



getting to flow in software development

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Tasktop Technologies Incorporated

“software is
eating the
world”

Marc Andreessen





premise

...

lots of software to build
should be fun to build it



hypothesis

...

tools and interfaces
that support **flow**
enable building

more software
with more fun

what is **flow**?
Mihaly Csikszentmihalyi
single-minded immersion

clear set of goals and progress
clear and immediate feedback
balance of challenges to skills



top 3 reasons for productive day (379 devs)

53.2%

complete tasks
or goals

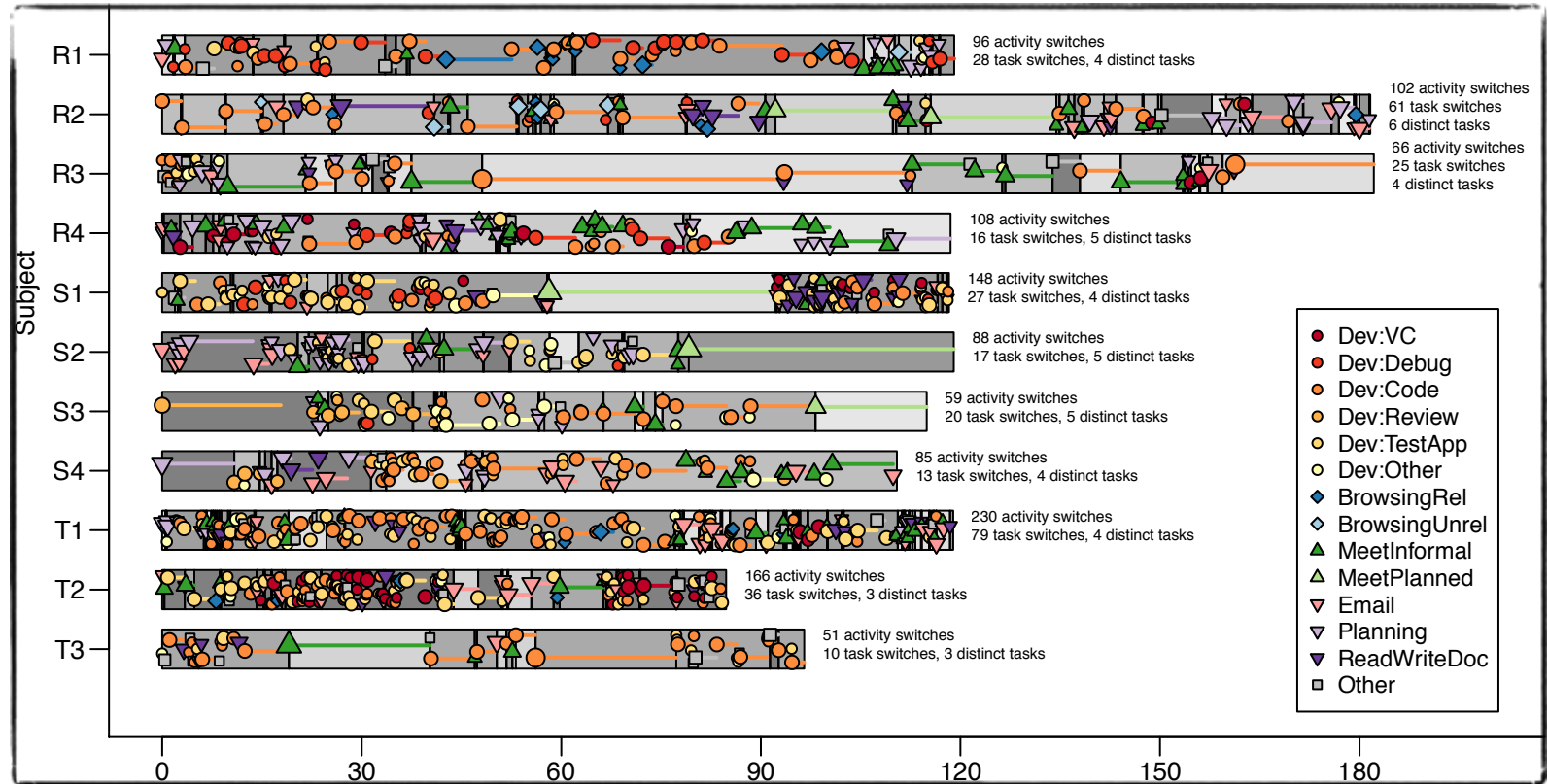
50.4%

getting into a
“**flow**” without
many “context
switches” and no
or few
interruptions
and distractions

21.9%

no meetings

[Meyer, Fritz, Murphy & Zimmermann, FSE 2014]



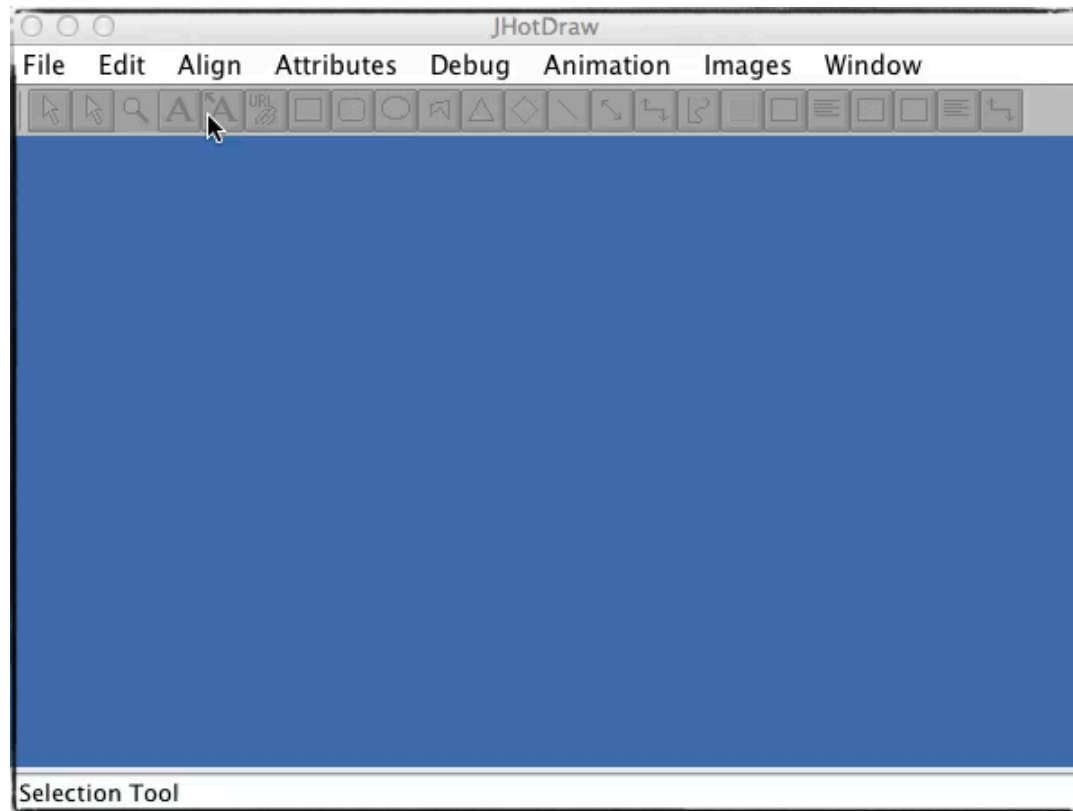
constant switching

[Meyer, Fritz, Murphy & Zimmermann, FSE 2014]



ok?

development tools and
interfaces already do a great job
at supporting flow



jHotDraw

[Dashboards](#) ▾[Projects](#) ▾[Issues](#) ▾[Agile](#)[Create issue](#)[jHotDraw](#) / [JHOT-9](#)

set the fill colour of a figure

[Edit](#)[Comment](#)[Summarizer](#)[More ▾](#)[Start Progress](#)[Done](#)[Start Review](#)

Details

Type:

Story

Status:

TO DO

Priority:

Major

[\(View Workflow\)](#)

Resolution:

Unresolved

Labels:

None

Description

As a drawing creator, I need to set the fill colour of a figure on a canvas.

A variety of fill colours must be provided. It should be simple for the drawing creator to select a figure and from the selected figure, see and choose an appropriate colour.

Sub-Tasks

1.

[allow selection of a figure](#)**TO DO**

Gail Murphy



2.

[add a menu for setting fill colour of a figure](#)**TO DO**

Gail Murphy

3.

[draw the fill colour of a figure](#)**DONE**

Gail Murphy

Java - jHotDraw/src/org/jhotdraw/samples/javadraw/JavaDrawApp.java - Eclipse - /Users/murphy/Documents/Talks/AWSEC/workspac

Quick Access

Type Hiera

JavaDrawApp.java

```
+ * @(#)JavaDrawApp.java

package org.jhotdraw.samples.javadraw;

+ import org.jhotdraw.framework.*;

- /**
 * @version <${CURRENT_VERSION}>
 */
+ public class JavaDrawApp extends MDI_DrawApplication {

    private Animator          fAnimator;
    private static String     fgSampleImagesPath = "/org/jhotdraw/samples/javadraw/sam
    private static String     fgSampleImagesResourcePath = fgSampleImagesPath + "/";

-   JavaDrawApp() {
        super("JHotDraw");
    }

-   /**
    * Expose constructor for benefit of subclasses.
    *
    * @param title The window title for this application's frame.
    */
-   public JavaDrawApp(String title) {
        super(title);
    }

    ...
}
```

Writable | Smart Insert | 2 : 1 | Home - The Glob

Search string (* = any string, ? = any character):

pen

☐ Case sensitive

Search For

- ☐ Type ☒ Method
☐ Package ☐ Constructor
☐ Field

Limit To

- ☐ All occurrences ☒ Declarations
☐ References
☐ Match locations ([0 of 4 selected](#))

Search In

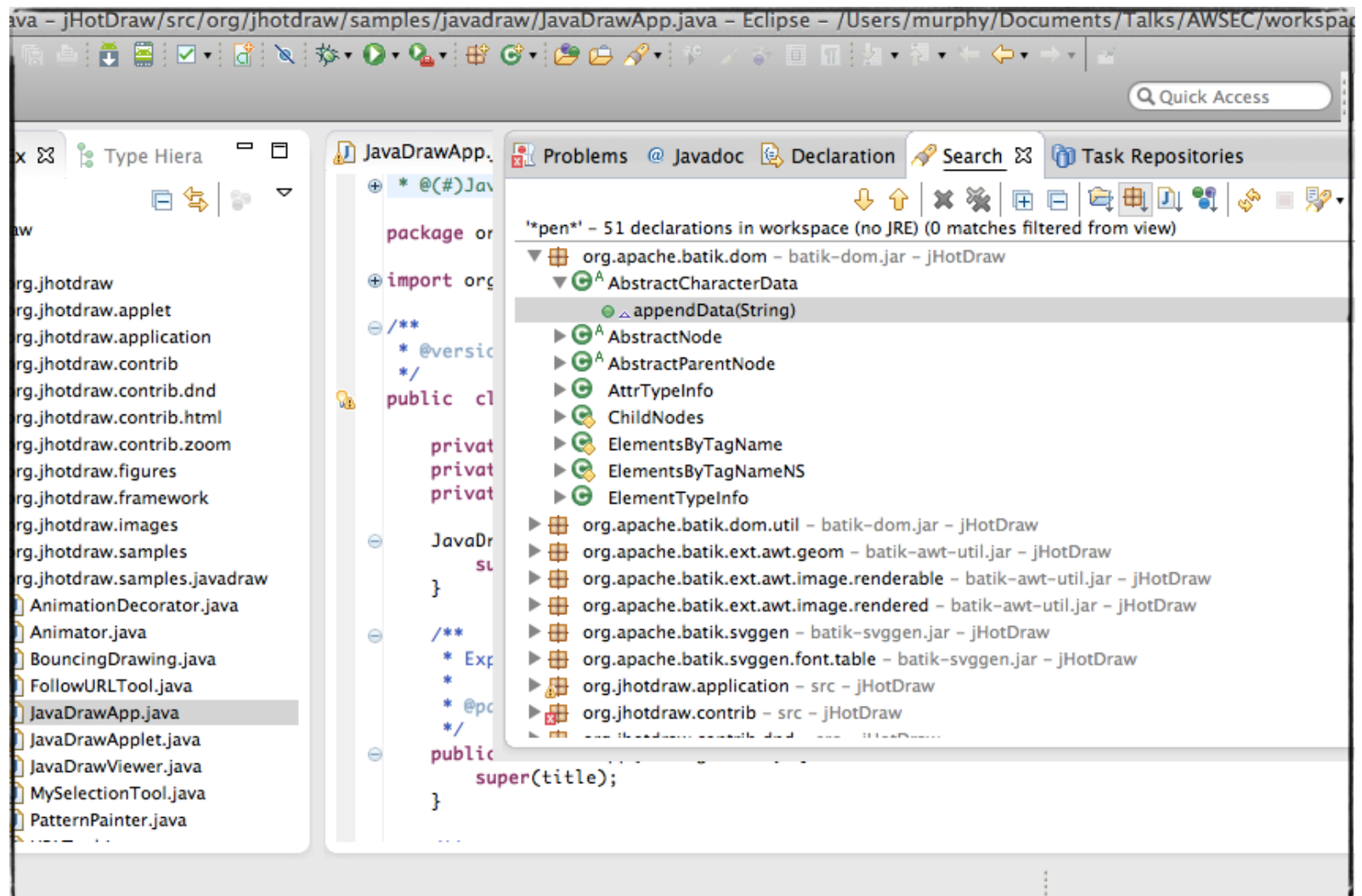
- ☒ Sources ☒ Required projects ☐ JRE libraries ☒ Application libraries

Scope

- ☒ Workspace ☐ Selected resources ☐ Enclosing projects

☐ Working set:

Choose...



Java - jHotDraw/src/org/jhotdraw/figures/AttributeFigure.java - Eclipse - /Users/murphy/Documents/Talks/AWSEC/workspace

Quick Access

Type Hiera

rg.jhotdraw
rg.jhotdraw.applet
rg.jhotdraw.application
rg.jhotdraw.contrib
rg.jhotdraw.contrib.dnd
rg.jhotdraw.contrib.html
rg.jhotdraw.contrib.zoom
rg.jhotdraw.figures
rg.jhotdraw.framework
rg.jhotdraw.images
rg.jhotdraw.samples
rg.jhotdraw.samples.javadraw
AnimationDecorator.java
Animator.java
BouncingDrawing.java
FollowURLTool.java
JavaDrawApp.java
JavaDrawApplet.java
JavaDrawViewer.java
MySelectionTool.java
PatternPainter.java

JavaDrawApp.java AttributeFigure.java

```
    /*  
    private static FigureAttributes fgDefaultAttributes = null;  
  
    /*  
    * Serialization support.  
    */  
    private static final long serialVersionUID = -10857585979273442L;  
    private int attributeFigureSerializedDataVersion = 1;  
  
    protected AttributeFigure() { }  
  
    /**  
    * Draws the figure in the given graphics. Draw is a template  
    * method calling drawBackground followed by drawFrame.  
    */  
    public void draw(Graphics g) {  
        Color frame = getFrameColor();  
        if (!ColorMap.isTransparent(frame)) {  
            g.setColor(frame);  
            drawFrame(g);  
        }  
    }  
  
    /**  
    * Draws the background of the figure.  
    * @see #draw  
    */  
    protected void drawBackground(Graphics g) {
```

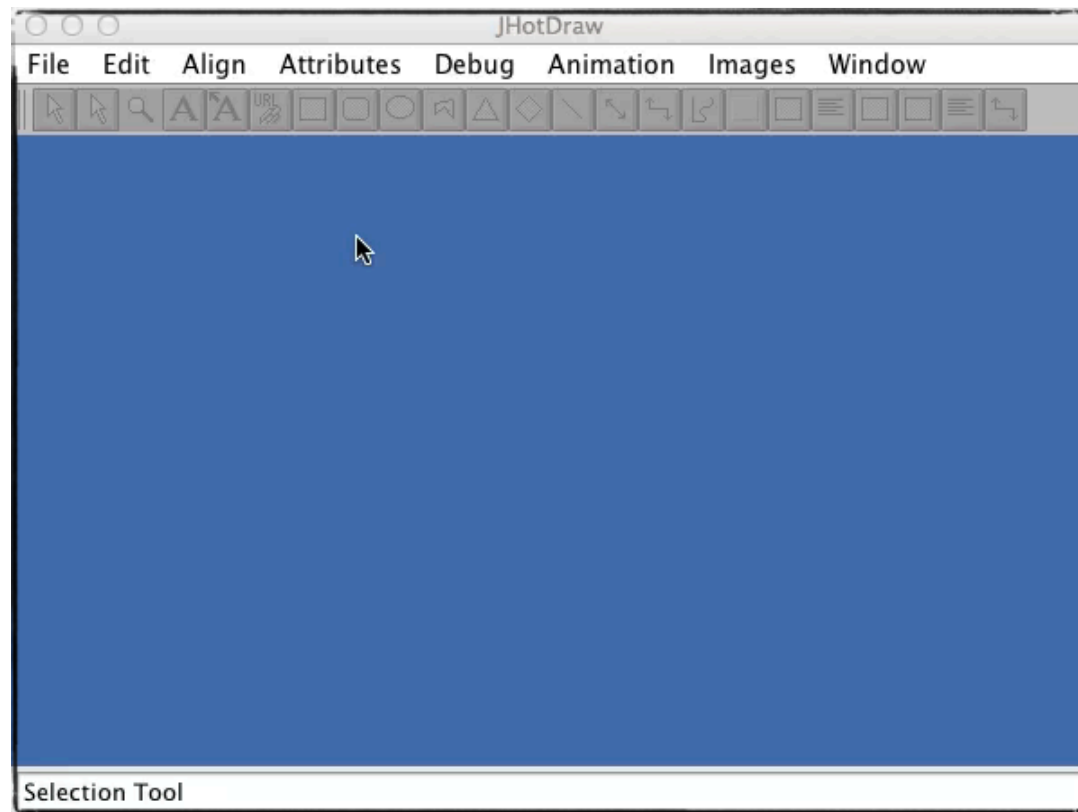
Writable Smart Insert 24 : 3

add code
in
several
places

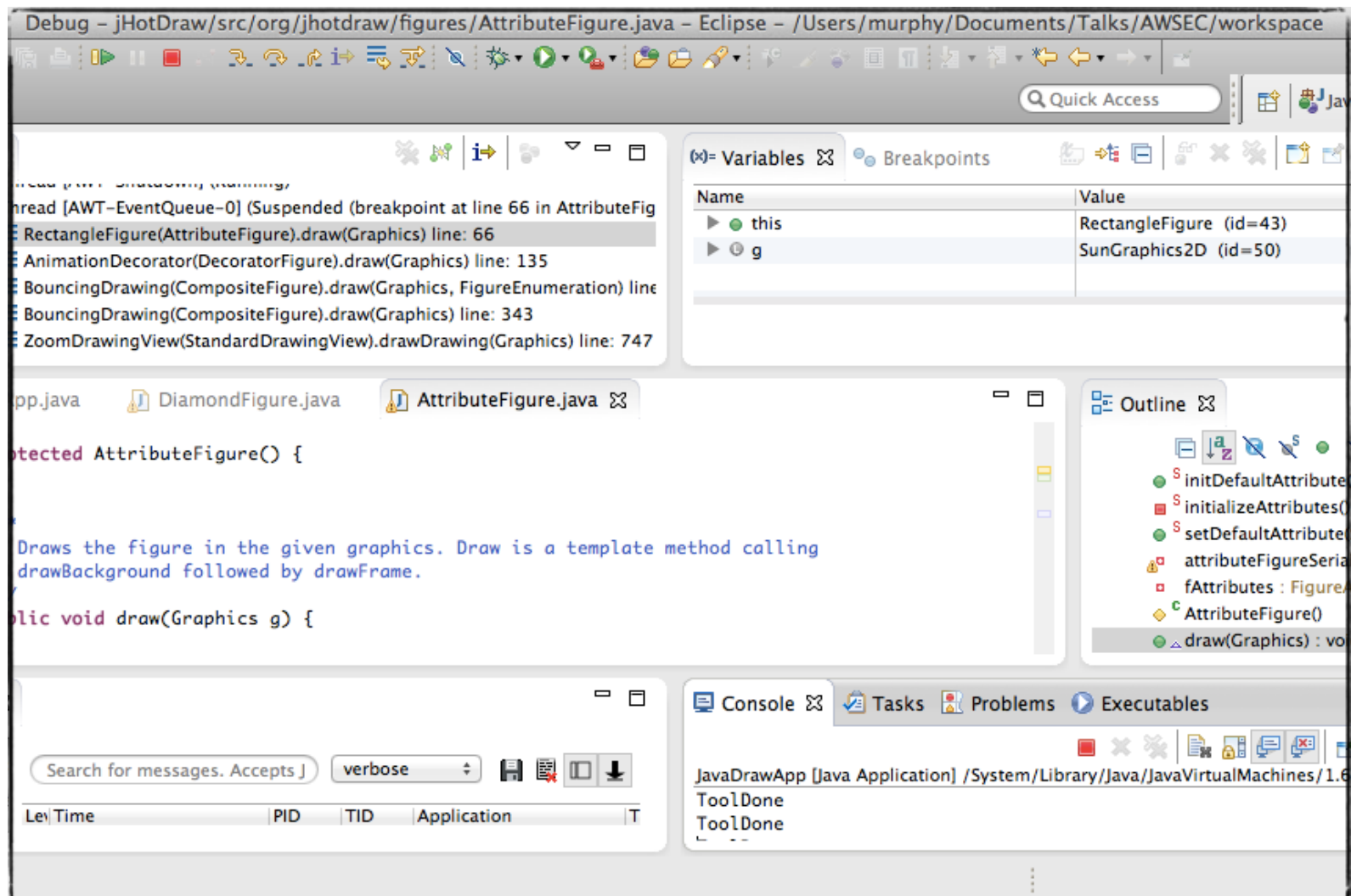
```
public void draw(Graphics g)
    Color fill = getFillColor()

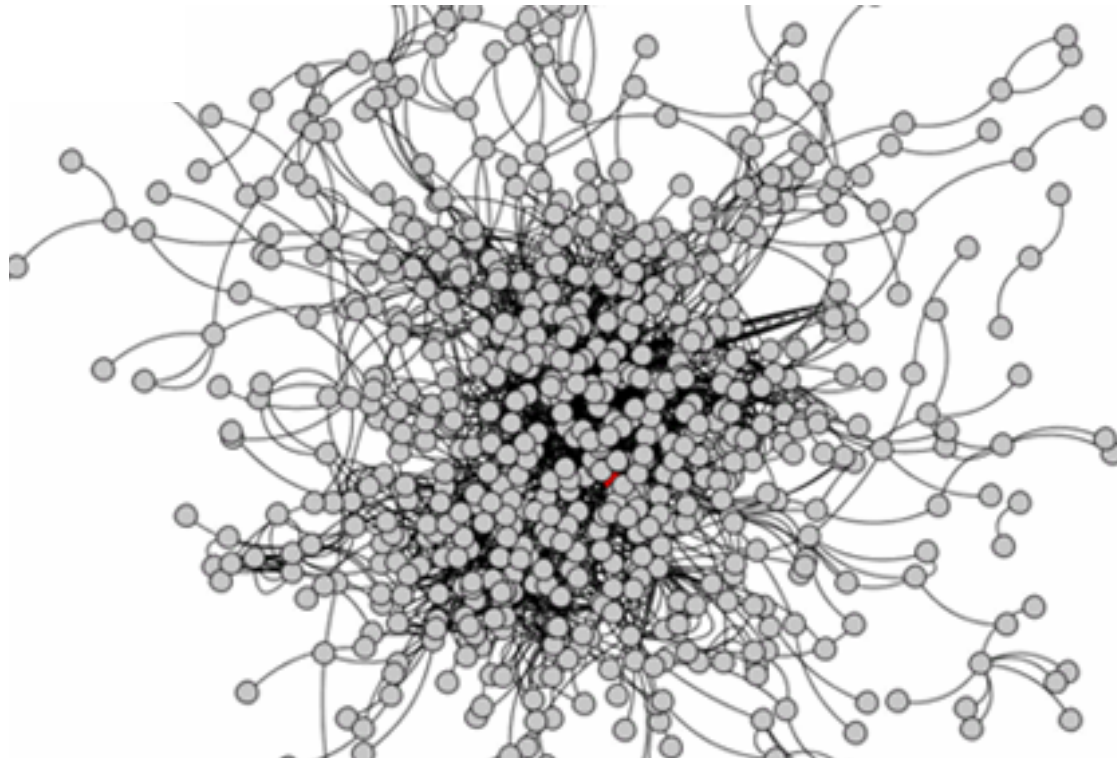
    if (!ColorMap.isTransparent)
        g.setColor(fill);
        drawBackground(g);
    }

    Color frame = getFrameColor()
    if (!ColorMap.isTransparent)
        g.setColor(frame);
        drawFrame(g);
    }
}
```

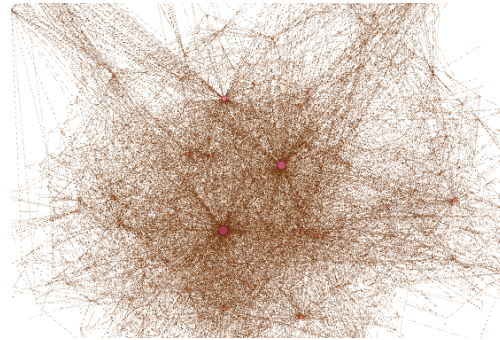
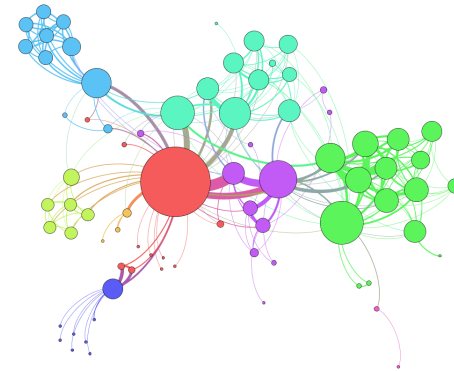
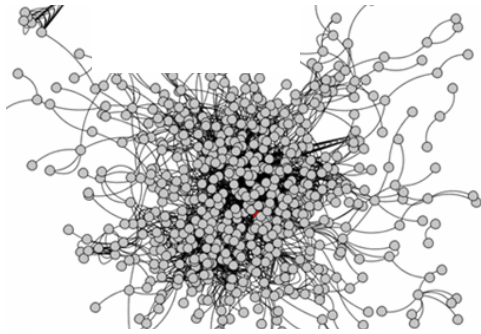


bug

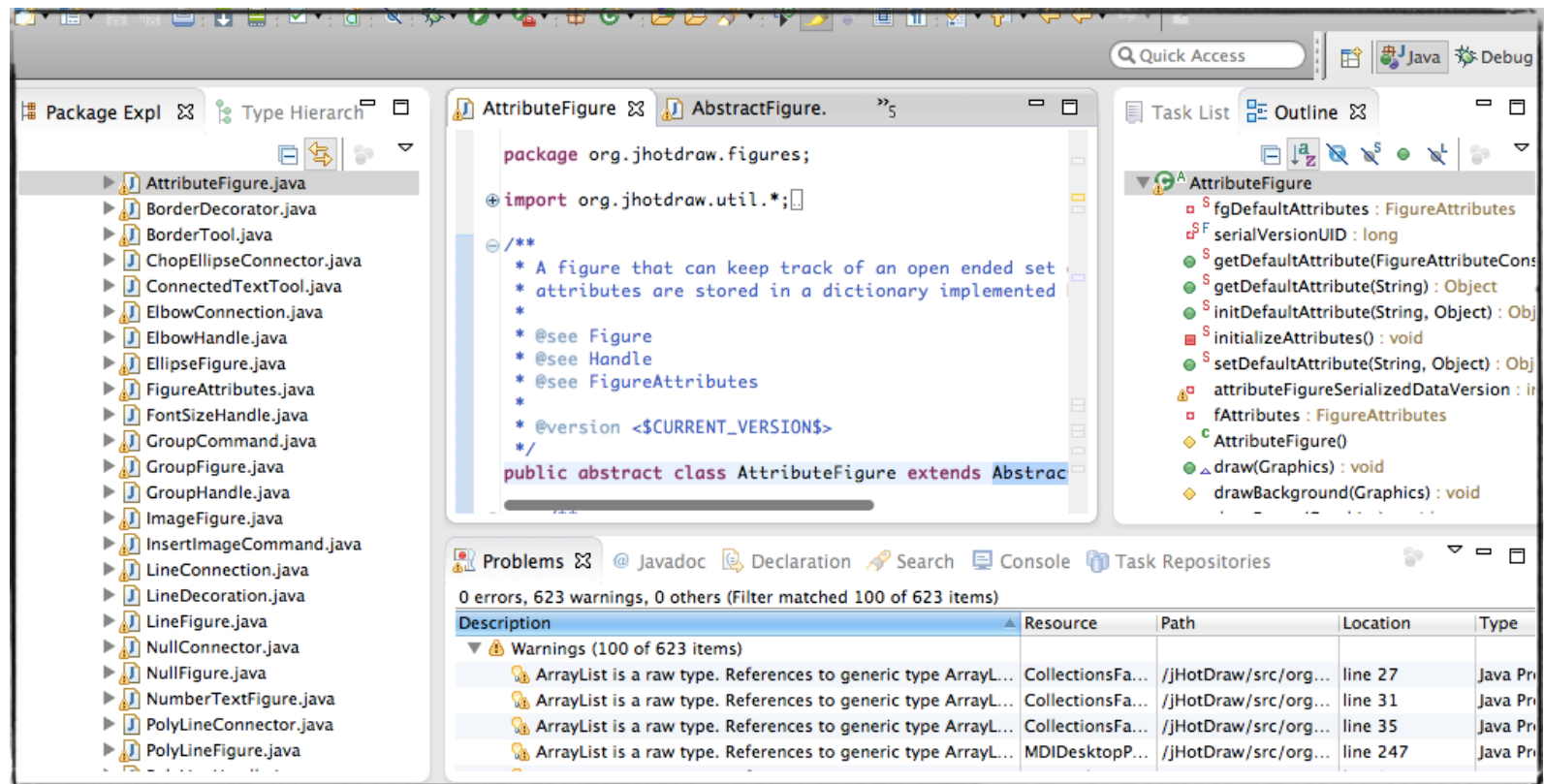




mismatch #1
flat information space



mismatch #2
multiple disconnected information



mismatch #3: information overload



mismatch #4: clickitis over cognition



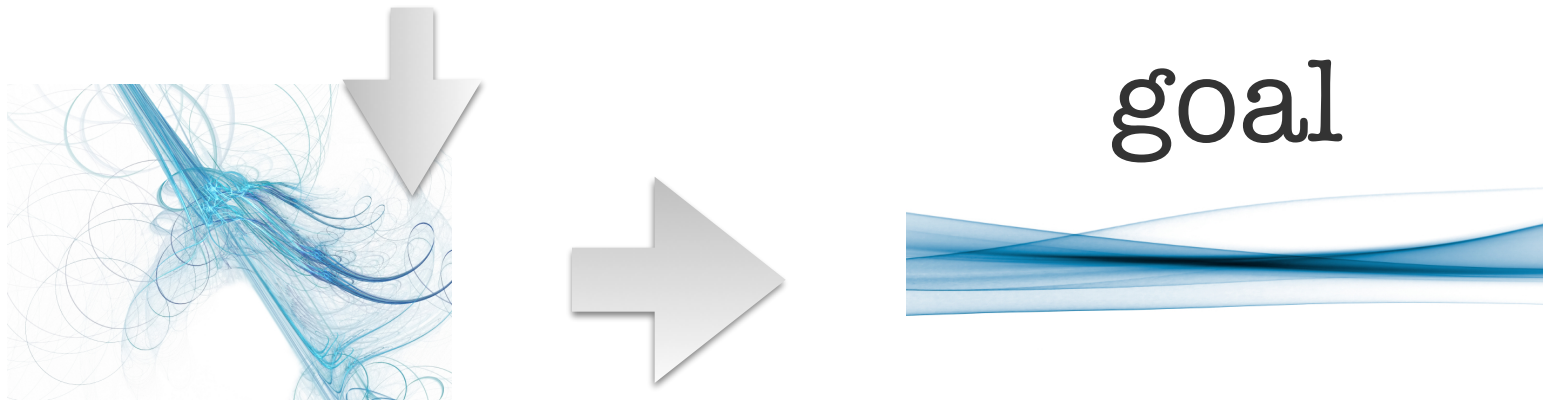
mismatches

#1: flat information space

#2: multiple disconnected information spaces

#3: information overload

#4: clickitis over cognition





an example of
how it could be

approaches and tools that
address the mismatches

Java - set the fill colour of a figure - Eclipse - /Users/murphy/Documents/Talks/AWSEC/workspace

Quick Access

Type Hiera

JHOT-9: set the fill colour of a figure

Issue JHOT-9 UBC SPL Submit

set the fill colour of a figure

Status: To Do Created: Apr 2, 2014 Modified: Apr 2, 2014 3:24 PM
Reported by: Gail Murphy Assigned to: Gail Murphy

Attributes

Project: JHotDraw Priority: N
Type: Story Due Date:
Estimate: 0m Time Spent: 0
Affects Versions: Components:
Fix Versions:
Subtasks: JHOT-10
Environment:

Description

As a drawing creator, I need to set the fill colour of a figure on a canvas.

A variety of fill colours must be provided. It should be simple for the drawing crea and from the selected figure, see and choose an appropriate colour.

Private Context JIRA

Task List

Find All Active

Assigned to me (iHotDr

JHOT-9: set the fill co

Assigned to SuperDeve

Reported by me (JHotDr

KeynotePro: Keynote Themes: MagnetBoard for K

Java - set the pen colour of a figure - Eclipse - /Users/murphy/Documents/Talks/AWSEC/workspace

Quick Access

Type Hiera

JHOT-9: set the fill colour

JHOT-5: set the pen colour

Issue JHOT-5 UBC SPL Submit

set the pen colour of a figure

Status: Done Done Created: Apr 2, 2014 Modified: Apr 2, 2014 8:1
Reported by: Gail Murphy Assigned to: Super Developer

Attributes

Project: JHotDraw Priority: M
Estimate: 10m Due Date:
Time Spent:
Fix Versions:
Subtasks: JHOT-6, JHOT-7, JHOT-8
Environment:

Description

As a drawing creator, I want figures to potentially have different colours for their I
A variety of pen colours must be provided. It should be possible to easily see and
There is no need at present for arbitrary colours to be allowed, just a reasonable s

Private Context JIRA

Task List

Find All Acti

Assigned to me (JHotDr

JHOT-9: set the fill co

Assigned to SuperDeve

JHOT-5: set the pen

JHOT-6: add a me

JHOT-7: draw the

JHOT-8: allow set

Reported by me (JHotDr

This completed task is similar and might be helpful



Task List

Find All Activate...

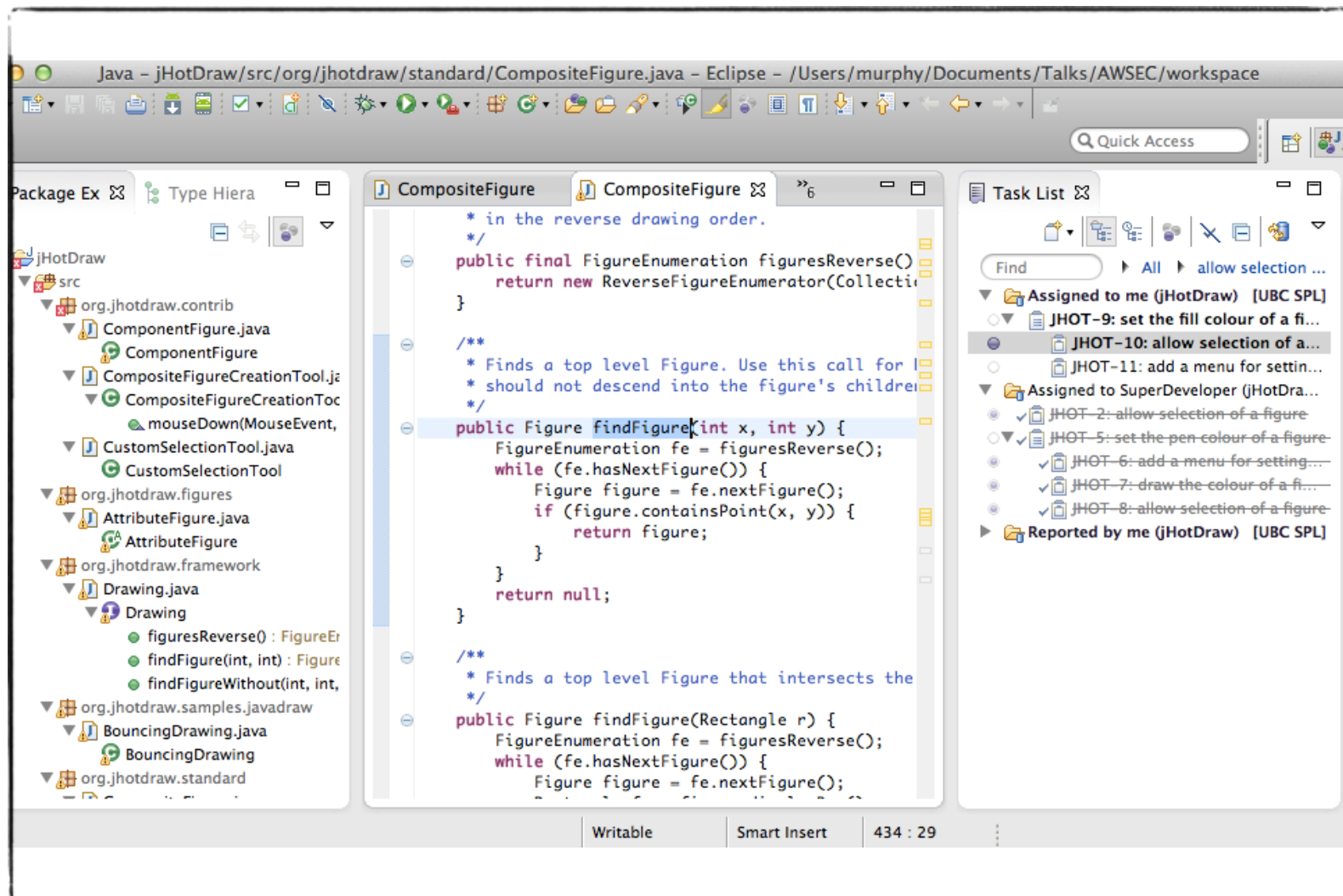
- Assigned to me (JHotDraw) [UBC SPL]
 - JHOT-9: set the fill colour of a figure
 - JHOT-10: allow selection of a figure
 - JHOT-11: add a menu for setting fill colour of a figure
- Assigned to SuperDeveloper (JHotDraw) [UBC SPL]
 - JHOT-2: allow selection of a figure
 - JHOT-5: set the pen colour of a figure
 - JHOT-6: add a...
 - JHOT-7: draw the...
 - JHOT-8: allow selection of a figure**
- Reported by me (JHotDraw) [UBC SPL]

Context menu for JHOT-8:

- New
- Schedule for
- Mark as
- Open
- Open with Browser
- Activate
- Copy Details
- Delete
- Set Category
- Import and Export
- Context**
- Synchronize F5
- Start Work

Sub-menu for Context:

- Attach...
- Retrieve...
- Copy to...**
- Clear



Problems Ferret X

AbstractLayout

Description	Category	#E	C
+ Q declared fields	declaration	10	
+ Q subclasses	inheritance	9	
+ Q superinterfaces	inheritance	3	
+ Q casts to type	inter-class	1	
+ Q fields of type	inter-class	1	
+ Q references to type	inter-class	13	
+ Q fields used	intra-class	14	
+ Q methods called	intra-class	50	
+ Q types referenced	intra-class	25	

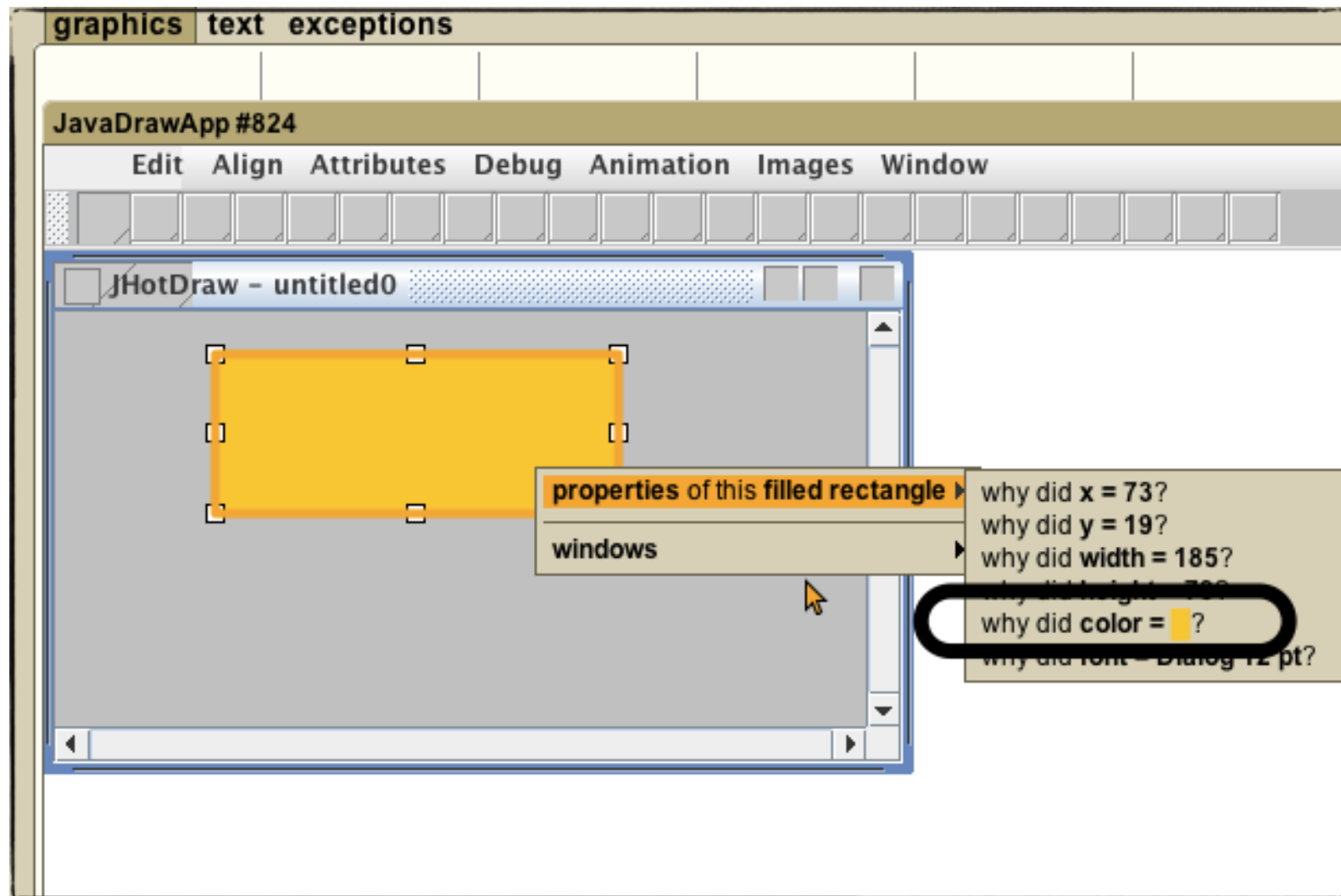
```
/**
 * Draws the figure in the given graphics. Draw
 * drawBackground followed by drawFrame.
 */
public void draw(Graphics g) {
    Color frame = getFrameColor();
    if (!ColorMap.isTransparent(frame)) {
        g.setColor(frame);
        drawFrame(g);
    }
}
```

**why did code
change?**

```
/**
 * Draws the figure in the given graphics. Draw
 * drawBackground followed by drawFrame.
 */
public void draw(Graphics g) {
    Color frame = getFrameColor();
    if (!ColorMap.isTransparent(frame)) {
        g.setColor(frame);
        drawFrame(g);
    }
}
```

**set the pen colour
of a figure. I want
figures to potentially
have ...**

```
/**
 * Draws the figure in the given graphics. Draw
 * drawBackground followed by drawFrame.
 */
public void draw(Graphics g) {
    Color fill = getFillColor();
    if (ColorMap.isTransparent(fill)) {
        g.setColor(fill);
        drawBackground(g);
    }
    Color frame = getFrameColor();
    if (!ColorMap.isTransparent(frame)) {
        g.setColor(frame);
        drawFrame(g);
    }
}
```

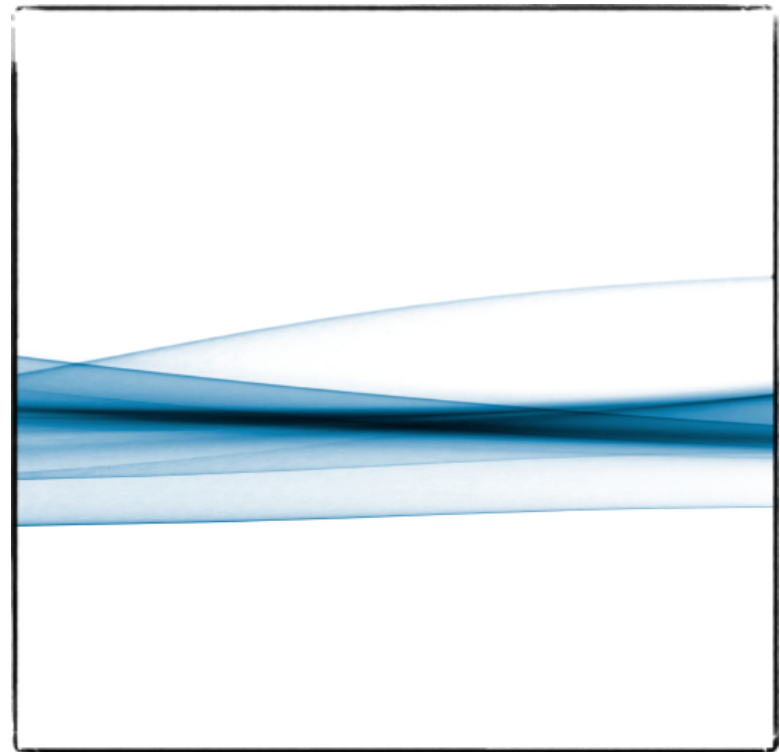


[Ko and Myers, 2008]



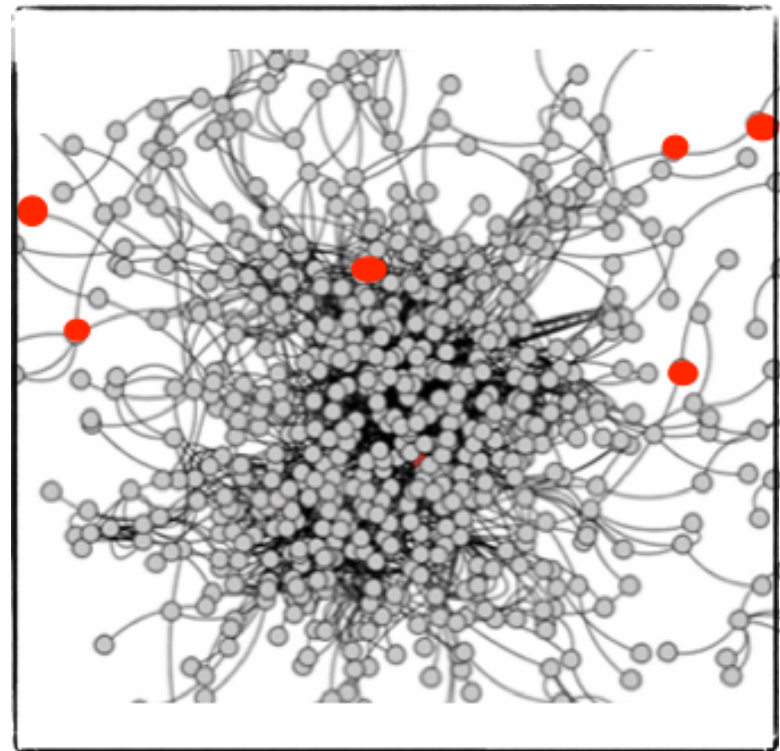
techniques for improved flow

- task context
- recommendations
- dialog
- summarization

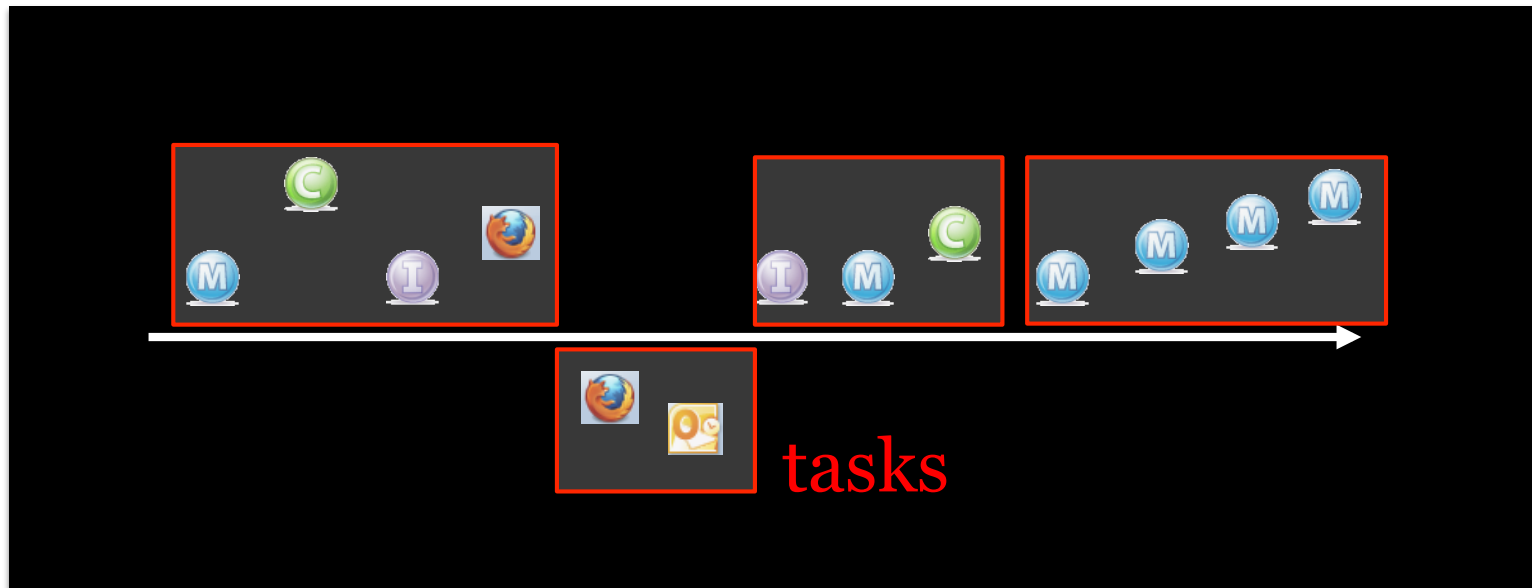


technique #1 of 4: task context

- parts and relationships of artifacts relevant to developer as they work on a task
- different approximations
 - e.g., commits
 - e.g., interaction history (Eclipse Mylyn)

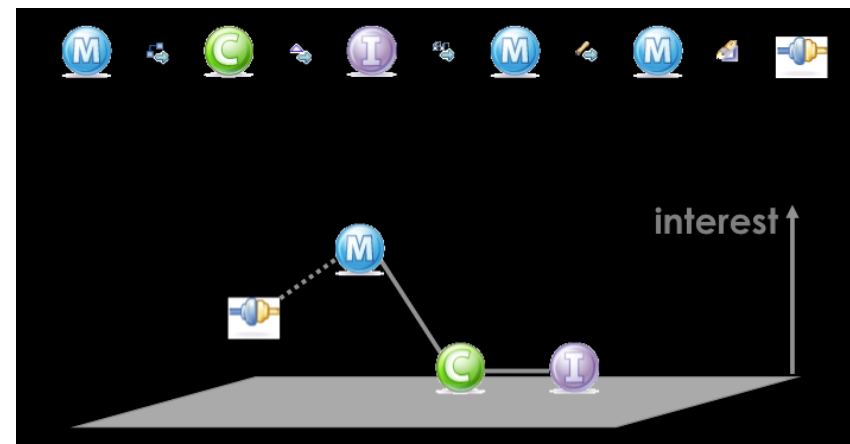


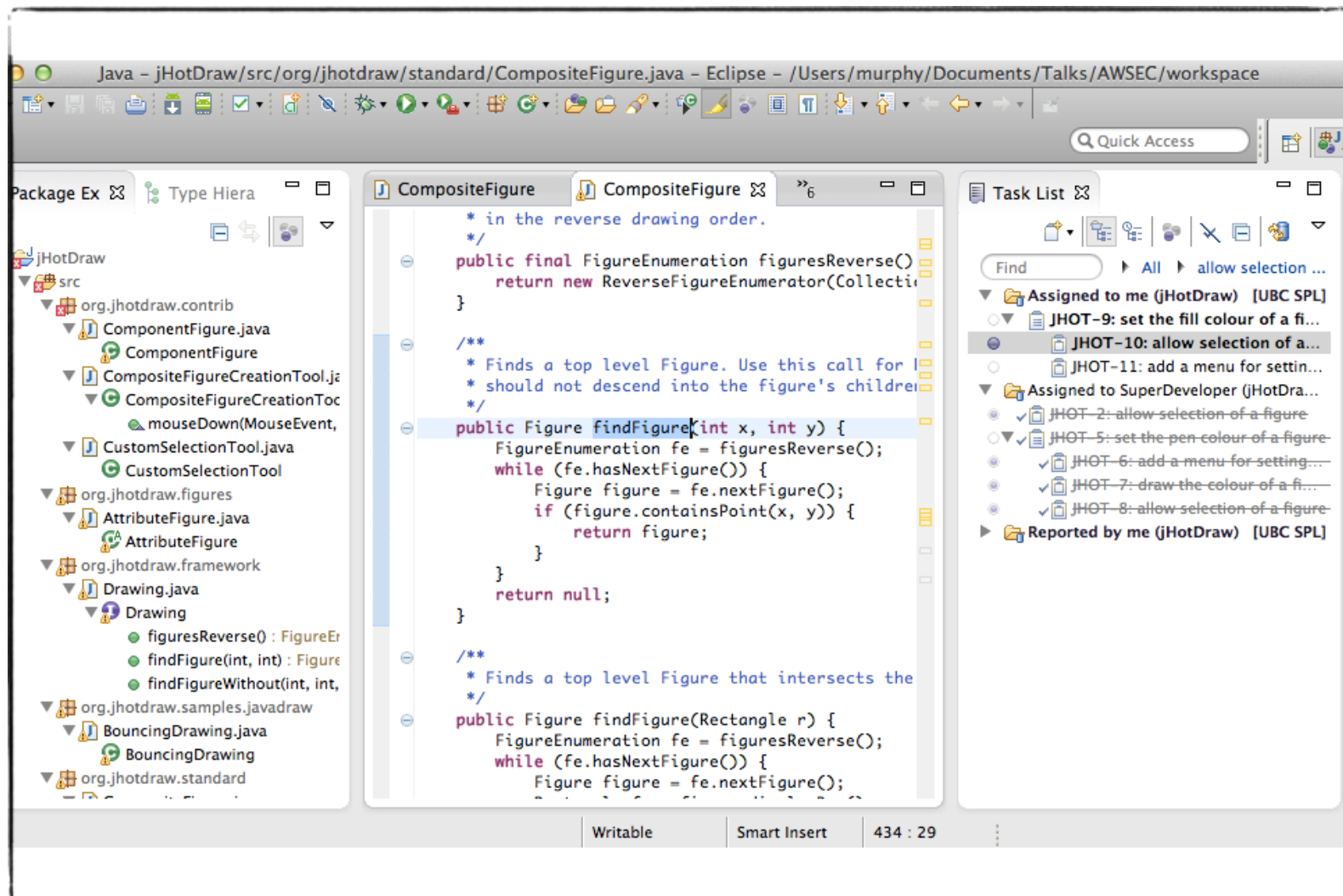
[Kersten & Murphy, 2006]



task context in
Mylyn

[Kersten & Murphy, 2006]







if we have task context...

- have a mapping between “intent” and parts of artifacts
 - can use as a concept mapping
 - can use as basis for recommending artifacts to look at
 - could use to analyze defects based on ‘intent’
- reduce information space shown to the developer
- share work

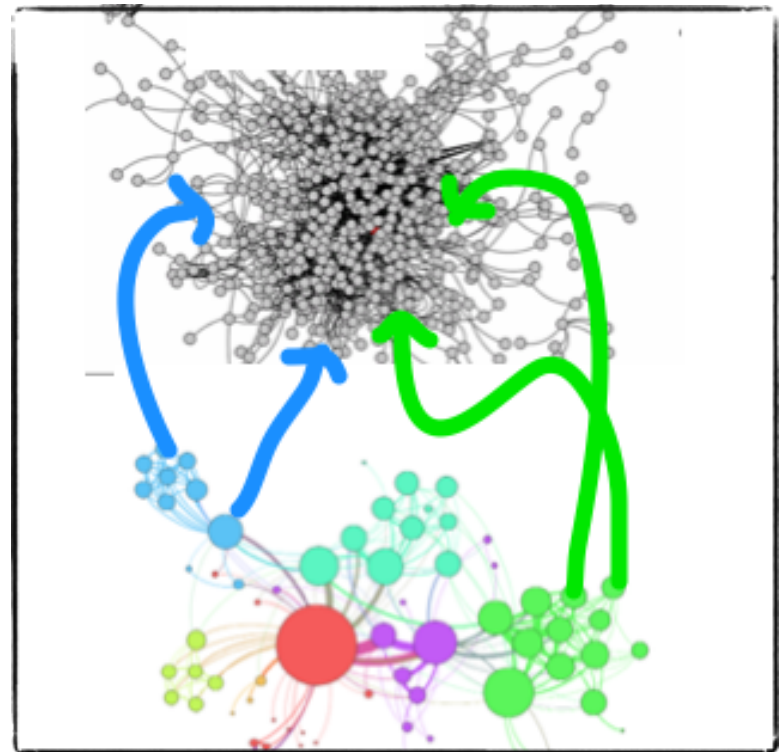


achieving flow with task context...

- capture without requiring work on the part of the developer
- challenge: how to get broader intent?
- challenge: how to get all parts of artefacts worked on or looked at?
- challenge: how to infer task switches automatically?

technique #2 of 4: recommendations

- suggest parts of current or past information spaces that might be helpful for current work
- e.g., text similarity on previously solved bugs [Čubranić & Murphy 2003]
- e.g., where others have navigated from a given point [DeLine et. al. 2005]



Java - set the pen colour of a figure - Eclipse - /Users/murphy/Documents/Talks/AWSEC/workspace

Quick Access

Type Hiera

JHOT-9: set the fill colour

JHOT-5: set the pen colour

Issue JHOT-5 UBC SPL Submit

set the pen colour of a figure

Status: Done Done Created: Apr 2, 2014 Modified: Apr 2, 2014 8:1
Reported by: Gail Murphy Assigned to: Super Developer

Attributes

Project: JHotDraw Priority: M
Estimate: 10m Due Date:
Time Spent:
Fix Versions:
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JHOT-5: set the pen

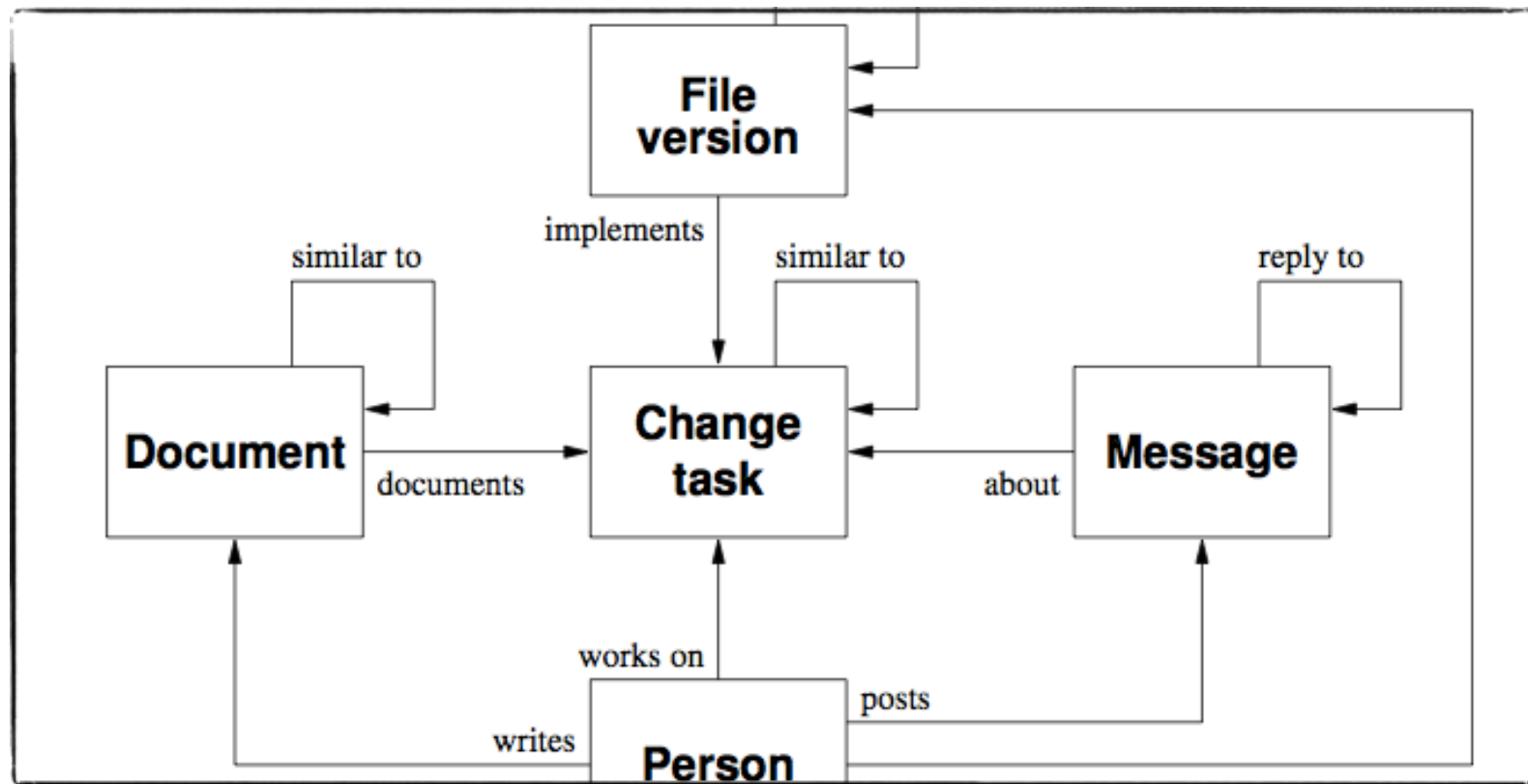
JHOT-6: add a me

JHOT-7: draw the

JHOT-8: allow set

Reported by me (JHotDr

This completed task is similar and might be helpful



recommendations in Hipikat

[Čubranić & Murphy, 2003]



if we have recommendations...

- can eliminate low-level searching and navigating
- can reduce incorrect paths followed
- can help if developer is stuck
- can provide information a developer might miss



achieving flow with recommendations...

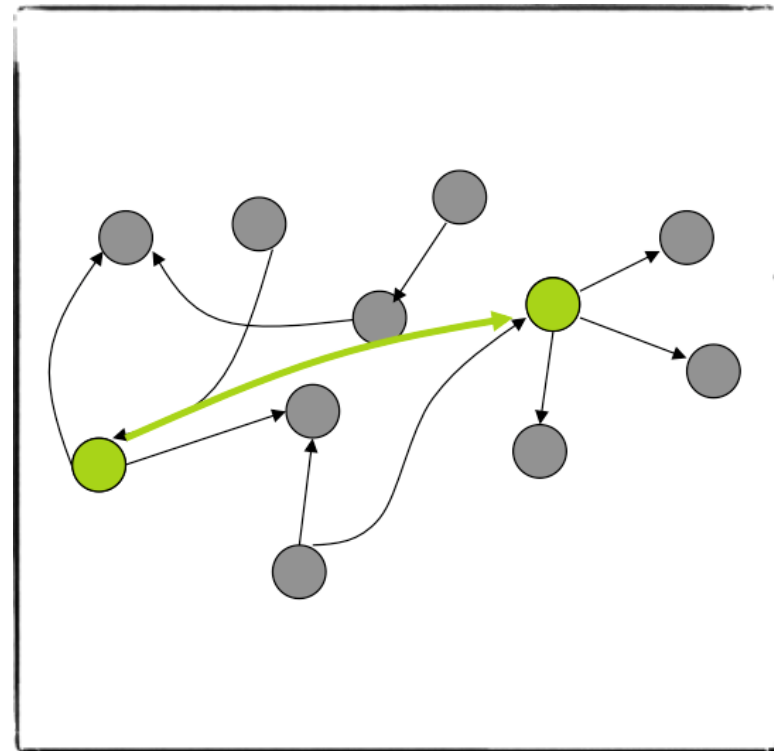
- challenge: appropriate effective user interface delivery

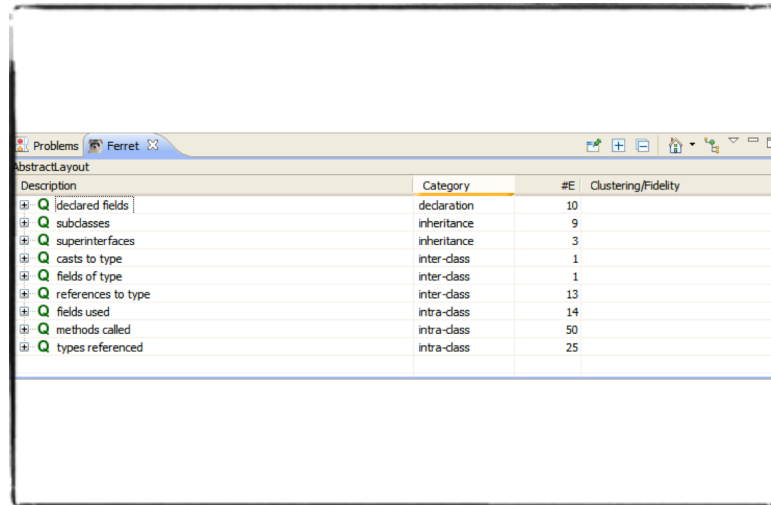


- challenge: what are sufficient precision and recall for various tasks
- challenge: explaining recommendations

technique #3 of 4: dialog

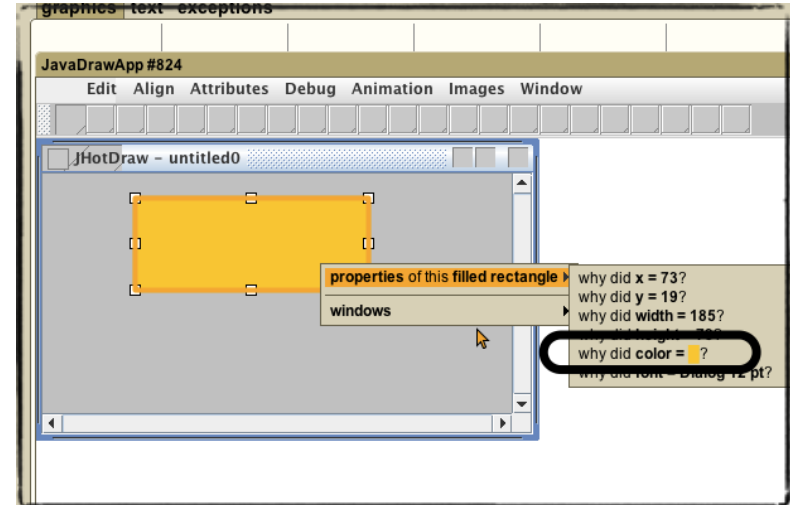
- make units of discourse between developer and interface dialog
- task-specific
 - e.g., Whyline for debugging [Ko & Myers 2004 & 2008]
 - e.g., Ferret for code navigation [de Alwis & Murphy 2008]





Ferret

navigation



Whyline

debugging



if we have dialog...

- can eliminate low-level searching and navigating
- can reduce incorrect paths followed
- may be able to make it easier for broader range of people to program effectively

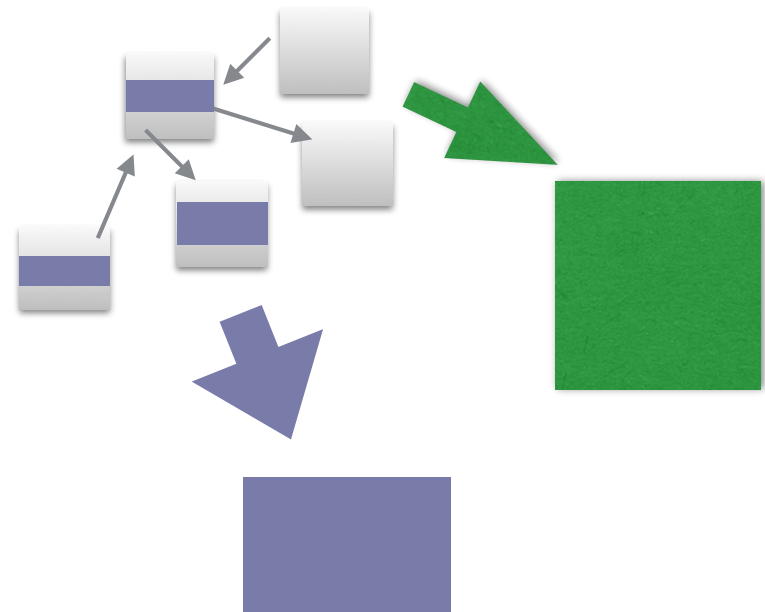


achieving flow with dialog...

- challenge: can we make general approaches for broad task categories?
- challenge: what are appropriate user interaction flows for dialog?
- challenge: what if a question isn't presented that needs to be asked?

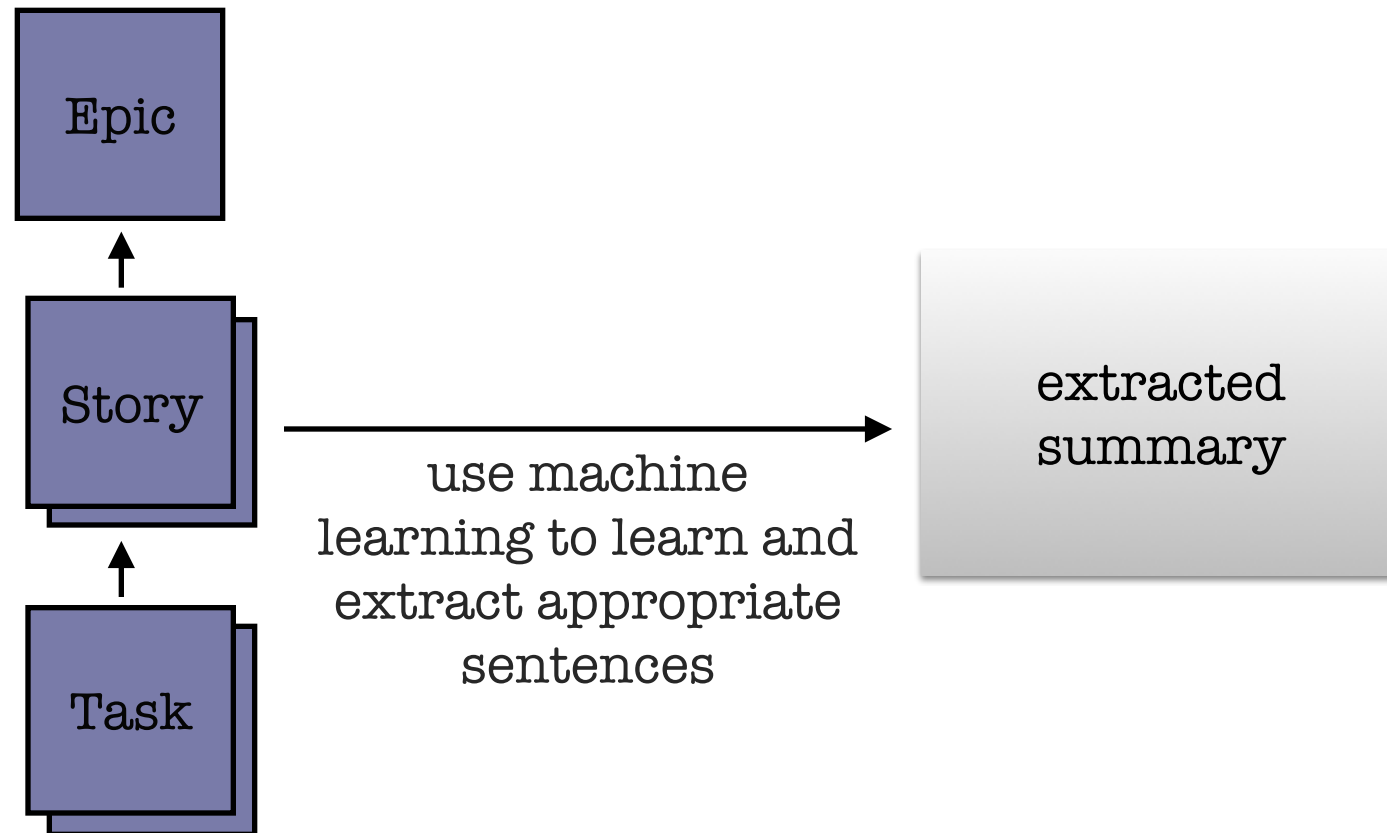
technique #4 of 4: summarization

- present abstracted form of information
- extractive or abstractive
- e.g., bugs [Rastkar & Murphy, 2010, 2013]
- e.g., code [Moreno 2013]



```
/**
 * Draws the figure in the given graphics. Draw
 * drawBackground followed by drawFrame.
 */
public void draw(Graphics g) {
    Color frame = getFrameColor();
    if (!ColorMap.isTransparent(frame)) {
        g.setColor(frame);
        drawFrame(g);
    }
}
```

**set the pen colour
of a figure. I want
figures to potentially
have ...**



bug summarization

[Rastkar & Murphy, 2010 & 2012]



if we have summarization...

- developer can make more informed decisions as timely effective access to information
- can look for similarities and trends at different level of abstraction
- keep developer focused on task by eliminating cognitive switches



achieving flow with summarization

- challenge: what to summarize when?
- challenge: how much intent needs to be known to summarize effectively?
- challenge: how accurate must a summary be not to be mis-leading?



interaction for flow

mismatches

1. flat information space
2. multiple disconnected information spaces
3. information overload
4. clickitis over cognition

interaction types

- **task context**
- **recommendation**
- **dialog**
- **summarization**





what should the
programming tools of
the future look like?

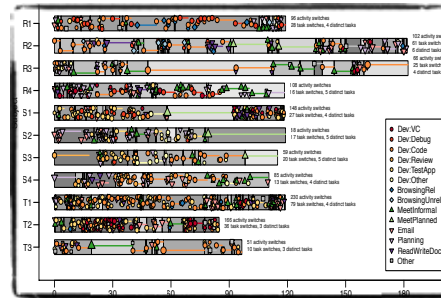
is it enough in research
to produce approaches
that fill information
spaces?



john anvik
elisa baniassad
wesley coelho
davor cubranic
brian de alwis
rob elves
thomas fritz
reid holmes
rahul jiresal
mik kersten
shawn minto
e murphy-hill
jingwen ou
martin robillard
sarah rastkar
nick sawadsky
david shepherd
ducky sherwood
annie ying
robert walker
and many others!



software is
eating the
world



interfaces
need to
support flow

interaction styles that might improve flow

- task context
- recommendation
- dialog
- summarization

what might programming environments look like to make
programming more fun and more inclusive



Gail C. Murphy
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