The Next IDE

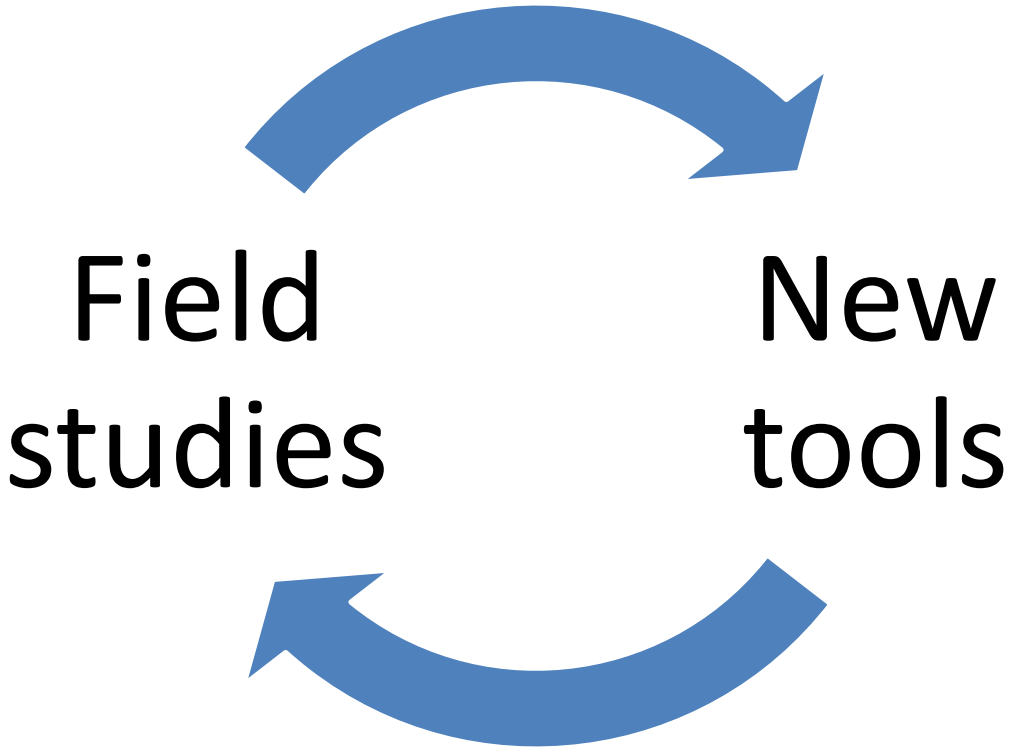
Informative Development Environments

Gina Venolia ▪ Microsoft Research ▪ research.microsoft.com/hip
HCSS 2010

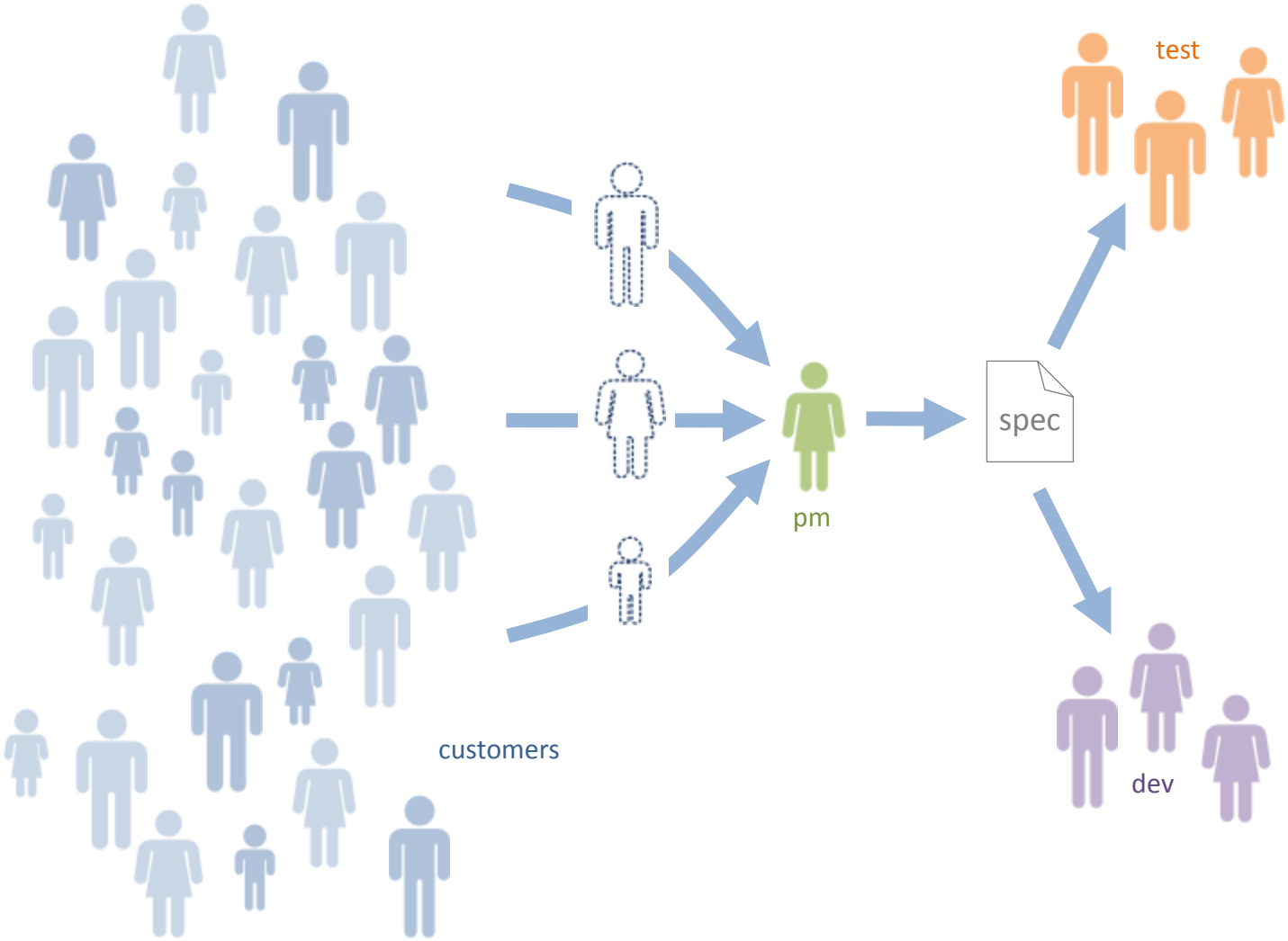
The **Human Interactions in Programming** team studies software engineering…

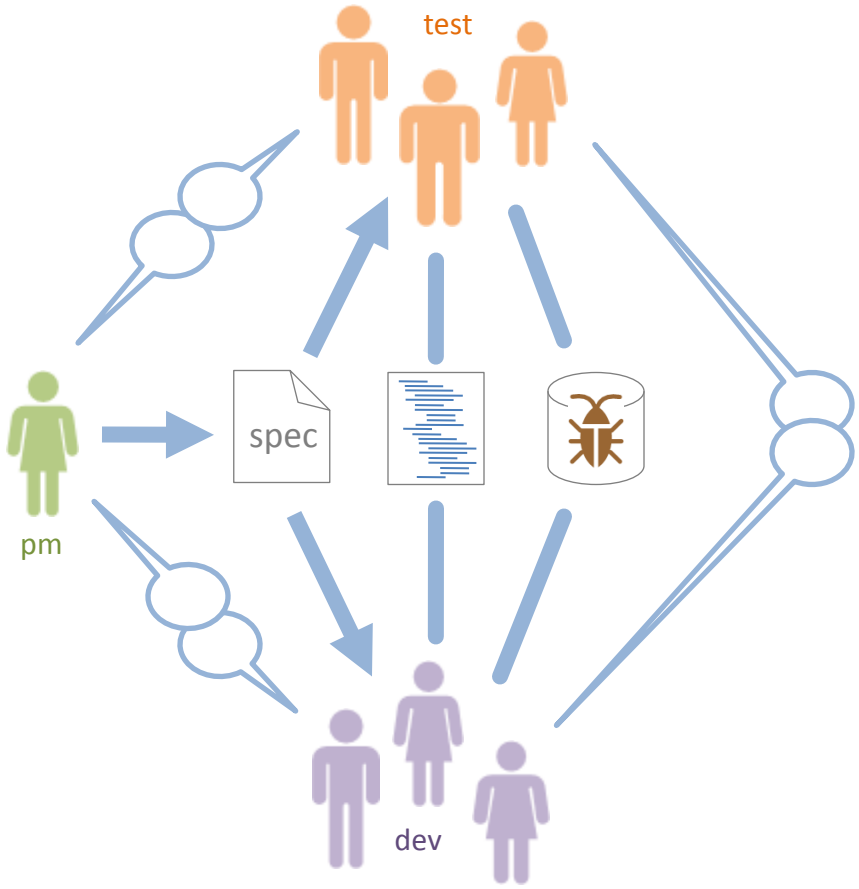
…as if it were done by **people**…

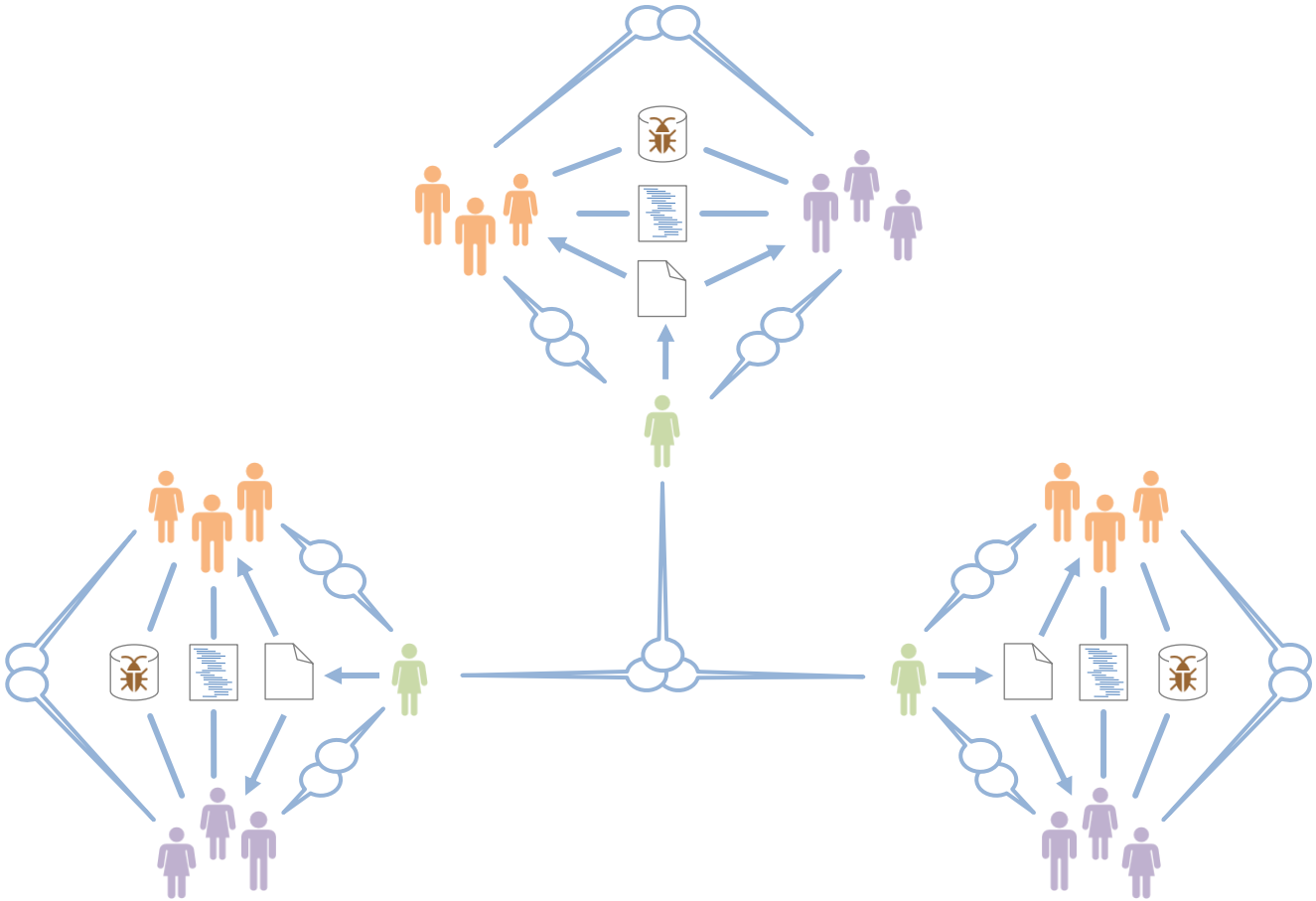
…working **together**.

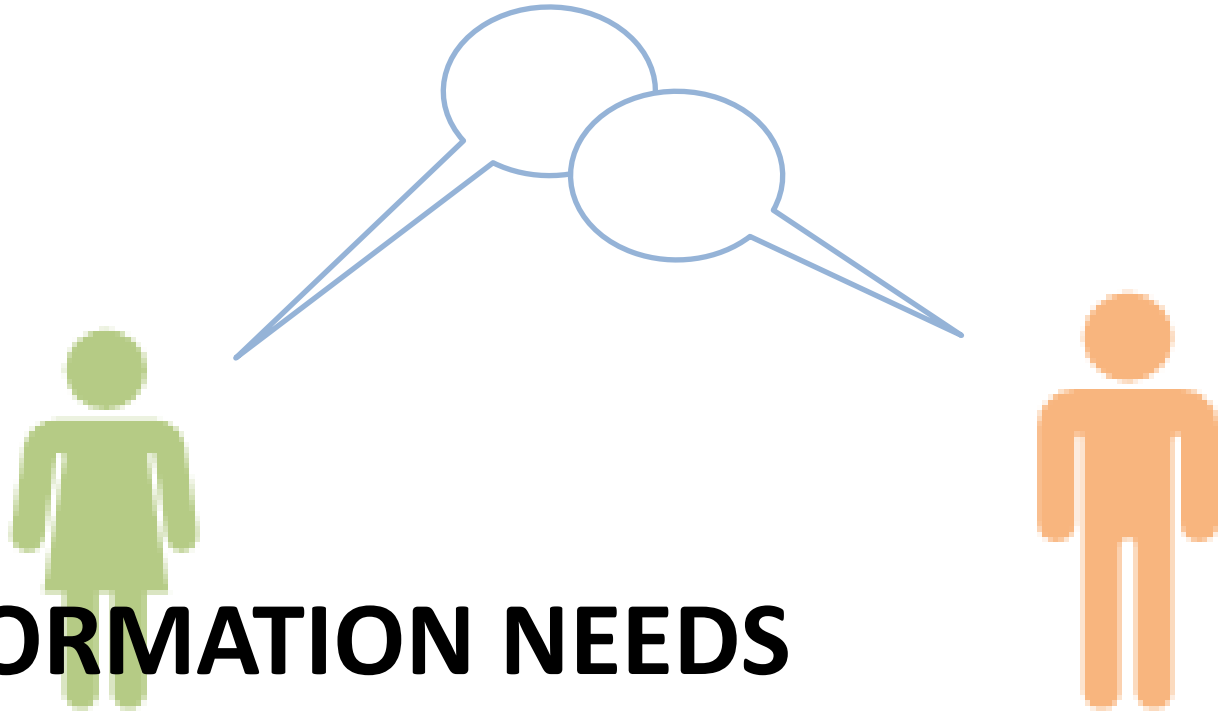

Field studies
New tools

TEAMS AT MICROSOFT

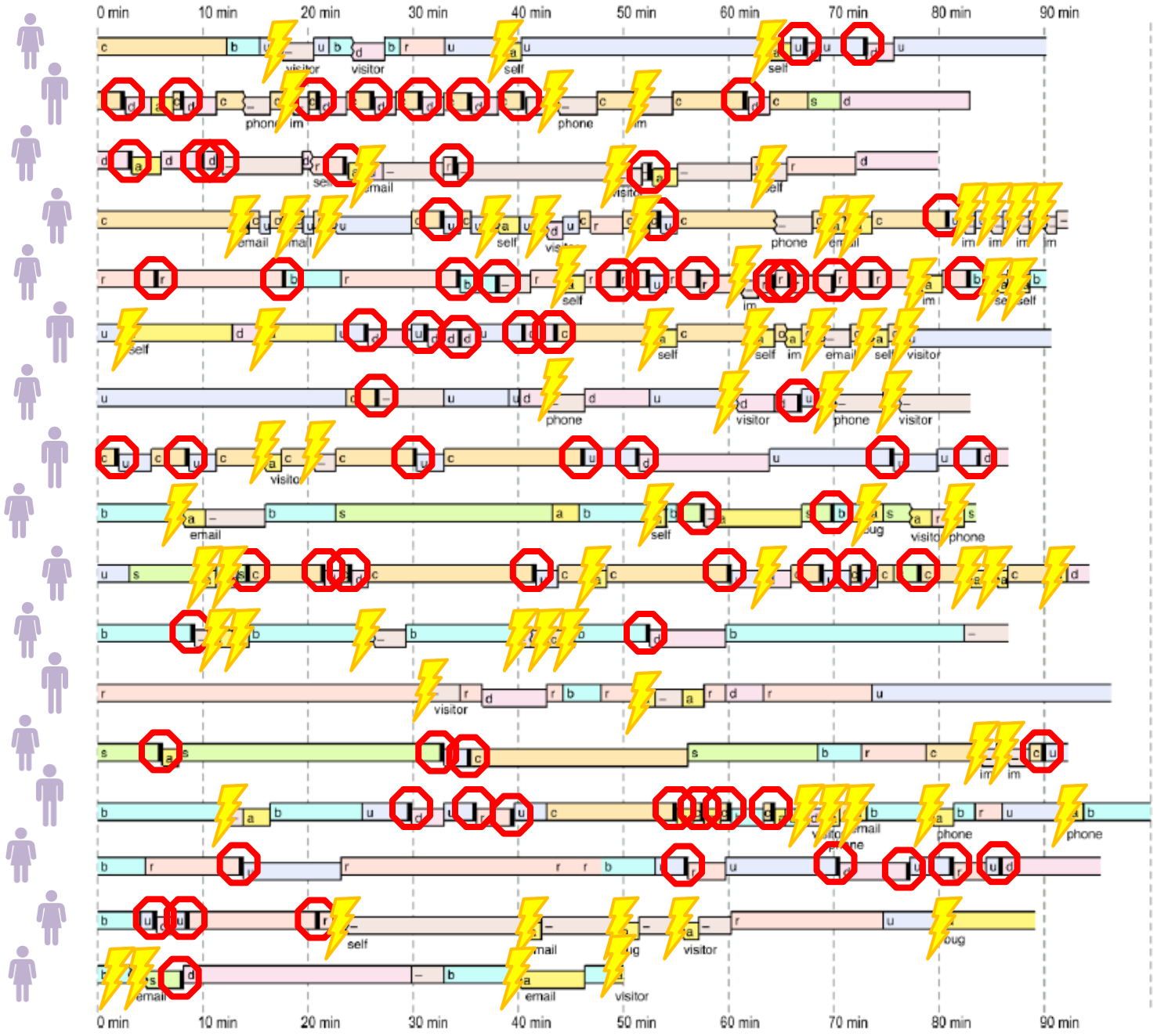

test
spec
pm
customers
dev


test
spec
pm
dev





INFORMATION NEEDS



Ko, DeLine, and Venolia, ICSE 2007

information type

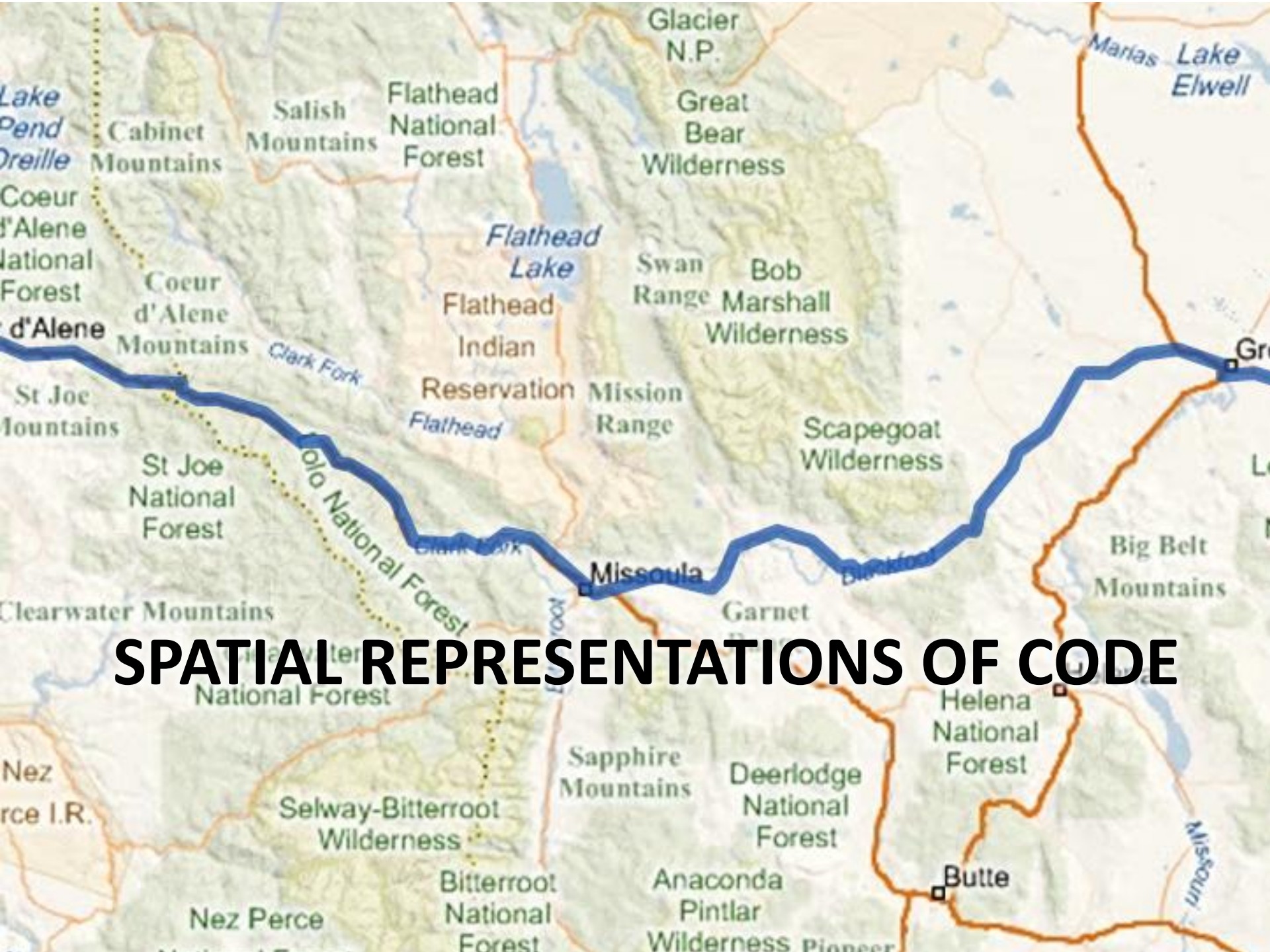
What have my coworkers been doing?
What code caused this program state?
In what situations does this failure occur?
What is the program supposed to do?
How have resources I depend on changed?
What code could have caused this behavior?
How do I used this data structure or function?
Why was this code implemented this way?
Is this problem worth fixing?
What are the implications of this change?
What is the purpose of this code?
What's statically related to this code?
Is this a legitimate problem?
Did I follow my team's conventions?
What does the failure look like?
Which changes are part of this submission?
How can I coordinate this with other code?
How difficult will this problem be to fix?
What can be used to implement this behavior?
What information was relevant to my task?

	coworker	tools	brain	bugs	dbug	code	docs	email	specs	log	im	TOTAL
What have my coworkers been doing?	20	8						13			2	43
What code caused this program state?	1	3	3	3	16	2				3		31
What is the program supposed to do?	9						5	1	13			28
In what situations does this failure occur?	8	3	5	8	2	1						27
How have resources I depend on changed?	6	12		2		1		4				25
What code could have caused this behavior?	5		4	4	2	1			1	4	1	22
How do I used this data structure or function?	4					5	11		1			21
Why was this code implemented this way?	2	2	4	1	2	8						19
Is this problem worth fixing?	12		1	1				2				16
What are the implications of this change?	13									1		14
What is the purpose of this code?		2	5		2	2	1		1			13
What's statically related to this code?		8	2					1				11
Is this a legitimate problem?	1			5						1		7
Did I follow my team's conventions?		2	1				2					5
What does the failure look like?				5								5
Which changes are part of this submission?		2	2									4
How can I coordinate this with other code?	1					1	2					4
How difficult will this problem be to fix?	1			1		1						3
What can be used to implement this behavior?			1				1					2
What information was relevant to my task?			2									2
TOTAL	83	42	30	30	24	22	22	21	16	9	3	**302**
	.27	.14	.10	.10	.08	.07	.07	.07	.05	.03	.01	

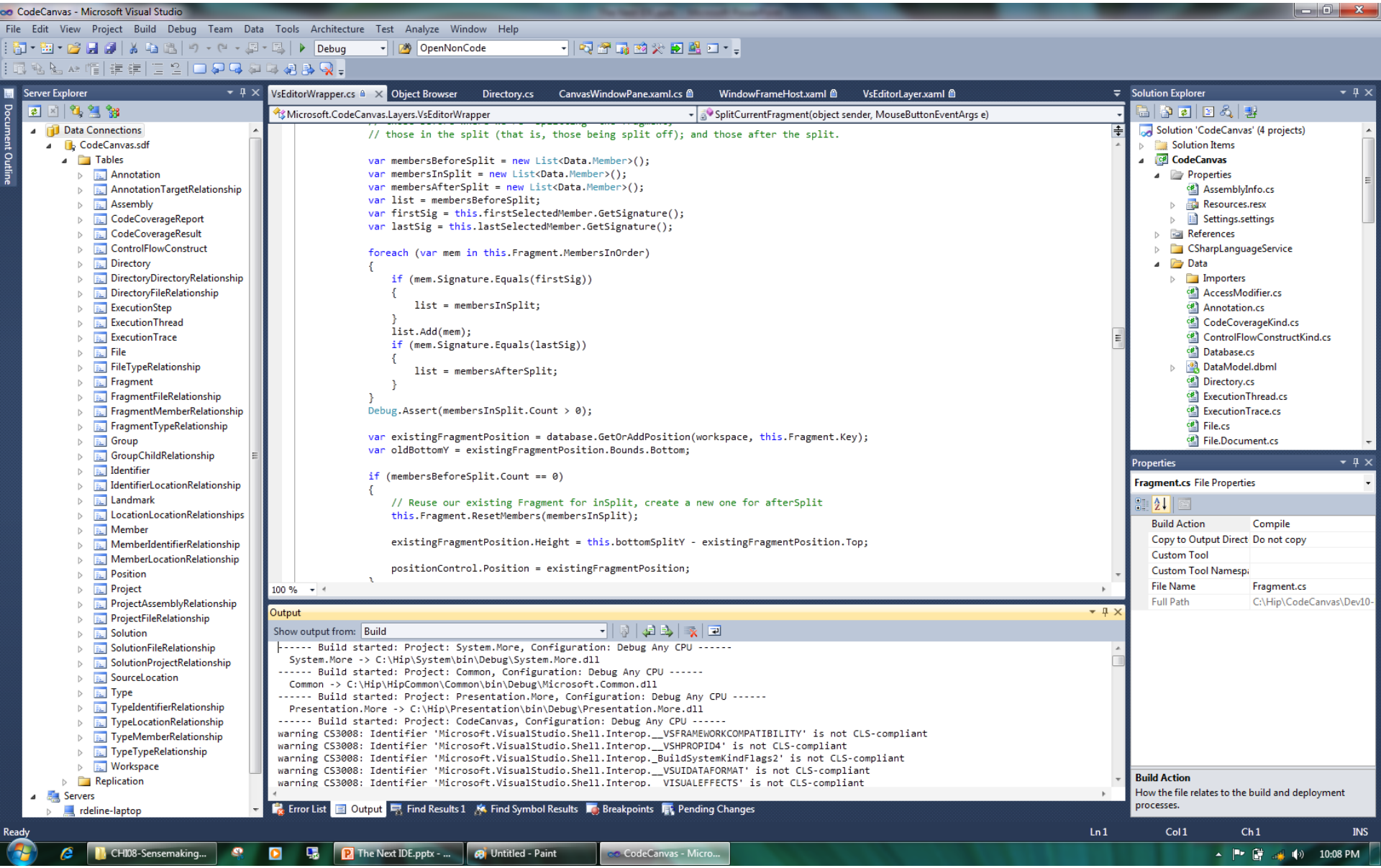
The hall of shame

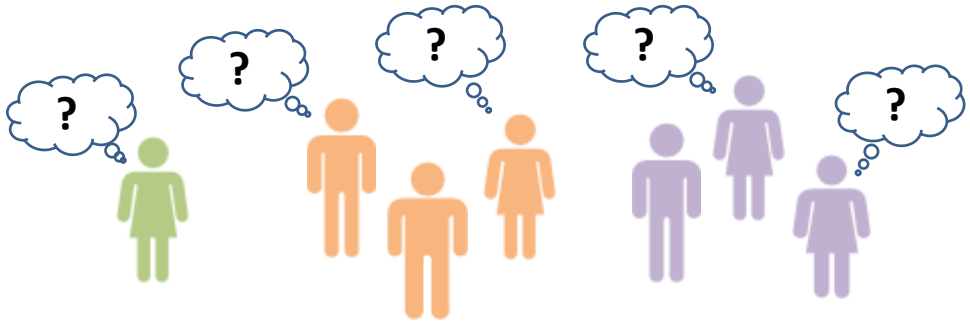
Information Need	Unsuccessful	Max. Time
What code caused this program state? ★	61%	21 min
Why was the code implemented this way?	44%	21 min
In what situations does this failure occur? ★	41%	49 min
What code *could* have caused this behavior? ★	36%	17 min
How have the resources I depend on changed?	24%	9 min
What is the program supposed to do?	15%	21 min
What have my coworkers been doing?	14%	11 min

★ = amenable human-centered analytical tools



SPATIAL REPRESENTATIONS OF CODE


CodeCanvas - Microsoft Visual Studio
File Edit View Project Build Debug Team Data Tools Architecture Test Analyze Window Help
Debug
OpenNonCode
Server Explorer
Data Connections
CodeCanvas.sdf
Tables
Annotation
AnnotationTargetRelationship
Assembly
CodeCoverageReport
CodeCoverageResult
ControlFlowConstruct
Directory
DirectoryDirectoryRelationship
DirectoryFileRelationship
ExecutionStep
ExecutionThread
ExecutionTrace
File
FileTypeRelationship
Fragment
FragmentFileRelationship
FragmentMemberRelationship
FragmentTypeRelationship
Group
GroupChildRelationship
Identifier
IdentifierLocationRelationship
Landmark
LocationLocationRelationships
Member
MemberIdentifierRelationship
MemberLocationRelationship
Position
Project
ProjectAssemblyRelationship
ProjectFileRelationship
Solution
SolutionFileRelationship
SolutionProjectRelationship
SourceLocation
Type
TypeIdentifierRelationship
TypeLocationRelationship
TypeMemberRelationship
TypeTypeRelationship
Workspace
Replication
Servers
rdeline-laptop
VsEditorWrapper.cs
Object Browser
Directory.cs
CanvasWindowPane.xaml.cs
WindowFrameHost.xaml
VsEditorLayer.xaml
Microsoft.CodeCanvas.Layers.VsEditorWrapper
SplitCurrentFragment(object sender, MouseButtonEventArgs e)
// those in the split (that is, those being split off); and those after the split.
var membersBeforeSplit = new List<Data.Member>();
var membersInSplit = new List<Data.Member>();
var membersAfterSplit = new List<Data.Member>();
var list = membersBeforeSplit;
var firstSig = this.firstSelectedMember.GetSignature();
var lastSig = this.lastSelectedMember.GetSignature();
foreach (var mem in this.Fragment.MembersInOrder)
{
if (mem.Signature.Equals(firstSig))
{
list = membersInSplit;
}
list.Add(mem);
if (mem.Signature.Equals(lastSig))
{
list = membersAfterSplit;
}
}
Debug.Assert(membersInSplit.Count > 0);
var existingFragmentPosition = database.GetOrAddPosition(workspace, this.Fragment.Key);
var oldBottomY = existingFragmentPosition.Bounds.Bottom;
if (membersBeforeSplit.Count == 0)
{
// Reuse our existing Fragment for inSplit, create a new one for afterSplit
this.Fragment.ResetMembers(membersInSplit);
existingFragmentPosition.Height = this.bottomSplitY - existingFragmentPosition.Top;
positionControl.Position = existingFragmentPosition;
100 %
Output
Show output from: Build
------ Build started: Project: System.More, Configuration: Debug Any CPU ------
System.More -> C:\Hip\System\bin\Debug\System.More.dll
------ Build started: Project: Common, Configuration: Debug Any CPU ------
Common -> C:\Hip\HipCommon\Common\bin\Debug\Microsoft.Common.dll
------ Build started: Project: Presentation.More, Configuration: Debug Any CPU ------
Presentation.More -> C:\Hip\Presentation\bin\Debug\Presentation.More.dll
------ Build started: Project: CodeCanvas, Configuration: Debug Any CPU ------
warning CS3008: Identifier 'Microsoft.VisualStudio.Shell.Interop.__VSFRAMEWORKCOMPATIBILITY' is not CLS-compliant
warning CS3008: Identifier 'Microsoft.VisualStudio.Shell.Interop.__VSHPROPID4' is not CLS-compliant
warning CS3008: Identifier 'Microsoft.VisualStudio.Shell.Interop._BuildSystemKindFlags2' is not CLS-compliant
warning CS3008: Identifier 'Microsoft.VisualStudio.Shell.Interop.__VSUIDATAFORMAT' is not CLS-compliant
warning CS3008: Identifier 'Microsoft.VisualStudio.Shell.Interop.__VISUALEFFECTS' is not CLS-compliant
Error List
Output
Find Results 1
Find Symbol Results
Breakpoints
Pending Changes
Solution Explorer
Solution 'CodeCanvas' (4 projects)
Solution Items
CodeCanvas
Properties
AssemblyInfo.cs
Resources.resx
Settings.settings
References
CSharpLanguageService
Data
Importers
AccessModifier.cs
Annotation.cs
CodeCoverageKind.cs
ControlFlowConstructKind.cs
Database.cs
DataModel.dbml
Directory.cs
ExecutionThread.cs
ExecutionTrace.cs
File.cs
File.Document.cs
Properties
Fragment.cs File Properties
Build Action Compile
Copy to Output Direct Do not copy
Custom Tool
Custom Tool Namespa
File Name Fragment.cs
Full Path C:\Hip\CodeCanvas\Dev10-
Build Action
How the file relates to the build and deployment processes.
Ready
Ln 1
Col 1
Ch 1
INS
CHI08-Sensemaking...
The Next IDE.pptx - ...
Untitled - Paint
CodeCanvas - Micro...
10:08 PM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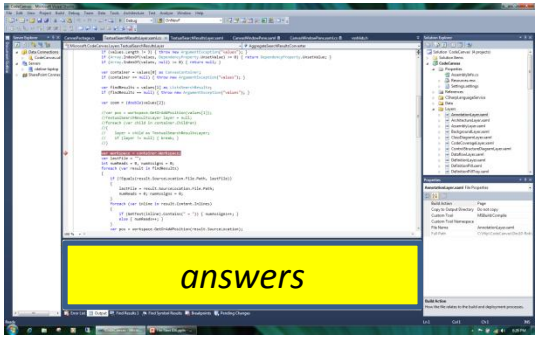
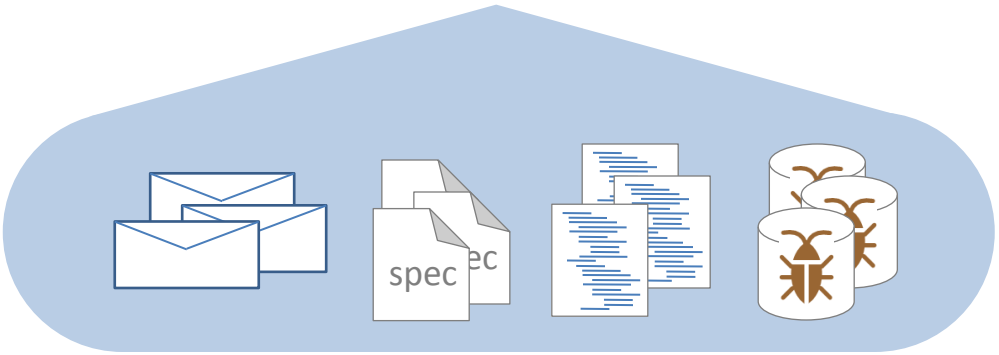
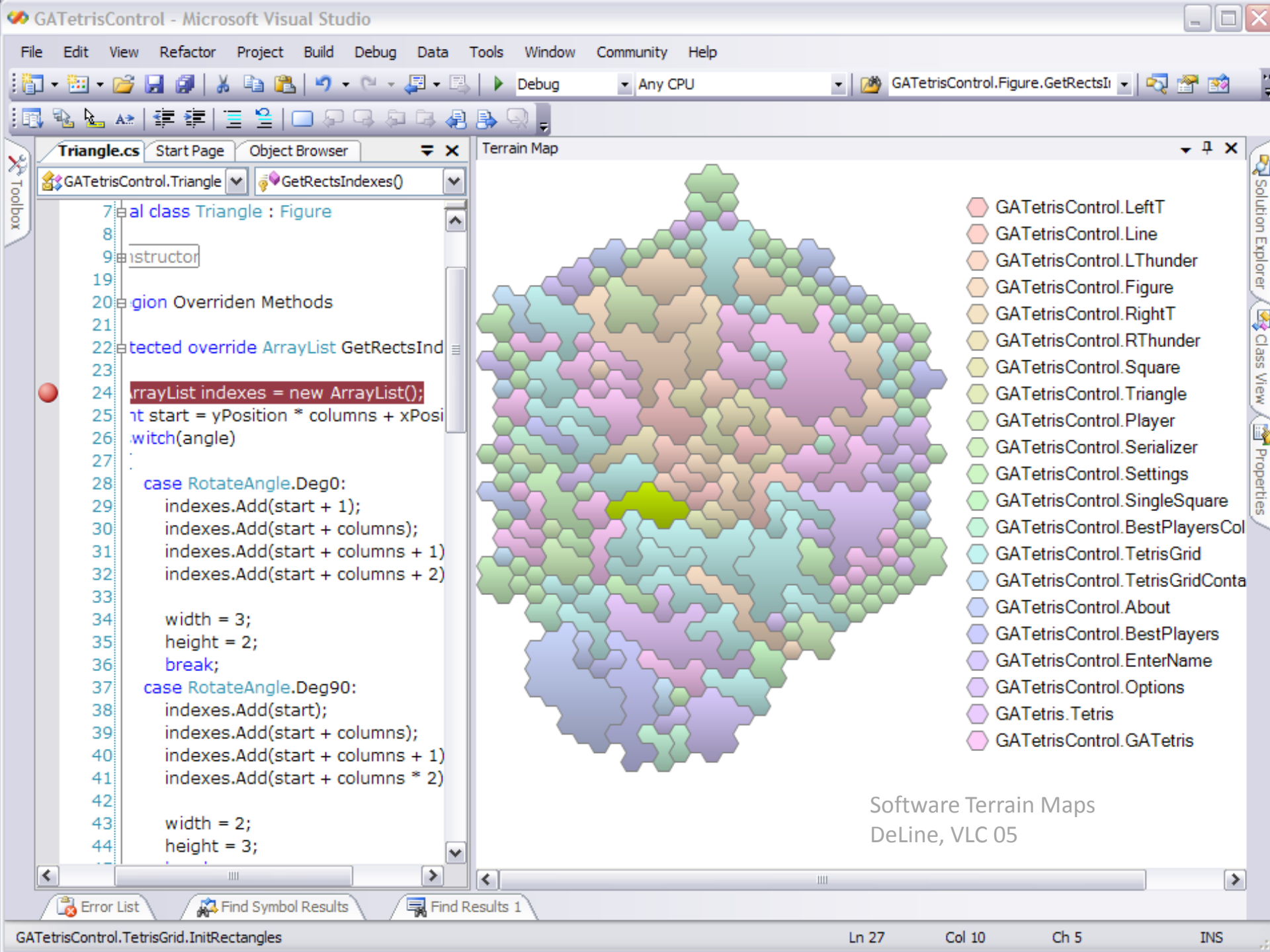
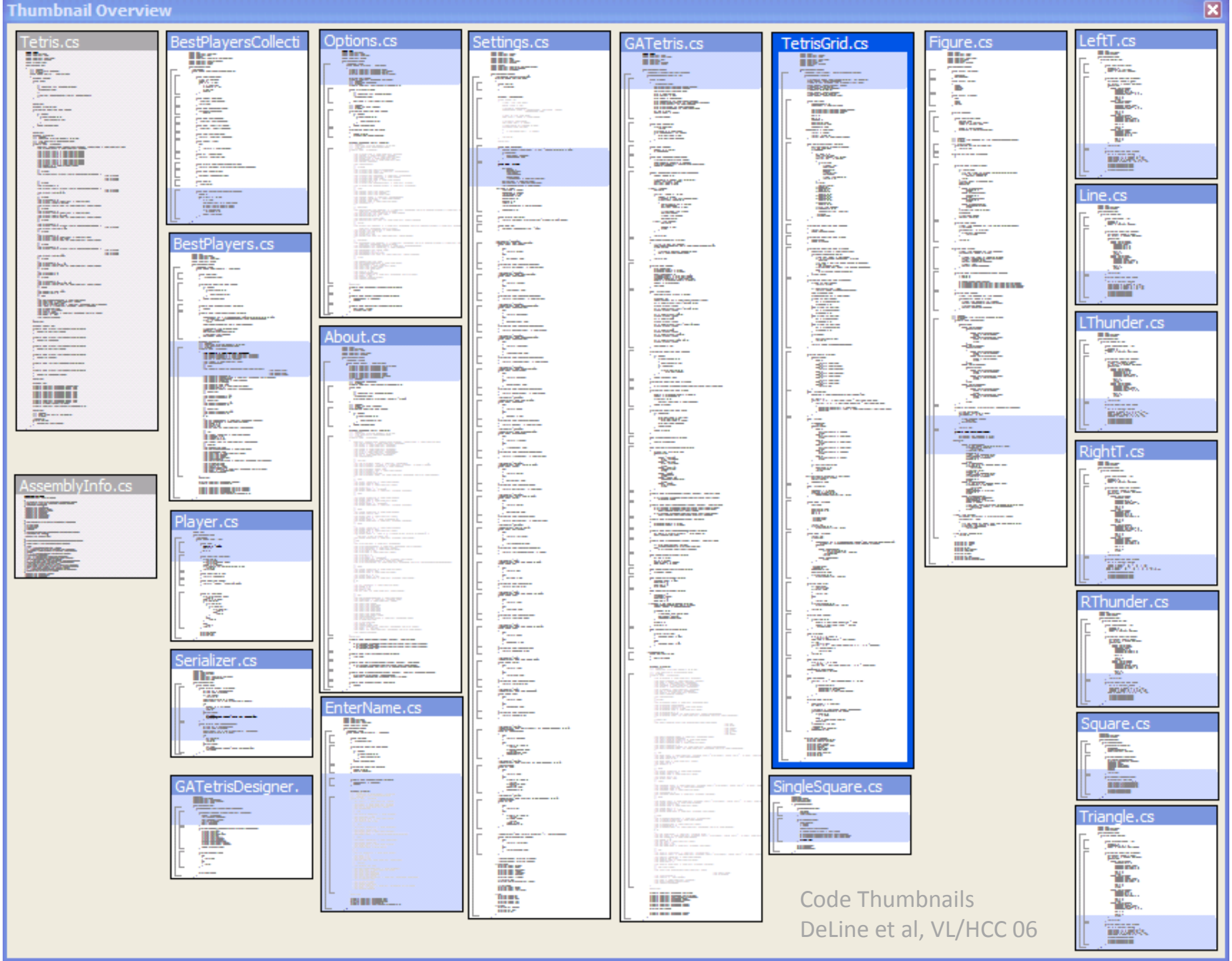
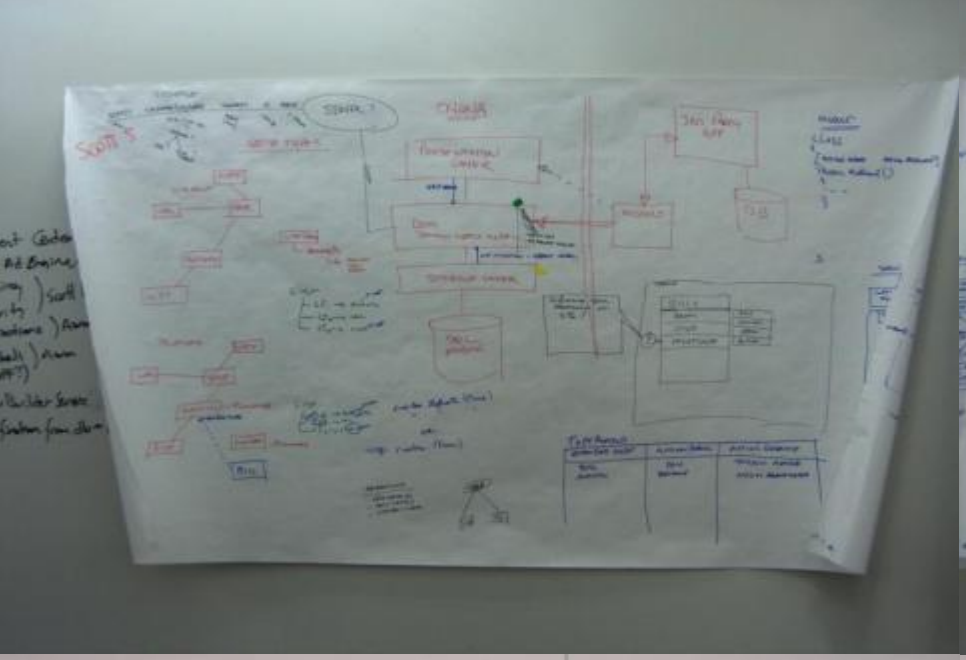
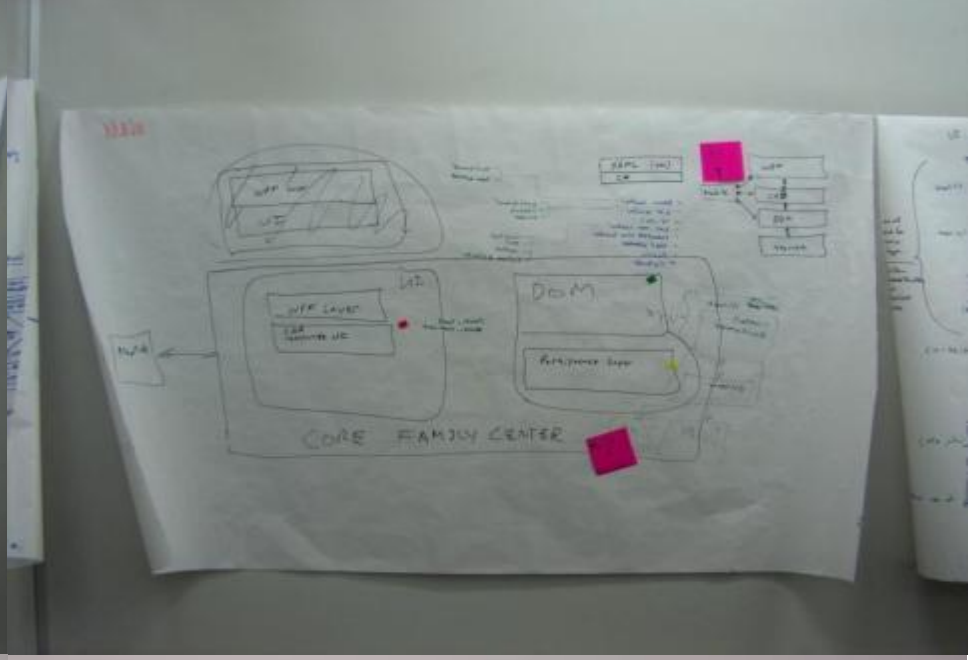

answers

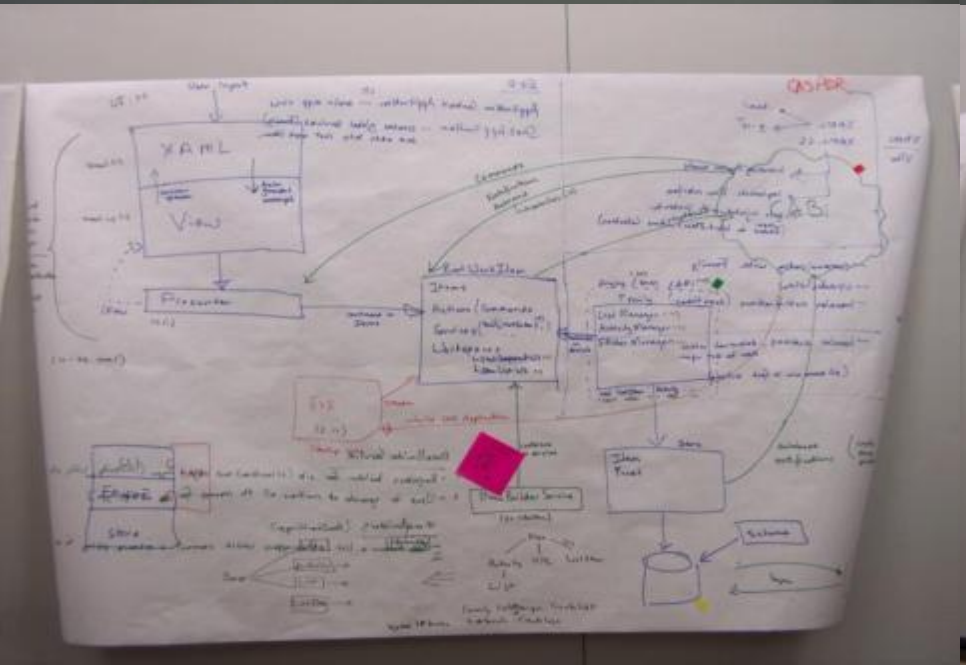

spec

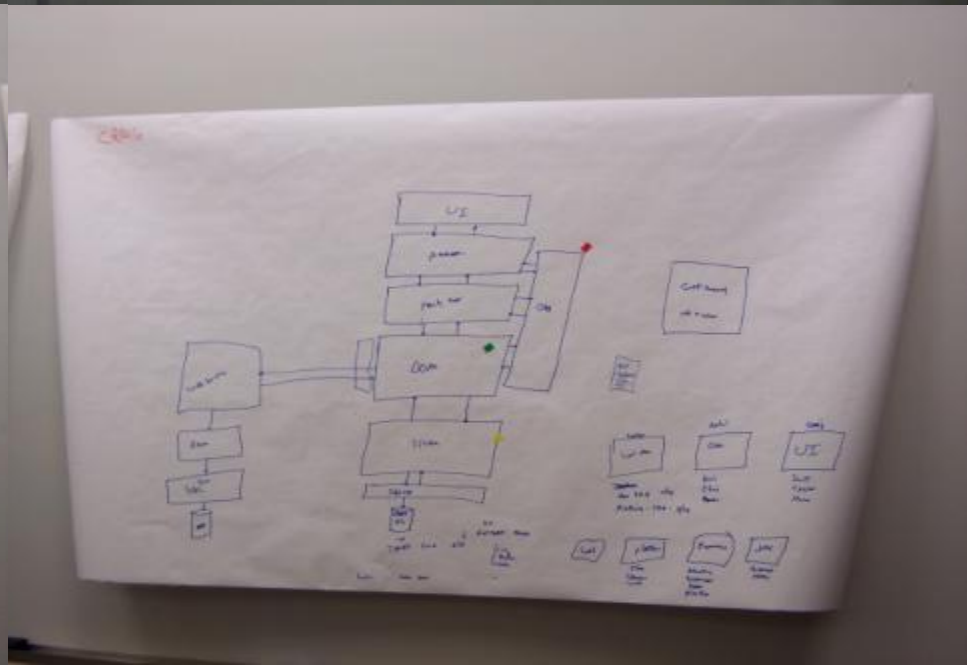

GATetrisControl - Microsoft Visual Studio
File Edit View Refactor Project Build Debug Data Tools Window Community Help
Debug
Any CPU
GATetrisControl.Figure.GetRectsIn
Triangle.cs
Start Page
Object Browser
GATetrisControl.Triangle
GetRectsIndexes()
al class Triangle : Figure
nstructor
gion Overriden Methods
tected override ArrayList GetRectsInd
rrayList indexes = new ArrayList();
nt start = yPosition * columns + xPosi
witch(angle)
case RotateAngle.Deg0:
indexes.Add(start + 1);
indexes.Add(start + columns);
indexes.Add(start + columns + 1)
indexes.Add(start + columns + 2)
width = 3;
height = 2;
break;
case RotateAngle.Deg90:
indexes.Add(start);
indexes.Add(start + columns);
indexes.Add(start + columns + 1)
indexes.Add(start + columns * 2)
width = 2;
height = 3;
Terrain Map
GATetrisControl.LeftT
GATetrisControl.Line
GATetrisControl.LThunder
GATetrisControl.Figure
GATetrisControl.RightT
GATetrisControl.RThunder
GATetrisControl.Square
GATetrisControl.Triangle
GATetrisControl.Player
GATetrisControl.Serializer
GATetrisControl.Settings
GATetrisControl.SingleSquare
GATetrisControl.BestPlayersCol
GATetrisControl.TetrisGrid
GATetrisControl.TetrisGridConta
GATetrisControl.About
GATetrisControl.BestPlayers
GATetrisControl.EnterName
GATetrisControl.Options
GATetris.Tetris
GATetrisControl.GATetris
Software Terrain Maps
DeLine, VLC 05
Error List
Find Symbol Results
Find Results 1
GATetrisControl.TetrisGrid.InitRectangles
Ln 27
Col 10
Ch 5
INS


Thumbnail Overview
Tetris.cs
BestPlayersCollecti
Options.cs
Settings.cs
GATetris.cs
TetrisGrid.cs
Figure.cs
LeftT.cs
BestPlayers.cs
About.cs
Line.cs
LThunder.cs
AssemblyInfo.cs
Player.cs
RightT.cs
Serializer.cs
EnterName.cs
RThunder.cs
Square.cs
GATetrisDesigner.
SingleSquare.cs
Triangle.cs
Code Thumbnails
DeLine et al, VL/HCC 06

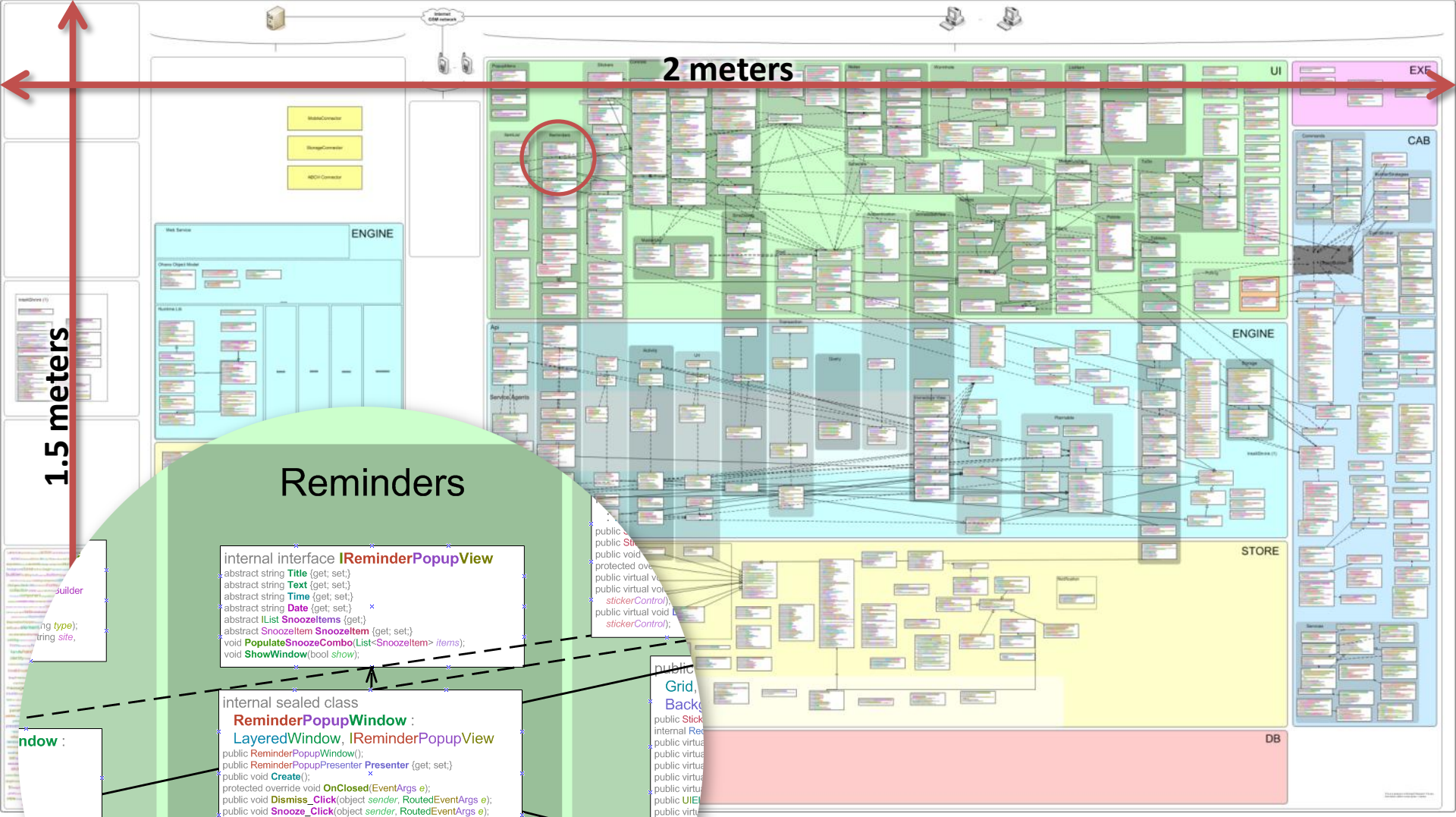




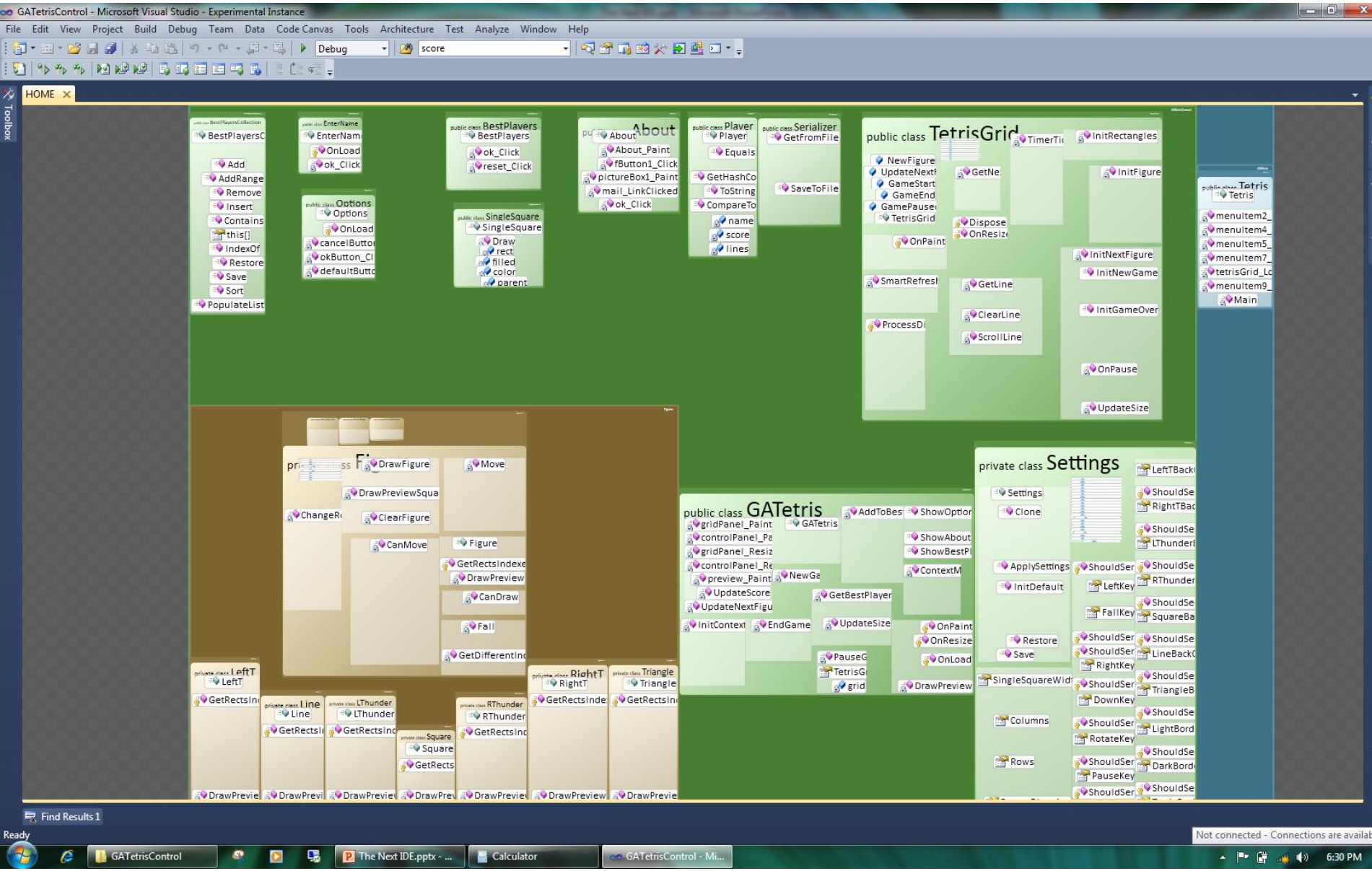




Code Map
Cherubini, Venolia, DeLine, VL/HCC 07



Code Map
Cherubini, Venolia, DeLine, VL/HCC 07



Code Canvas
DeLine and Rowan, ICSE 2010

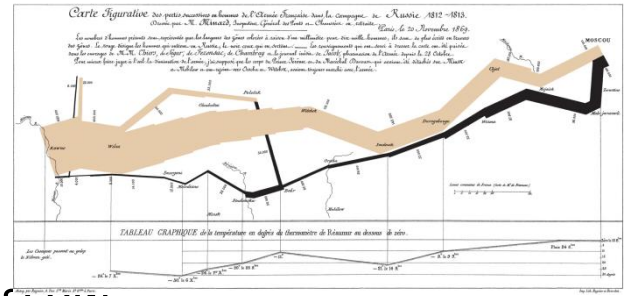
Future Visualizations

Check-in history with pop-up diffs

Code churn heat map

Watson crash reports

- heat map of last stack frame
- collected stacks à la Napoleon's march on Moscow

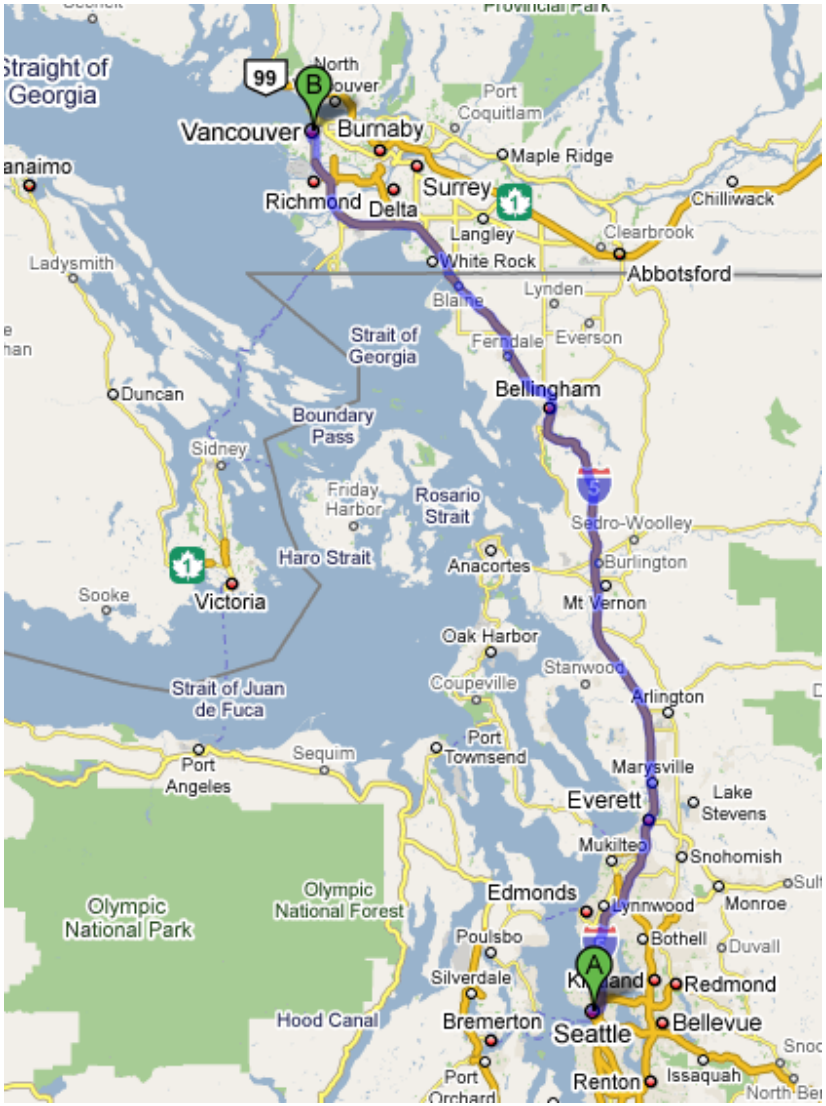


Execution traces

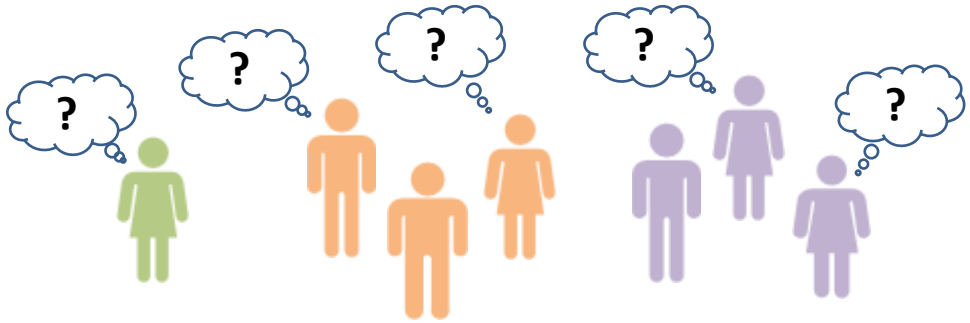
Team awareness: code check-outs

Annotations: text, images, screenshots

Execution Route Finder



CHALLENGES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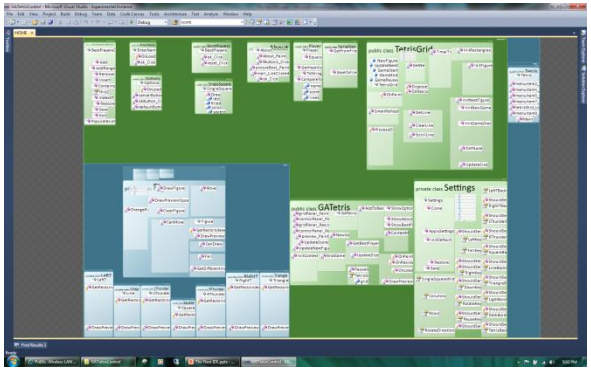

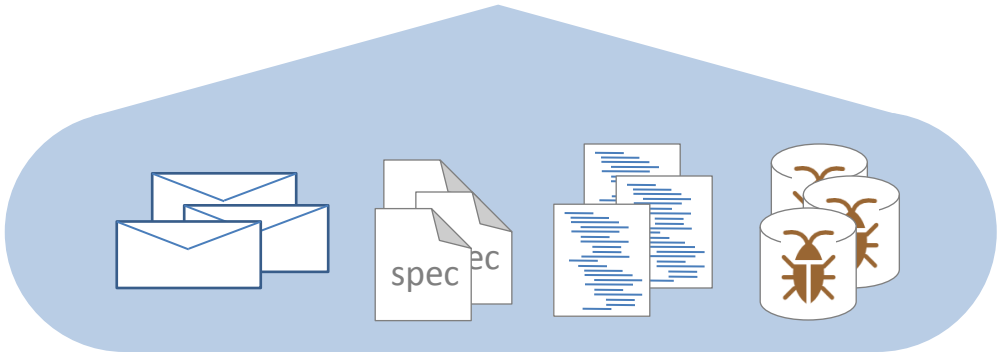
spec

Rationale

Finding *why* a choice was made is the hardest information need

- #2 by observation [Ko, DeLine, Venolia, ICSE 07]
- #1 by subjective rating [LaToza, Venolia, DeLine, ICSE 06]

How can we help engineers invest wisely in recording their decisions?

- Cost(recording) < Cost(future info seeking)

Data is dangerous!

Archive data is biased and full of errors!

- See Aranda and Venolia, “Secret Life of Bugs”, ICSE 09
- We could be giving misinformation

Archive data is highly personal (and therefore useful)

- Coworker asks: How much code has Joe contributed to this project?
- Boss asks: How much code has Joe contributed to this project?

The next IDE…

… Addresses information needs

… Helps teammates communicate

… Exploits spatial cognition

http://research.microsoft.com/hip/