective-C code. Annotations highlight potential issues: a warning about an object being deallocated after its last reference (line 13), and a leak detection message at the bottom.

```

10 }
11
12 void foo(int x, int y) {
13     id obj = [[NSString alloc] init];
14     switch (x) {
15         case 0:
16             [obj release];
17             break;
18         case 1:
19             // ...
20             [obj autorelease];
21             break;
22         default:
23             break;
24     }
25
26     // Object allocated on line 13 is no longer referenced after this point and has a retain count of +1 (object leaked)

```

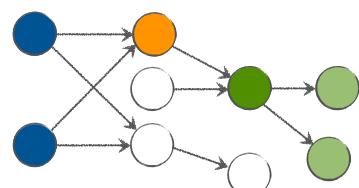
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Call Hierarchy



A screenshot of Xcode showing the MainController.m file. A call graph overlay highlights specific sections of the code, such as the performConvert and menuCallback methods, in orange and green boxes.

```

29 -(void)convertClicked:(id)sender {
30     //do something
31     if (self.theConverter == nil) {
32         self.theConverter = [[Converter alloc] init];
33     }
34     [self performConvert];
35 }
36
37 -(void)performConvert{
38     if (([self.input floatValue] != 0) || ([self.input stringValue] != @ ""))
39     {
40         [self convert];
41     }
42 }
43
44 -(void)menuCallback:(id)sender{
45     [self convert];
46 }
47
48 //convert from Celsius
49 //to Fahrenheit
50 -(void)convert{
51     //get celsius value
52     float c = [self.input floatValue];
53     //convert to fahrenheit
54     float f = [self.theConverter c2f:c];
55     //update view
56     [self update:f];
57 }
58
59 -(void)update:(float)f{
60     //do something
61 }
62
63 @end

```

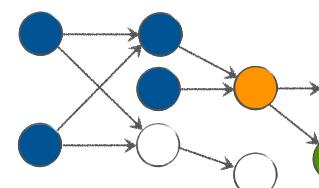
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Stacksplorer

[Karrer2011, Stacksplorer: Call Graph Navigation Helps Increasing Code Maintenance Efficiency]



A screenshot of Stacksplorer showing the MainController.m file. A call graph overlay highlights specific sections of the code, such as the performConvert and menuCallback methods, in orange and green boxes.

```

29 -(void)convertClicked:(id)sender {
30     //do something
31     if (self.theConverter == nil) {
32         self.theConverter = [[Converter alloc] init];
33     }
34     [self performConvert];
35 }
36
37 -(void)performConvert{
38     if (([self.input floatValue] != 0) || ([self.input stringValue] != @ ""))
39     {
40         [self convert];
41     }
42 }
43
44 -(void)menuCallback:(id)sender{
45     [self convert];
46 }
47
48 //convert from Celsius
49 //to Fahrenheit
50 -(void)convert{
51     //get celsius value
52     float c = [self.input floatValue];
53     //convert to fahrenheit
54     float f = [self.theConverter c2f:c];
55     //update view
56     [self update:f];
57 }
58
59 -(void)update:(float)f{
60     //do something
61 }
62
63 @end

```

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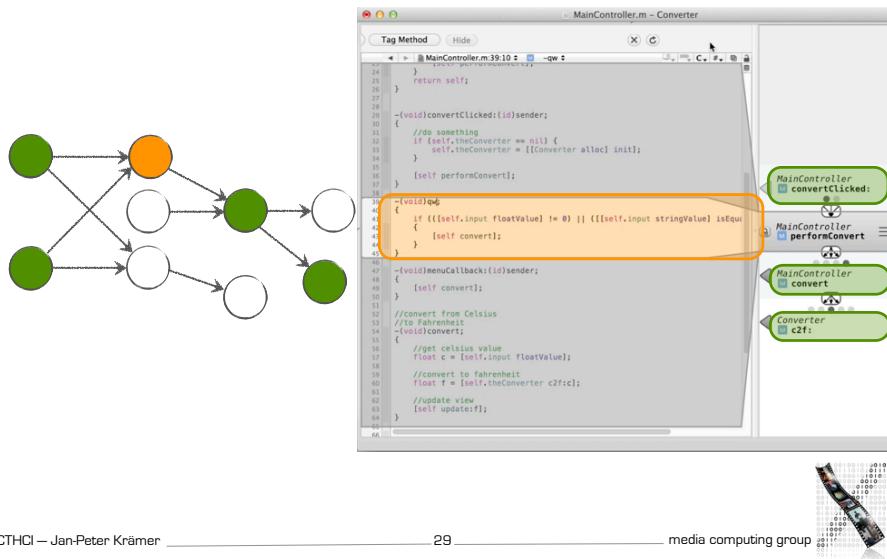
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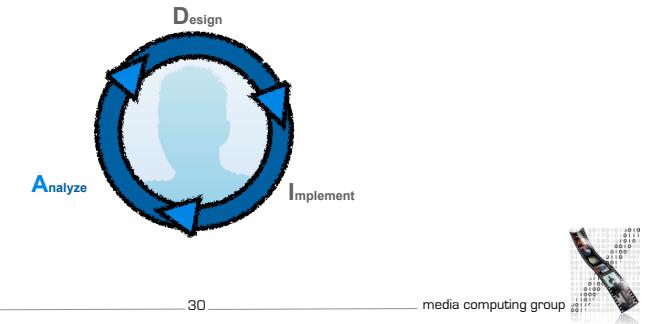


Blaze

[Krämer2012, Blaze: Supporting Two-phased Call Graph Navigation in Source Code]



Analyzing Navigation Behavior



Information Foraging Theory



Predator



Scent



Prey



Information Foraging Theory

[Lawrance2010, Reactive information foraging for evolving goals]



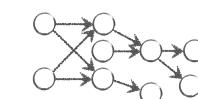
Predator



Scent



Prey



	Xcode	Call Hierarchy	Stacksplorer	Blaze
Find Change Location	Task Success Task Completion Time			
Side Effects of Change				

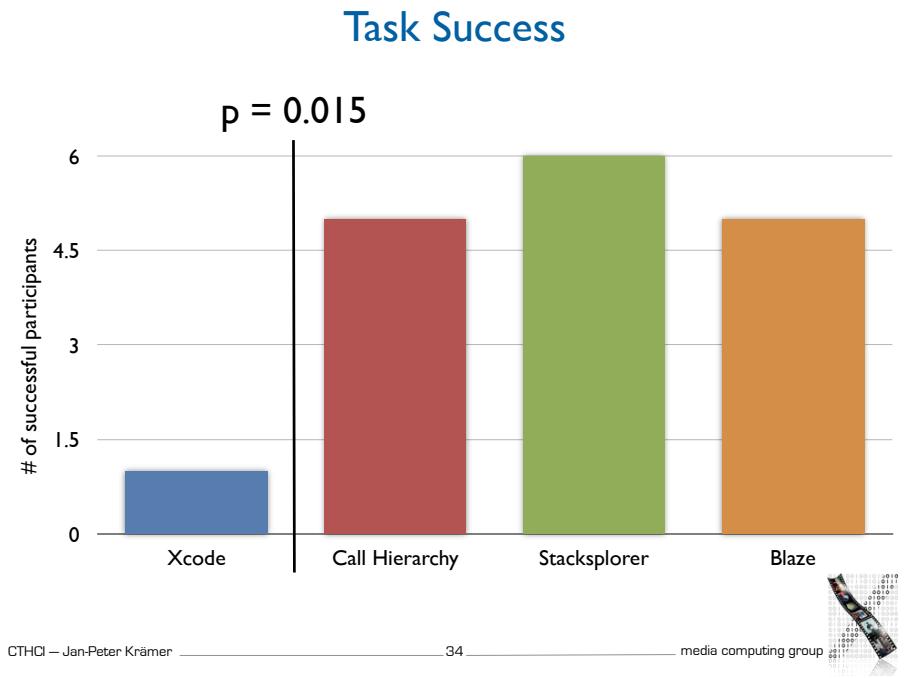
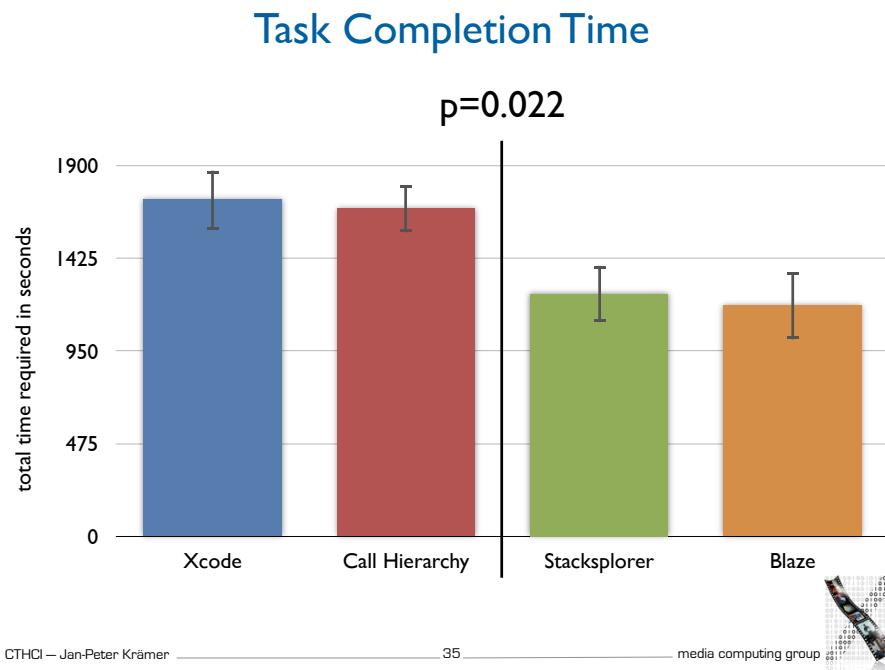


33 Developers



80.000 Lines of Code

[Krämer2013, How Tools in IDEs Shape Developers' Navigation Behavior]

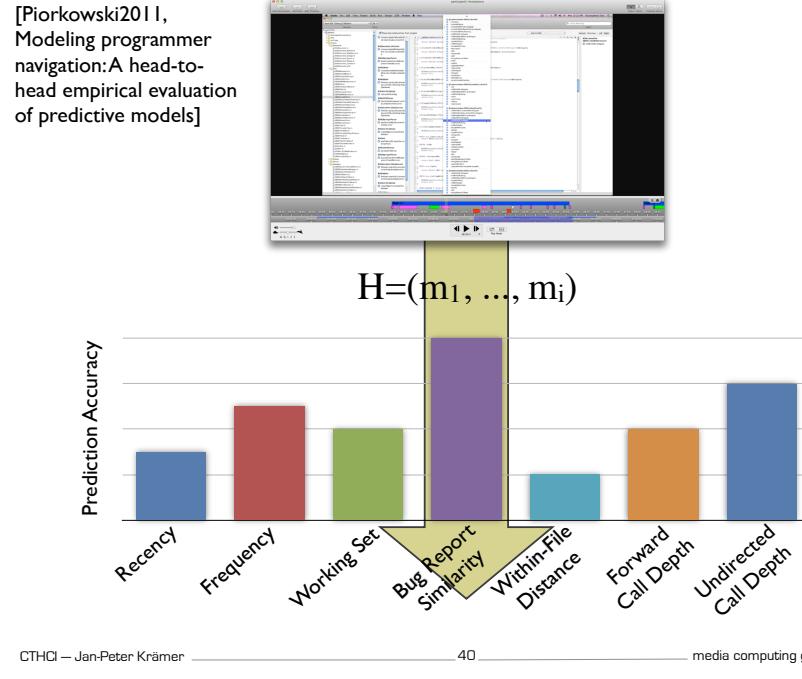
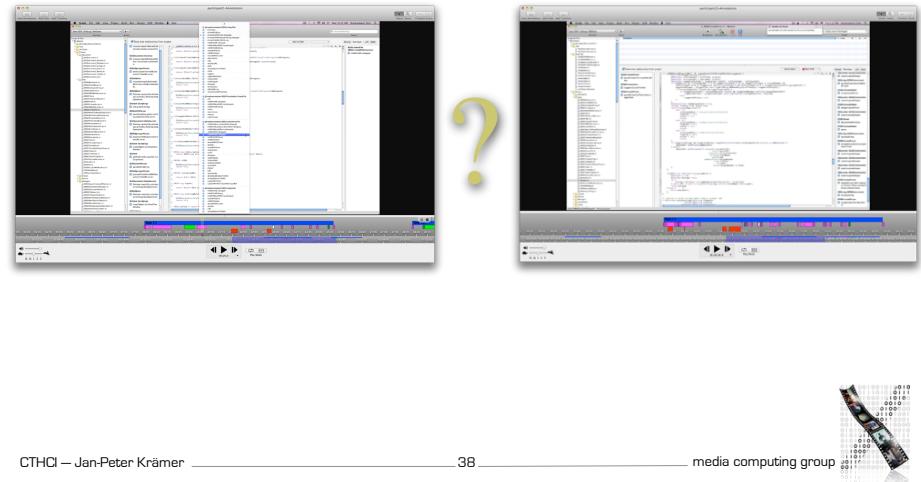
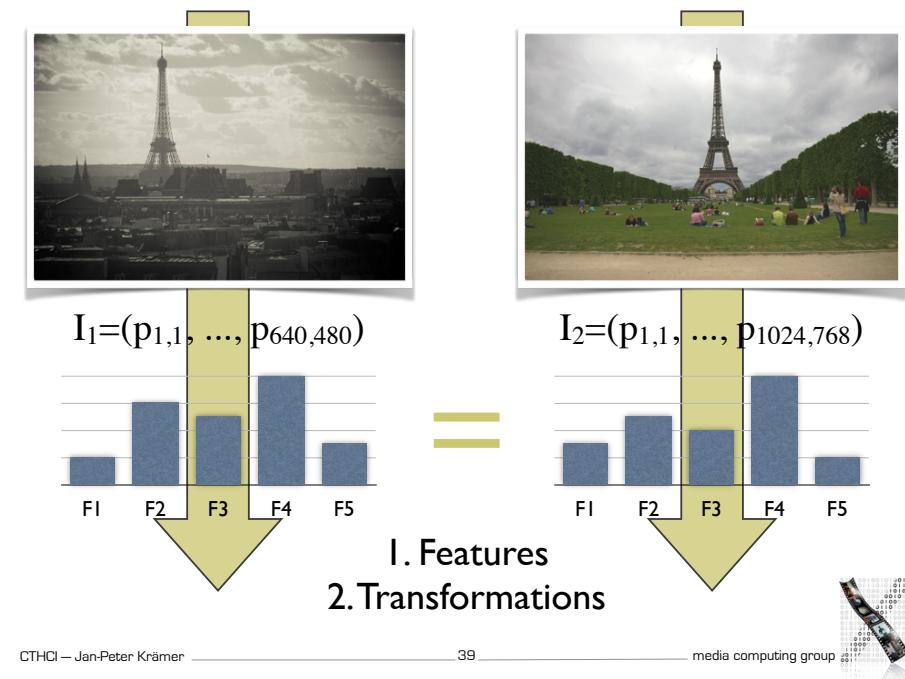
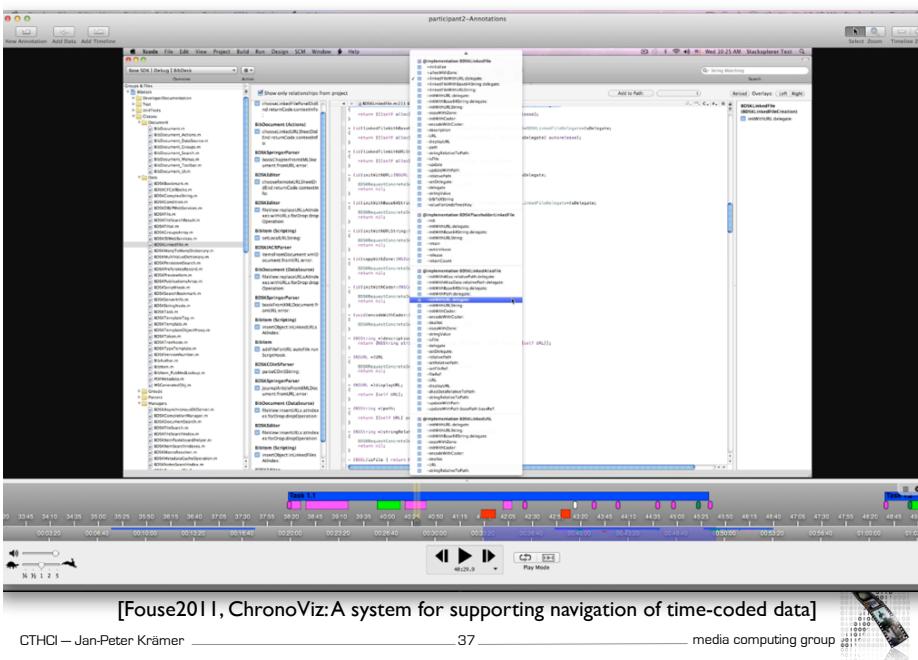


Why?

UI Differences

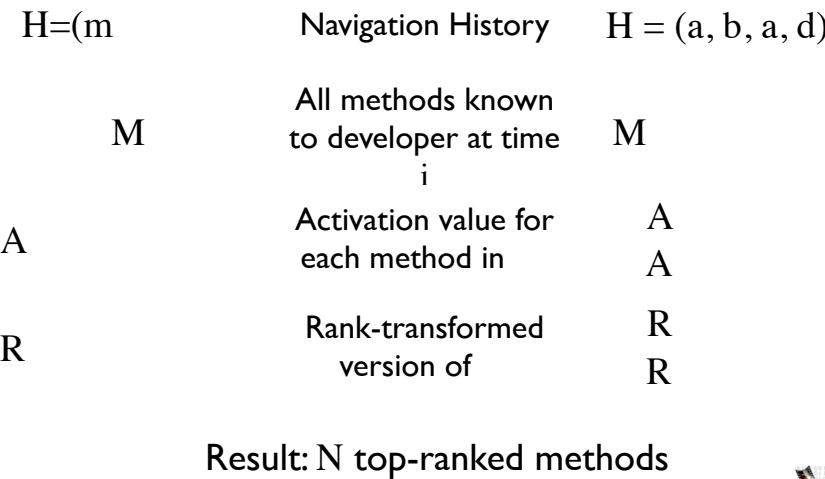
Navigation Behavior

Comparing Navigation Behavior

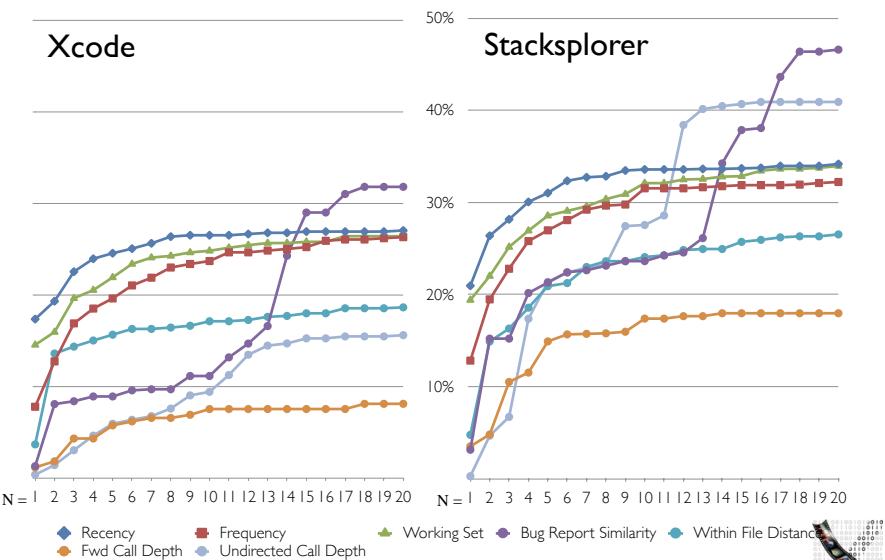


A Predictor

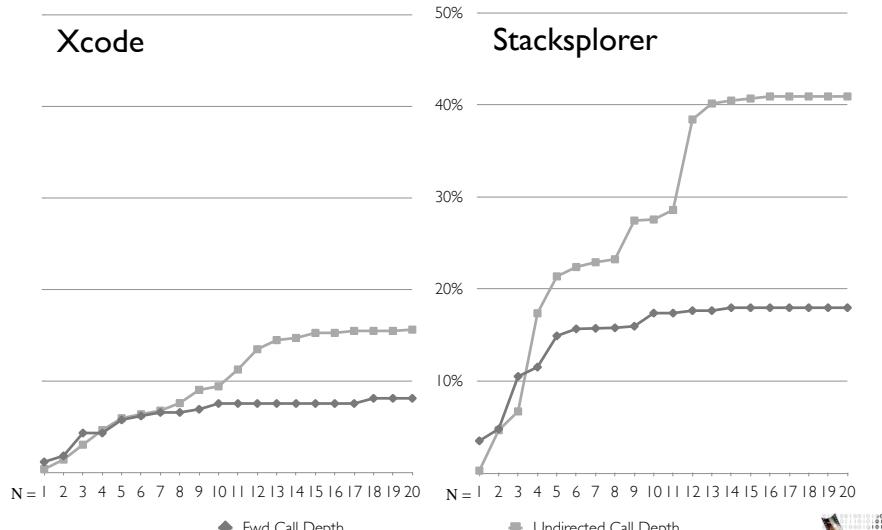
[Piorkowski2011, Modeling programmer navigation:A head-to-head empirical evaluation of predictive models]



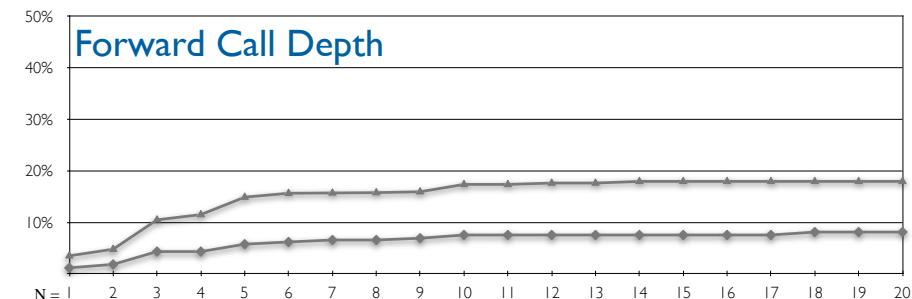
Prediction Accuracy



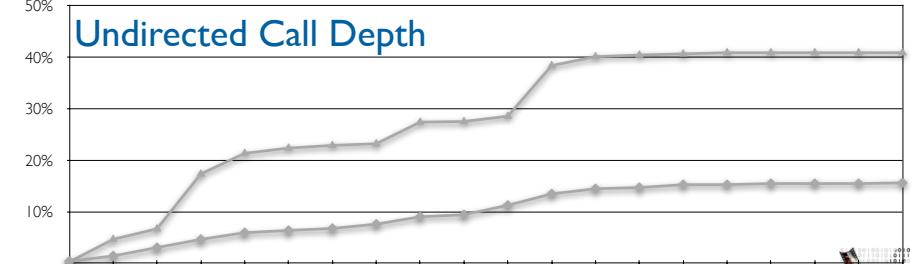
Prediction Accuracy

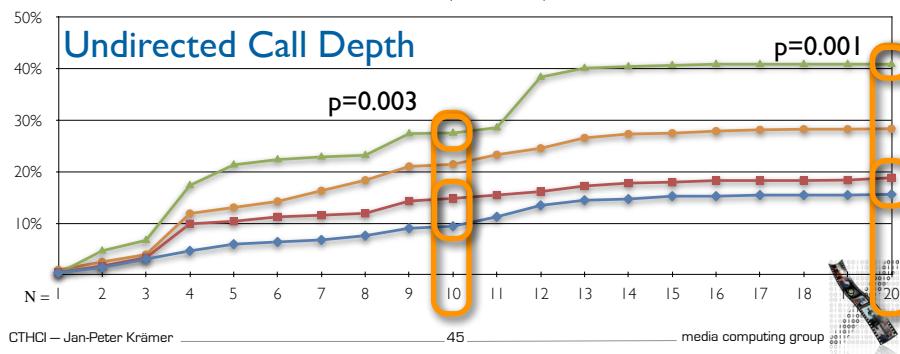
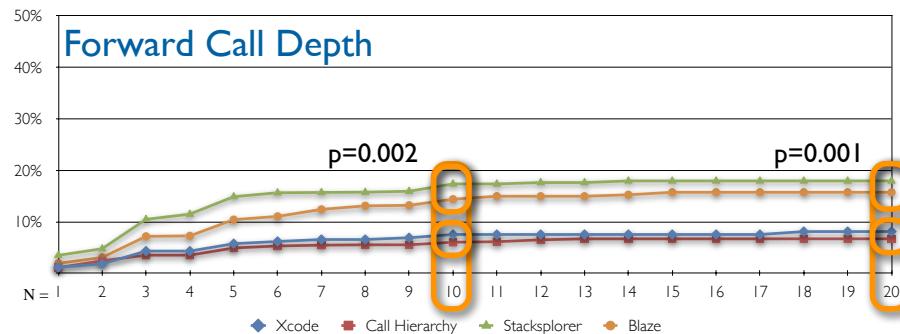


Forward Call Depth



Undirected Call Depth





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Flex Builder

```

Flex Builder File Edit Source Navigate Search Project Data Run Window Help
Flex Development - bpVideo/src/bpVideo.mxml - Adobe Flex Builder 3
bpVideo.mxml
Source Design
<?xml version="1.0" encoding="utf-8"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" layout="absolute" creationComplete="loadData()">
<mx:Script>
<![CDATA[
<public function loadData():void {
    var loader:URLLoader = new URLLoader();
    loader.load(new URLRequest("http://www.mirad.de/testfile.mp4"));
    loader.addEventListener(Event.COMPLETE, onFileLoaded);
}
]]>
</mx:Script>
</mx:Application>

```

Problems Console

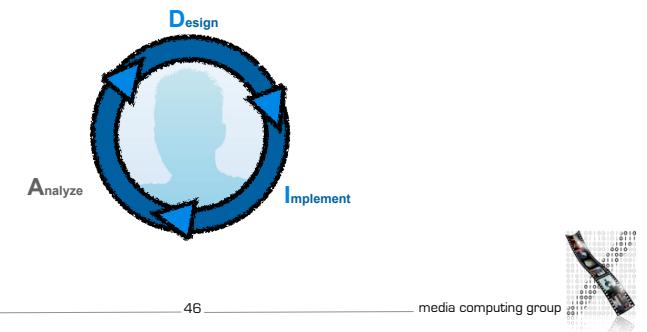
```

<terminated> bpVideo [Flex Application] file:/Users/mirad/work/projects/Blueprint/code/bin-debug/bpVideo.html
[SWF] users:mirad:work:projects:Blueprint:code/bin-debug:bpVideo.swf - 633,020 bytes after decompression
undefined

```

[Brandt2010, Example-centric programming: integrating web search into the development environment]

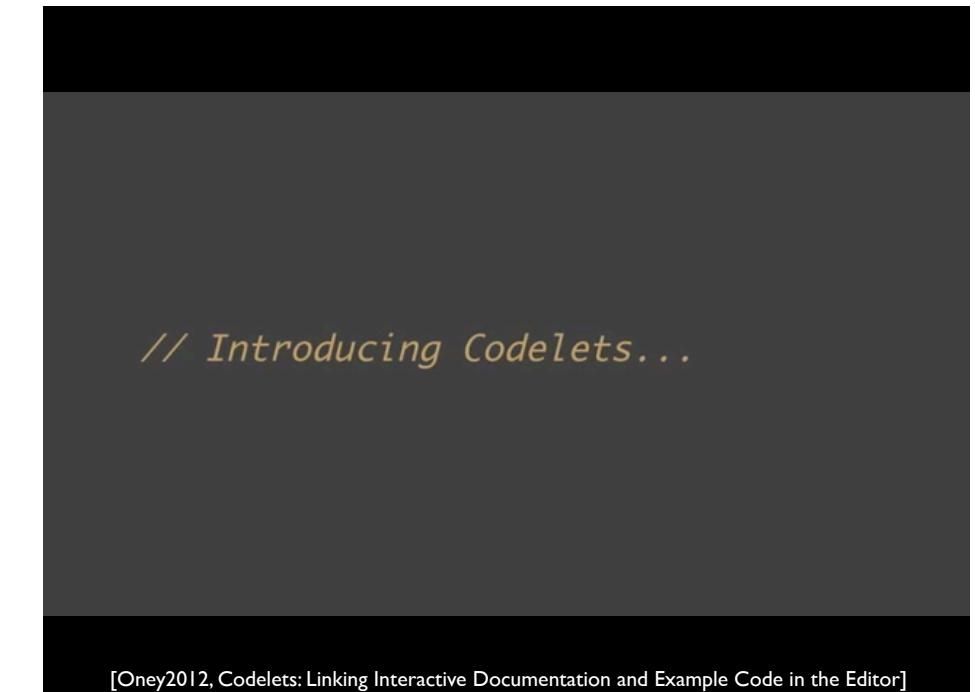
Away from static analysis only

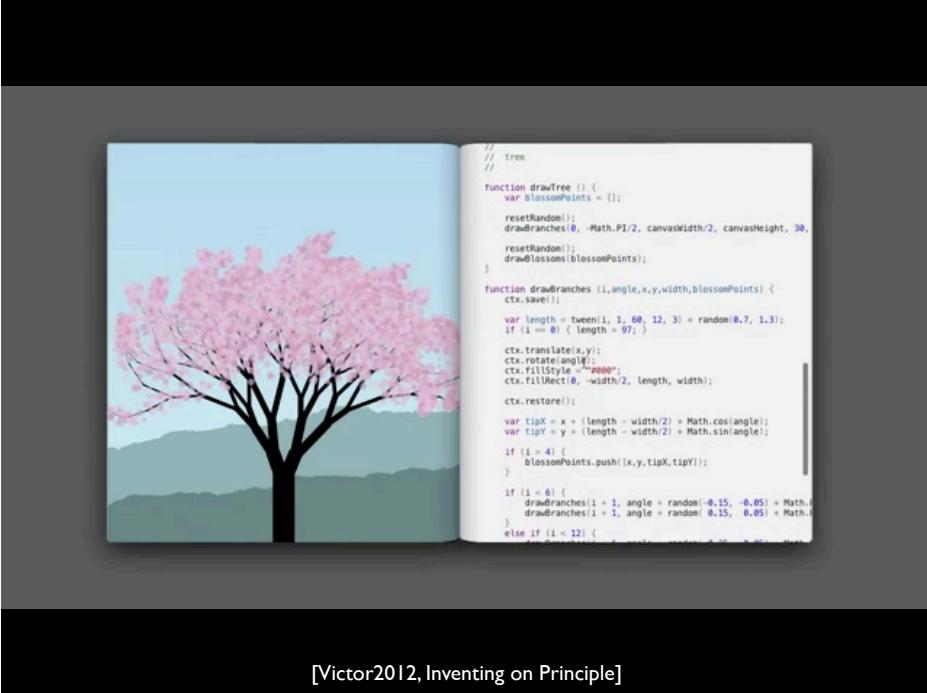


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Demo

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Live Coding Affects Coding Behavior

[Krämer2014, to appear, How Live Coding Affects Developers' Coding Behavior]

