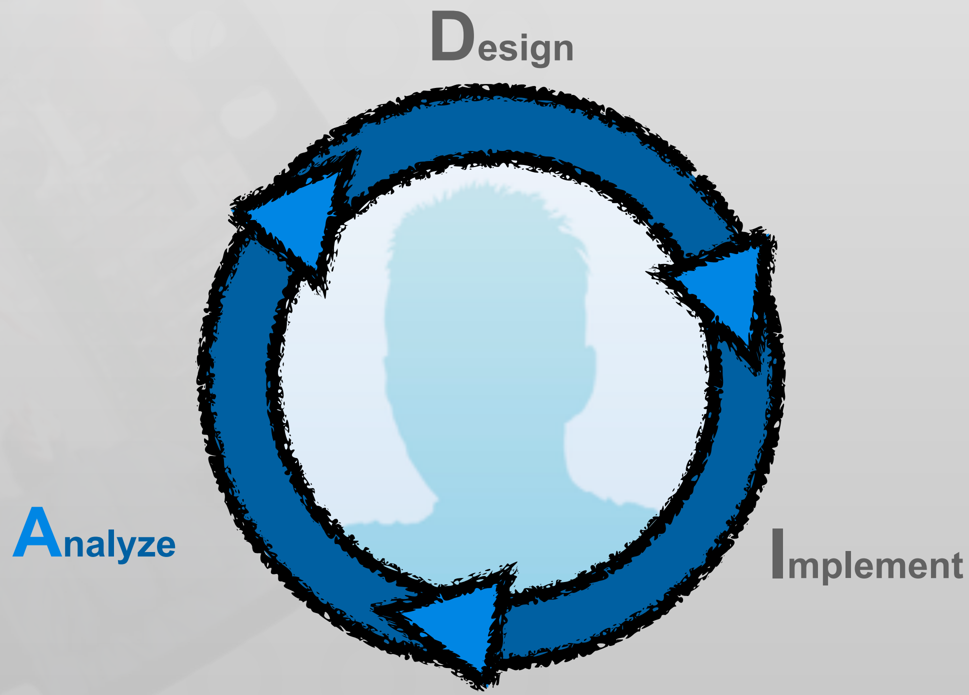
Research in Coding and IDEs

Jan-Peter Krämer
Media Computing Group
RWTH Aachen University

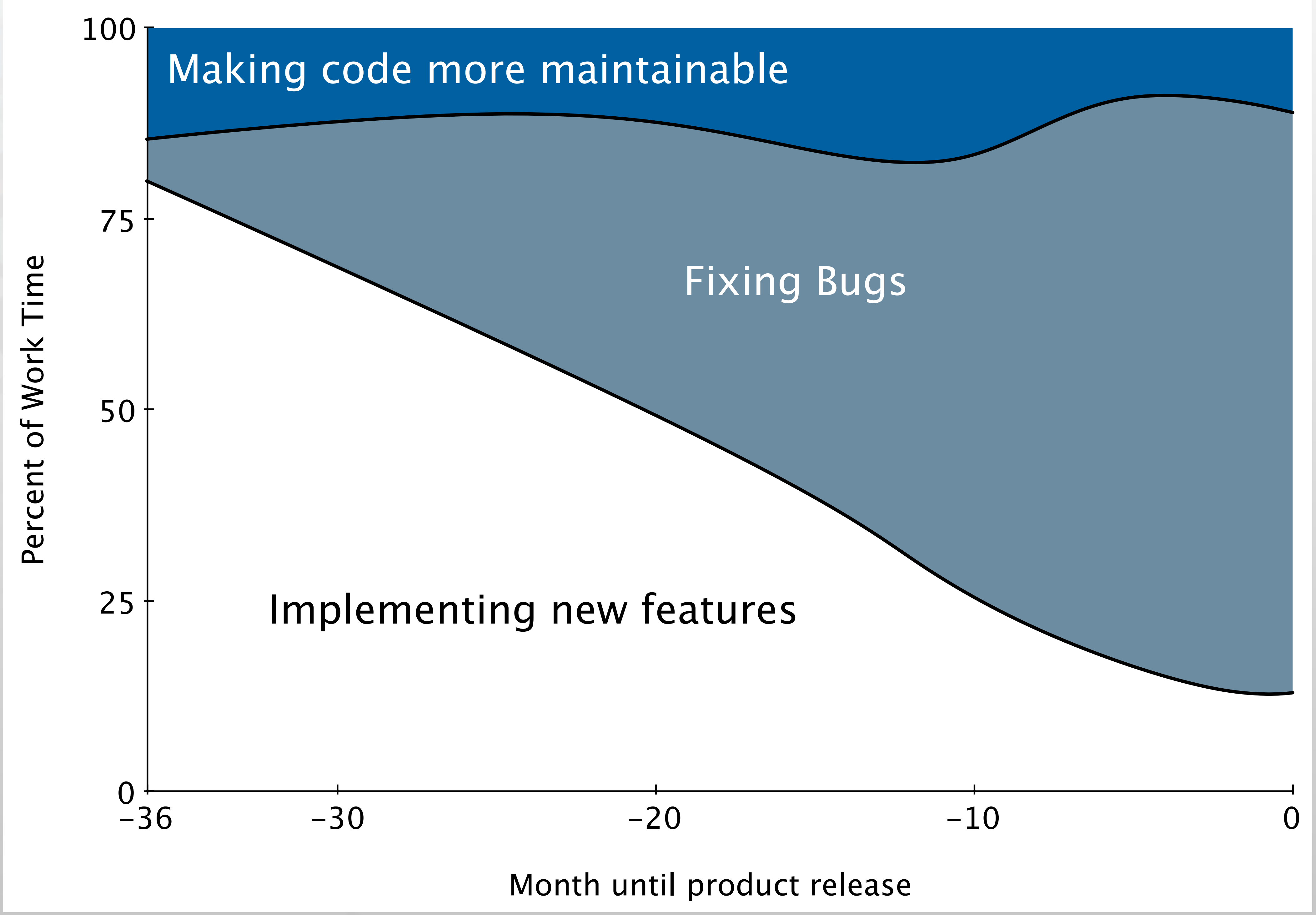
http://hci.rwth-aachen.de/cthci

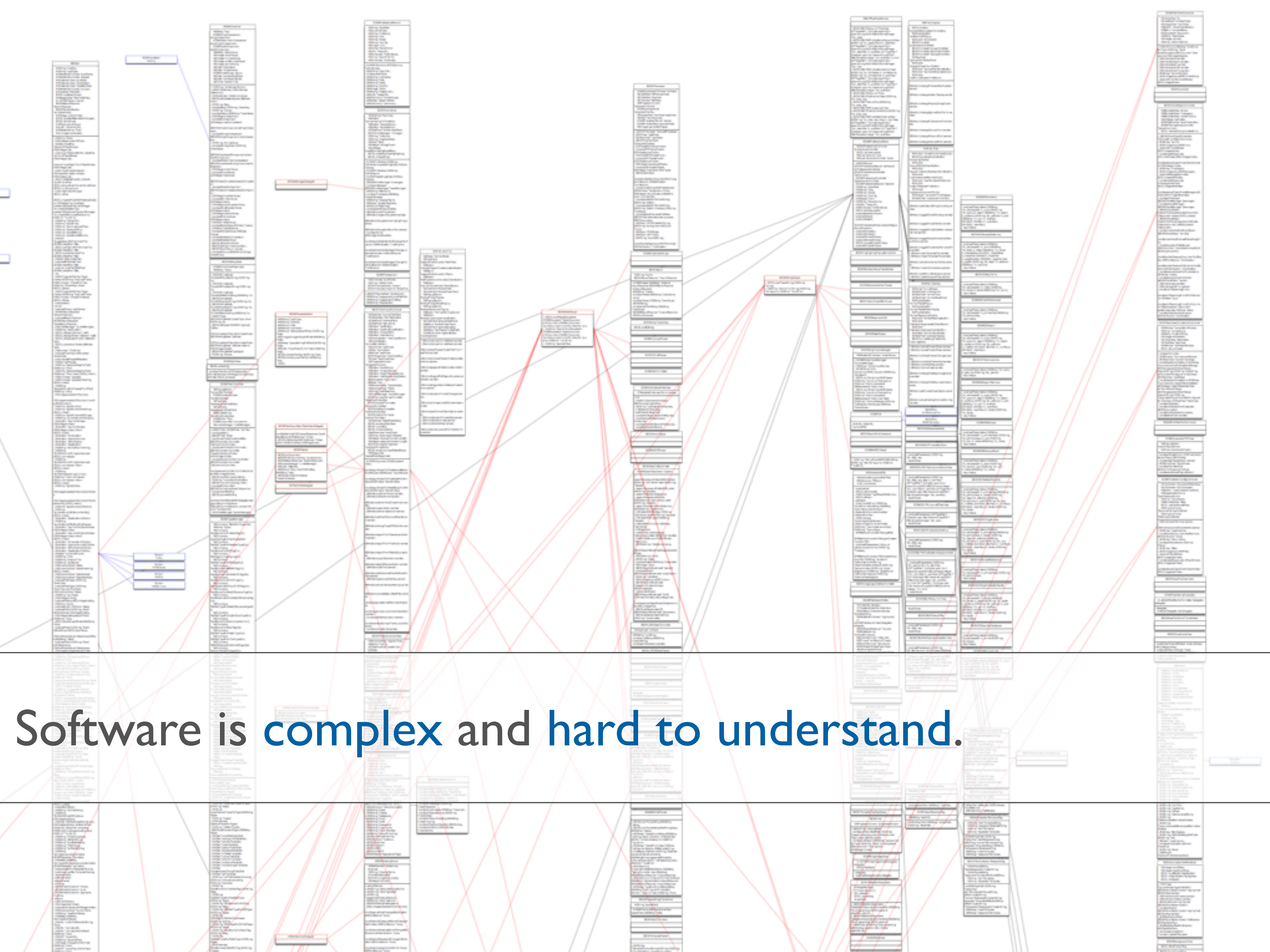
Status Quo



Time in Software Development

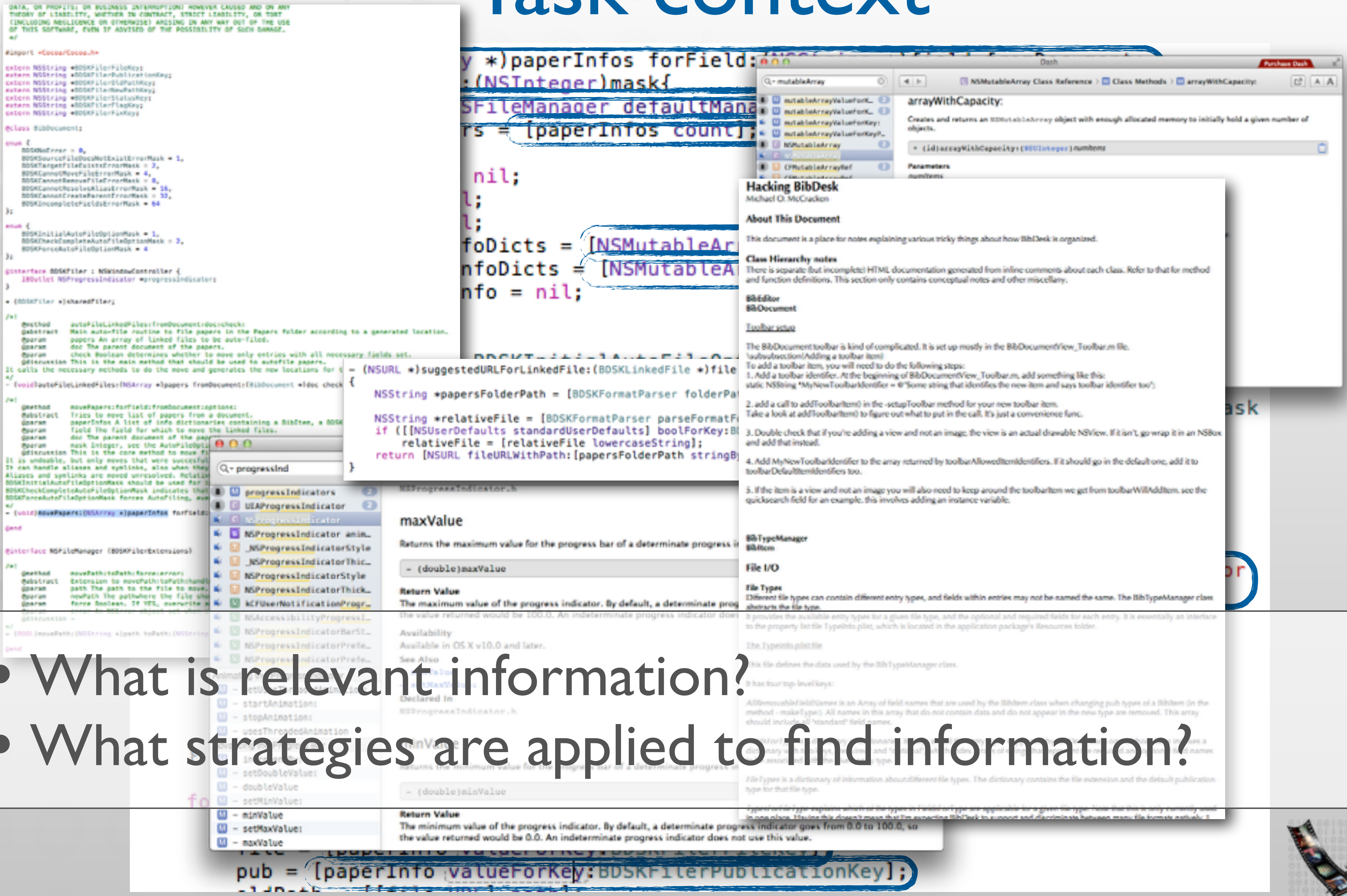
[LaToza2006, Maintaining mental models: a study of developer work habits]





Software is complex and hard to understand.

Task context



```
y *)paperInfos forField:
:(NSInteger)mask{
SFileManager defaultMana
rs = [paperInfos count];

nil;
l;
l;
foDicts = [NSMutableAr
nfoDicts = [NSMutableA
nfo = nil;
```

```
- (NSURL *)suggestedURLForLinkedFile:(BDSKLinkedFile *)file
{
    NSString *papersFolderPath = [BDSKFormatParser folderPat

    NSString *relativeFile = [BDSKFormatParser parseFormatF
    if ([[NSUserDefaults standardUserDefaults] boolForKey:BD
        relativeFile = [relativeFile lowercaseString];
    return [NSURL fileURLWithPath:[papersFolderPath stringBy
}
```

```
pub = [paperInfo valueForKey:BDSKFilerPublicationKey];
```

arrayWithCapacity:

Creates and returns an NSMutableArray object with enough allocated memory to initially hold a given number of objects.

`+ (id)arrayWithCapacity:(NSUInteger)numItems`

Parameters

numItems

Hacking BibDesk

Michael O. McCracken

About This Document

This document is a place for notes explaining various tricky things about how BibDesk is organized.

Class Hierarchy notes

There is separate (but incomplete) HTML documentation generated from inline comments about each class. Refer to that for method and function definitions. This section only contains conceptual notes and other miscellany.

BibEditor

BibDocument

Toolbar setup

The BibDocument toolbar is kind of complicated. It is set up mostly in the BibDocumentView_Toolbar.m file.
\subsubsection{Adding a toolbar item}
To add a toolbar item, you will need to do the following steps:
1. Add a toolbar identifier. At the beginning of BibDocumentView_Toolbar.m, add something like this:
static NSString *MyNewToolbarIdentifier = @"Some string that identifies the new item and says toolbar identifier too";

2. add a call to addToolbarItem() in the -setupToolbar method for your new toolbar item.
Take a look at addToolbarItem() to figure out what to put in the call. It's just a convenience func.

3. Double check that if you're adding a view and not an image, the view is an actual drawable NSView. If it isn't, go wrap it in an NSBox and add that instead.

4. Add MyNewToolbarIdentifier to the array returned by toolbarAllowedItemIdentifiers. If it should go in the default one, add it to toolbarDefaultItemIdentifiers too.

5. If the item is a view and not an image you will also need to keep around the toolbarItem we get from toolbarWillAddItem. see the quicksearch field for an example. this involves adding an instance variable.

BibTypeManager

BibItem

File I/O

File Types

Different file types can contain different entry types, and fields within entries may not be named the same. The BibTypeManager class abstracts the file type.

It provides the available entry types for a given file type, and the optional and required fields for each entry. It is essentially an interface to the property list file TypeInfo.plist, which is located in the application package's Resources folder.

The TypeInfo.plist file

This file defines the data used by the BibTypeManager class.

It has four top-level keys:

NSProgressIndicator.h

maxValue

Returns the maximum value for the progress bar of a determinate progress in

`- (double)maxValue`

Return Value

The maximum value of the progress indicator. By default, a determinate prog the value returned would be 100.0. An indeterminate progress indicator does

Availability

Available in OS X v10.0 and later.

See Also

Declared In

NSProgressIndicator.h

minValue

`- (double)minValue`

Return Value

The minimum value of the progress indicator. By default, a determinate progress indicator goes from 0.0 to 100.0, so the value returned would be 0.0. An indeterminate progress indicator does not use this value.

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

Models for Developer Strategies

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

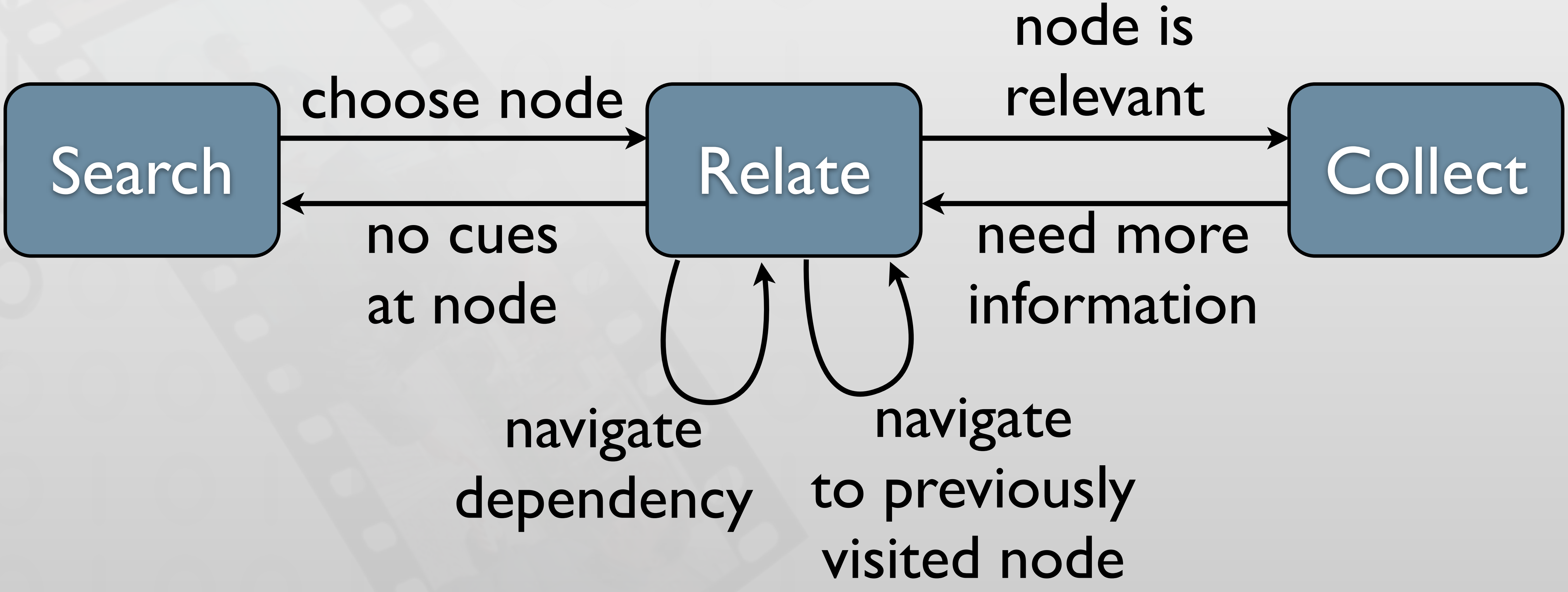
31 Professional Java Developers

5 Maintenance tasks
(3 Bugs, 2 Enhancements)

500 SLOC Java Paint Application

Models for Developer Strategies

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



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

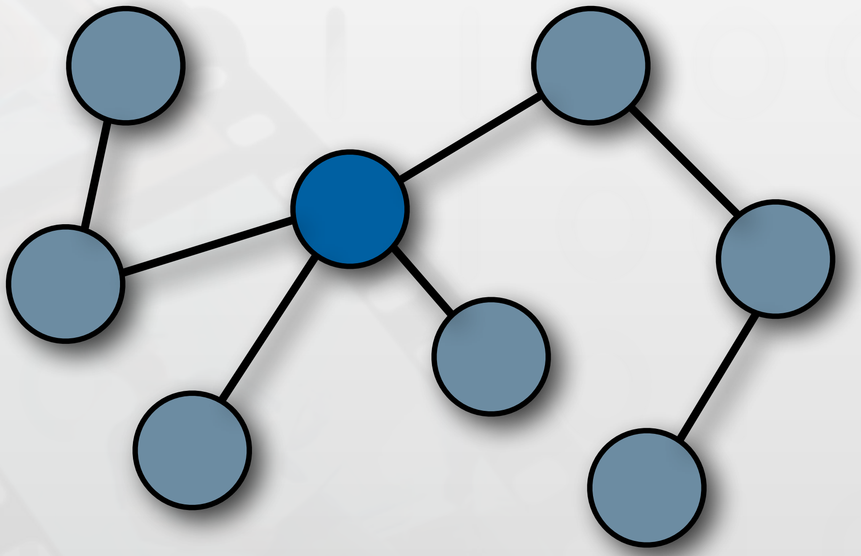
16 developers from industry

Real world change task

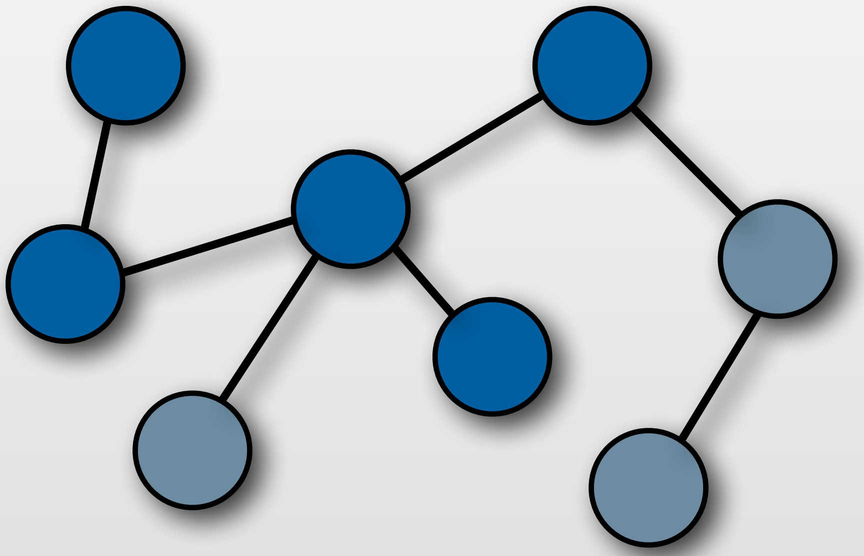
Real world sour code

Models for Developer Strategies

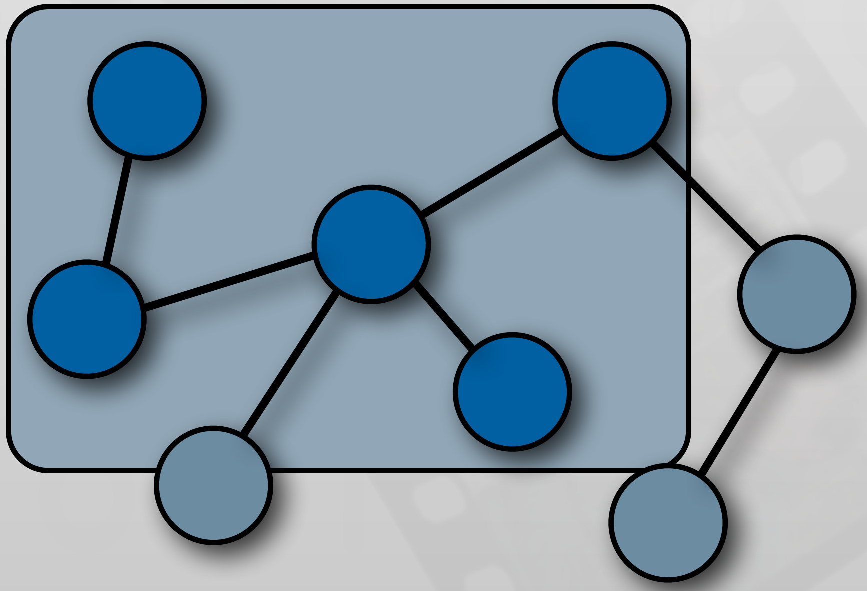
[Sillito2008, Asking and Answering Questions during a Programming Change Task]



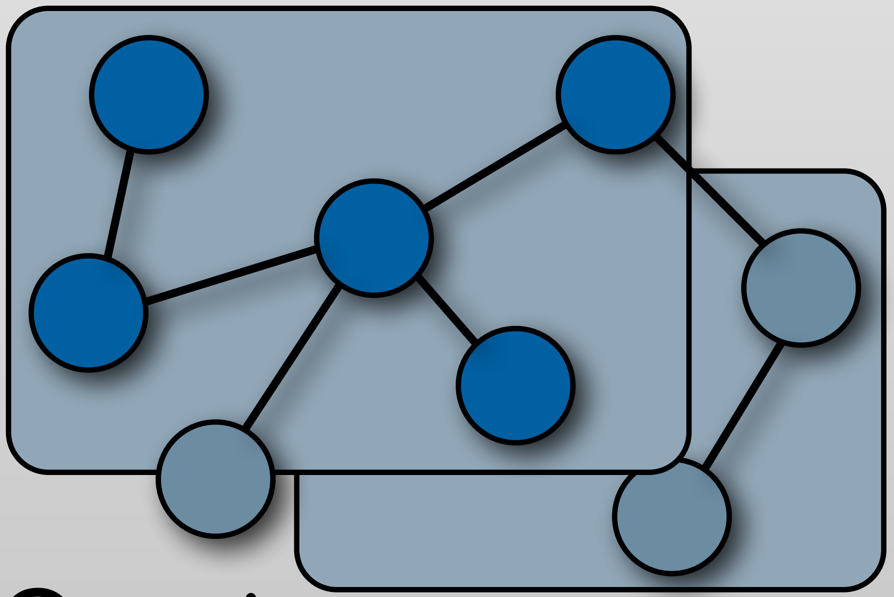
Finding focus points



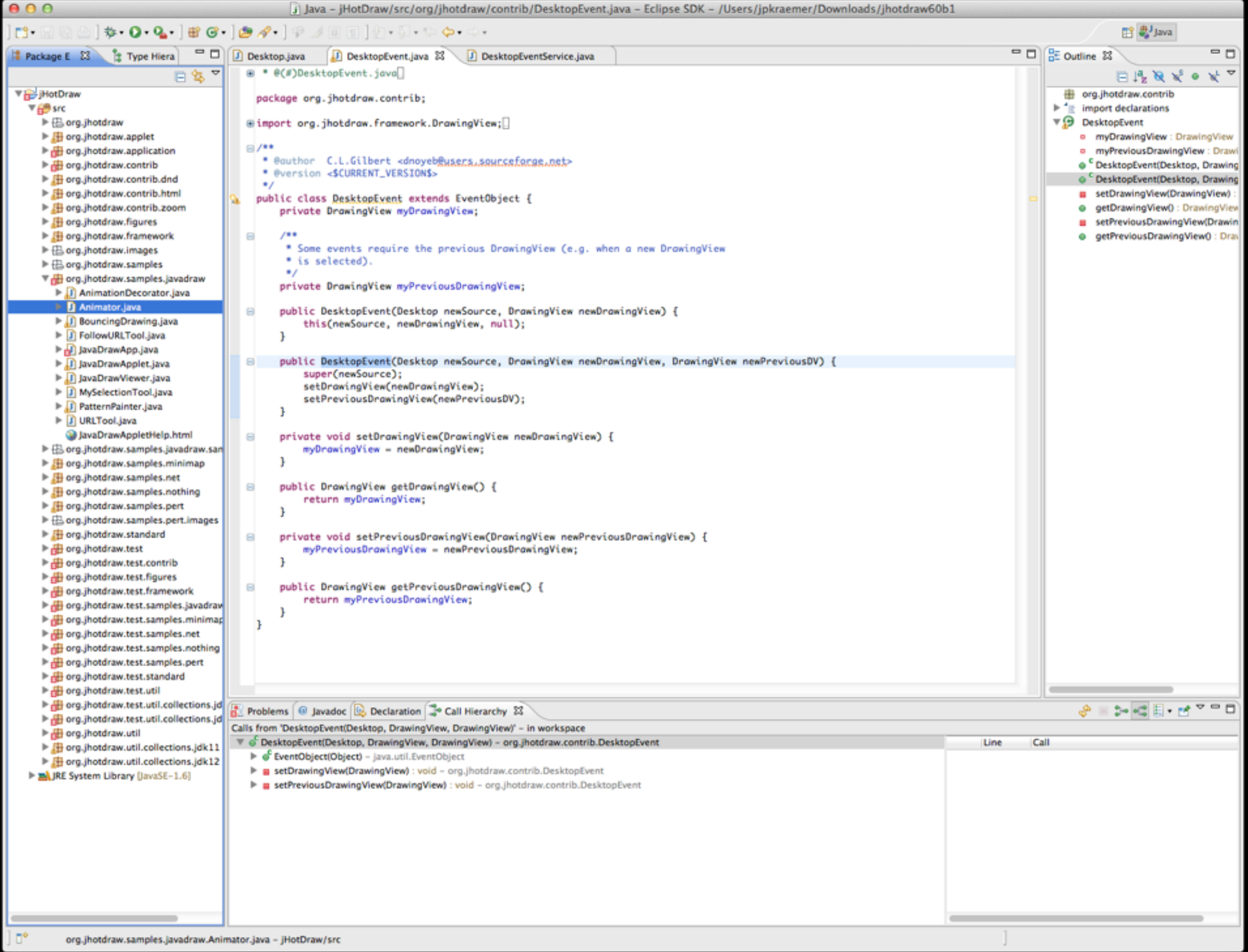
Expanding focus points



Understanding a subgraph



Questions over groups of subgraphs

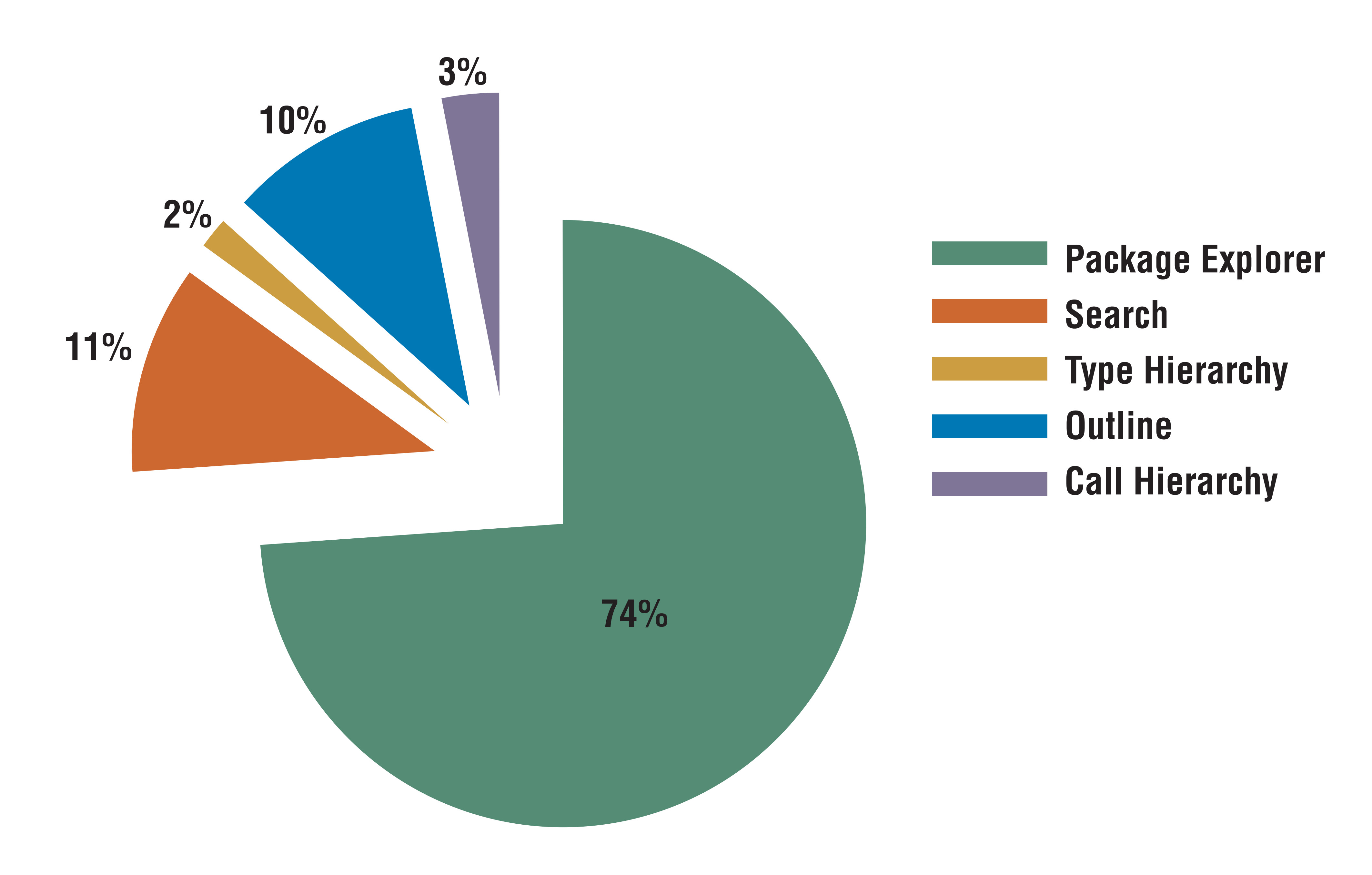

Java - jHotDraw/src/org/jhotdraw/contrib/DesktopEvent.java - Eclipse SDK - /Users/jpkraemer/Downloads/jhotdraw60b1
Java
Package E
Type Hiera
Desktop.java
DesktopEvent.java
DesktopEventService.java
Outline
jHotDraw
src
org.jhotdraw
org.jhotdraw.applet
org.jhotdraw.application
org.jhotdraw.contrib
org.jhotdraw.contrib.dnd
org.jhotdraw.contrib.html
org.jhotdraw.contrib.zoom
org.jhotdraw.figures
org.jhotdraw.framework
org.jhotdraw.images
org.jhotdraw.samples
org.jhotdraw.samples.javadraw
AnimationDecorator.java
Animator.java
BouncingDrawing.java
FollowURLTool.java
JavaDrawApp.java
JavaDrawApplet.java
JavaDrawViewer.java
MySelectionTool.java
PatternPainter.java
URLTool.java
JavaDrawAppletHelp.html
org.jhotdraw.samples.javadraw.san
org.jhotdraw.samples.minimap
org.jhotdraw.samples.net
org.jhotdraw.samples.nothing
org.jhotdraw.samples.pert
org.jhotdraw.samples.pert.images
org.jhotdraw.standard
org.jhotdraw.test
org.jhotdraw.test.contrib
org.jhotdraw.test.figures
org.jhotdraw.test.framework
org.jhotdraw.test.samples.javadrav
org.jhotdraw.test.samples.minimap
org.jhotdraw.test.samples.net
org.jhotdraw.test.samples.nothing
org.jhotdraw.test.samples.pert
org.jhotdraw.test.standard
org.jhotdraw.test.util
org.jhotdraw.test.util.collections.jd
org.jhotdraw.test.util.collections.jd
org.jhotdraw.util
org.jhotdraw.util.collections.jdk11
org.jhotdraw.util.collections.jdk12
JRE System Library [JavaSE-1.6]
org.jhotdraw.contrib
import declarations
DesktopEvent
myDrawingView : DrawingView
myPreviousDrawingView : Drawi
DesktopEvent(Desktop, Drawing
DesktopEvent(Desktop, Drawing
setDrawingView(DrawingView) :
getDrawingView() : DrawingView
setPreviousDrawingView(Drawin
getPreviousDrawingView() : Draw
Problems
Javadoc
Declaration
Call Hierarchy
Line
Call
org.jhotdraw.samples.javadraw.Animator.java - jHotDraw/src

```
 * @(#)DesktopEvent.java

package org.jhotdraw.contrib;

import org.jhotdraw.framework.DrawingView;

/**
 * @author  C.L.Gilbert <dnoyeb@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) {
        this(newSource, newDrawingView, null);
    }

    public DesktopEvent(Desktop newSource, DrawingView newDrawingView, DrawingView newPreviousDV) {
        super(newSource);
        setDrawingView(newDrawingView);
        setPreviousDrawingView(newPreviousDV);
    }

    private void setDrawingView(DrawingView newDrawingView) {
        myDrawingView = newDrawingView;
    }

    public DrawingView getDrawingView() {
        return myDrawingView;
    }

    private void setPreviousDrawingView(DrawingView newPreviousDrawingView) {
        myPreviousDrawingView = newPreviousDrawingView;
    }

    public DrawingView getPreviousDrawingView() {
        return myPreviousDrawingView;
    }
}
```

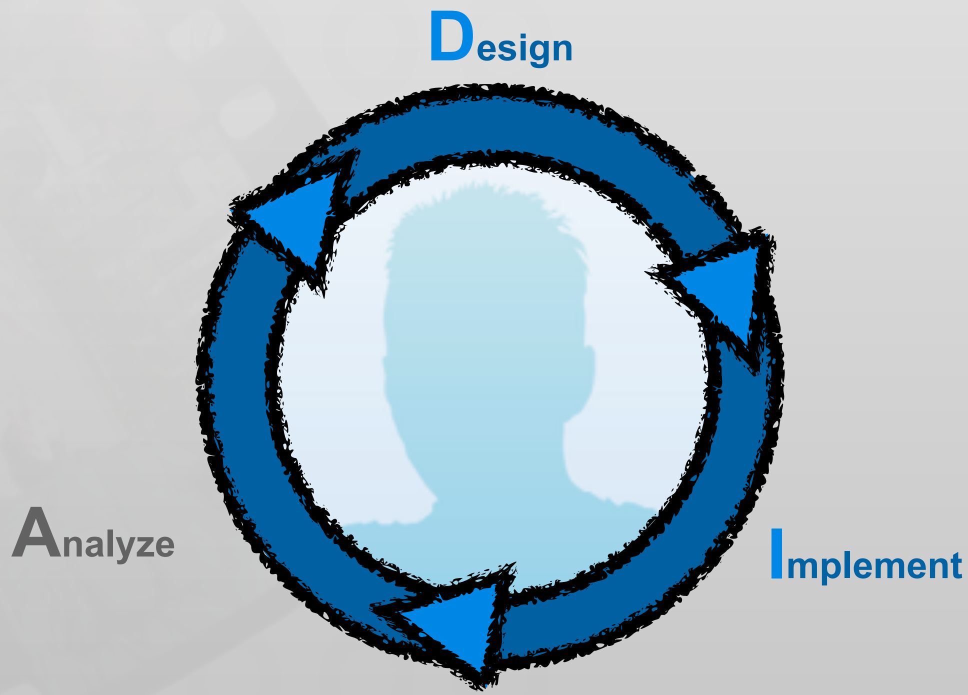
```
Calls from 'DesktopEvent(Desktop, DrawingView, DrawingView)' - in workspace
▼ DesktopEvent(Desktop, DrawingView, DrawingView) - org.jhotdraw.contrib.DesktopEvent
    ▶ EventObject(Object) - java.util.EventObject
    ▶ setDrawingView(DrawingView) : void - org.jhotdraw.contrib.DesktopEvent
    ▶ setPreviousDrawingView(DrawingView) : void - org.jhotdraw.contrib.DesktopEvent
```

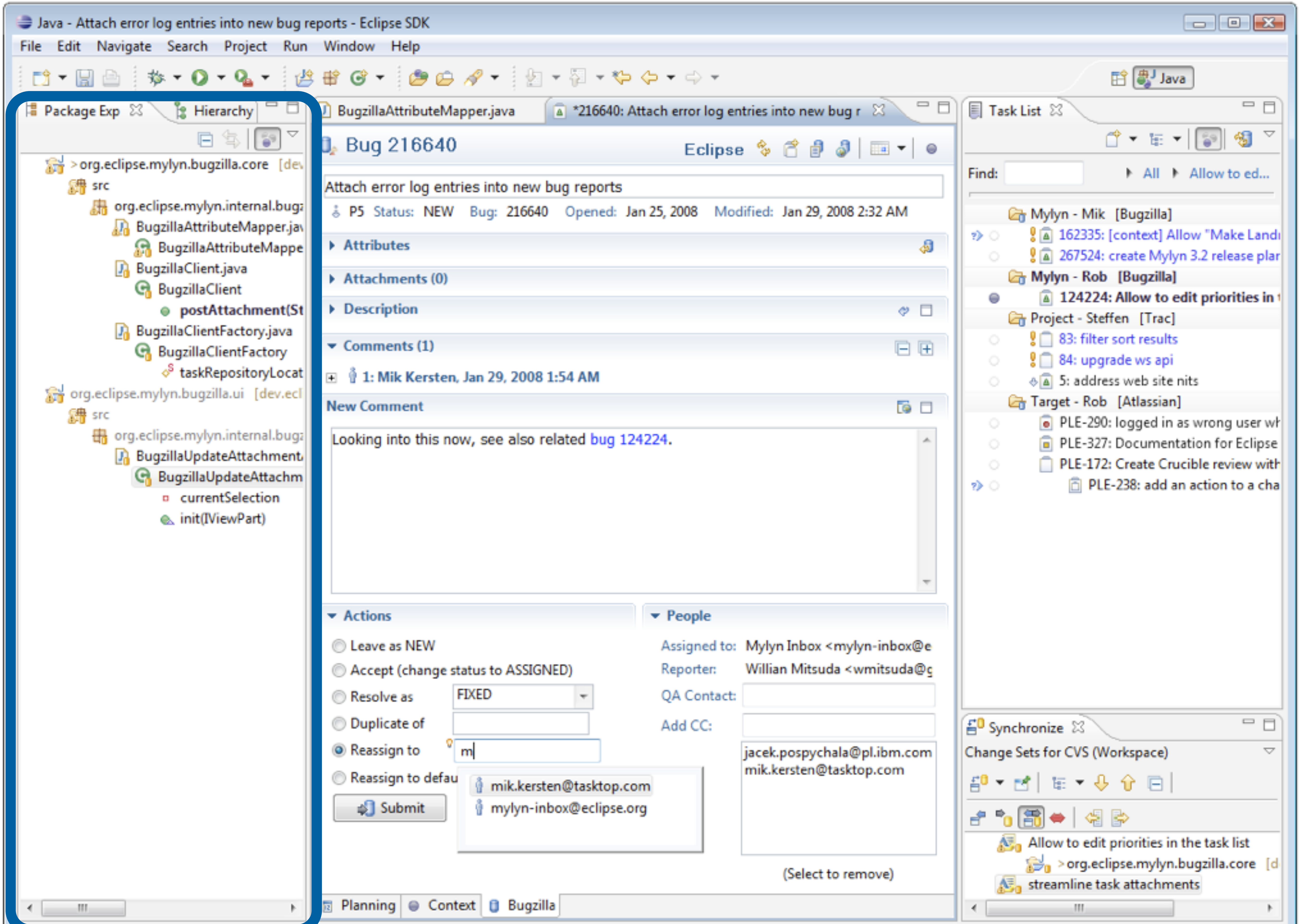
Tools Used in Eclipse

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



Easing Access to Task Context





Java - Attach error log entries into new bug reports - Eclipse SDK

File Edit Navigate Search Project Run Window Help

Package Exp | Hierarchy

- >org.eclipse.mylyn.bugzilla.core [dev
  - src
    - org.eclipse.mylyn.internal.bugz
      - BugzillaAttributeMapper.jav
        - BugzillaAttributeMappe
      - BugzillaClient.java
        - BugzillaClient
          - postAttachment(St
      - BugzillaClientFactory.java
        - BugzillaClientFactory
          - taskRepositoryLocat
- org.eclipse.mylyn.bugzilla.ui [dev.ecl
  - src
    - org.eclipse.mylyn.internal.bugz
      - BugzillaUpdateAttachment.
        - BugzillaUpdateAttachm
          - currentSelection
          - init(IViewPart)

BugzillaAttributeMapper.java | *216640: Attach error log entries into new bug r

Bug 216640 Eclipse

Attach error log entries into new bug reports

P5 Status: NEW Bug: 216640 Opened: Jan 25, 2008 Modified: Jan 29, 2008 2:32 AM

- Attributes
- Attachments (0)
- Description
- Comments (1)
  - 1: Mik Kersten, Jan 29, 2008 1:54 AM

New Comment

Looking into this now, see also related bug 124224.

Actions

- ○ Leave as NEW
- ○ Accept (change status to ASSIGNED)
- ○ Resolve as FIXED
- ○ Duplicate of
- ● Reassign to m
- ○ Reassign to defau

Submit

mik.kersten@tasktop.com
mylyn-inbox@eclipse.org

People

Assigned to: Mylyn Inbox <mylyn-inbox@e
Reporter: Willian Mitsuda <wmitsuda@g
QA Contact:
Add CC:

jacek.pospychala@pl.ibm.com
mik.kersten@tasktop.com

(Select to remove)

Planning | Context | Bugzilla

Task List

Find: All Allow to ed...

- Mylyn - Mik [Bugzilla]
  - 162335: [context] Allow "Make Landi
  - 267524: create Mylyn 3.2 release plar
- Mylyn - Rob [Bugzilla]
  - 124224: Allow to edit priorities in t
- Project - Steffen [Trac]
  - 83: filter sort results
  - 84: upgrade ws api
  - 5: address web site nits
- Target - Rob [Atlassian]
  - PLE-290: logged in as wrong user wh
  - PLE-327: Documentation for Eclipse
  - PLE-172: Create Crucible review with
    - PLE-238: add an action to a cha

Synchronize

Change Sets for CVS (Workspace)

- Allow to edit priorities in the task list
  - >org.eclipse.mylyn.bugzilla.core [d
- streamline task attachments

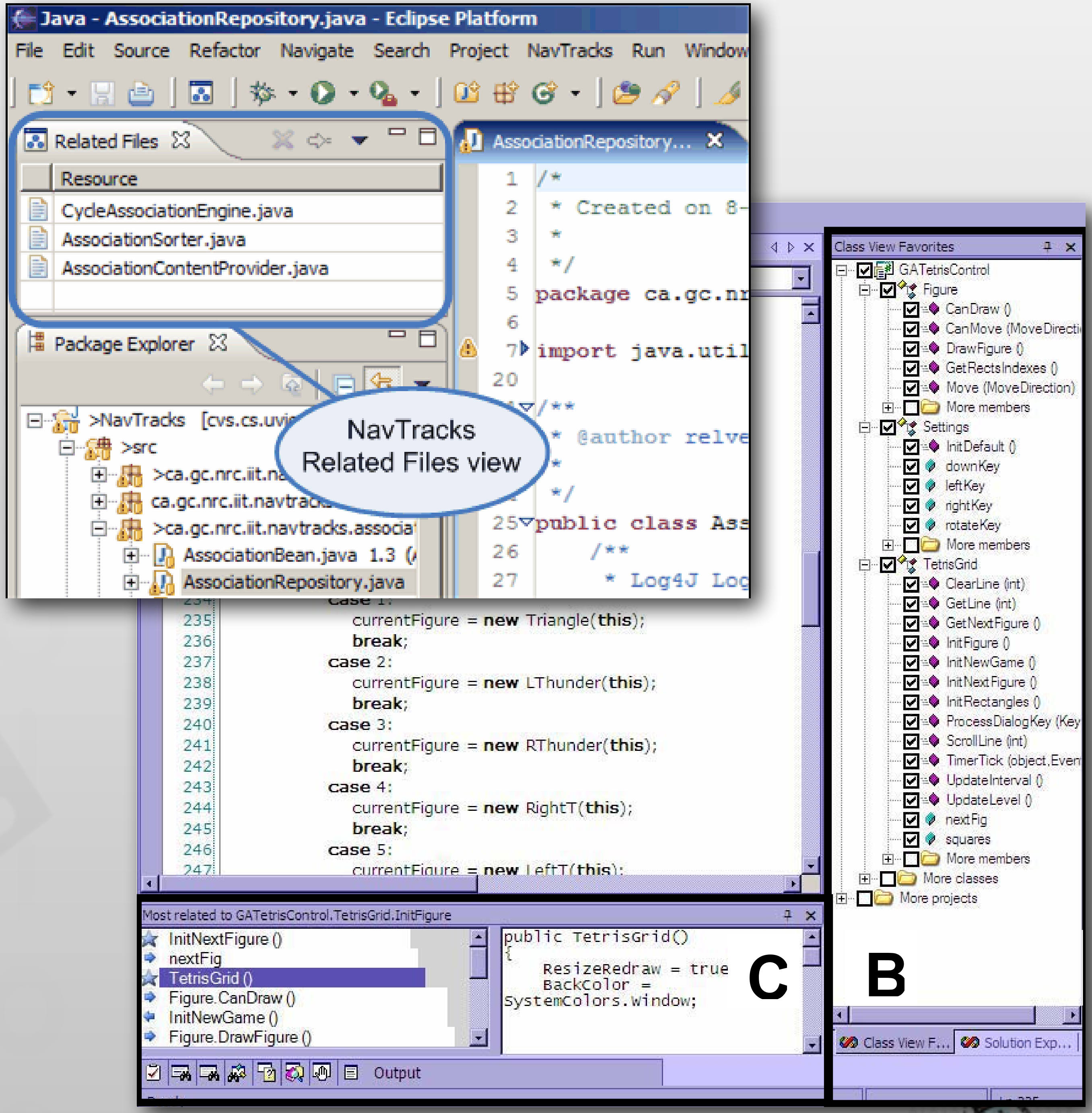
[Kersten2006, Using Task Context to Improve Programmer Productivity]

Recommender Tools

[Singer2005, NavTracks: supporting navigation in software maintenance]
[DeLine2005, Easing program comprehension by sharing navigation data]
[Čubranic´2005, Hipikat: 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



```
/*
 * Created on 8-
 *
 */
package ca.gc.nr

import java.util

/**
 * @author relve
 *
 */
public class Ass
    /**
     * Log4J Log
```

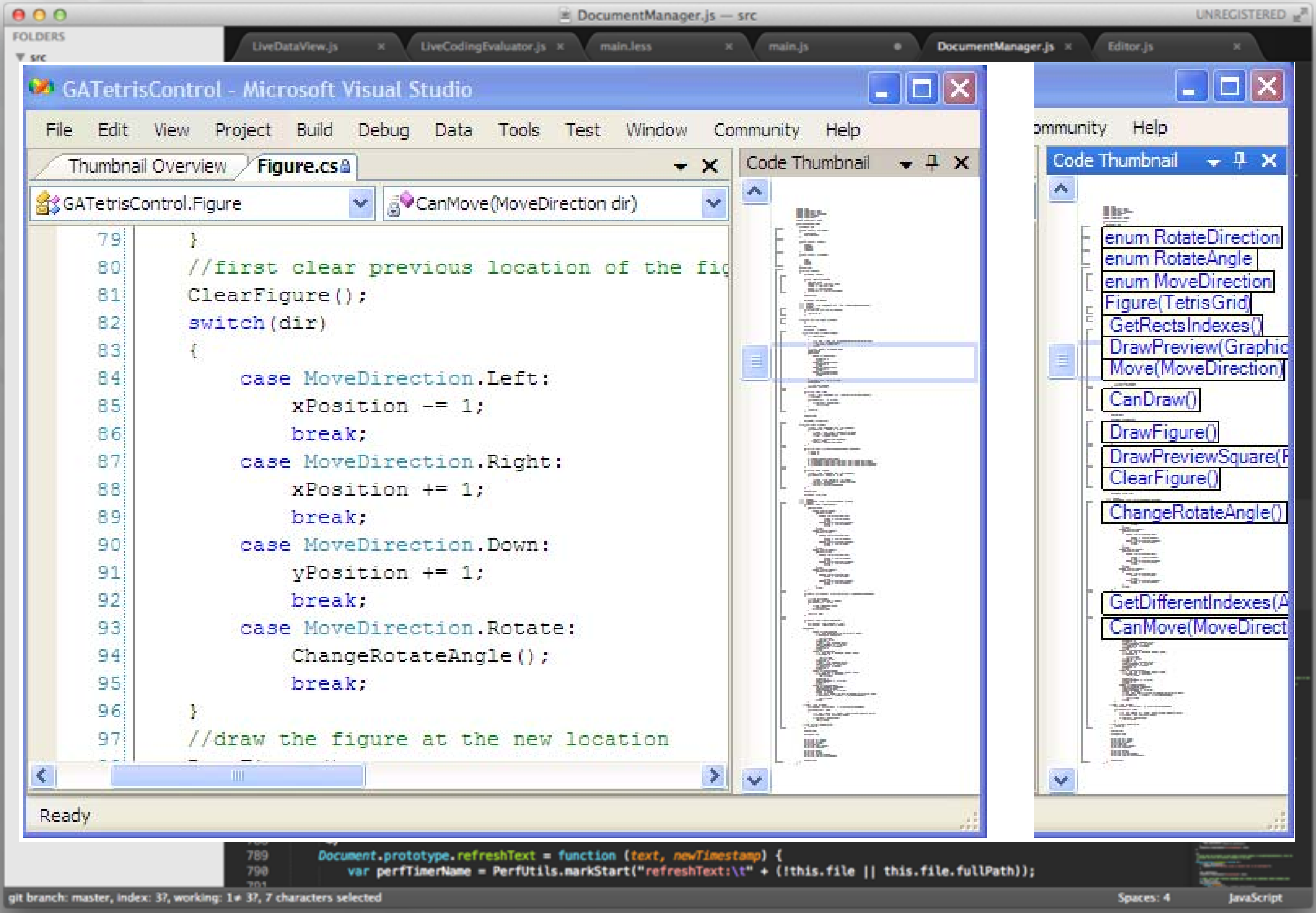
```
            case 1:
                currentFigure = new Triangle(this);
                break;
            case 2:
                currentFigure = new LThunder(this);
                break;
            case 3:
                currentFigure = new RThunder(this);
                break;
            case 4:
                currentFigure = new RightT(this);
                break;
            case 5:
                currentFigure = new LeftT(this);
```

```
public TetrisGrid()
{
    ResizeRedraw = true
    BackColor =
SystemColors.Window;
```

Changing the Presentation

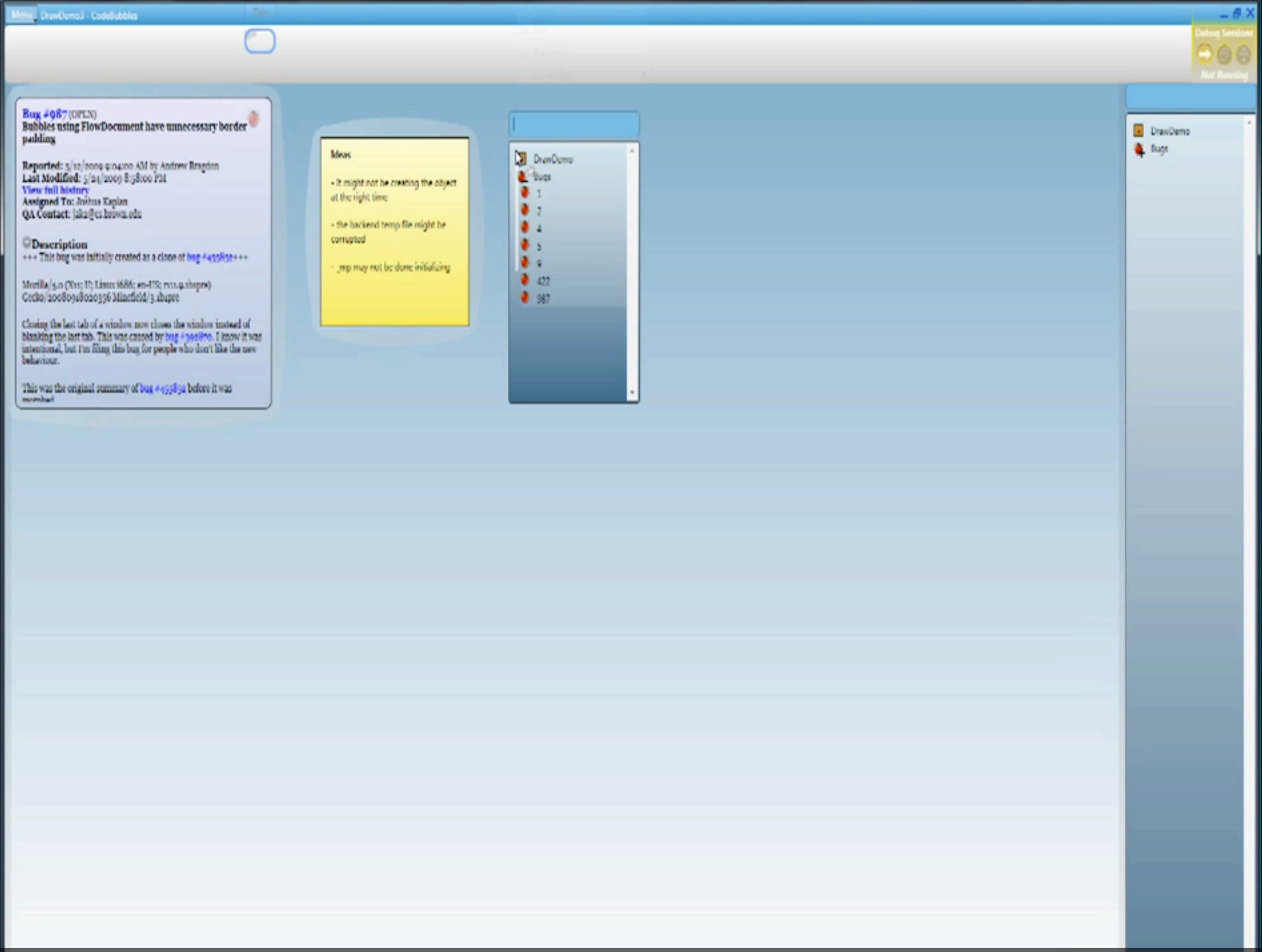
[DeLine2006, Code Thumbnails: Using Spatial Memory to Navigate Source Code]

[Sublime Text 2, http://www.sublimetext.com/2]



```
}
//first clear previous location of the fig
ClearFigure();
switch(dir)
{
    case MoveDirection.Left:
        xPosition -= 1;
        break;
    case MoveDirection.Right:
        xPosition += 1;
        break;
    case MoveDirection.Down:
        yPosition += 1;
        break;
    case MoveDirection.Rotate:
        ChangeRotateAngle();
        break;
}
//draw the figure at the new location
```

```
Document.prototype.refreshText = function (text, newTimestamp) {
    var perfTimerName = PerfUtils.markStart("refreshText:\t" + (!this.file || this.file.fullPath));
```



Bug #987 (OPEN)
Bubbles using FlowDocument have unnecessary border padding

Reported: 5/12/2009 9:04:00 AM by Andrew Bragdon
Last Modified: 5/24/2009 8:58:00 PM
View full history
Assigned To: Joshua Kaplan
QA Contact: jaka@cs.brown.edu

Description
+++ This bug was initially created as a clone of bug #455852+++

Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.1b1pre) Gecko/20080918020356 Minefield/3.1b1pre

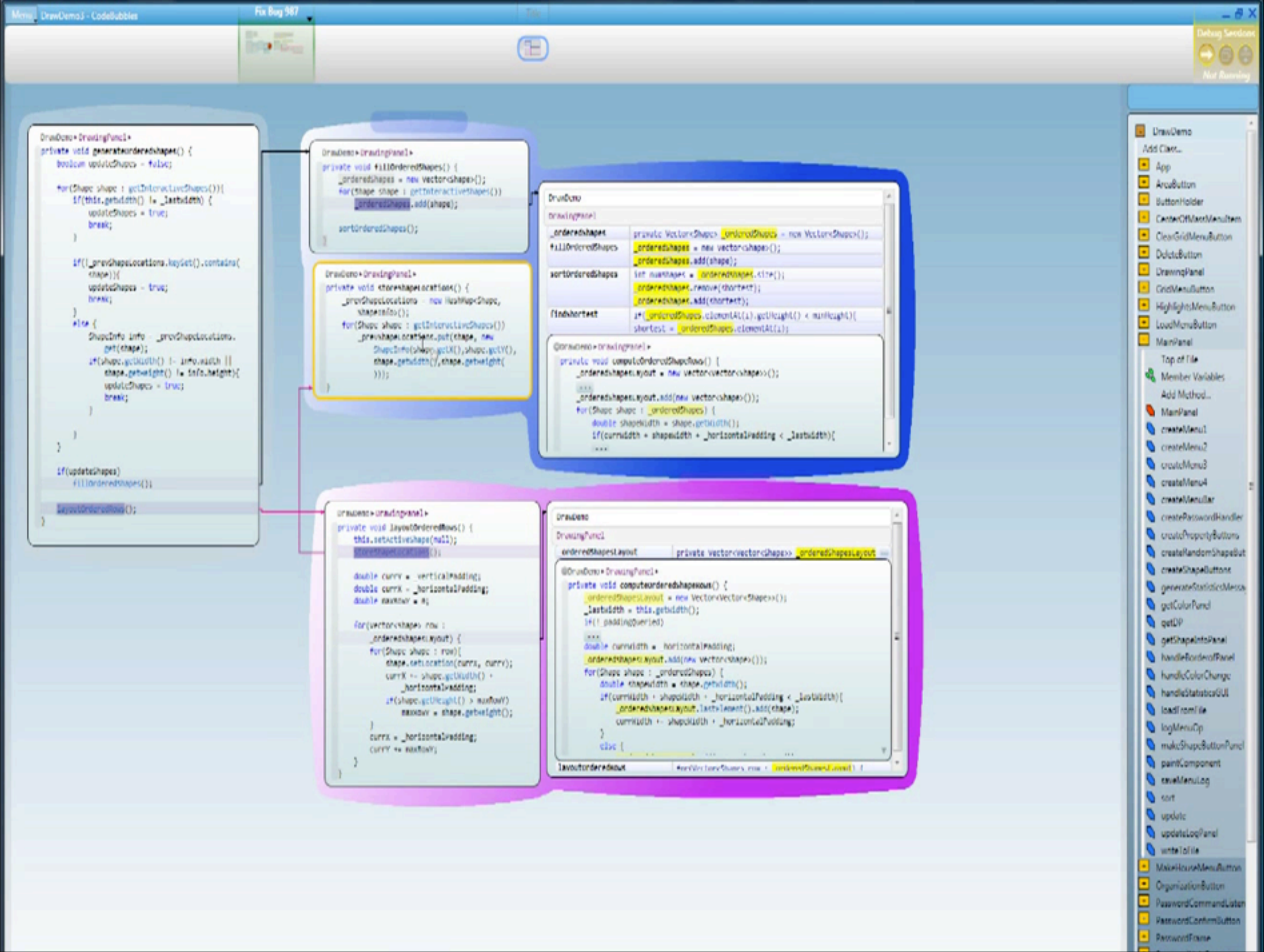
Closing the last tab of a window now closes the window instead of blanking the last tab. This was caused by bug #308870. I know it was intentional, but I'm filing this bug for people who don't like the new behaviour.

This was the original summary of bug #455852 before it was morphed

Ideas

- It might not be creating the object at the right time
- the backend temp file might be corrupted
- _mp may not be done initializing

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



DrawDemo▸DrawingPanel▸

```
private void generateOrderedShapes() {
    boolean updateShapes = false;

    for(Shape shape : getInteractiveShapes()){
        if(this.getWidth() != _lastWidth) {
            updateShapes = true;
            break;
        }

        if(!_prevShapeLocations.keySet().contains(
            shape)){
            updateShapes = true;
            break;
        }
        else {
            ShapeInfo info = _prevShapeLocations.
                get(shape);
            if(shape.getWidth() != info.width ||
                shape.getHeight() != info.height){
                updateShapes = true;
                break;
            }

        }
    }

    if(updateShapes)
        fillOrderedShapes();

    layoutOrderedRows();
}
```

DrawDemo▸DrawingPanel▸

```
private void fillOrderedShapes() {
    _orderedShapes = new Vector<Shape>();
    for(Shape shape : getInteractiveShapes())
        _orderedShapes.add(shape);

    sortOrderedShapes();
}
```

DrawDemo▸DrawingPanel▸

```
private void storeShapeLocations() {
    _prevShapeLocations = new HashMap<Shape,
        ShapeInfo>();
    for(Shape shape : getInteractiveShapes())
        _prevShapeLocations.put(shape, new
            ShapeInfo(shape.getX(),shape.getY(),
            shape.getWidth(),shape.getHeight(
            )));
}
```

DrawDemo

DrawingPanel

_orderedShapes	private Vector<Shape> _orderedShapes = new Vector<Shape>();

fillOrderedShapes	_orderedShapes = new Vector<Shape>();
	_orderedShapes.add(shape);

sortOrderedShapes	int numShapes = _orderedShapes.size();
	_orderedShapes.remove(shortest);
	_orderedShapes.add(shortest);

findShortest	if(_orderedShapes.elementAt(i).getHeight() < minHeight){
	shortest = _orderedShapes.elementAt(i);

@DrawDemo▸DrawingPanel▸

```
private void computeOrderedShapeRows() {
    _orderedShapesLayout = new Vector<Vector<Shape>>();
    ...
    _orderedShapesLayout.add(new Vector<Shape>());
    for(Shape shape : _orderedShapes) {
        double shapeWidth = shape.getWidth();
        if(currWidth + shapeWidth + _horizontalPadding < _lastWidth){
        ...
```

DrawDemo▸DrawingPanel▸

```
private void layoutOrderedRows() {
    this.setActiveShape(null);
    storeShapeLocations();

    double currY = _verticalPadding;
    double currX = _horizontalPadding;
    double maxRowY = 0;

    for(Vector<Shape> row :
        _orderedShapesLayout) {
        for(Shape shape : row){
            shape.setLocation(currX, currY);
            currX += shape.getWidth() +
                _horizontalPadding;
            if(shape.getHeight() > maxRowY)
                maxRowY = shape.getHeight();
        }
        currX = _horizontalPadding;
        currY += maxRowY;
    }
}
```

DrawDemo

DrawingPanel

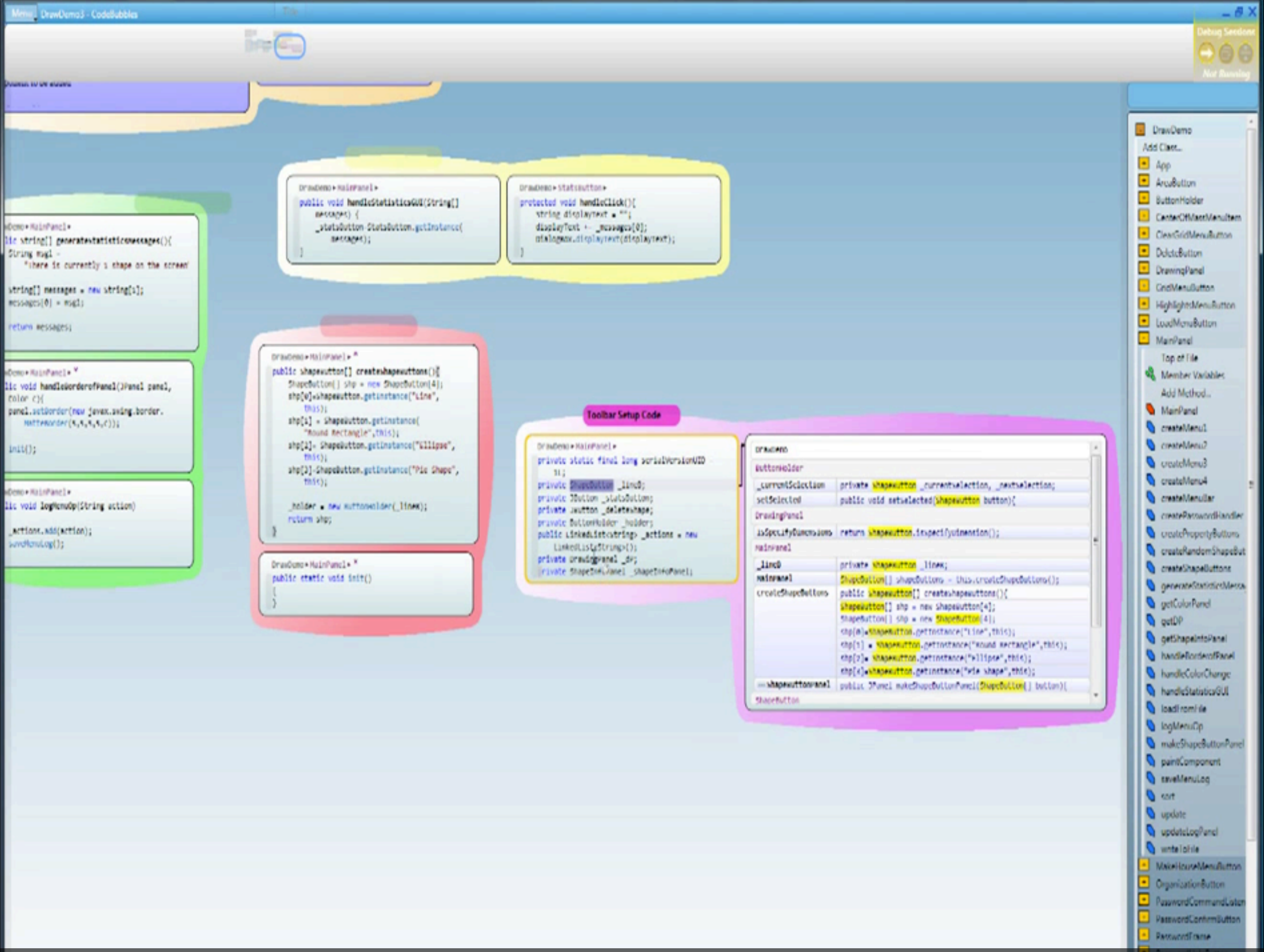
orderedShapesLayout	private Vector<Vector<Shape>> _orderedShapesLayout ...

@DrawDemo▸DrawingPanel▸

```
private void computeOrderedShapeRows() {
    _orderedShapesLayout = new Vector<Vector<Shape>>();
    _lastWidth = this.getWidth();
    if(!_paddingQueried)
    ...
    double currWidth = _horizontalPadding;
    _orderedShapesLayout.add(new Vector<Shape>());
    for(Shape shape : _orderedShapes) {
        double shapeWidth = shape.getWidth();
        if(currWidth + shapeWidth + _horizontalPadding < _lastWidth){
            _orderedShapesLayout.lastElement().add(shape);
            currWidth += shapeWidth + _horizontalPadding;
        }
        else {
```

layoutOrderedRows	for(Vector<Shape> row : _orderedShapesLayout) {

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



```
DrawDemo▸MainPanel▸
lic String[] generateStatisticMessages(){
 String msg1 =
     "There is currently 1 shape on the screen"

 String[] messages = new String[1];
 messages[0] = msg1;

 return messages;
```

```
DrawDemo▸MainPanel▸ *
lic void handleBorderofPanel(JPanel panel,
 Color c){
 panel.setBorder(new javax.swing.border.
     MatteBorder(5,5,5,5,c));

 init();
```

```
DrawDemo▸MainPanel▸
lic void logMenuOp(String action)

 _actions.add(action);
 saveMenuLog();
```

```
DrawDemo▸MainPanel▸
public void handleStatisticsGUI(String[]
    messages) {
    _statsButton=StatsButton.getInstance(
        messages);
}
```

```
DrawDemo▸StatsButton▸
protected void handleClick(){
    String displayText = "";
    displayText += _messages[0];
    dialogBox.displayText(displayText);
}
```

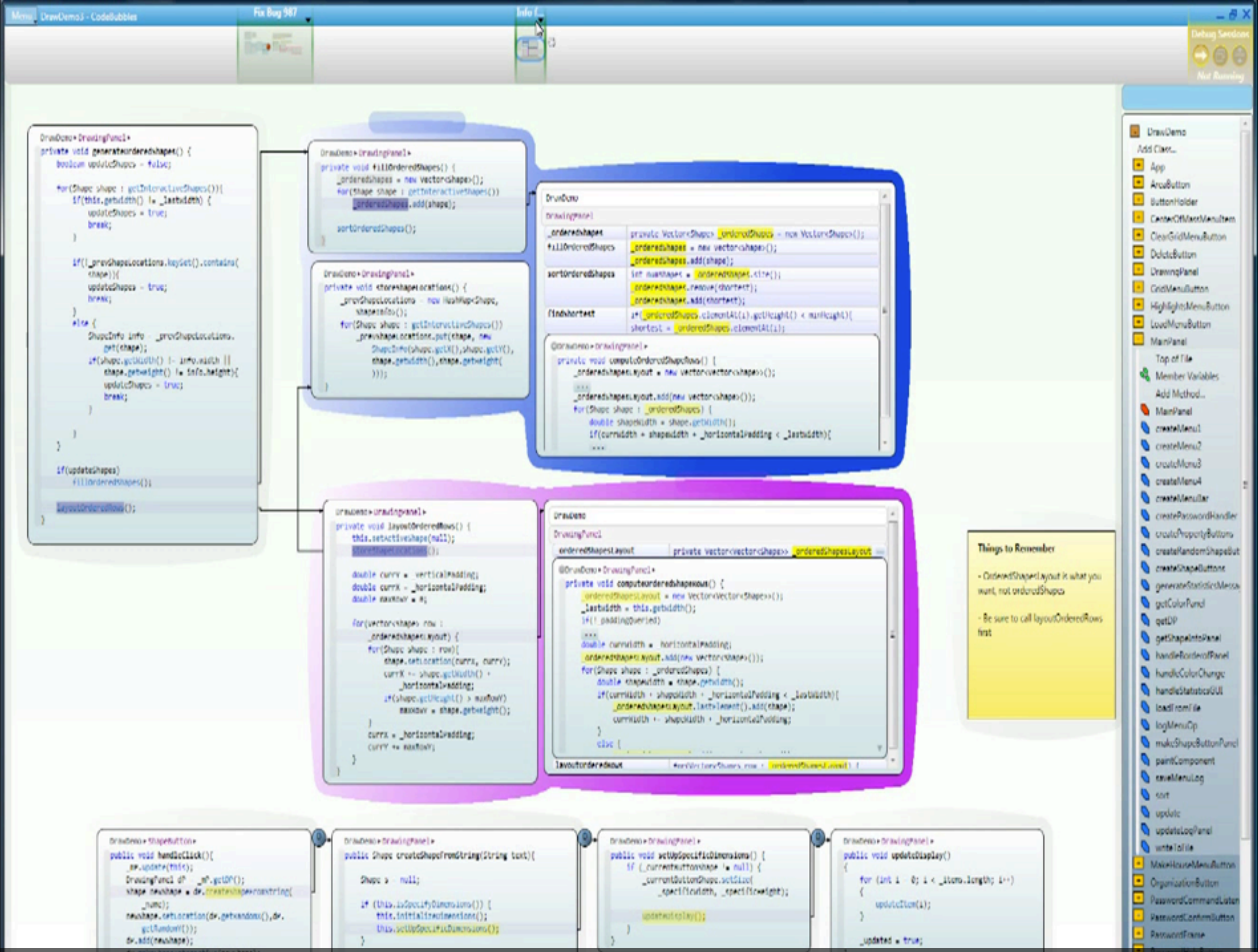
```
DrawDemo▸MainPanel▸ *
public ShapeButton[] createShapeButtons(){
    ShapeButton[] shp = new ShapeButton[4];
    shp[0]=ShapeButton.getInstance("Line",
        this);
    shp[1] = ShapeButton.getInstance(
        "Round Rectangle",this);
    shp[2]= ShapeButton.getInstance("Ellipse",
        this);
    shp[3]=ShapeButton.getInstance("Pie Shape",
        this);

    _holder = new ButtonHolder(_lineB);
    return shp;
}
```

```
DrawDemo▸MainPanel▸ *
public static void init()
{
}
```

```
DrawDemo▸MainPanel▸
private static final long serialVersionUID =
    1L;
private ShapeButton _lineB;
private JButton _statsButton;
private JButton _deleteShape;
private ButtonHolder _holder;
public LinkedList<String> _actions = new
    LinkedList<String>();
private DrawingPanel _dr;
private ShapeInfoPanel _shapeInfoPanel;
```

```
DrawDemo
ButtonHolder
_currentSelection      private ShapeButton _currentSelection, _nextSelection;
setSelected            public void setSelected(ShapeButton button){
DrawingPanel
isSpecifyDimensions    return ShapeButton.isSpecifyDimension();
MainPanel
_lineB                 private ShapeButton _lineB;
MainPanel              ShapeButton[] shapeButtons = this.createShapeButtons();
createShapeButtons     public ShapeButton[] createShapeButtons(){
                       ShapeButton[] shp = new ShapeButton[4];
                       ShapeButton[] shp = new ShapeButton[4];
                       shp[0]=ShapeButton.getInstance("Line",this);
                       shp[1] = ShapeButton.getInstance("Round Rectangle",this);
                       shp[2]= ShapeButton.getInstance("Ellipse",this);
                       shp[3]=ShapeButton.getInstance("Pie Shape",this);
— ShapeButtonPanel     public JPanel makeShapeButtonPanel(ShapeButton[] button){
ShapeButton
```

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



DrawDemo▸DrawingPanel▸

```
private void generateOrderedShapes() {
    boolean updateShapes = false;

    for(Shape shape : getInteractiveShapes()){
        if(this.getWidth() != _lastWidth) {
            updateShapes = true;
            break;
        }

        if(!_prevShapeLocations.keySet().contains(
            shape)){
            updateShapes = true;
            break;
        }
        else {
            ShapeInfo info = _prevShapeLocations.
                get(shape);
            if(shape.getWidth() != info.width ||
                shape.getHeight() != info.height){
                updateShapes = true;
                break;
            }

        }
    }

    if(updateShapes)
        fillOrderedShapes();

    layoutOrderedRows();
}
```

DrawDemo▸DrawingPanel▸

```
private void fillOrderedShapes() {
    _orderedShapes = new Vector<Shape>();
    for(Shape shape : getInteractiveShapes())
        _orderedShapes.add(shape);

    sortOrderedShapes();
}
```

DrawDemo▸DrawingPanel▸

```
private void storeShapeLocations() {
    _prevShapeLocations = new HashMap<Shape,
        ShapeInfo>();
    for(Shape shape : getInteractiveShapes())
        _prevShapeLocations.put(shape, new
            ShapeInfo(shape.getX(),shape.getY(),
            shape.getWidth(),shape.getHeight(
            )));
}
```

DrawDemo

DrawingPanel

_orderedShapes	private Vector<Shape> _orderedShapes = new Vector<Shape>();

fillOrderedShapes	_orderedShapes = new Vector<Shape>();
	_orderedShapes.add(shape);

sortOrderedShapes	int numShapes = _orderedShapes.size();
	_orderedShapes.remove(shortest);
	_orderedShapes.add(shortest);

findShortest	if(_orderedShapes.elementAt(i).getHeight() < minHeight){
	shortest = _orderedShapes.elementAt(i);

@DrawDemo▸DrawingPanel▸

```
private void computeOrderedShapeRows() {
    _orderedShapesLayout = new Vector<Vector<Shape>>();
    ...
    _orderedShapesLayout.add(new Vector<Shape>());
    for(Shape shape : _orderedShapes) {
        double shapeWidth = shape.getWidth();
        if(currWidth + shapeWidth + _horizontalPadding < _lastWidth){
        ...
```

DrawDemo▸DrawingPanel▸

```
private void layoutOrderedRows() {
    this.setActiveShape(null);
    storeShapeLocations();

    double currY = _verticalPadding;
    double currX = _horizontalPadding;
    double maxRowY = 0;

    for(Vector<Shape> row :
        _orderedShapesLayout) {
        for(Shape shape : row){
            shape.setLocation(currX, currY);
            currX += shape.getWidth() +
                _horizontalPadding;
            if(shape.getHeight() > maxRowY)
                maxRowY = shape.getHeight();
        }
        currX = _horizontalPadding;
        currY += maxRowY;
    }
}
```

DrawDemo

DrawingPanel

orderedShapesLayout	private Vector<Vector<Shape>> _orderedShapesLayout ...

@DrawDemo▸DrawingPanel▸

```
private void computeOrderedShapeRows() {
    _orderedShapesLayout = new Vector<Vector<Shape>>();
    _lastWidth = this.getWidth();
    if(!_paddingQueried)
    ...
    double currWidth = _horizontalPadding;
    _orderedShapesLayout.add(new Vector<Shape>());
    for(Shape shape : _orderedShapes) {
        double shapeWidth = shape.getWidth();
        if(currWidth + shapeWidth + _horizontalPadding < _lastWidth){
            _orderedShapesLayout.lastElement().add(shape);
            currWidth += shapeWidth + _horizontalPadding;
        }
        else {
```

layoutOrderedRows	for(Vector<Shape> row : _orderedShapesLayout) {

Things to Remember

- OrderedShapesLayout is what you want, not orderedShapes

- Be sure to call layoutOrderedRows first

DrawDemo▸ShapeButton▸

```
public void handleClick(){
    _mf.update(this);
    DrawingPanel dP = _mf.getDP();
    Shape newShape = dP.createShapeFromString(
        _name);
    newShape.setLocation(dP.getRandomX(),dP.
        getRandomY());
    dP.add(newShape);
    dP.makeShapeInteractive(newShape);
    dP.setActiveShape(newShape);
```

DrawDemo▸DrawingPanel▸

```
public Shape createShapeFromString(String text){

    Shape s = null;

    if (this.isSpecifyDimensions()) {
        this.initializeDimensions();
        this.setUpSpecificDimensions();
    }

    ...
```

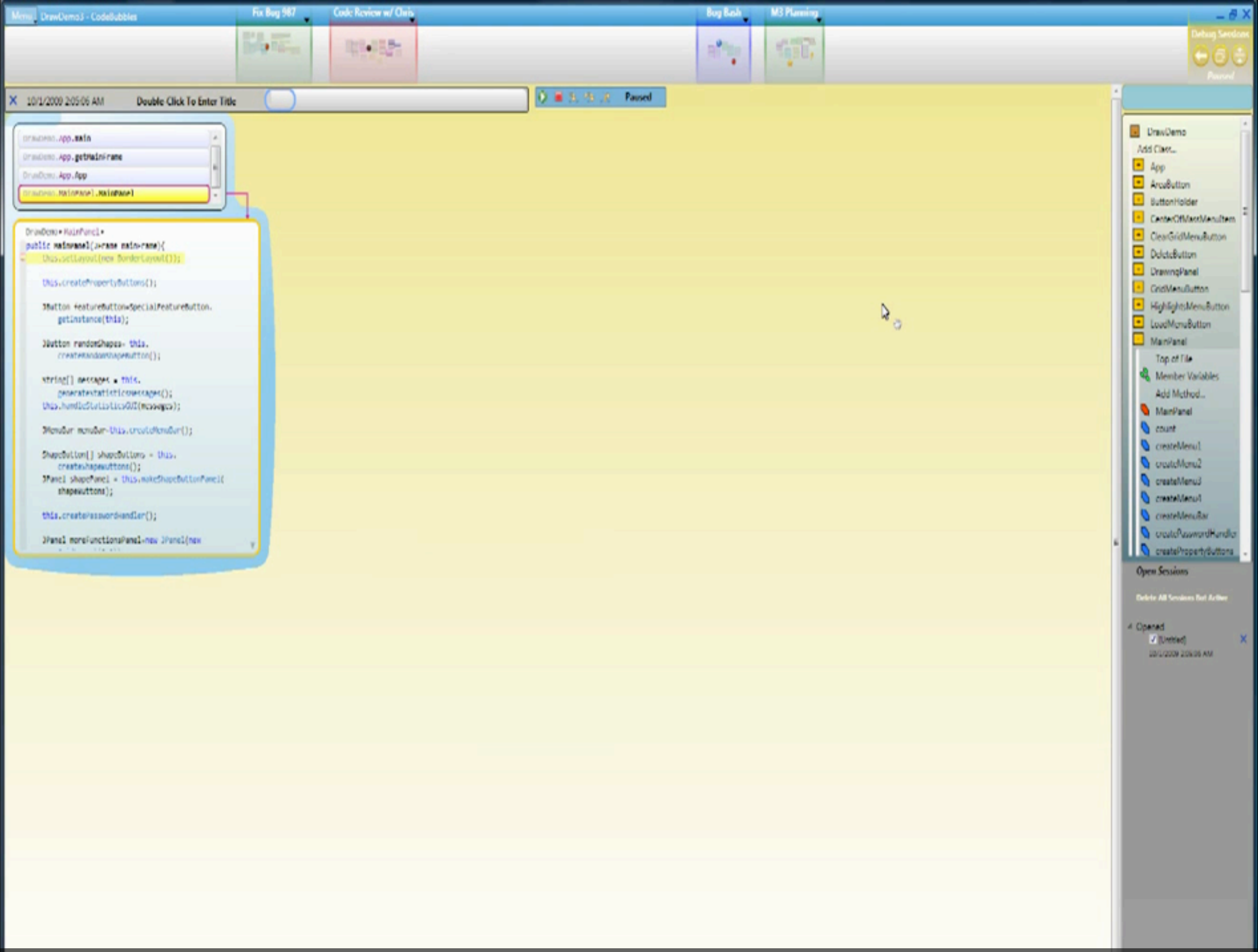
DrawDemo▸DrawingPanel▸

```
public void setUpSpecificDimensions() {
    if (_currentButtonShape != null) {
        _currentButtonShape.setSize(
            _specificWidth, _specificHeight);

        updateDisplay();
    }
}
```

DrawDemo▸DrawingPanel▸

```
public void updateDisplay()
{
    for (int i = 0; i < _items.length; i++)
    {
        updateItem(i);
    }

    _updated = true;
}
```

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

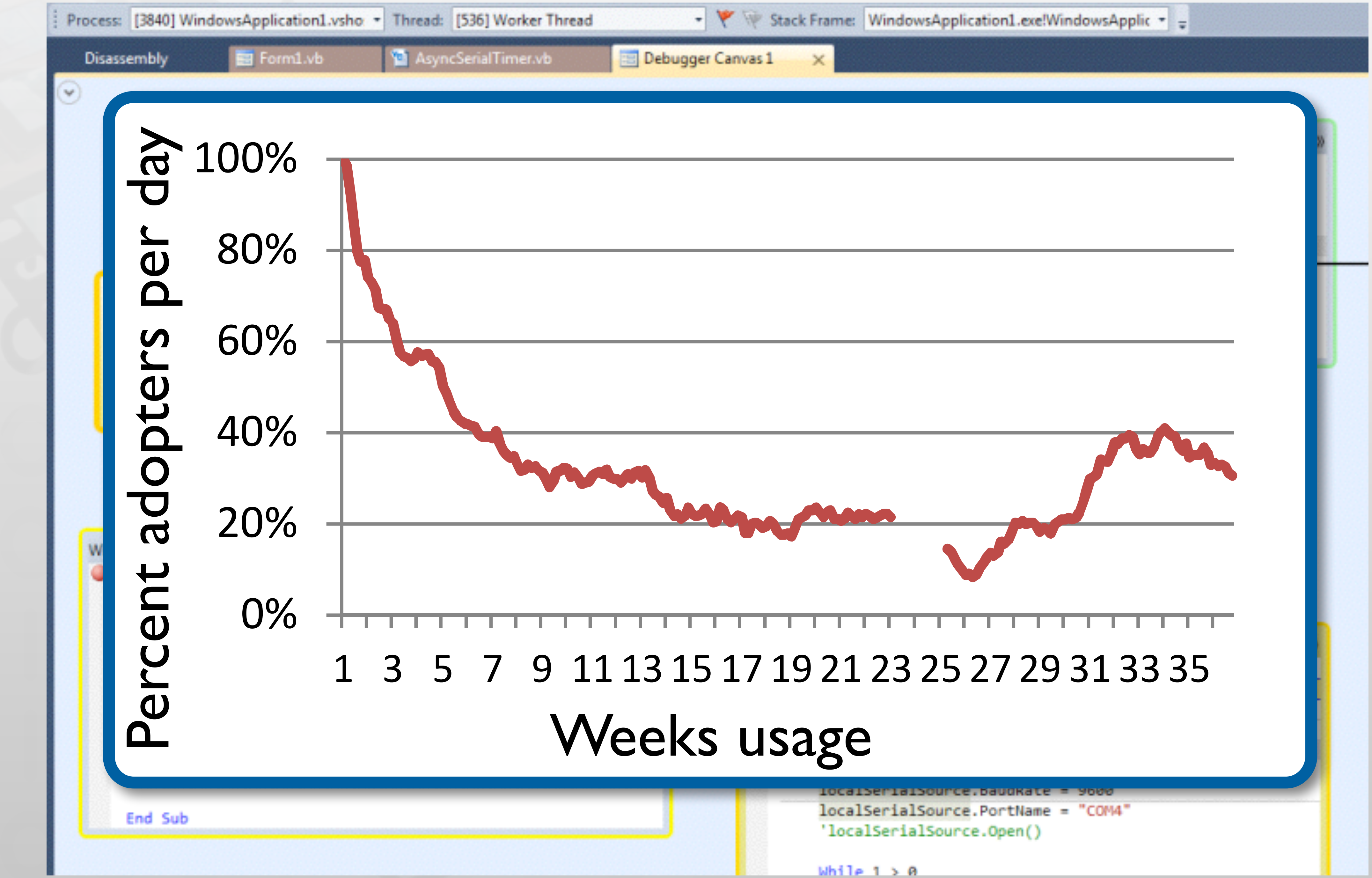


```
DrawDemo • MainPanel •
public MainPanel(JFrame mainFrame){
    this.setLayout(new BorderLayout());

    this.createPropertyButtons();

    JButton featureButton=SpecialFeatureButton.
        getInstance(this);

    JButton randomShapes= this.
        createRandomShapeButton();

    String[] messages = this.
        generateStatisticsMessages();
    this.handleStatisticsGUI(messages);

    JMenuBar menuBar=this.createMenuBar();

    ShapeButton[] shapeButtons = this.
        createShapeButtons();
    JPanel shapePanel = this.makeShapeButtonPanel(
        shapeButtons);

    this.createPasswordHandler();

    JPanel moreFunctionsPanel=new JPanel(new
```

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

Canvas Interfaces in the Wild

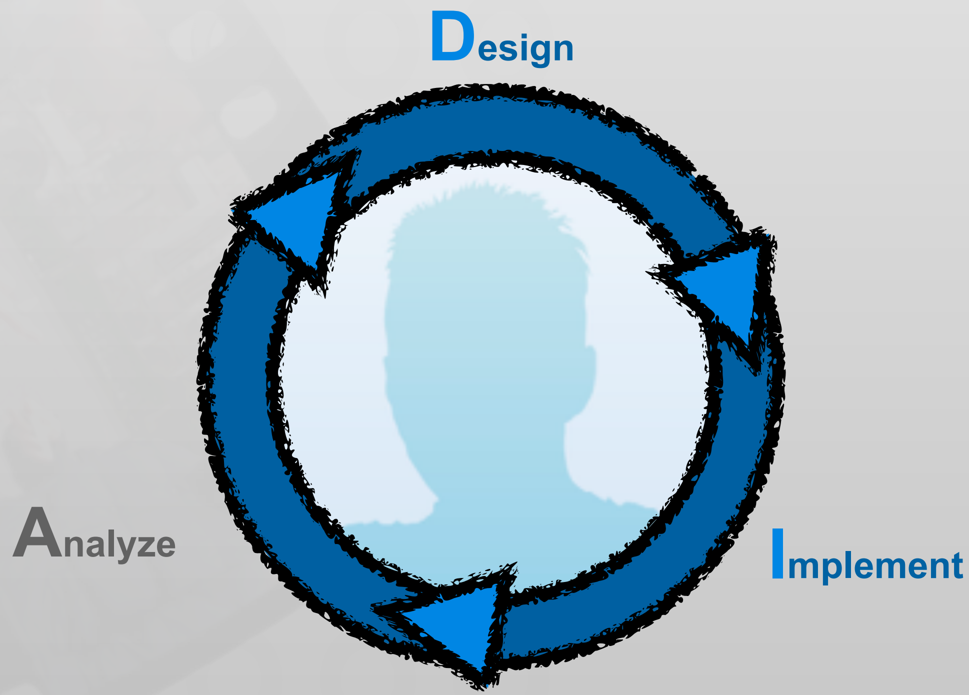
[DeLine2012, Debugger Canvas: Industrial experience with the code bubbles paradigm]

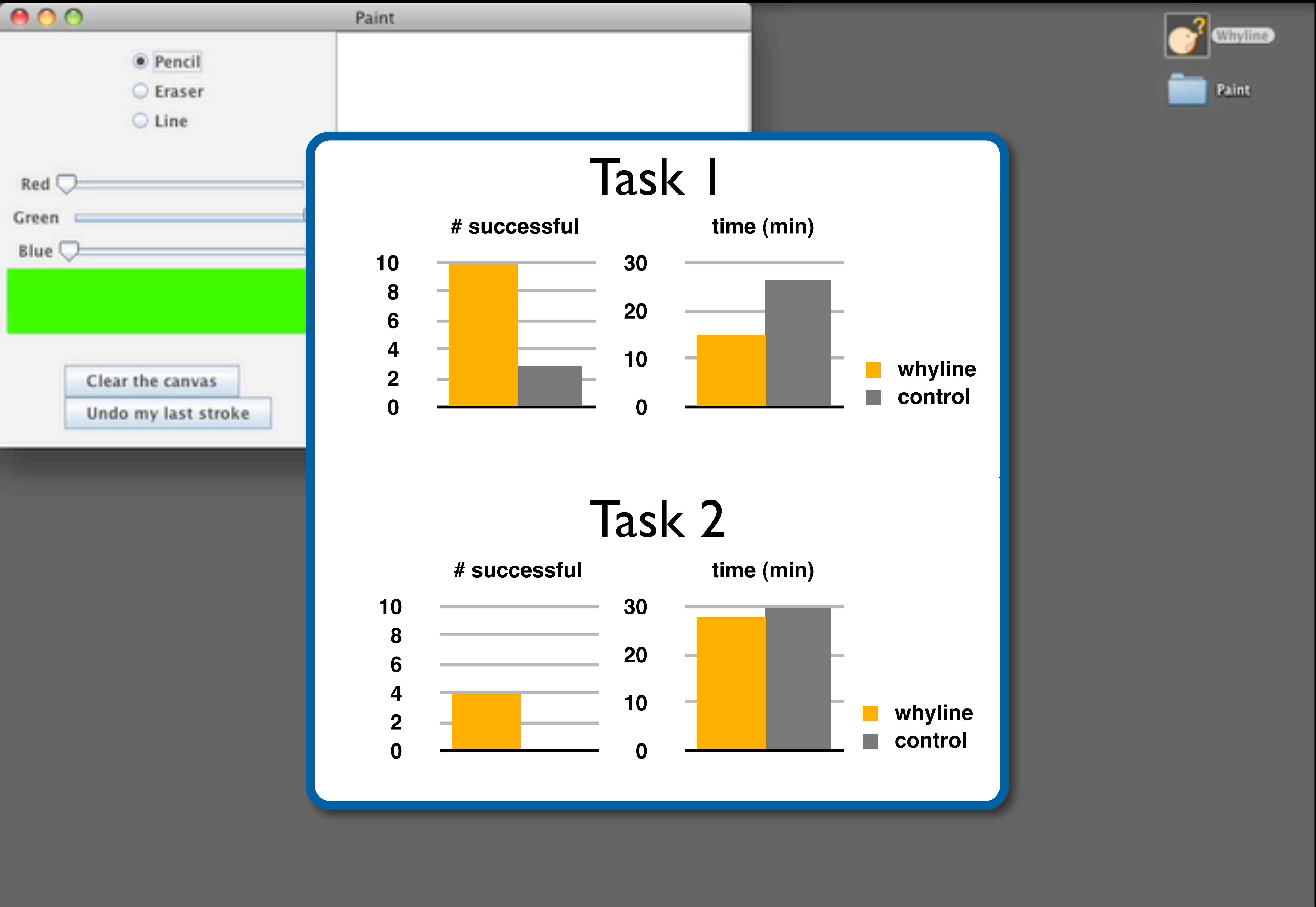


```
End Sub
```

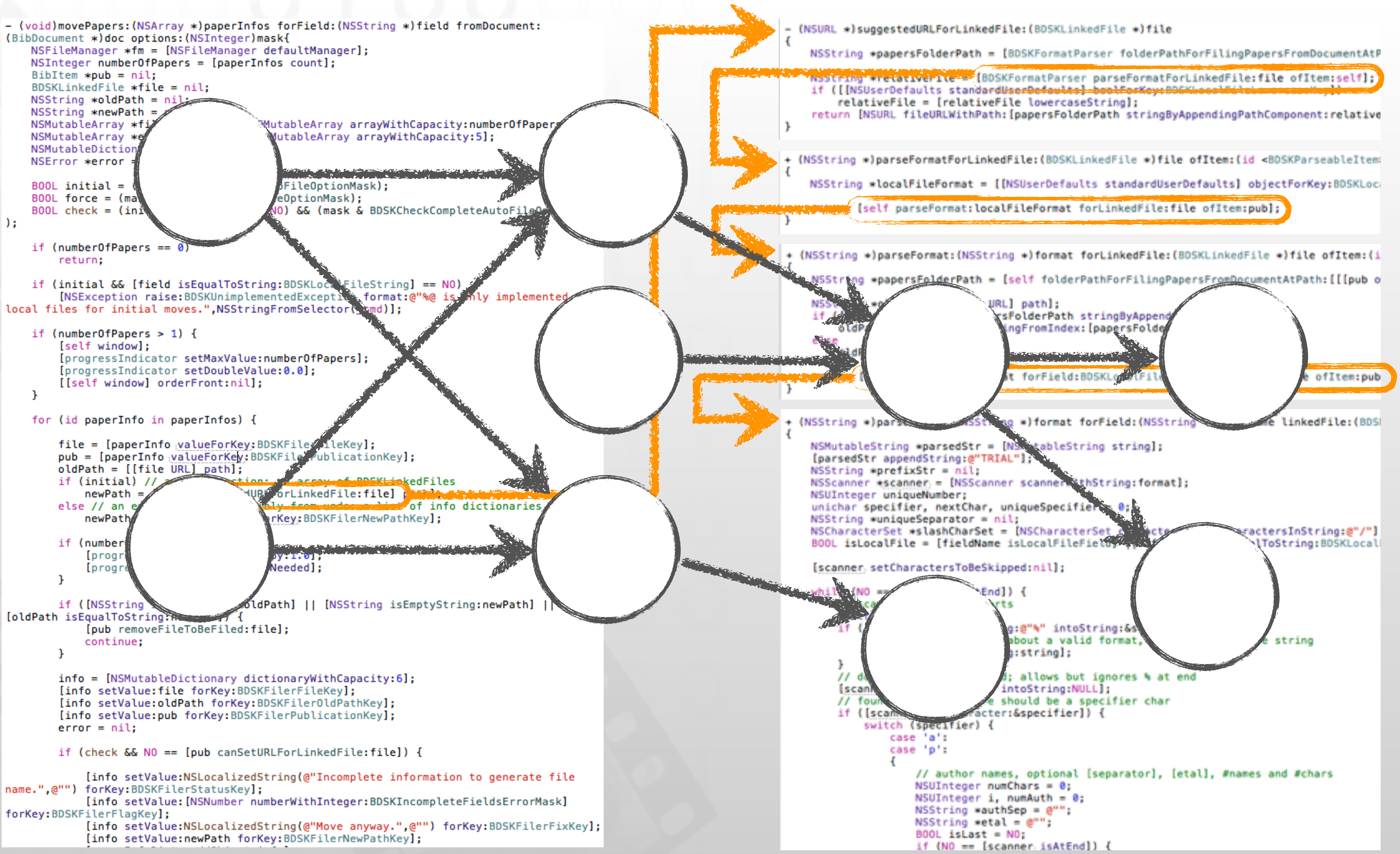
```
localSerialSource.BaudRate = 9600
localSerialSource.PortName = "COM4"
'localSerialSource.Open()

While 1 > 0
```

Utilizing the Call Graph





[Ko2009, Finding causes of program output with the Java Whyline]



```
- (void)movePapers:(NSArray *)paperInfos forField:(NSString *)field fromDocument:
(BibDocument *)doc options:(NSInteger)mask{
    NSFileManager *fm = [NSFileManager defaultManager];
    NSInteger numberOfPapers = [paperInfos count];
    BibItem *pub = nil;
    BDSKLinkedFile *file = nil;
    NSString *oldPath = nil;
    NSString *newPath =
    NSMutableArray *fi                  MutableArray arrayWithCapacity:numberOfPapers
    NSMutableArray *e                   MutableArray arrayWithCapacity:5];
    NSMutableDiction
    NSError *error =

    BOOL initial =                      FileOptionMask);
    BOOL force = (ma                    eOptionMask);
    BOOL check = (ini                   NO) && (mask & BDSKCheckCompleteAutoFileO
);

    if (numberOfPapers == 0)
        return;

    if (initial && [field isEqualToString:BDSKLocalFileString] == NO)
        [NSException raise:BDSKUnimplementedException format:@"%@ is only implemented
local files for initial moves.",NSStringFromSelector(_cmd)];

    if (numberOfPapers > 1) {
        [self window];
        [progressIndicator setMaxValue:numberOfPapers];
        [progressIndicator setDoubleValue:0.0];
        [[self window] orderFront:nil];
    }

    for (id paperInfo in paperInfos) {

        file = [paperInfo valueForKey:BDSKFilerFileKey];
        pub = [paperInfo valueForKey:BDSKFilerPublicationKey];
        oldPath = [[file URL] path];
        if (initial) //                     array of BDSKLinkedFiles
            newPath =                   URLForLinkedFile:file]
        else // an e                                   of info dictionaries
            newPath                     rKey:BDSKFilerNewPathKey];

        if (number
            [progr                      y:1.0];
            [progre                     Needed];
        }

        if ([NSString                   ldPath] || [NSString isEmptyString:newPath] ||
[oldPath isEqualToString:
            [pub removeFileToBeFiled:file];
            continue;
        }

        info = [NSMutableDictionary dictionaryWithCapacity:6];
        [info setValue:file forKey:BDSKFilerFileKey];
        [info setValue:oldPath forKey:BDSKFilerOldPathKey];
        [info setValue:pub forKey:BDSKFilerPublicationKey];
        error = nil;

        if (check && NO == [pub canSetURLForLinkedFile:file]) {

            [info setValue:NSLocalizedString(@"Incomplete information to generate file
name.",@"") forKey:BDSKFilerStatusKey];
            [info setValue:[NSNumber numberWithInteger:BDSKIncompleteFieldsErrorMask]
forKey:BDSKFilerFlagKey];
            [info setValue:NSLocalizedString(@"Move anyway.",@"") forKey:BDSKFilerFixKey];
            [info setValue:newPath forKey:BDSKFilerNewPathKey];
```

```
- (NSURL *)suggestedURLForLinkedFile:(BDSKLinkedFile *)file
{
    NSString *papersFolderPath = [BDSKFormatParser folderPathForFilingPapersFromDocumentAtP
    NSString *relativeFile = [BDSKFormatParser parseFormatForLinkedFile:file ofItem:self];
    if ([[NSUserDefaults standardUserDefaults] boolForKey:
        relativeFile = [relativeFile lowercaseString];
    return [NSURL fileURLWithPath:[papersFolderPath stringByAppendingPathComponent:relative
}
```

```
+ (NSString *)parseFormatForLinkedFile:(BDSKLinkedFile *)file ofItem:(id <BDSKParseableItem
{
    NSString *localFileFormat = [[NSUserDefaults standardUserDefaults] objectForKey:BDSKLoc
                  [self parseFormat:localFileFormat forLinkedFile:file ofItem:pub];
}
```

```
+ (NSString *)parseFormat:(NSString *)format forLinkedFile:(BDSKLinkedFile *)file ofItem:(i
{
    NSString *papersFolderPath = [self folderPathForFilingPapersFromDocumentAtPath:[[[pub o
    NSS                          URL] path];
    if (                         rsFolderPath stringByAppend
        oldP                     ingFromIndex:[papersFolde
    else
        oldP
                                 t forField:BDSKLocalFile              e ofItem:pub
}
```

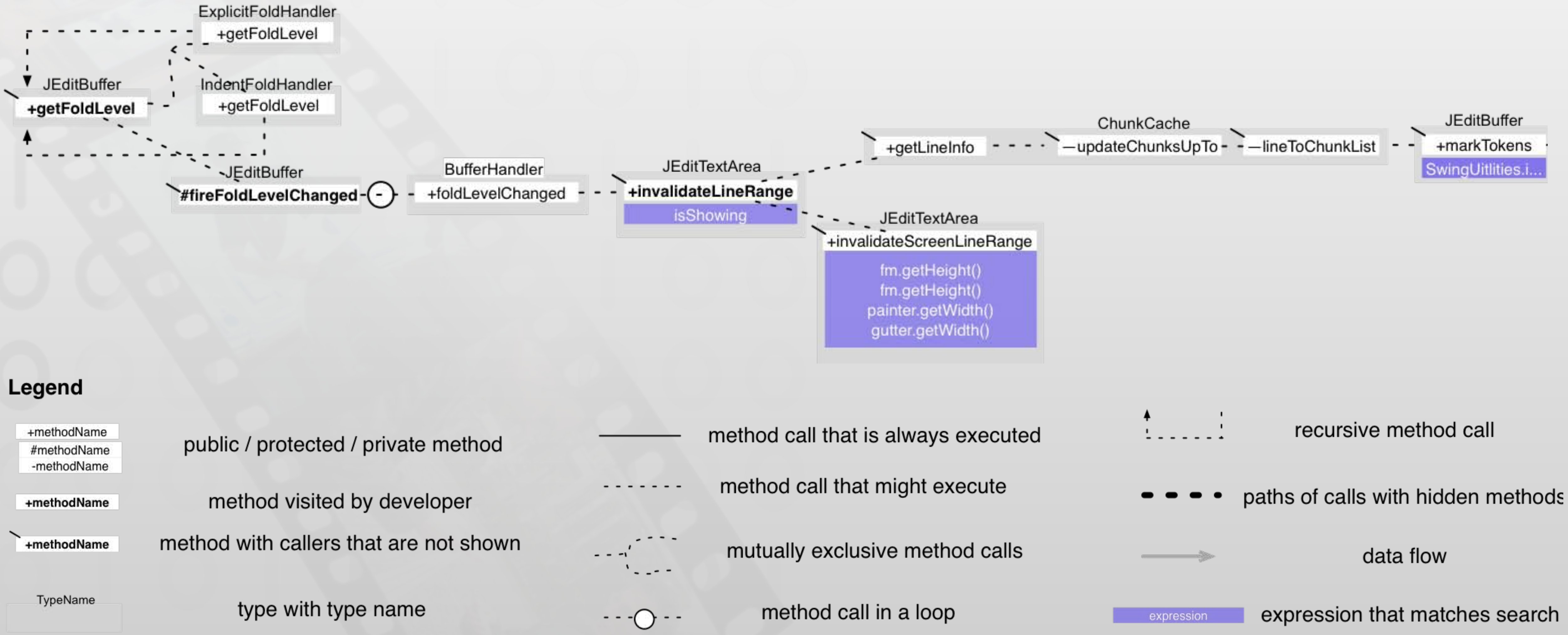
```
+ (NSString *)pars           NSString *)format forField:(NSString              e linkedFile:(BDS
{
    NSMutableString *parsedStr = [NSMutableString string];
    [parsedStr appendString:@"TRIAL"];
    NSString *prefixStr = nil;
    NSScanner *scanner = [NSScanner scannerWithString:format];
    NSUInteger uniqueNumber;
    unichar specifier, nextChar, uniqueSpecifier = 0;
    NSString *uniqueSeparator = nil;
    NSCharacterSet *slashCharSet = [NSCharacterSet c                acters InString:@"/"]
    BOOL isLocalFile = [fieldName isLocalFileField]                 lToString:BDSKLocal

    [scanner setCharactersToBeSkipped:nil];

    while (NO ==                 End]) {
                                 rts
        if (                     g:@"%" intoString:&s
                                 bout a valid format,                e string
                                 :string];
        }
        // d                     d; allows but ignores % at end
        [scan                    intoString:NULL];
        // foun                  e should be a specifier char
        if ([scan                racter:&specifier]) {
            switch (specifier) {
                case 'a':
                case 'p':
                {
                    // author names, optional [separator], [etal], #names and #chars
                    NSUInteger numChars = 0;
                    NSUInteger i, numAuth = 0;
                    NSString *authSep = @"";
                    NSString *etal = @"";
                    BOOL isLast = NO;
                    if (NO == [scanner isAtEnd]) {
```

In practice: Feasible paths most interesting

[LaToza2010, Developers ask reachability questions]

Utilizing Call Graph Information

[LaToza2010, Searching Across Paths]



ExplicitFoldHandler
+getFoldLevel

JEditBuffer
+getFoldLevel

IndentFoldHandler
+getFoldLevel

JEditBuffer
#fireFoldLevelChanged

BufferHandler
+foldLevelChanged

JEditTextArea
+invalidateLineRange
isShowing

+getLineInfo

ChunkCache
—updateChunksUpTo
—lineToChunkList

JEditBuffer
+markTokens
SwingUitlities.i...

JEditTextArea
+invalidateScreenLineRange
fm.getHeight()
fm.getHeight()
painter.getWidth()
gutter.getWidth()

Legend

+methodName
#methodName
-methodName
public / protected / private method

+methodName
method visited by developer

+methodName
method with callers that are not shown

TypeName
type with type name

method call that is always executed

method call that might execute

mutually exclusive method calls

method call in a loop

recursive method call

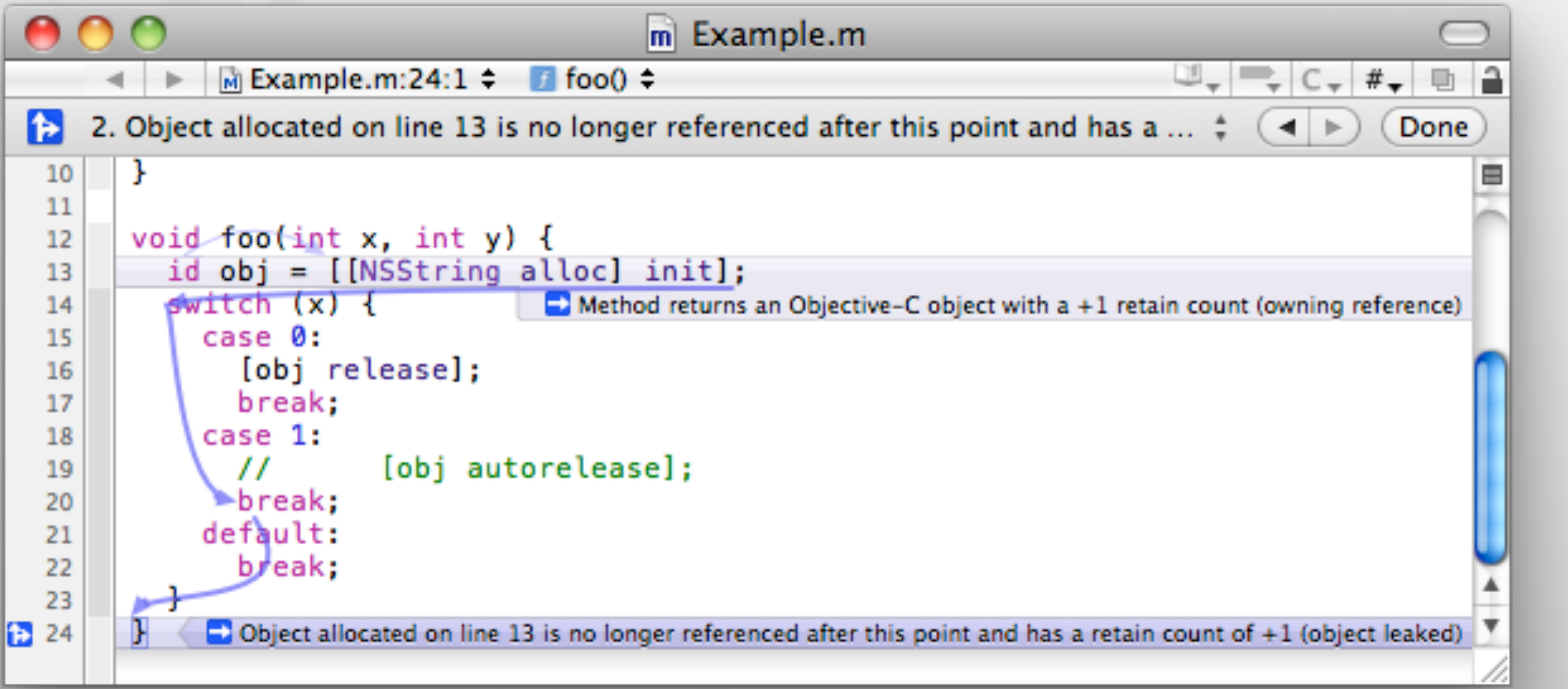
paths of calls with hidden methods

data flow

expression
expression that matches search

Static Analysis in the Wild

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



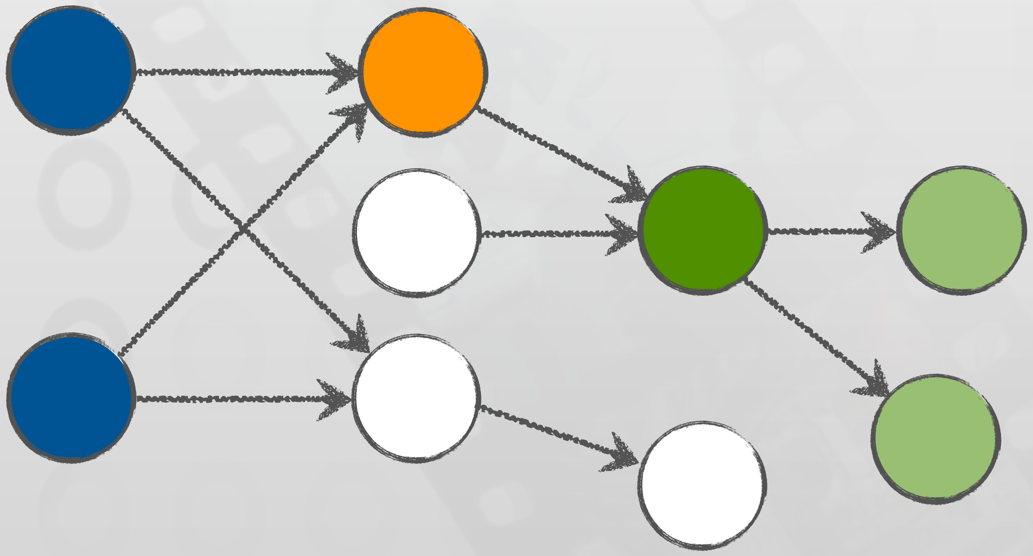
2. Object allocated on line 13 is no longer referenced after this point and has a ...

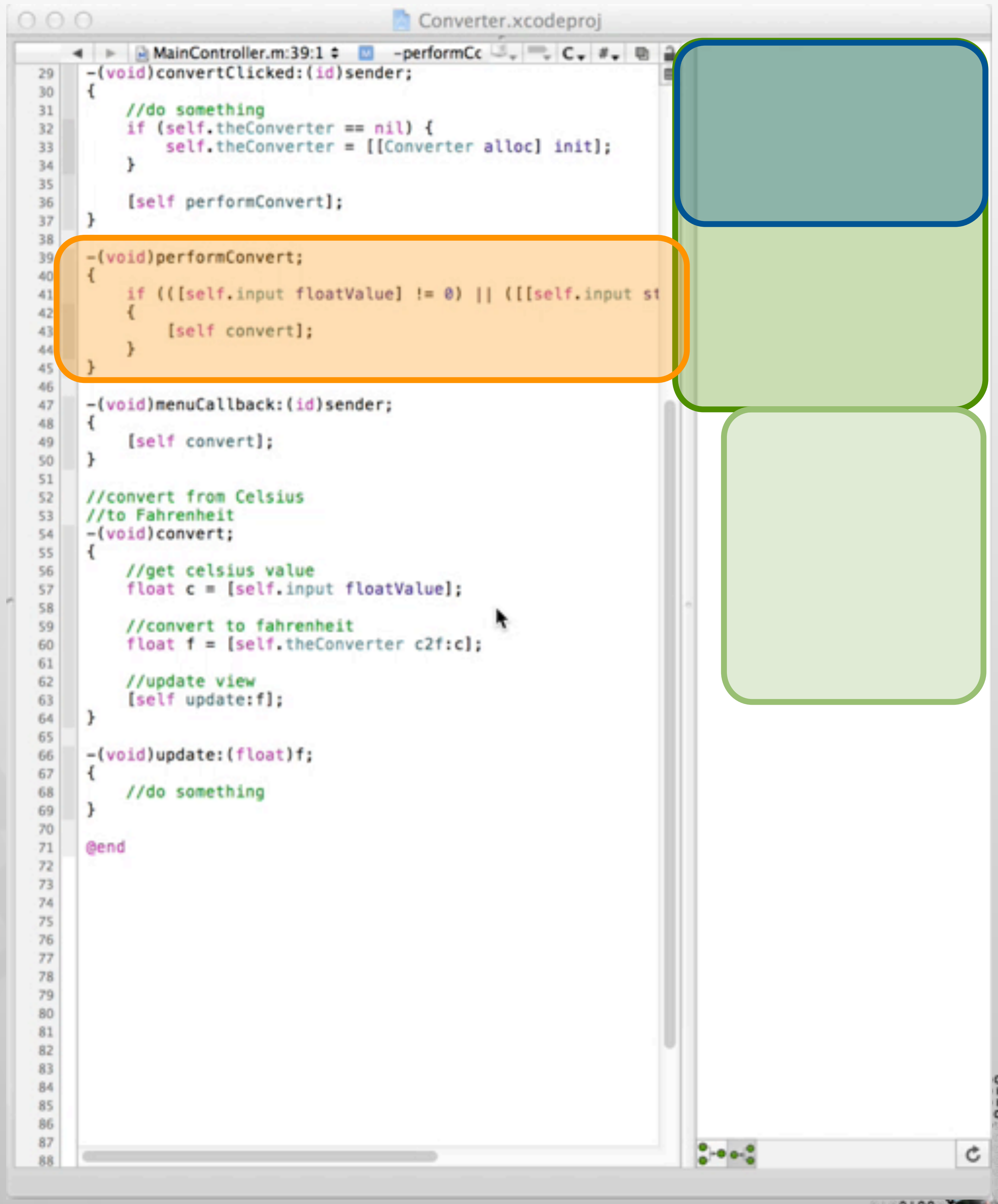
```
10  }
11
12  void foo(int x, int y) {
13    id obj = [[NSString alloc] init];
14    switch (x) {
15      case 0:
16        [obj release];
17        break;
18      case 1:
19        //        [obj autorelease];
20        break;
21      default:
22        break;
23    }
24  }
```

Method returns an Objective-C object with a +1 retain count (owning reference)

Object allocated on line 13 is no longer referenced after this point and has a retain count of +1 (object leaked)

Call Hierarchy

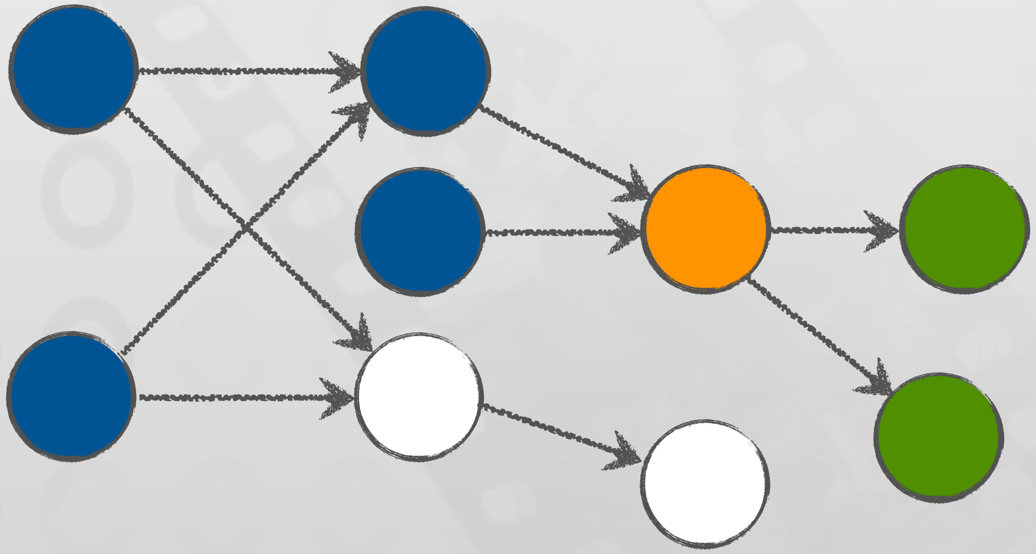


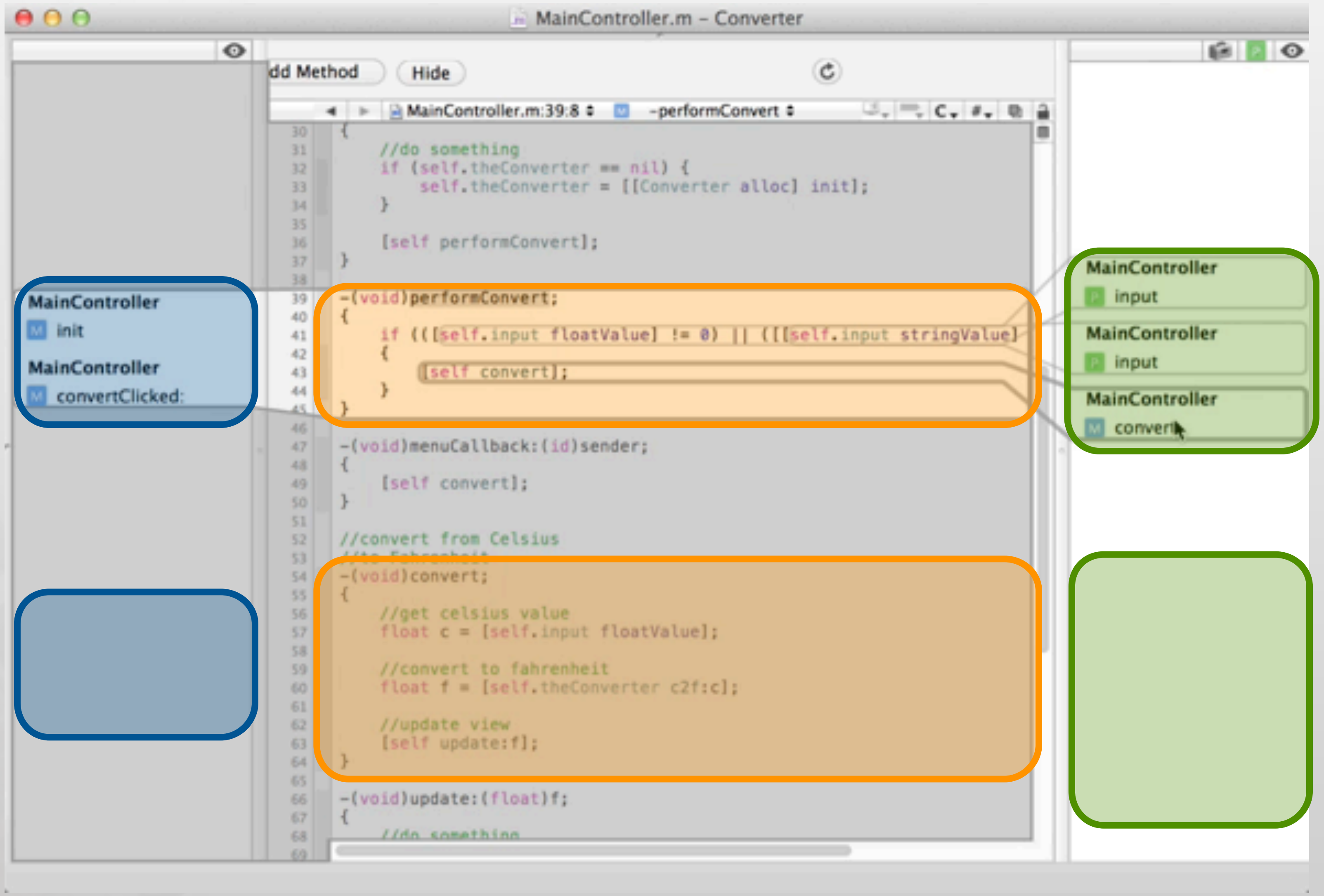


```
-(void)convertClicked:(id)sender;
{
    //do something
    if (self.theConverter == nil) {
        self.theConverter = [[Converter alloc] init];
    }

    [self performConvert];
}

-(void)performConvert;
{
    if (([self.input floatValue] != 0) || ([[self.input st
    {
        [self convert];
    }
}

-(void)menuCallback:(id)sender;
{
    [self convert];
}

//convert from Celsius
//to Fahrenheit
-(void)convert;
{
    //get celsius value
    float c = [self.input floatValue];

    //convert to fahrenheit
    float f = [self.theConverter c2f:c];

    //update view
    [self update:f];
}

-(void)update:(float)f;
{
    //do something
}

@end
```

Stacksplorer

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

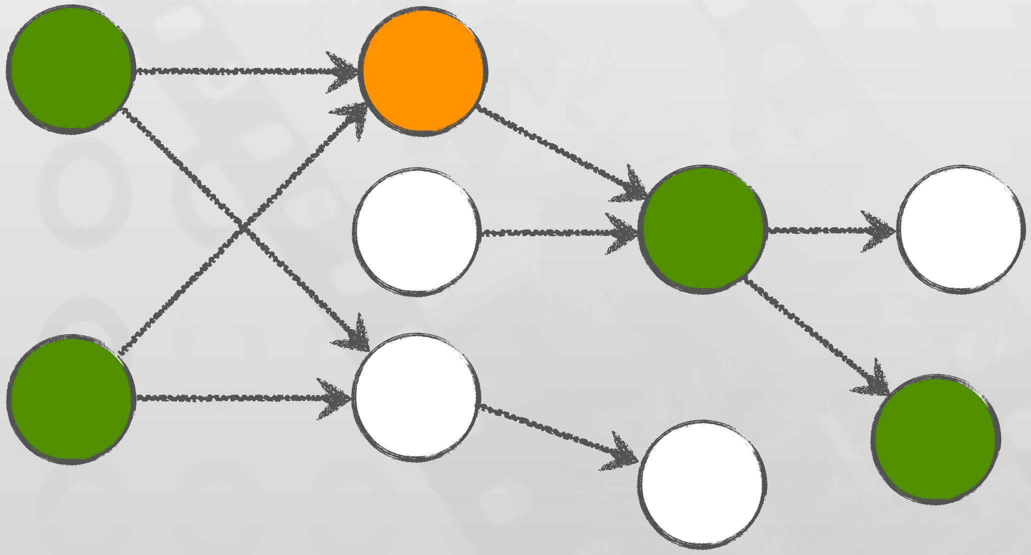


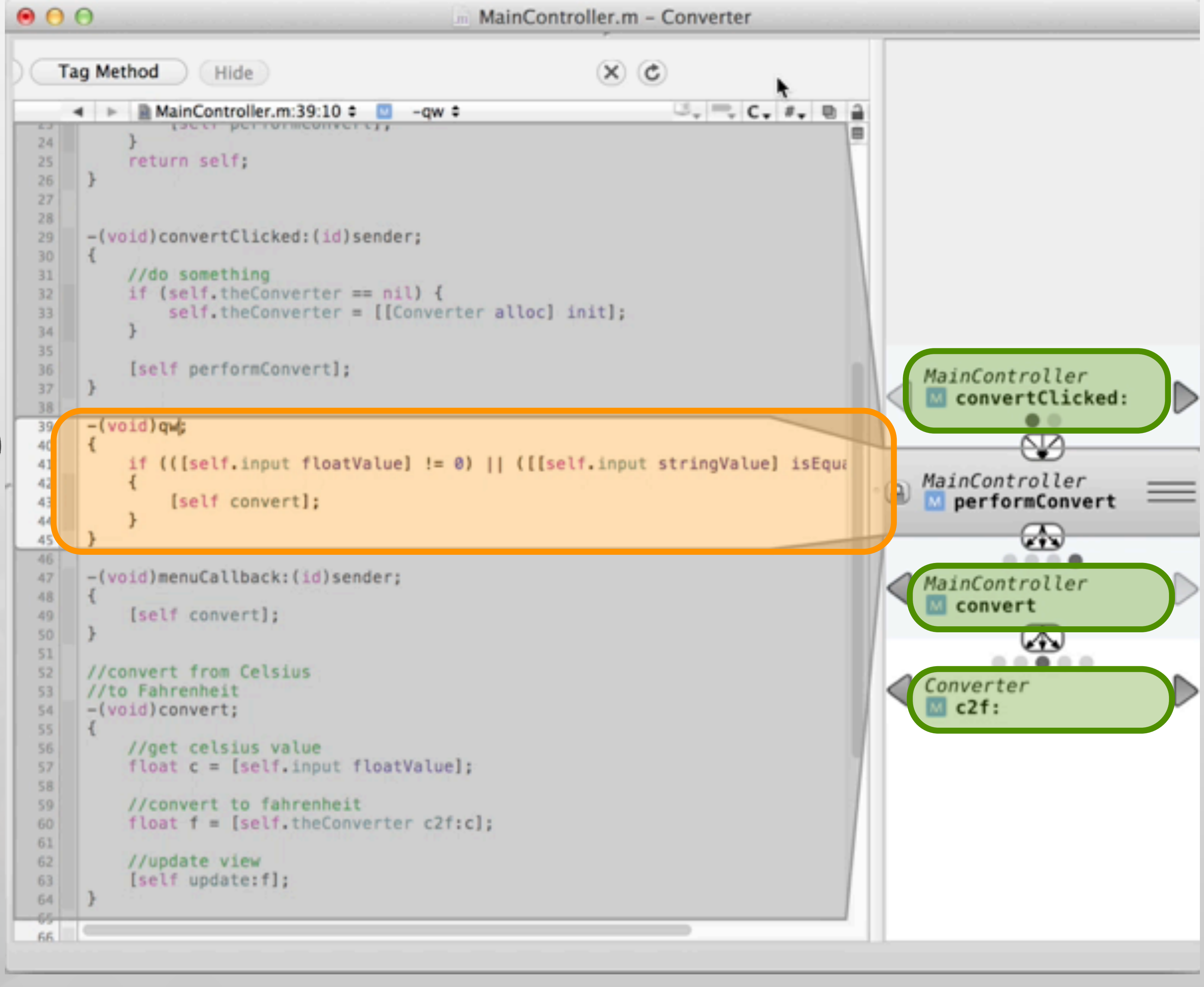


```
{
    //do something
    if (self.theConverter == nil) {
        self.theConverter = [[Converter alloc] init];
    }

    [self performConvert];
}

-(void)performConvert;
{
    if (([self.input floatValue] != 0) || ([[self.input stringValue]
    {
        [self convert];
    }
}

-(void)menuCallback:(id)sender;
{
    [self convert];
}

//convert from Celsius
//to Fahrenheit
-(void)convert;
{
    //get celsius value
    float c = [self.input floatValue];

    //convert to fahrenheit
    float f = [self.theConverter c2f:c];

    //update view
    [self update:f];
}

-(void)update:(float)f;
{
    //do something
```

Blaze

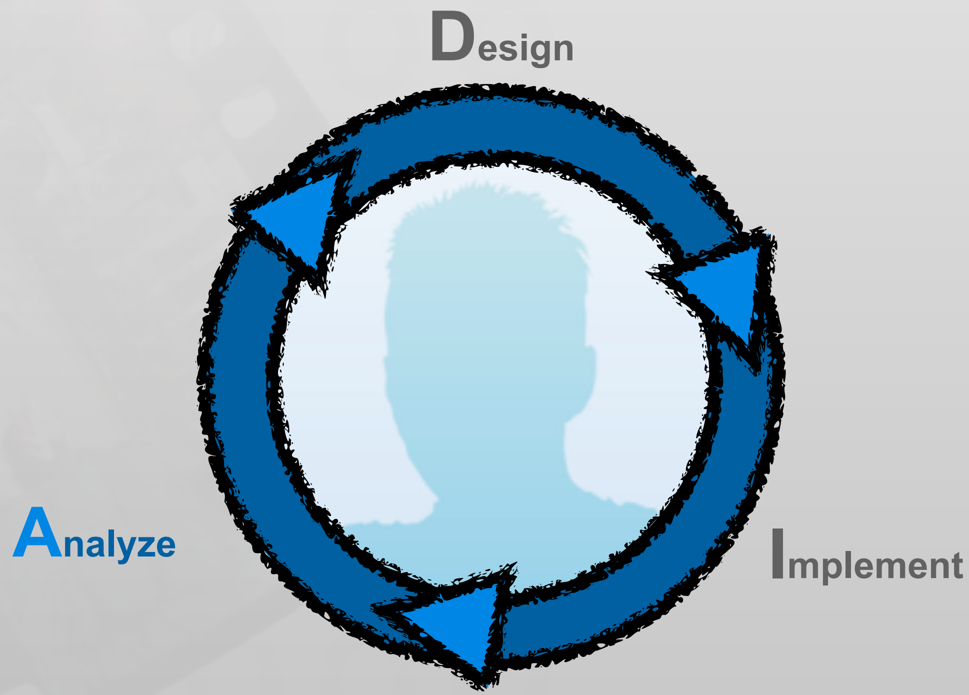
[Krämer2012, Blaze: Supporting Two-phased Call Graph Navigation in Source Code]





```
    }
    return self;
}


-(void)convertClicked:(id)sender;
{
    //do something
    if (self.theConverter == nil) {
        self.theConverter = [[Converter alloc] init];
    }

    [self performConvert];
}

-(void)qw;
{
    if (([self.input floatValue] != 0) || ([[self.input stringValue] isEqu
    {
        [self convert];
    }
}

-(void)menuCallback:(id)sender;
{
    [self convert];
}

//convert from Celsius
//to Fahrenheit
-(void)convert;
{
    //get celsius value
    float c = [self.input floatValue];

    //convert to fahrenheit
    float f = [self.theConverter c2f:c];

    //update view
    [self update:f];
}
```

Analyzing Navigation Behavior

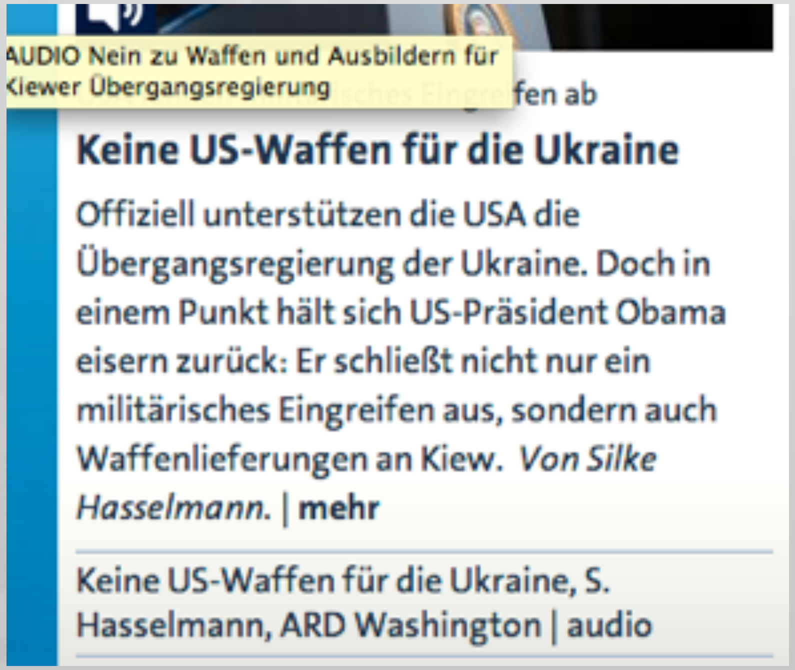


Information Foraging Theory

Predator

Scent

Prey



AUDIO Nein zu Waffen und Ausbildern für Kiewer Übergangsregierung

fen ab

Keine US-Waffen für die Ukraine

Offiziell unterstützen die USA die Übergangsregierung der Ukraine. Doch in einem Punkt hält sich US-Präsident Obama eisern zurück: Er schließt nicht nur ein militärisches Eingreifen aus, sondern auch Waffenlieferungen an Kiew. *Von Silke Hasselmann.* | **mehr**

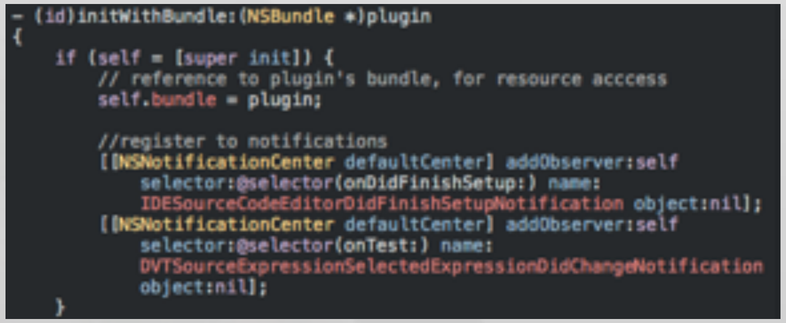
Keine US-Waffen für die Ukraine, S. Hasselmann, ARD Washington | audio

Information Foraging Theory

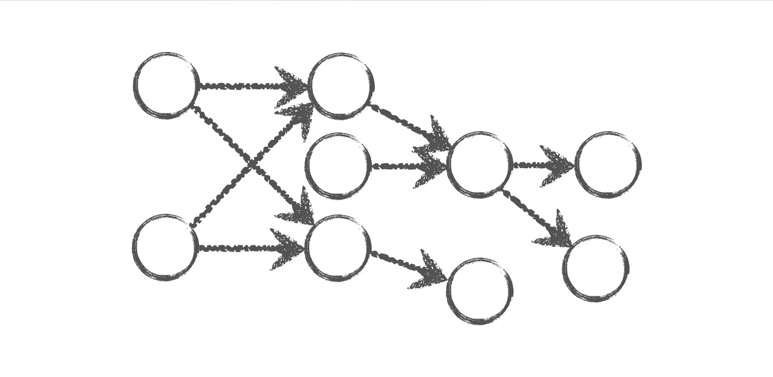
[Lawrance2010, Reactive information foraging for evolving goals]

Predator

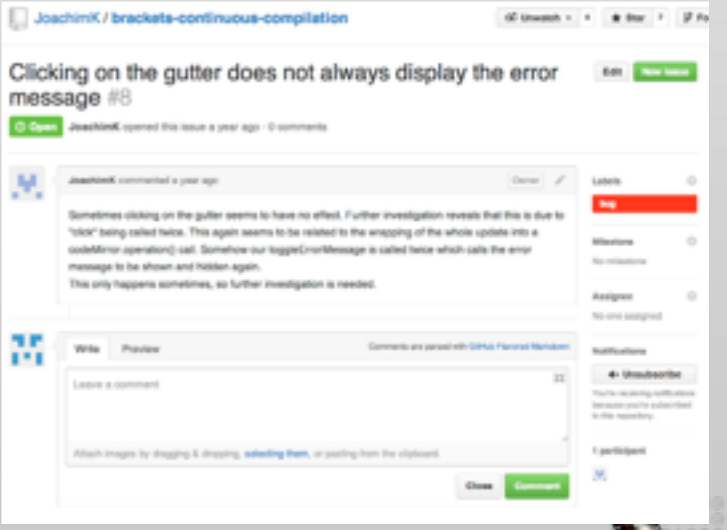
Scent



```
- (id)initWithBundle:(NSBundle *)plugin
{
    if (self = [super init]) {
        // reference to plugin's bundle, for resource acccess
        self.bundle = plugin;

        //register to notifications
        [[NSNotificationCenter defaultCenter] addObserver:self
            selector:@selector(onDidFinishSetup:) name:
            IDESourceCodeEditorDidFinishSetupNotification object:nil];
        [[NSNotificationCenter defaultCenter] addObserver:self
            selector:@selector(onTest:) name:
            DVTSourceExpressionSelectedExpressionDidChangeNotification
            object:nil];
    }
```



Prey



JoachimK / brackets-continuous-compilation

Clicking on the gutter does not always display the error message #8

JoachimK opened this issue a year ago · 0 comments

JoachimK commented a year ago

Sometimes clicking on the gutter seems to have no effect. Further investigation reveals that this is due to "click" being called twice. This again seems to be related to the wrapping of the whole update into a codeMirror.operation() call. Somehow our toggleErrorMessage is called twice which calls the error message to be shown and hidden again.
This only happens sometimes, so further investigation is needed.

Unwatch
Star
Edit
New issue
Open
Owner
Labels
bug
Milestone
No milestone
Assignee
No one assigned
Notifications
Unsubscribe
You're receiving notifications because you're subscribed to this repository.
1 participant
Write
Preview
Comments are parsed with GitHub Flavored Markdown
Leave a comment
Attach images by dragging & dropping, selecting them, or pasting from the clipboard.
Close
Comment

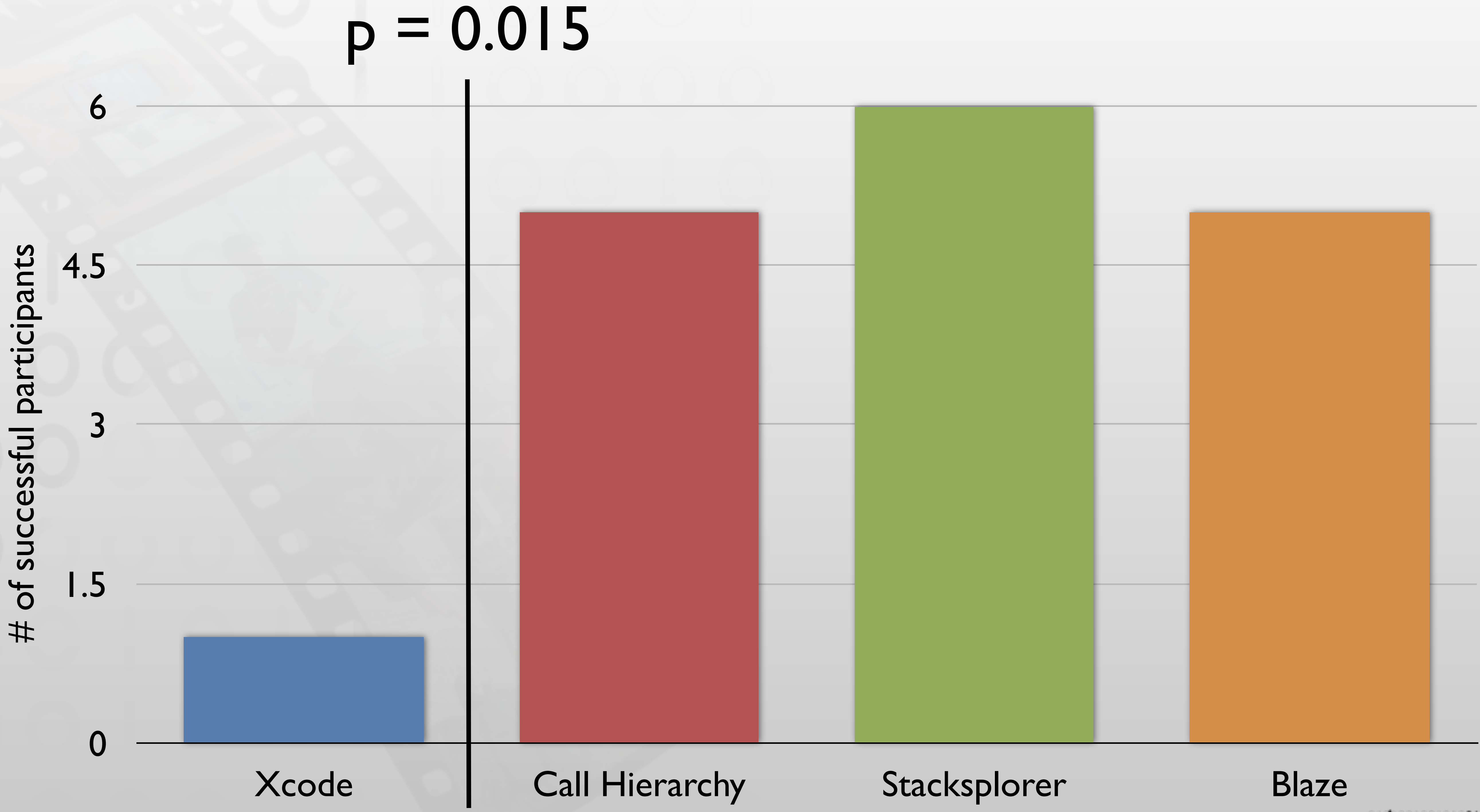
	Xcode	Call Hierarchy	Stacksplorer	Blaze
Find Change Location	Task Success Task Completion Time			
Side Effects of Change				

33 Developers

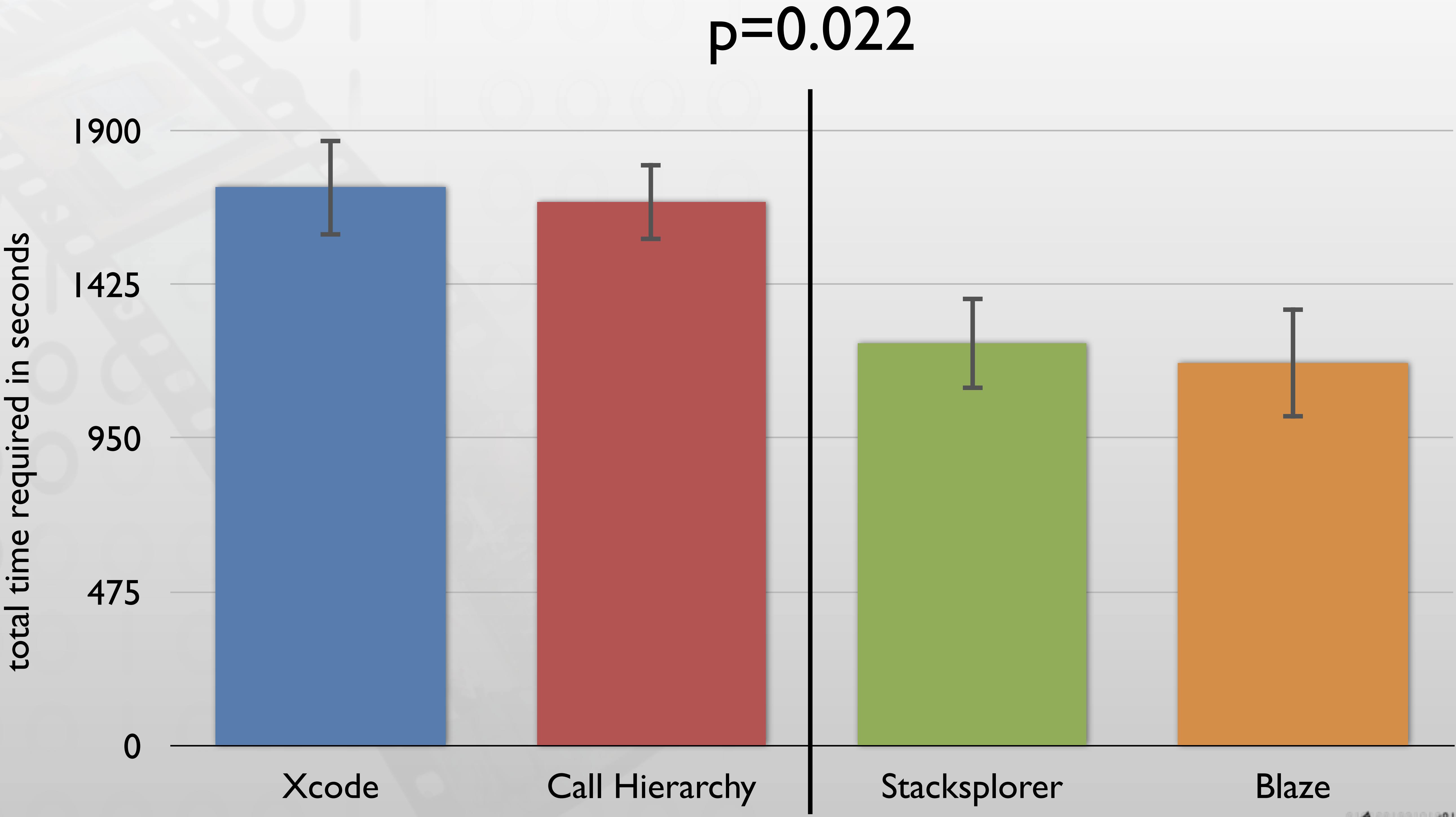
80.000 Lines of Code

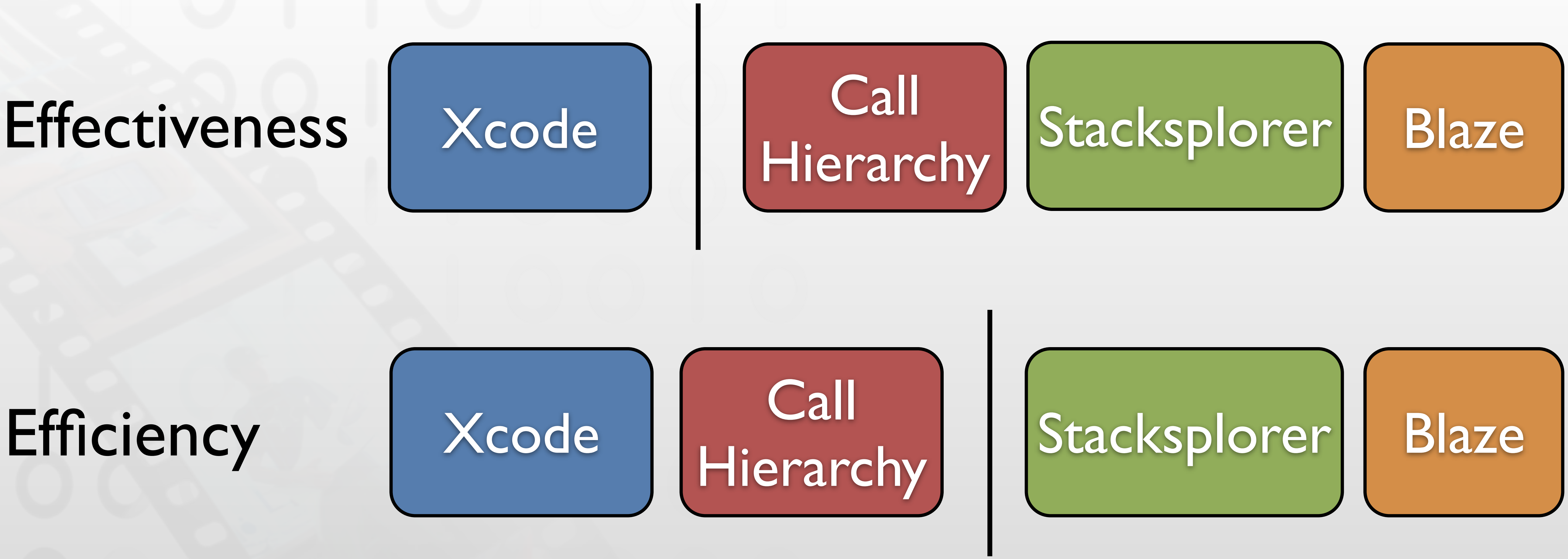
[Krämer2013, How Tools in IDEs Shape Developers' Navigation Behavior]

Task Success



Task Completion Time





Effectiveness

Xcode

Call Hierarchy

Stacksplorer

Blaze

Efficiency

Xcode

Call Hierarchy

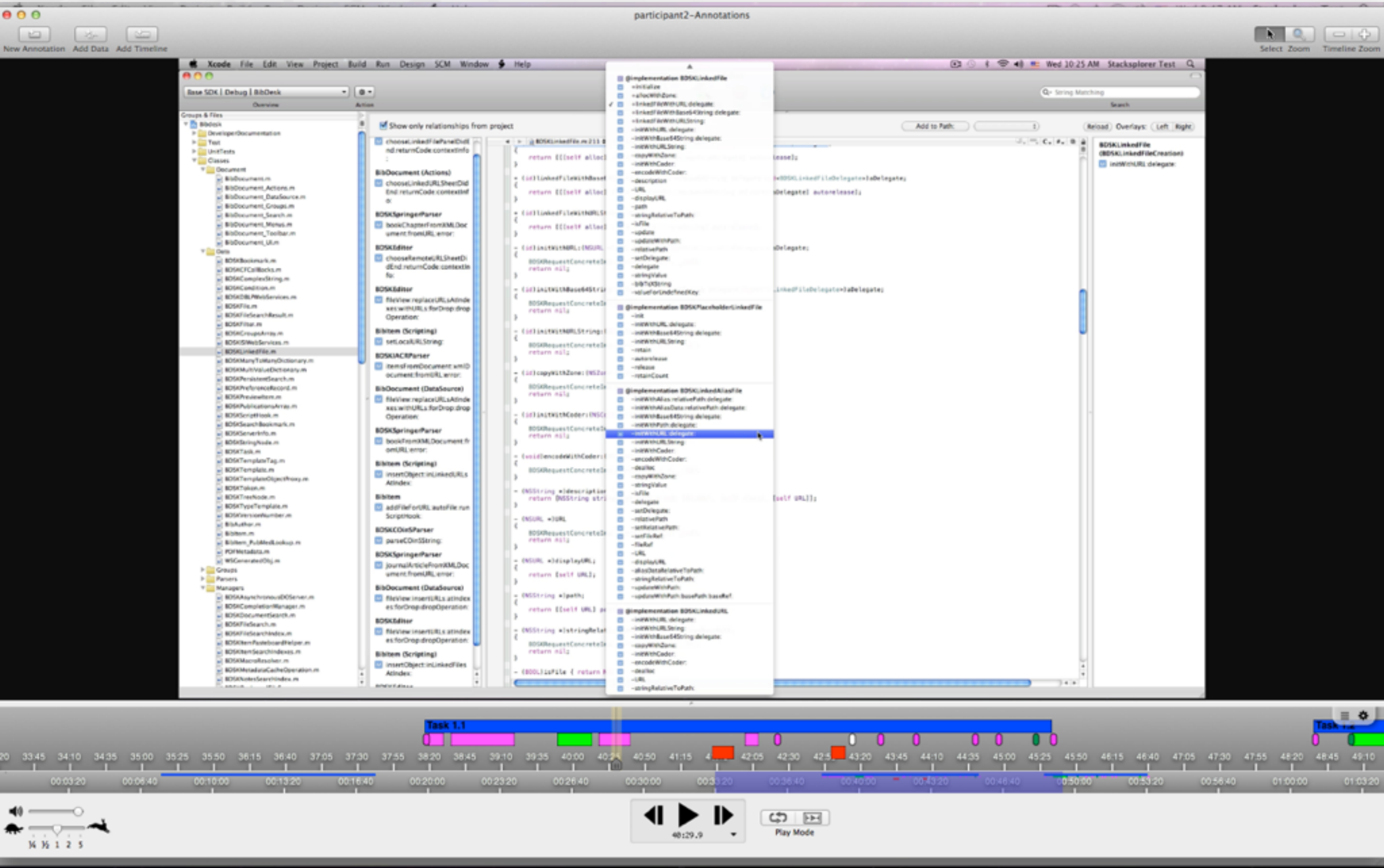
Stacksplorer

Blaze

Why?

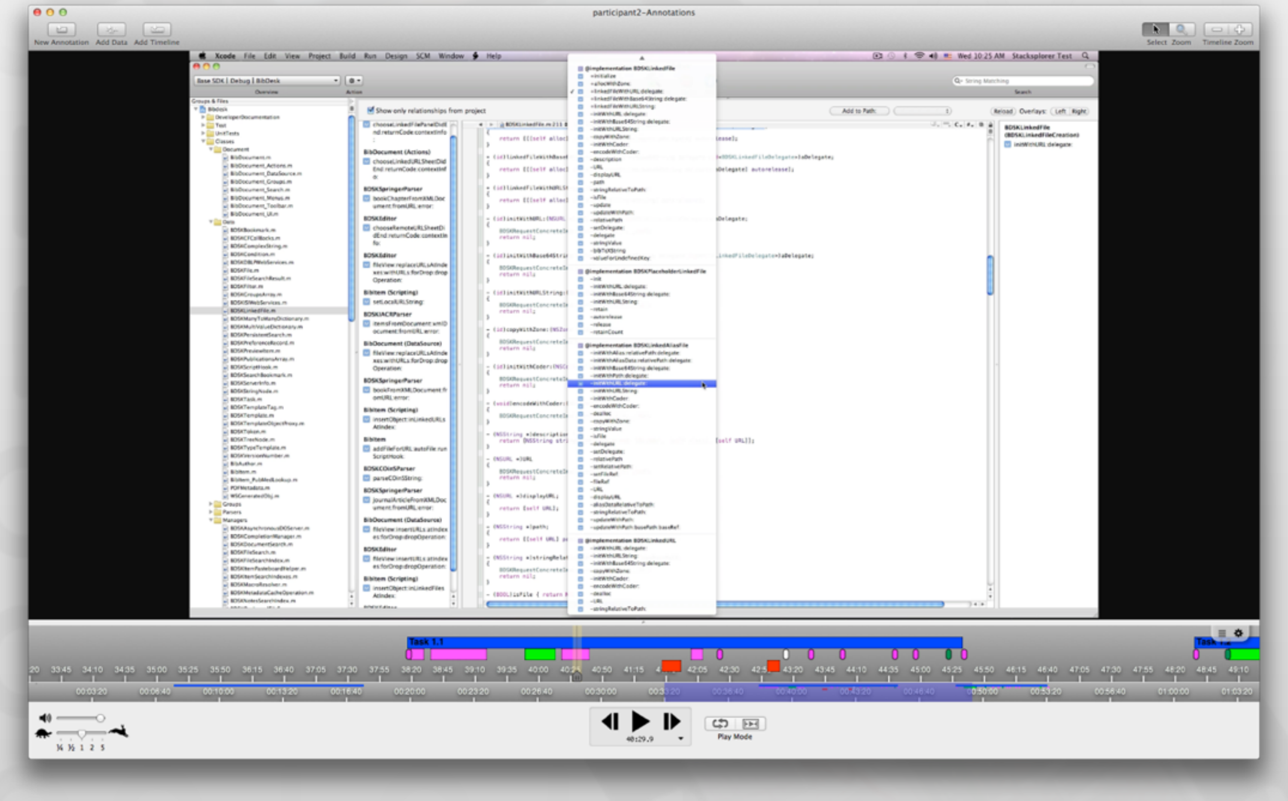
UI Differences

Navigation Behavior

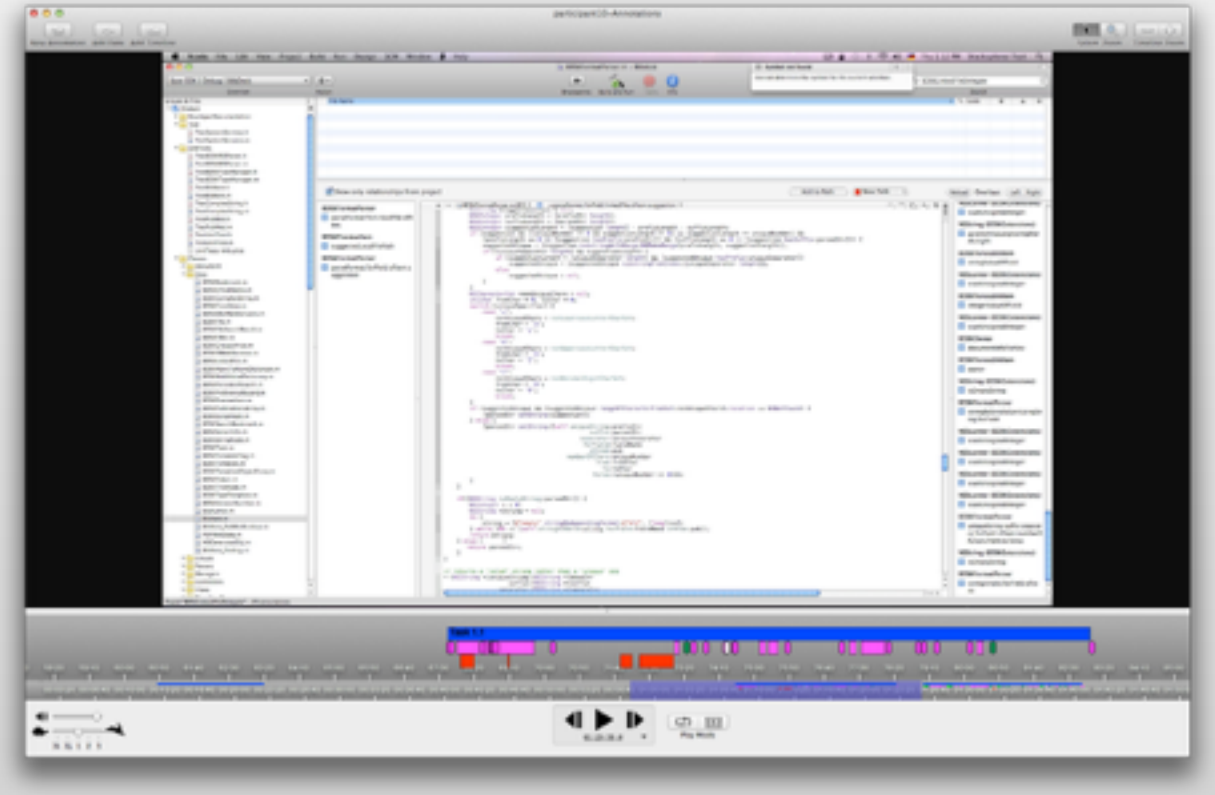


[Fouse2011, ChronoViz: A system for supporting navigation of time-coded data]

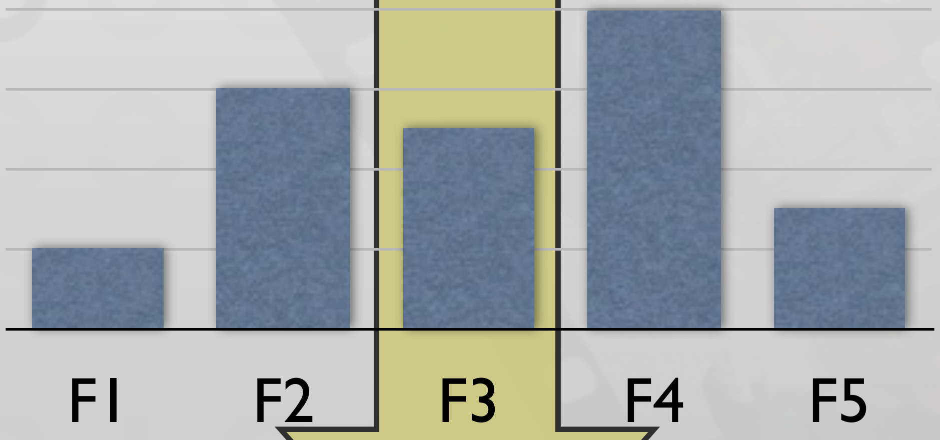
Comparing Navigation Behavior



?

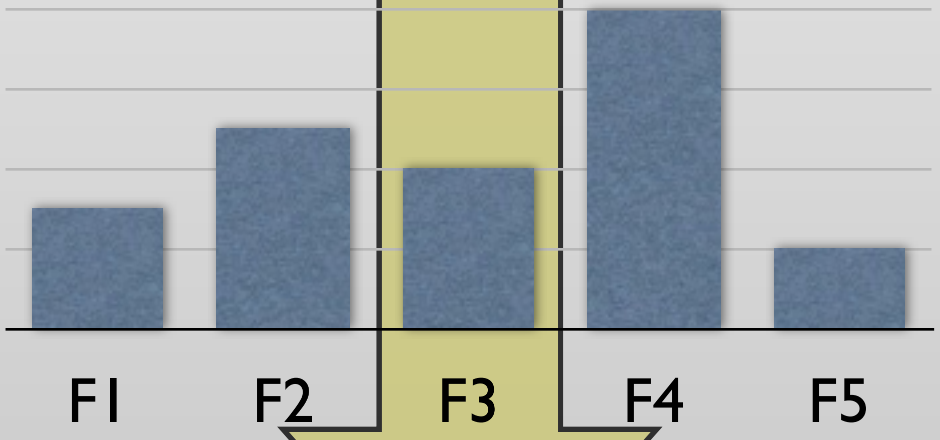


$I_1=(p_{1,1}, \ldots, p_{640,480})$



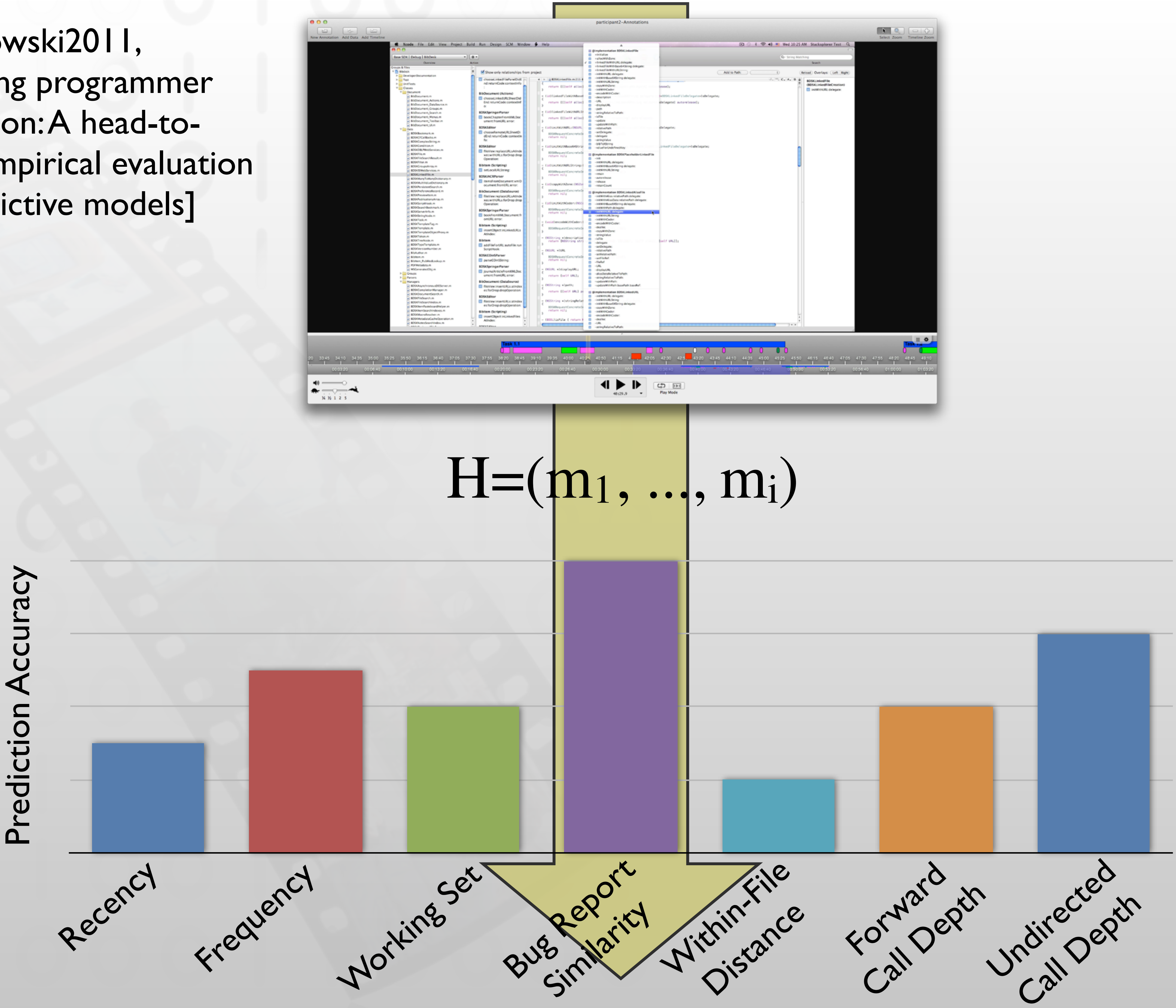
=

$I_2=(p_{1,1}, \ldots, p_{1024,768})$



1. Features
2. Transformations

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



$$H=(m_1, ..., m_i)$$

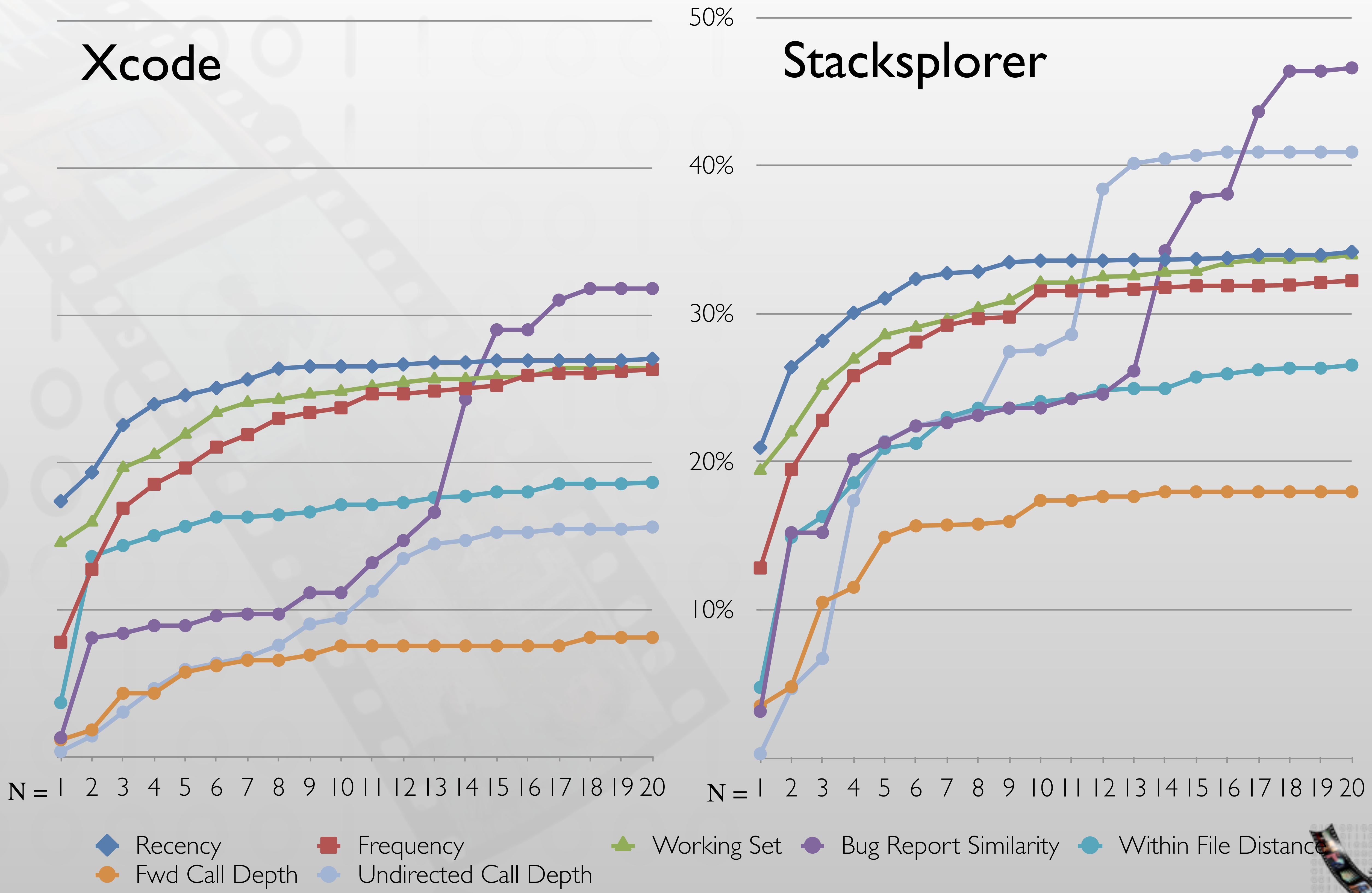
A Predictor

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

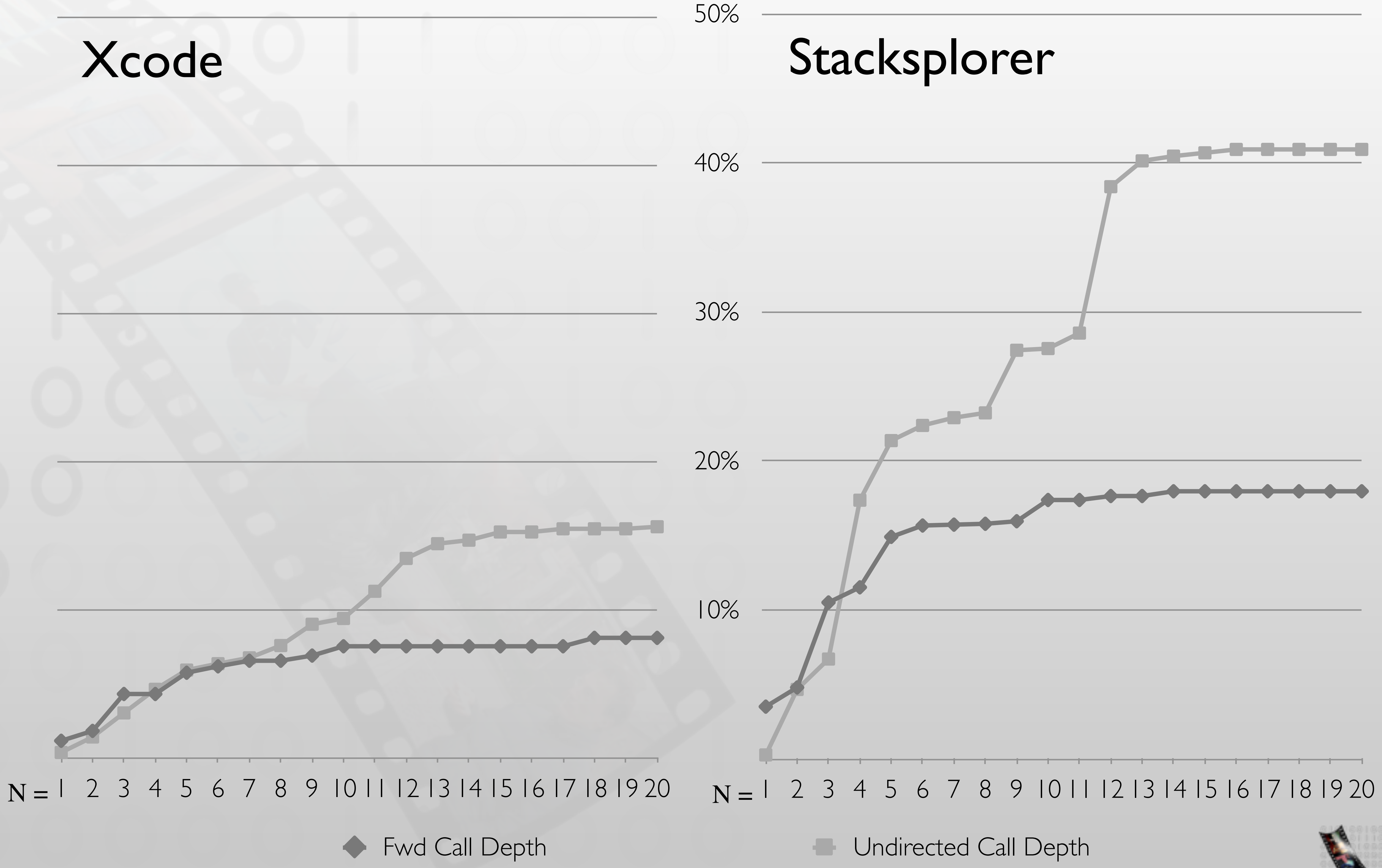
H=(m	Navigation History	H = (a, b, a, d)
M	All methods known to developer at time i	M
A	Activation value for each method in	A A
R	Rank-transformed version of	R R

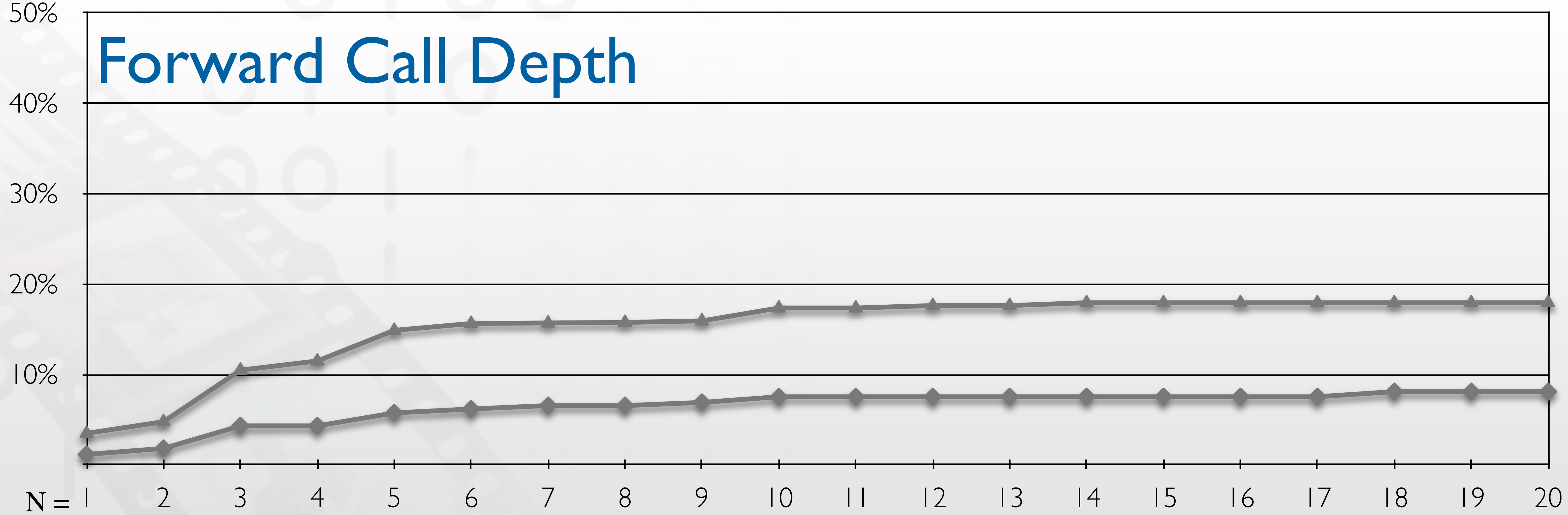
Result: N top-ranked methods

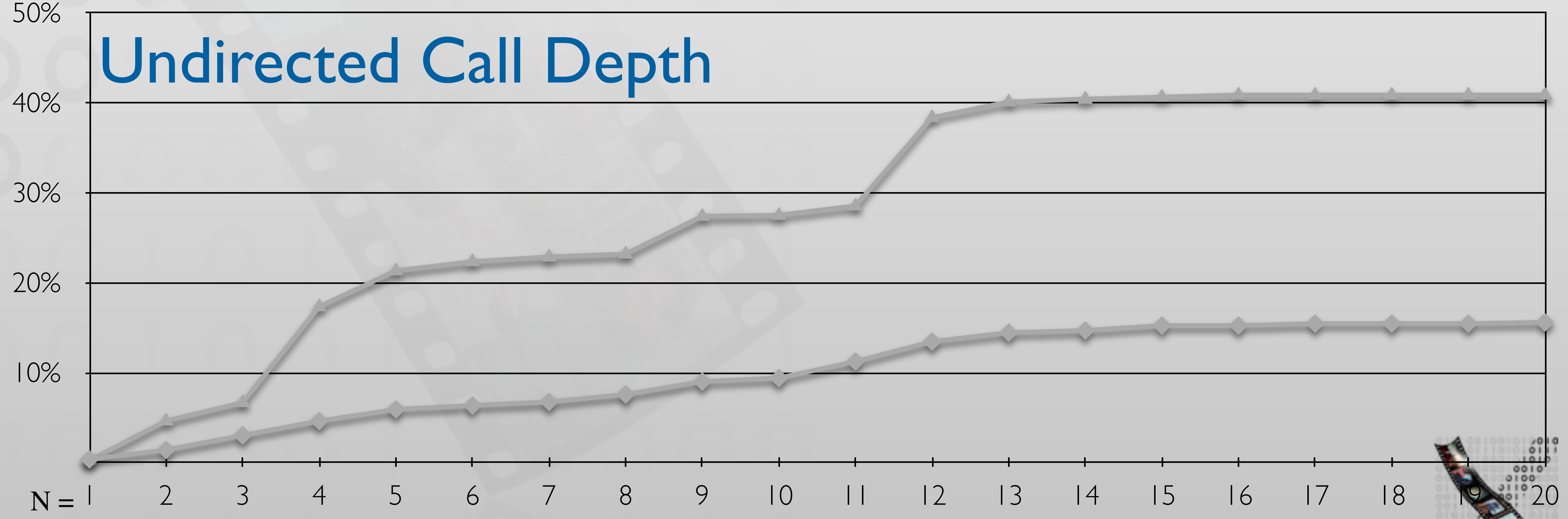
Prediction Accuracy

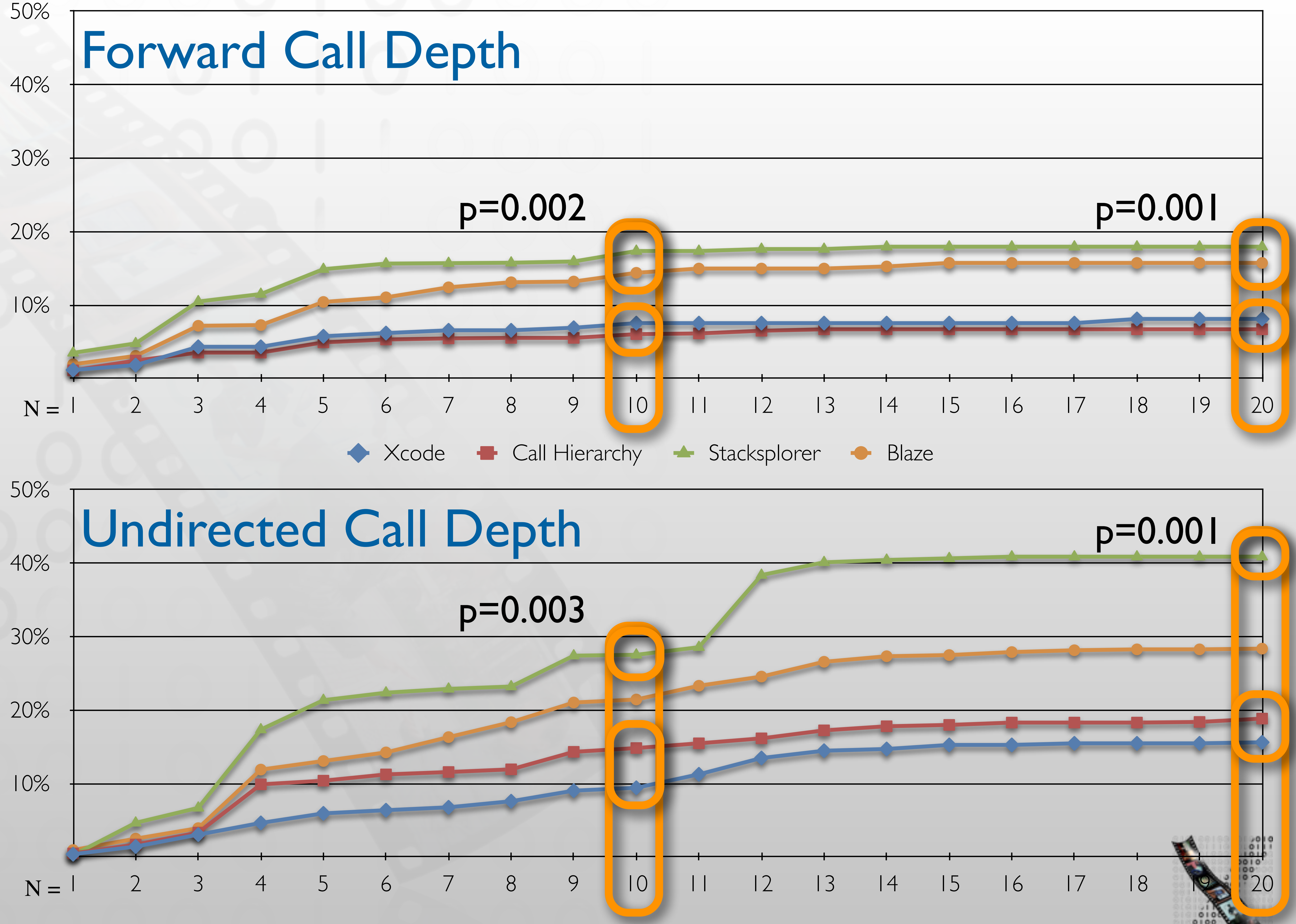


Prediction Accuracy




Forward Call Depth
50%
40%
30%
20%
10%
N =
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20


Undirected Call Depth
50%
40%
30%
20%
10%
N =
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20



Forward Call Depth

p=0.002

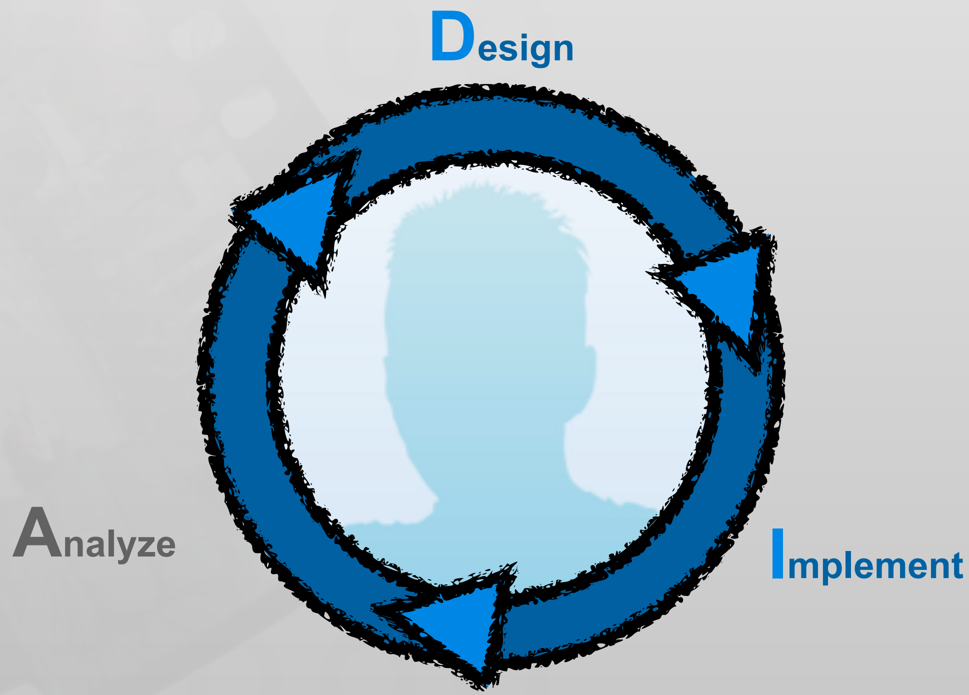
p=0.001

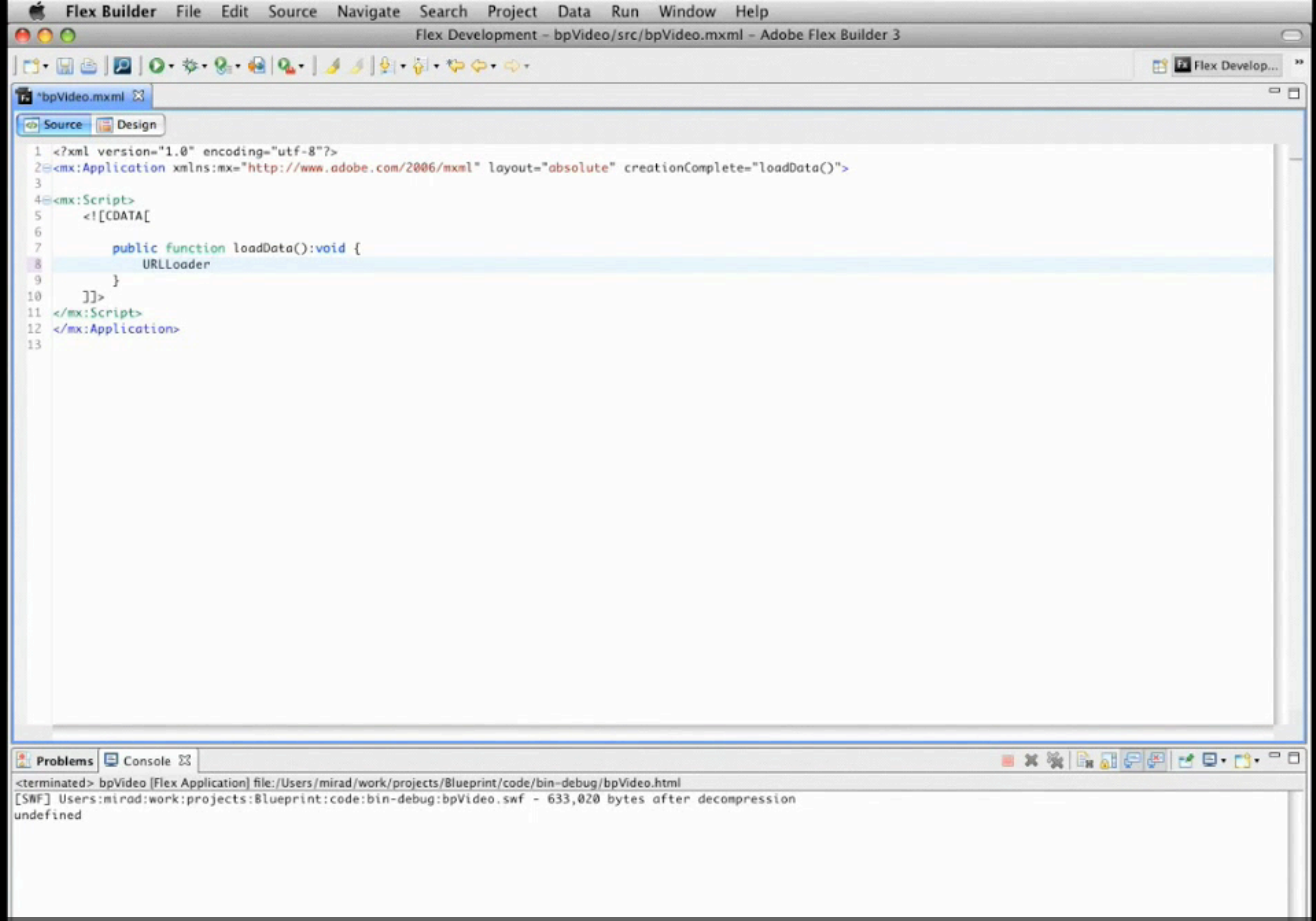
Undirected Call Depth

p=0.001

p=0.003

Away from static analysis only

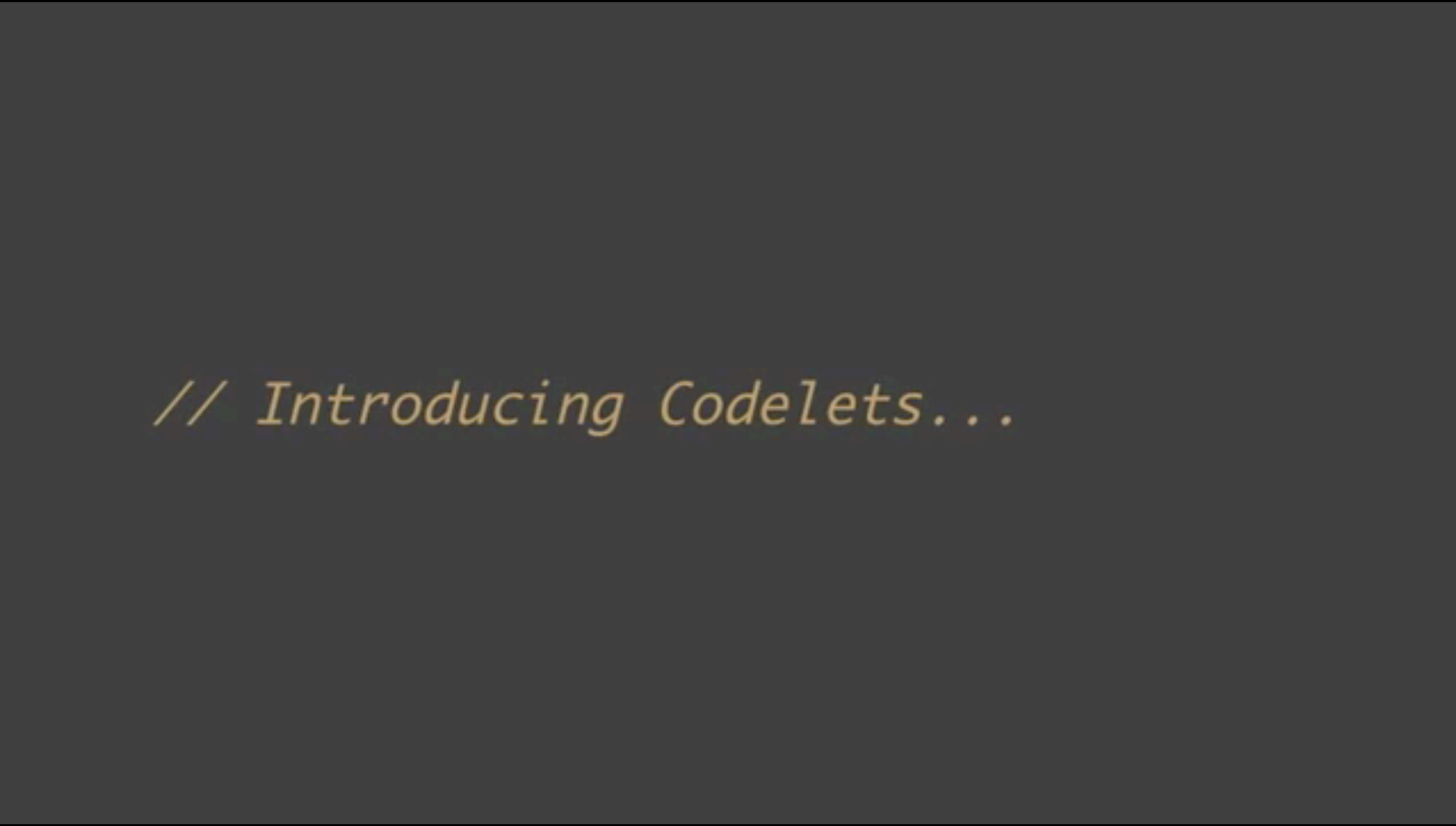




```
<?xml version="1.0" encoding="utf-8"?>
<mx:Application xmlns:mx="http://www.adobe.com/2006/mxml" layout="absolute" creationComplete="loadData()">

<mx:Script>
    <![CDATA[

        public function loadData():void {
            URLLoader
        }
    ]]>
</mx:Script>
</mx:Application>

```

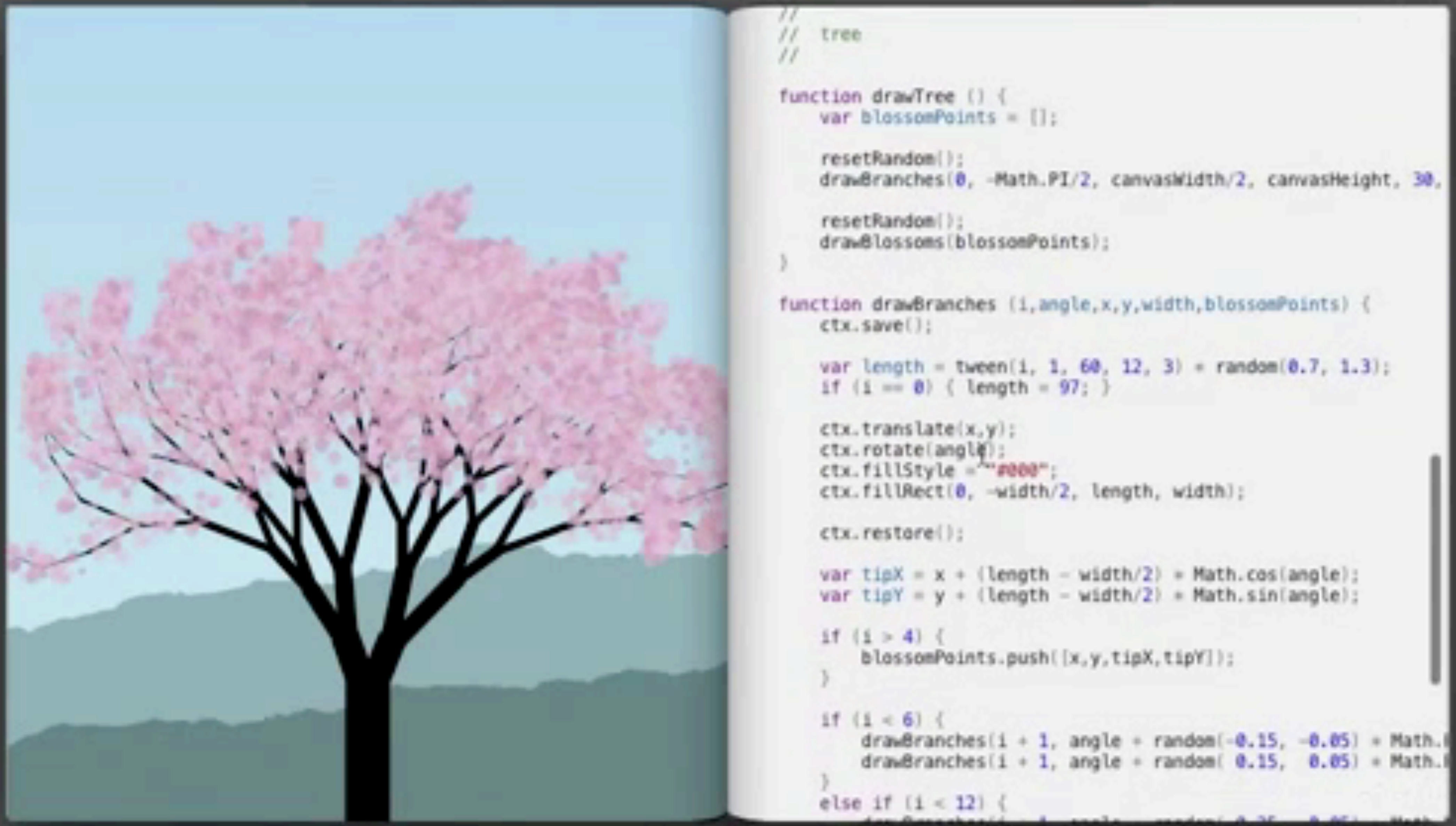
```
<terminated> bpVideo [Flex Application] file:/Users/mirad/work/projects/Blueprint/code/bin-debug/bpVideo.html
[SWF] Users:mirad:work:projects:Blueprint:code:bin-debug:bpVideo.swf - 633,020 bytes after decompression
undefined
```

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



```
// Introducing Codelets...
```

[Oney2012, Codelets: Linking Interactive Documentation and Example Code in the Editor]



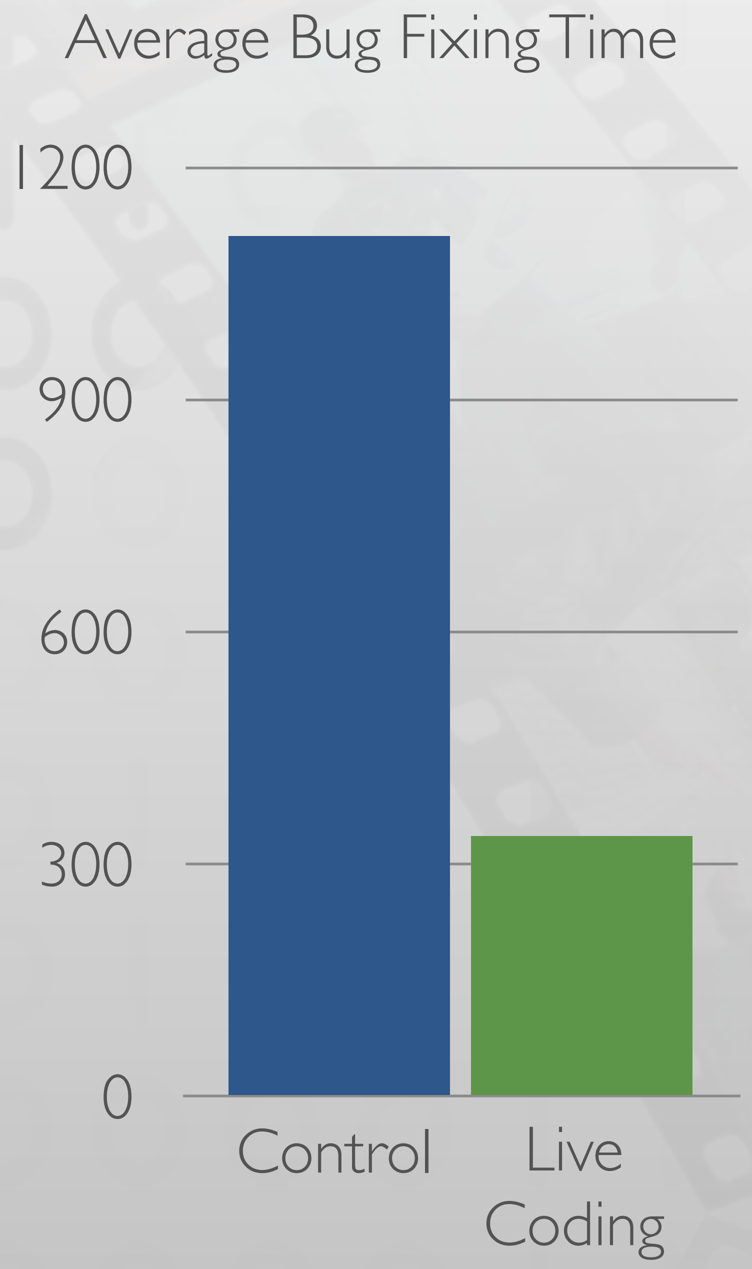
```
//
//  tree
//

function drawTree () {
    var blossomPoints = [];

    resetRandom();
    drawBranches(0, -Math.PI/2, canvasWidth/2, canvasHeight, 30,

    resetRandom();
    drawBlossoms(blossomPoints);
}

function drawBranches (i,angle,x,y,width,blossomPoints) {
    ctx.save();

    var length = tween(i, 1, 60, 12, 3) * random(0.7, 1.3);
    if (i == 0) { length = 97; }

    ctx.translate(x,y);
    ctx.rotate(angle);
    ctx.fillStyle = "#000";
    ctx.fillRect(0, -width/2, length, width);

    ctx.restore();

    var tipX = x + (length - width/2) * Math.cos(angle);
    var tipY = y + (length - width/2) * Math.sin(angle);

    if (i > 4) {
        blossomPoints.push([x,y,tipX,tipY]);
    }

    if (i < 6) {
        drawBranches(i + 1, angle + random(-0.15, -0.05) * Math.
        drawBranches(i + 1, angle + random( 0.15,  0.05) * Math.
    }
    else if (i < 12) {
```

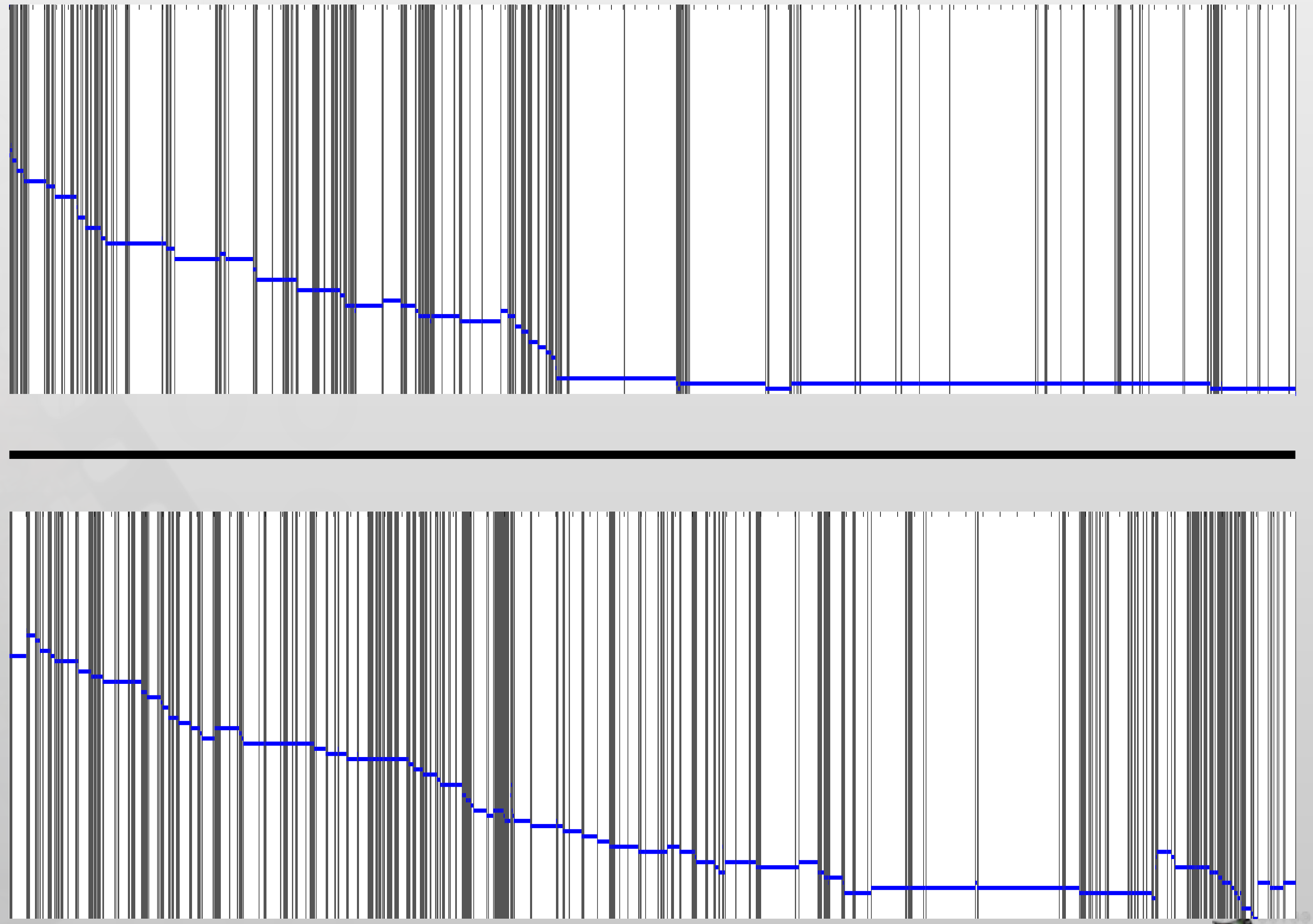
[Victor2012, Inventing on Principle]

Demo

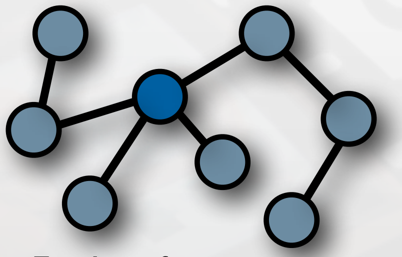
Live Coding Affects Coding Behavior

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

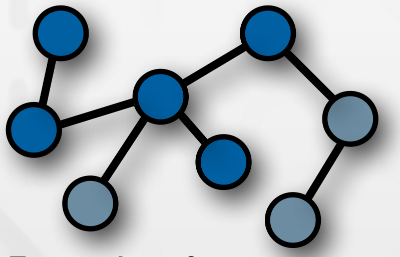




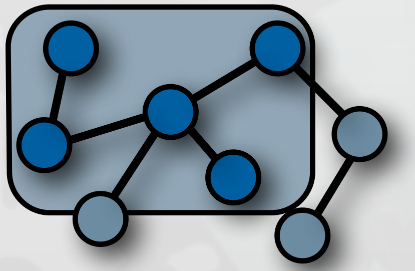
Summary



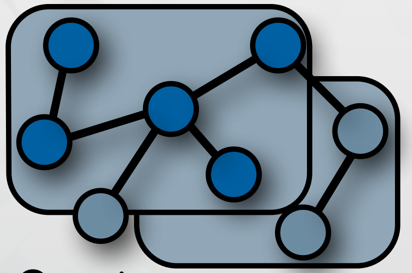
Finding focus points



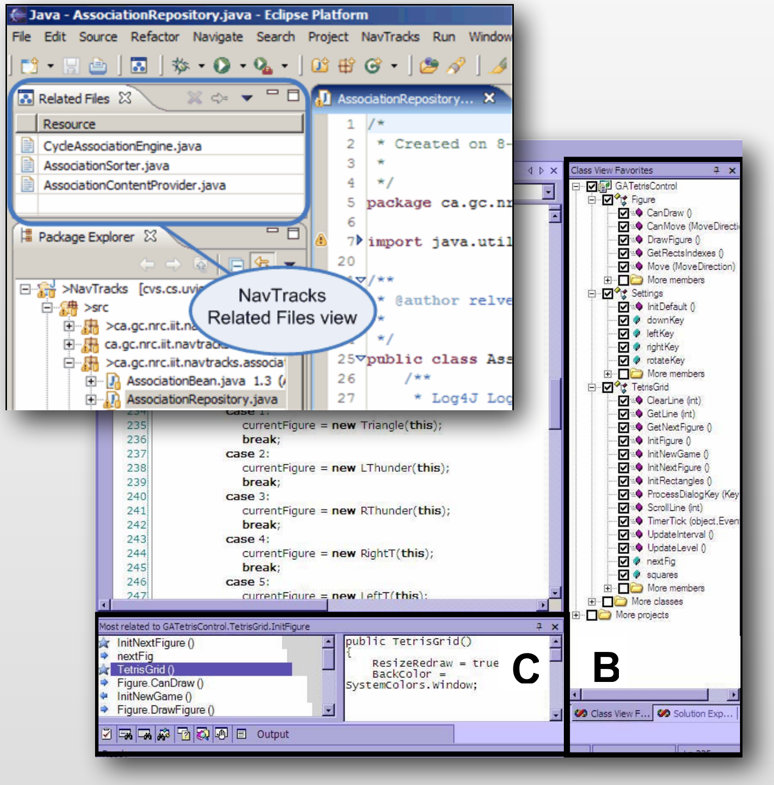
Expanding focus points



Understanding a subgraph



Questions over groups of subgraphs



Java - AssociationRepository.java - Eclipse Platform
File Edit Source Refactor Navigate Search Project NavTracks Run Window
Related Files
Resource
Package Explorer
AssociationRepository...
NavTracks Related Files view
Class View Favorites
Most related to GATetrisControl.TetrisGrid.InitFigure
Output
Class View F...
Solution Exp...
C
B

Related Files:

- CycleAssociationEngine.java
- AssociationSorter.java
- AssociationContentProvider.java

Package Explorer:

```
⊟ >NavTracks [cvs.cs.uvic
  ⊟ >src
    ⊞ >ca.gc.nrc.iit.na
    ⊞ ca.gc.nrc.iit.navtrac
    ⊟ >ca.gc.nrc.iit.navtracks.associa
      ⊞ AssociationBean.java 1.3 (
      ⊞ AssociationRepository.java
```

```
/*
 * Created on 8-
 *
 */
package ca.gc.nr

import java.util

/**
 * @author relve
 *
 */
public class Ass
    /**
     * Log4J Log
```

```
            currentFigure = new Triangle(this);
            break;
        case 2:
            currentFigure = new LThunder(this);
            break;
        case 3:
            currentFigure = new RThunder(this);
            break;
        case 4:
            currentFigure = new RightT(this);
            break;
        case 5:
            currentFigure = new LeftT(this);
```

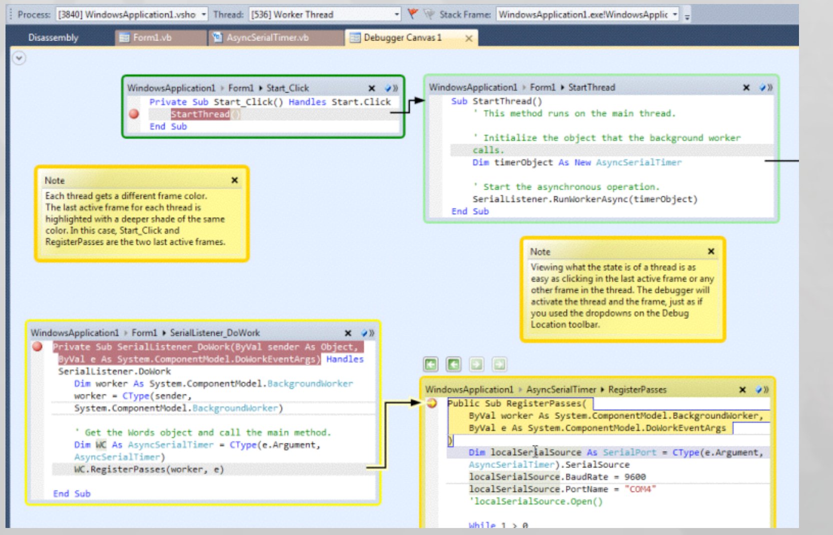
Class View Favorites:

```
⊟ ☑ GATetrisControl
  ⊟ ☑ Figure
      ☑ CanDraw ()
      ☑ CanMove (MoveDirecti
      ☑ DrawFigure ()
      ☑ GetRectsIndexes ()
      ☑ Move (MoveDirection)
    ⊞ □ More members
  ⊟ ☑ Settings
      ☑ InitDefault ()
      ☑ downKey
      ☑ leftKey
      ☑ rightKey
      ☑ rotateKey
    ⊞ □ More members
  ⊟ ☑ TetrisGrid
      ☑ ClearLine (int)
      ☑ GetLine (int)
      ☑ GetNextFigure ()
      ☑ InitFigure ()
      ☑ InitNewGame ()
      ☑ InitNextFigure ()
      ☑ InitRectangles ()
      ☑ ProcessDialogKey (Key
      ☑ ScrollLine (int)
      ☑ TimerTick (object,Even
      ☑ UpdateInterval ()
      ☑ UpdateLevel ()
      ☑ nextFig
      ☑ squares
    ⊞ □ More members
  ⊞ □ More classes
⊞ □ More projects
```

Most related to GATetrisControl.TetrisGrid.InitFigure:

- InitNextFigure ()
- nextFig
- TetrisGrid ()
- Figure.CanDraw ()
- InitNewGame ()
- Figure.DrawFigure ()

```
public TetrisGrid()
{
    ResizeRedraw = true
    BackColor =
SystemColors.Window;
```



Process: [3840] WindowsApplication1.vsho
Thread: [536] Worker Thread
Stack Frame: WindowsApplication1.exe!WindowsApplic
Disassembly
Form1.vb
AsyncSerialTimer.vb
Debugger Canvas 1

WindowsApplication1 ▸ Form1 ▸ Start_Click

```
Private Sub Start_Click() Handles Start.Click
    StartThread()
End Sub
```

WindowsApplication1 ▸ Form1 ▸ StartThread

```
Sub StartThread()
    ' This method runs on the main thread.

    ' Initialize the object that the background worker
    calls.
    Dim timerObject As New AsyncSerialTimer

    ' Start the asynchronous operation.
    SerialListener.RunWorkerAsync(timerObject)
End Sub
```

Note

Each thread gets a different frame color. The last active frame for each thread is highlighted with a deeper shade of the same color. In this case, Start_Click and RegisterPasses are the two last active frames.

Note

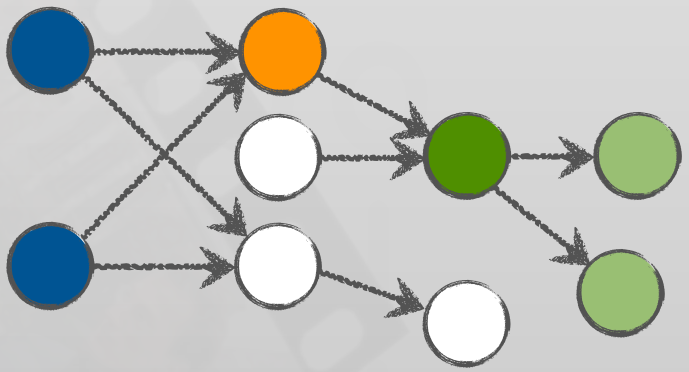
Viewing what the state is of a thread is as easy as clicking in the last active frame or any other frame in the thread. The debugger will activate the thread and the frame, just as if you used the dropdowns on the Debug Location toolbar.

WindowsApplication1 ▸ Form1 ▸ SerialListener_DoWork

```
Private Sub SerialListener_DoWork(ByVal sender As Object,
 ByVal e As System.ComponentModel.DoWorkEventArgs) Handles
 SerialListener.DoWork
    Dim worker As System.ComponentModel.BackgroundWorker
    worker = CType(sender,
    System.ComponentModel.BackgroundWorker)

    ' Get the Words object and call the main method.
    Dim WC As AsyncSerialTimer = CType(e.Argument,
    AsyncSerialTimer)
    WC.RegisterPasses(worker, e)

End Sub
```

WindowsApplication1 ▸ AsyncSerialTimer ▸ RegisterPasses

```
Public Sub RegisterPasses(
    ByVal worker As System.ComponentModel.BackgroundWorker,
    ByVal e As System.ComponentModel.DoWorkEventArgs
)
    Dim localSerialSource As SerialPort = CType(e.Argument,
    AsyncSerialTimer).SerialSource
    localSerialSource.BaudRate = 9600
    localSerialSource.PortName = "COM4"
    'localSerialSource.Open()

    While 1 > 0
```



```
//
//  tree
//

function drawTree () {
    var blossomPoints = [];

    resetRandom();
    drawBranches(0, -Math.PI/2, canvasWidth/2, canvasHeight, 30,

    resetRandom();
    drawBlossoms(blossomPoints);
}

function drawBranches (i,angle,x,y,width,blossomPoints) {
    ctx.save();

    var length = tween(i, 1, 60, 12, 3) * random(0.7, 1.3);
    if (i == 0) { length = 97; }

    ctx.translate(x,y);
    ctx.rotate(angle);
    ctx.fillStyle = "#000";
    ctx.fillRect(0, -width/2, length, width);

    ctx.restore();

    var tipX = x + (length - width/2) * Math.cos(angle);
    var tipY = y + (length - width/2) * Math.sin(angle);

    if (i > 4) {
        blossomPoints.push([x,y,tipX,tipY]);
    }

    if (i < 6) {
        drawBranches(i + 1, angle + random(-0.15, -0.05) * Math.
        drawBranches(i + 1, angle + random( 0.15,  0.05) * Math.
    }
    else if (i < 12) {
```