The Next IDE

Informative Development Environments

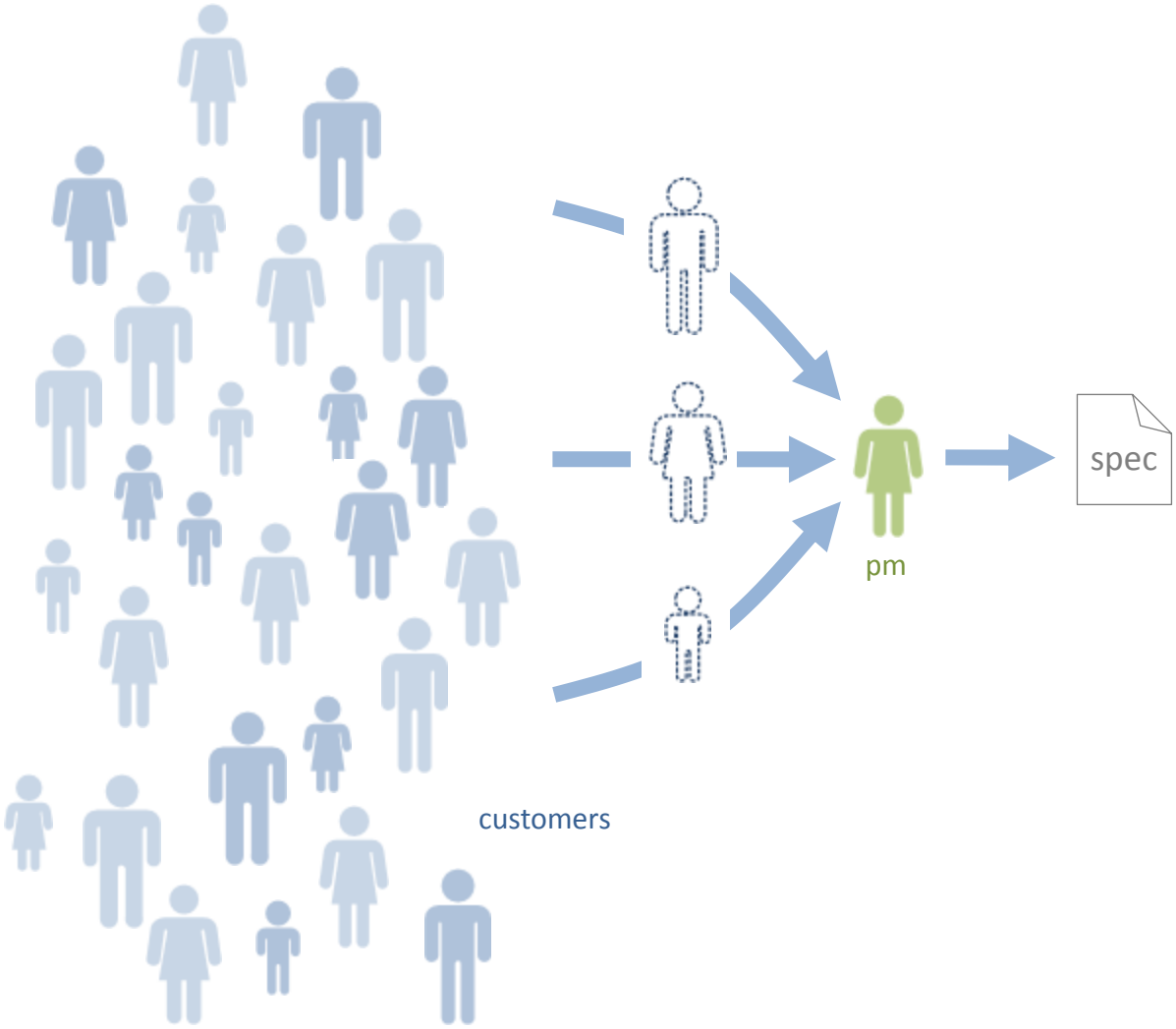
Teams at Microsoft

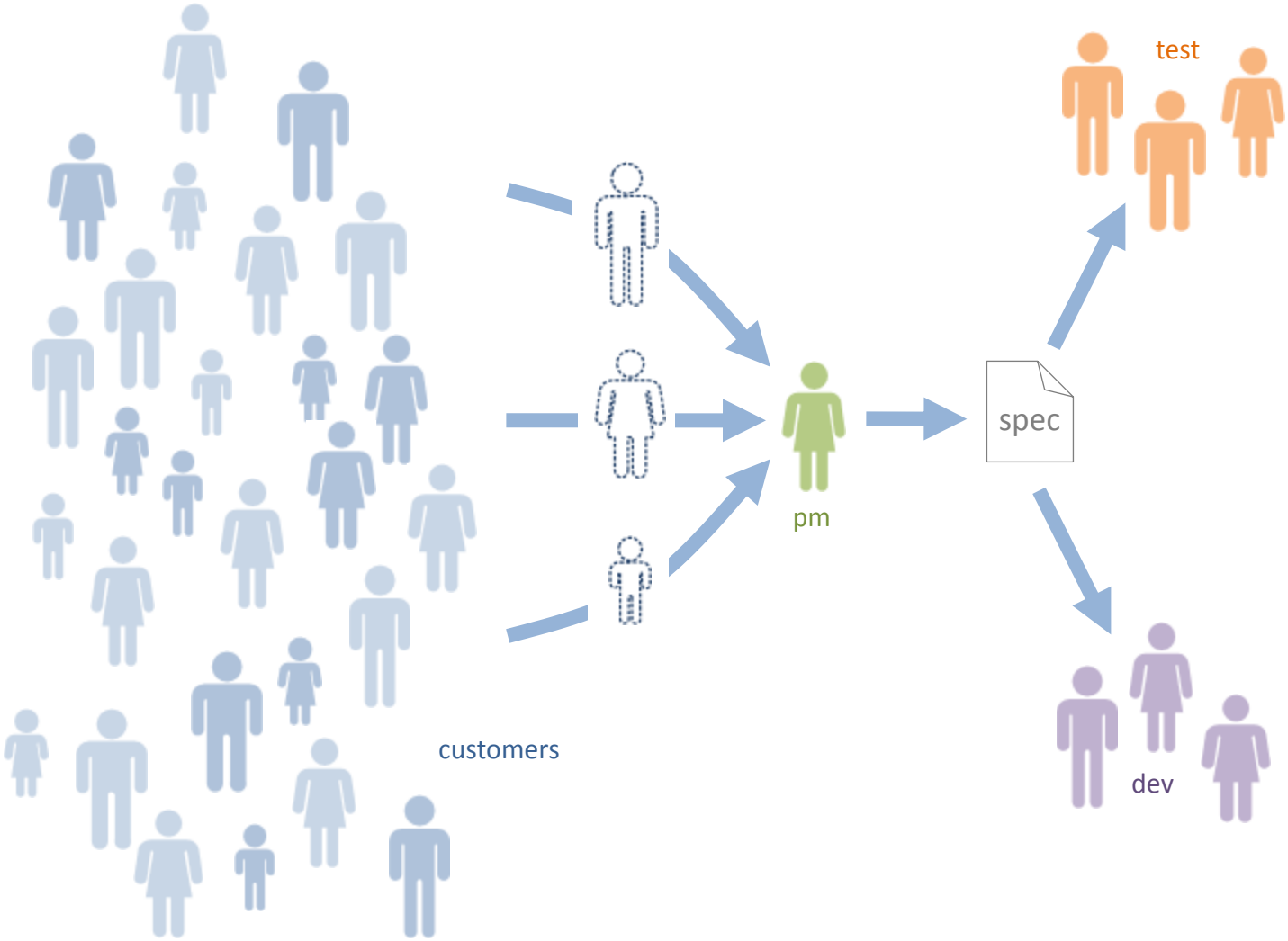
Information Needs

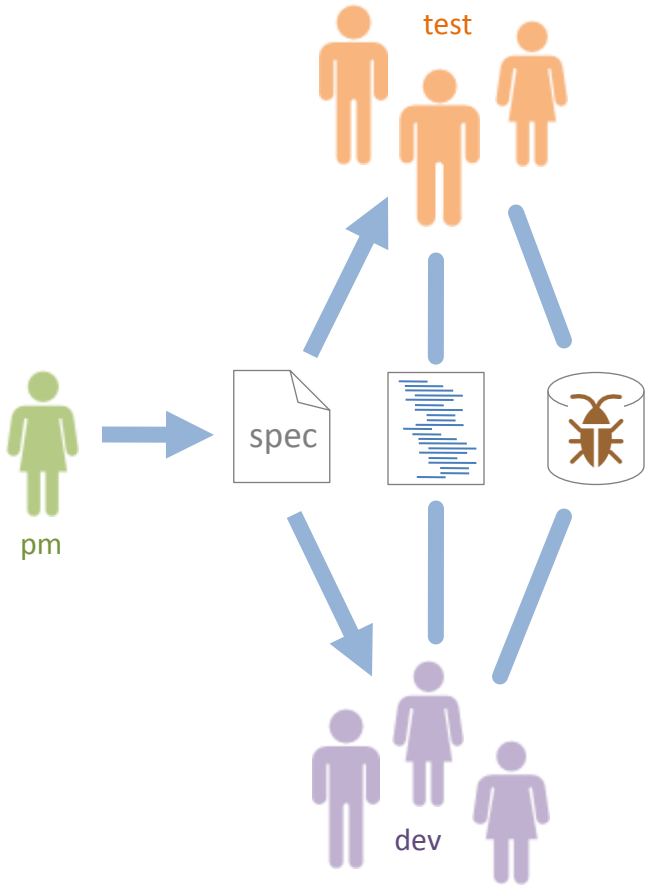
Think outside the Bento Box

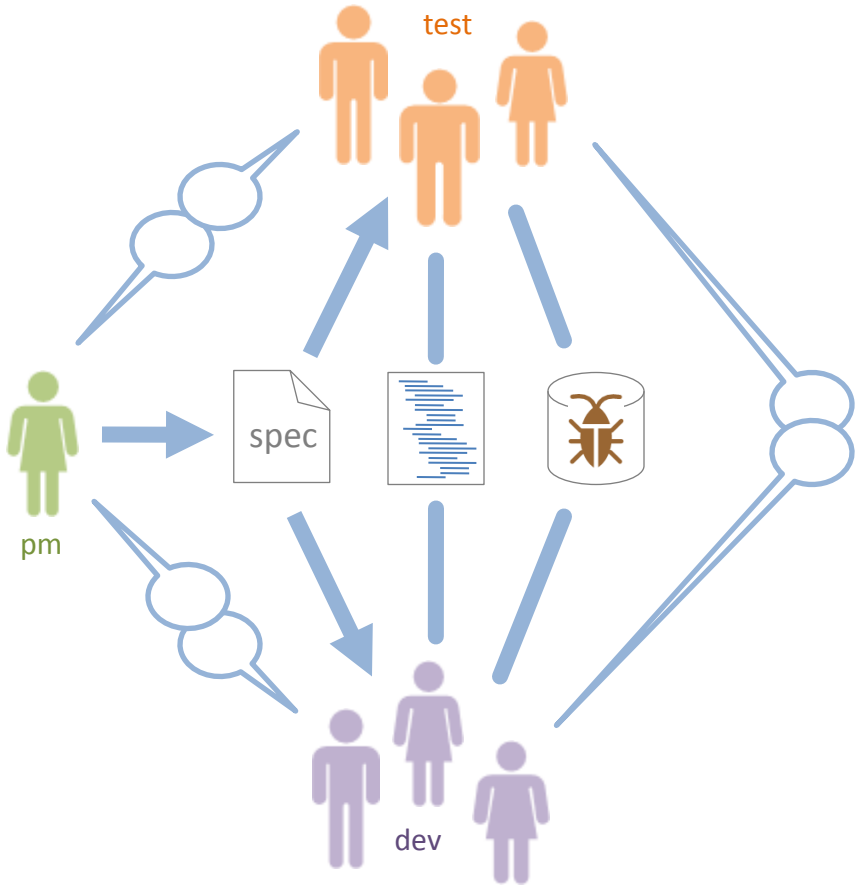
Challenges

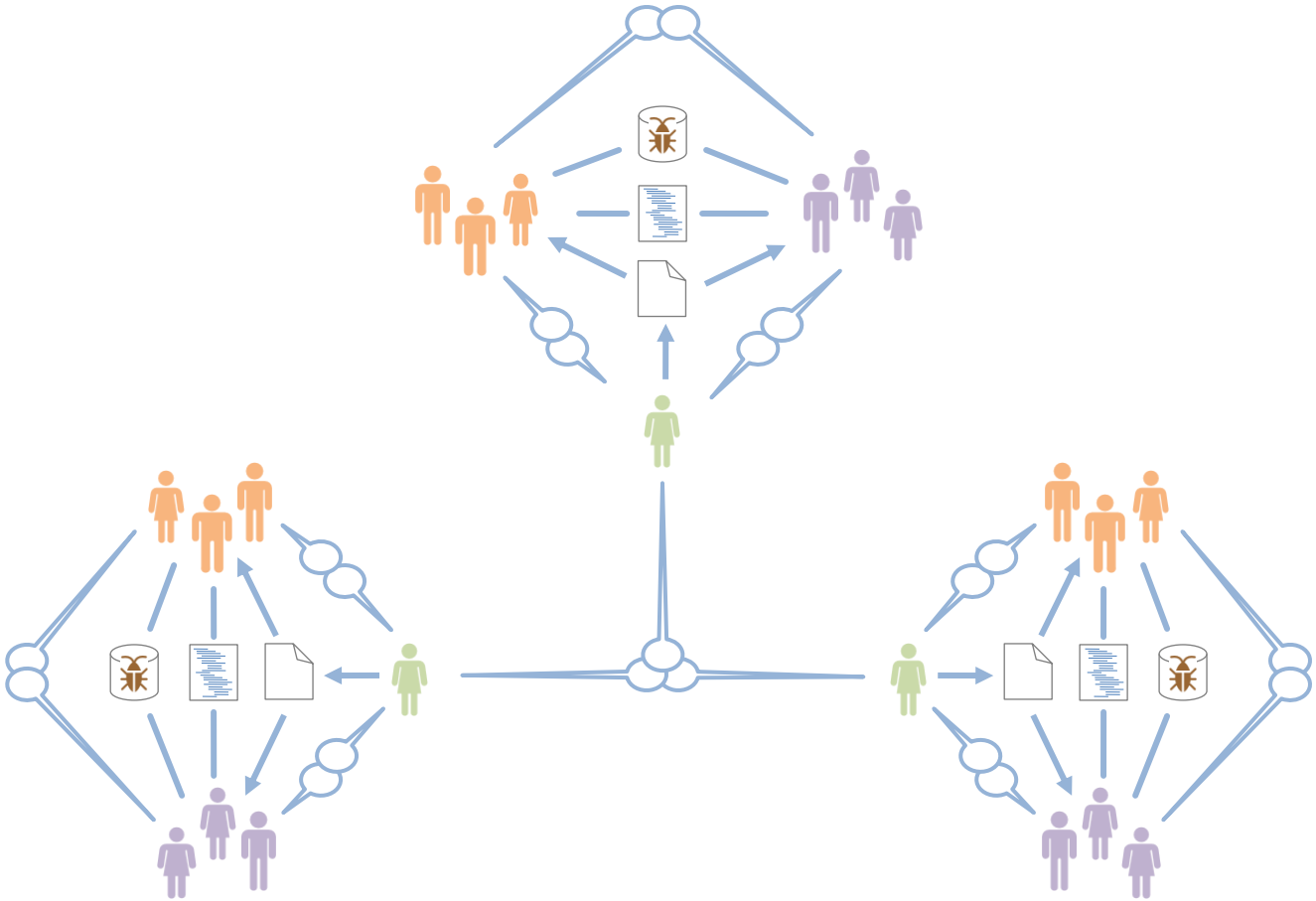
Rob DeLine ▪ Microsoft Research ▪ research.microsoft.com/hip
Mining Software Archives 2010

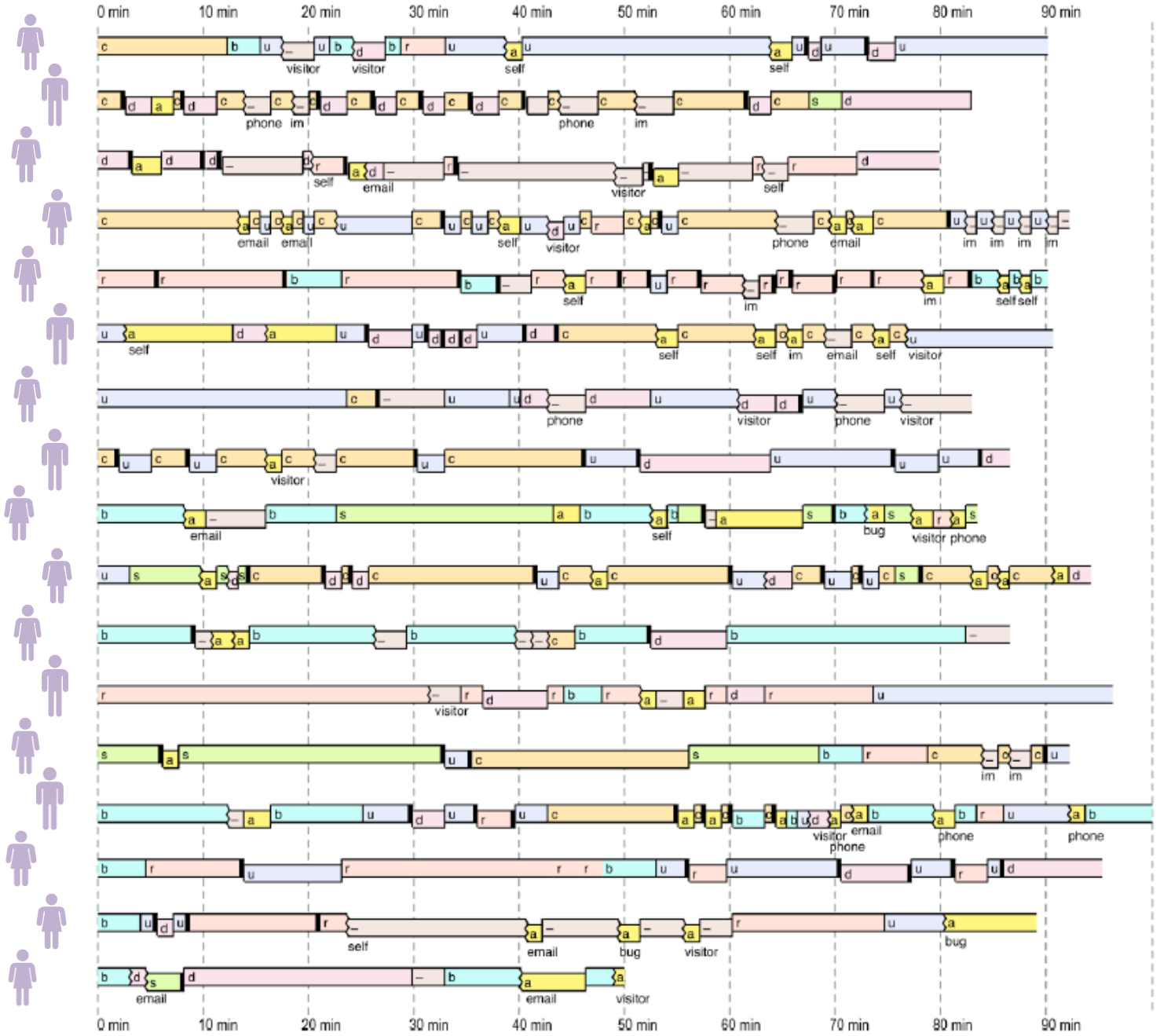

customers
pm
spec


test
spec
pm
customers
dev


test
spec
pm
dev

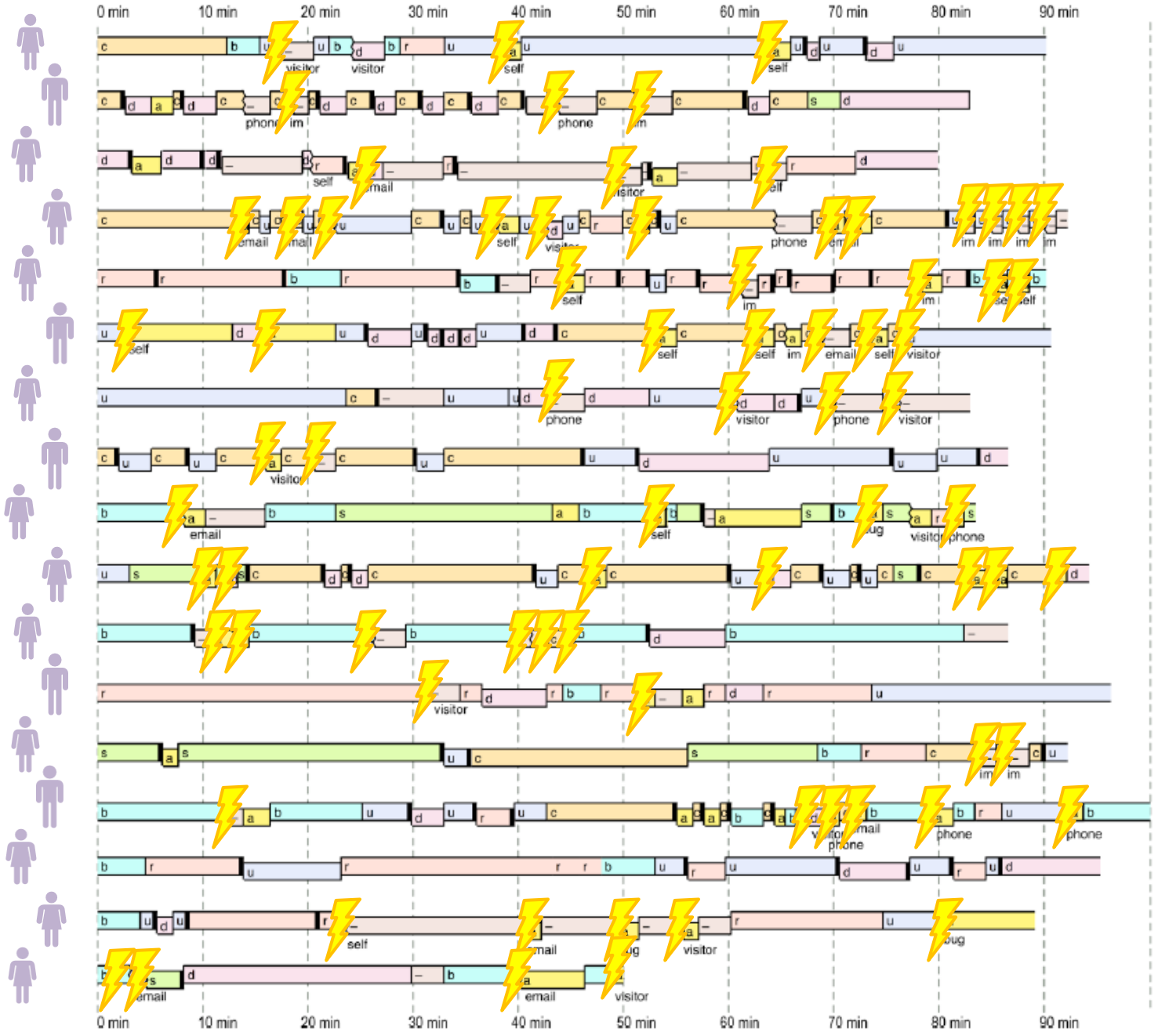

test
spec
pm
dev



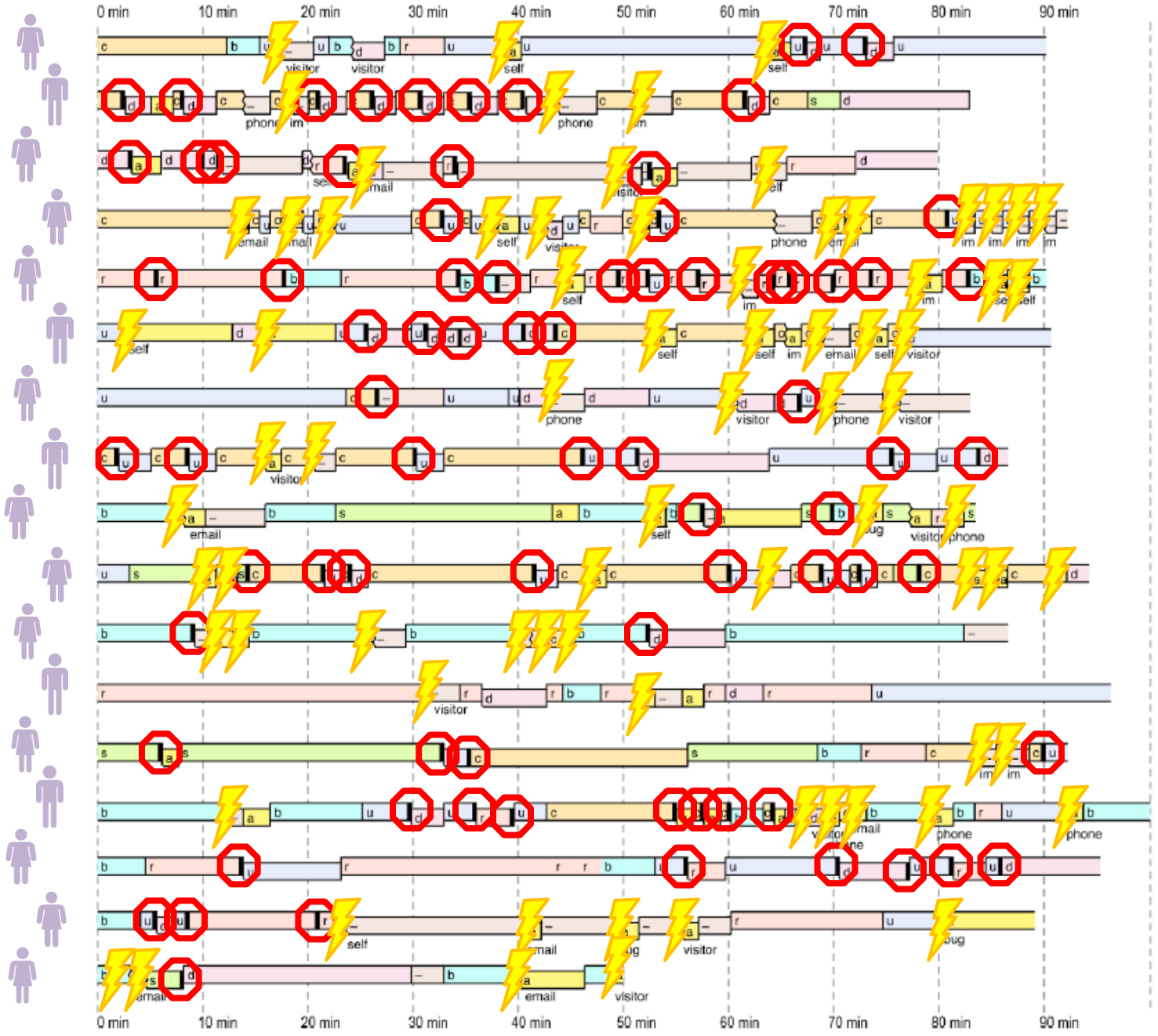


code
submit
bug triage
bug repro
understanding
design
awareness
non-work (—)

Ko, DeLine, and Venolia, ICSE 2007

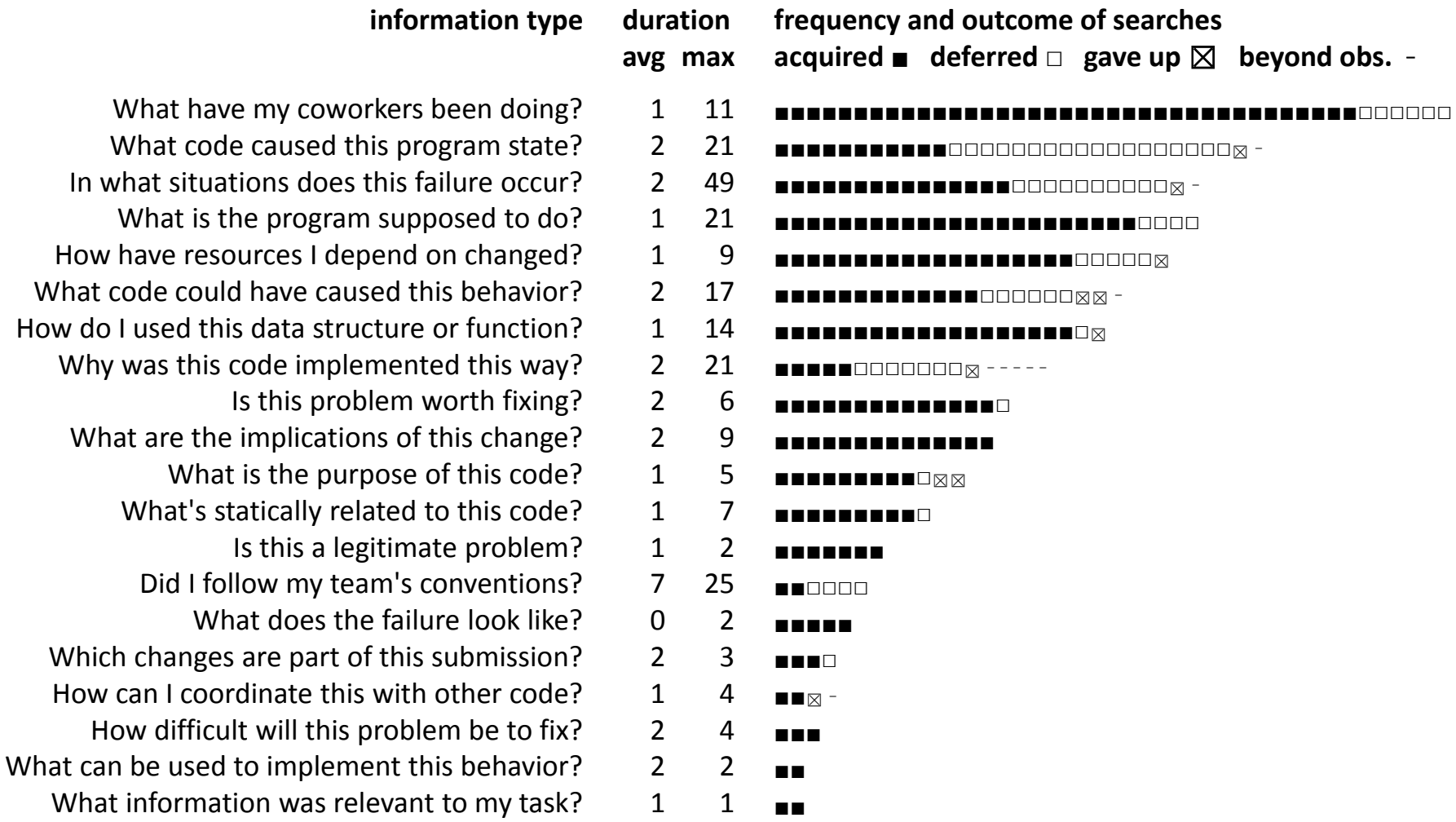


Ko, DeLine, and Venolia, ICSE 2007



Ko, DeLine, and Venolia, ICSE 2007

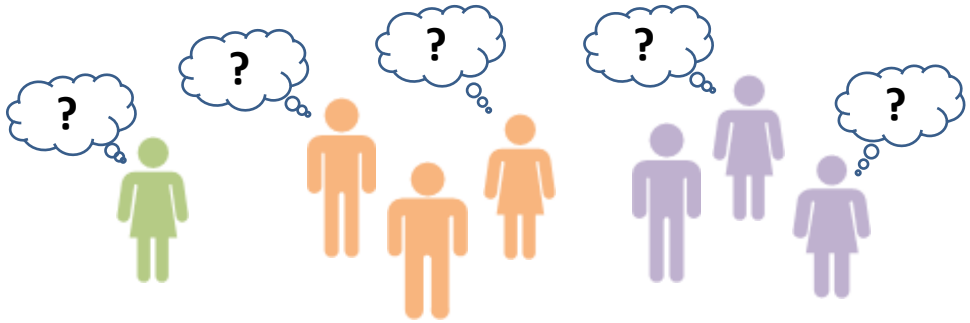
```
void BeProductiveProgrammer()
{
    while (!quittingTime) {
        try {
            var task = readyTasks.PickOne();
            while (!task.IsDone && !task.IsBlocked)
                task.MakeProgress();
            if (task.IsBlocked)
                blockedTasks.Add(task);
            readyTasks.Remove(task);
        }
        catch (Interruption interruption) {
            var newInfo = interruption.InformationContent;
            foreach (var task in blockedTasks) {
                if (task.BlockedOn(newInfo)) {
                    blockedTasks.Remove(task);
                    readyTasks.Add(task);
                }
            }
        }
    }
}
```


information type
duration
avg max
frequency and outcome of searches
acquired ■ deferred □ gave up ☒ beyond obs. -
What have my coworkers been doing? 1 11
What code caused this program state? 2 21
In what situations does this failure occur? 2 49
What is the program supposed to do? 1 21
How have resources I depend on changed? 1 9
What code could have caused this behavior? 2 17
How do I used this data structure or function? 1 14
Why was this code implemented this way? 2 21
Is this problem worth fixing? 2 6
What are the implications of this change? 2 9
What is the purpose of this code? 1 5
What's statically related to this code? 1 7
Is this a legitimate problem? 1 2
Did I follow my team's conventions? 7 25
What does the failure look like? 0 2
Which changes are part of this submission? 2 3
How can I coordinate this with other code? 1 4
How difficult will this problem be to fix? 2 4
What can be used to implement this behavior? 2 2
What information was relevant to my task? 1 1

	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	

Worst of the worst

What code caused this program state?	61% unsatisfied, max 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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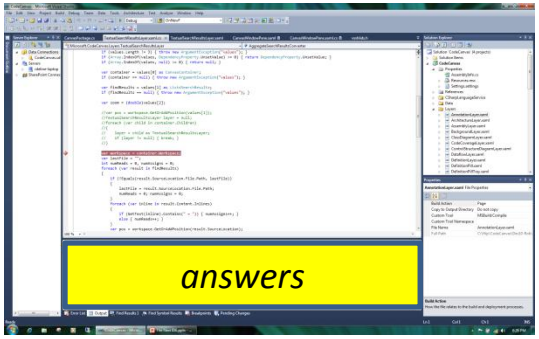
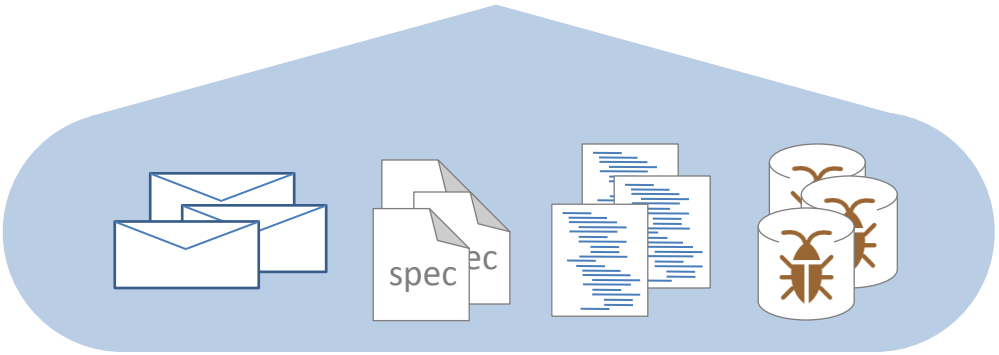
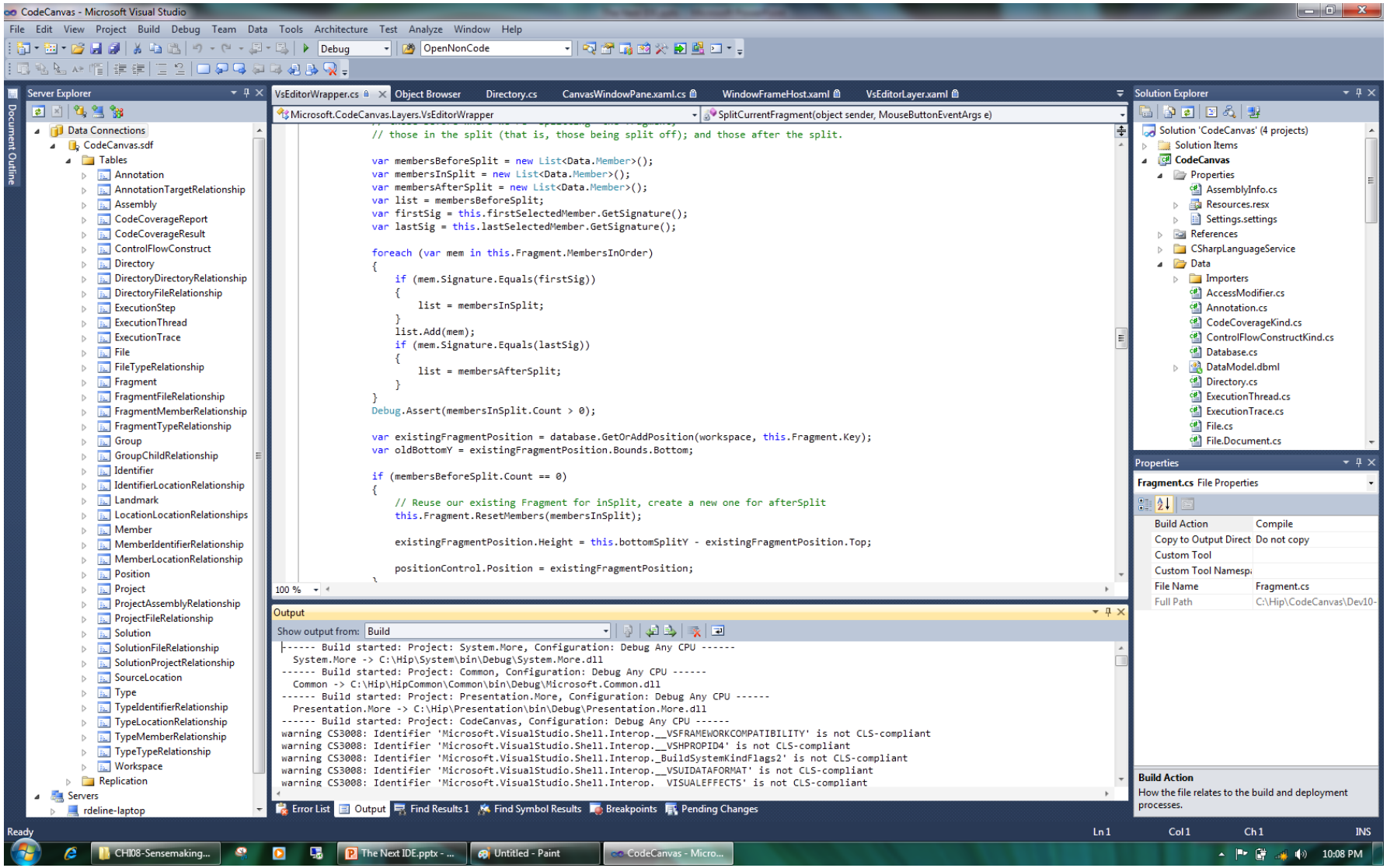
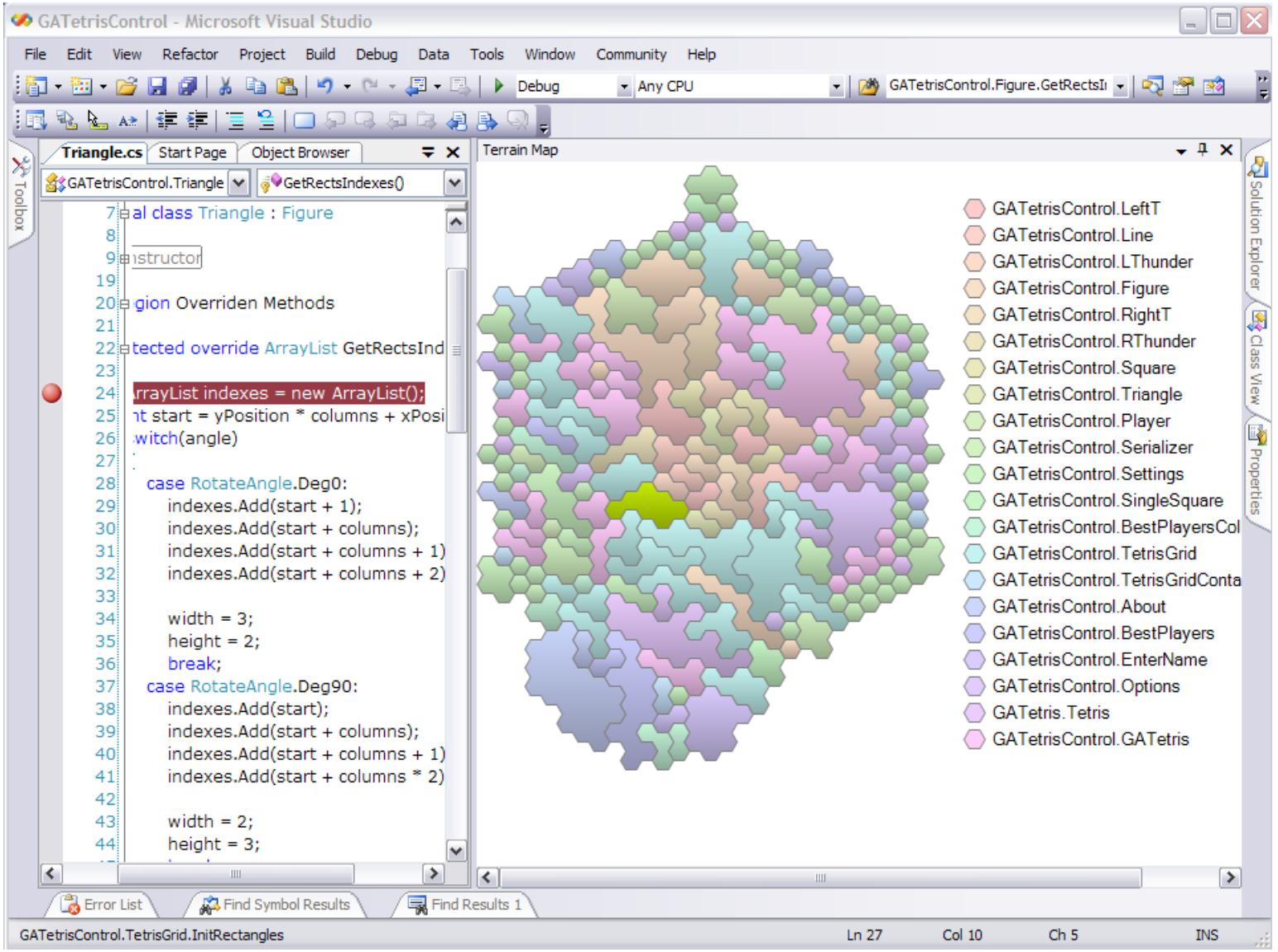
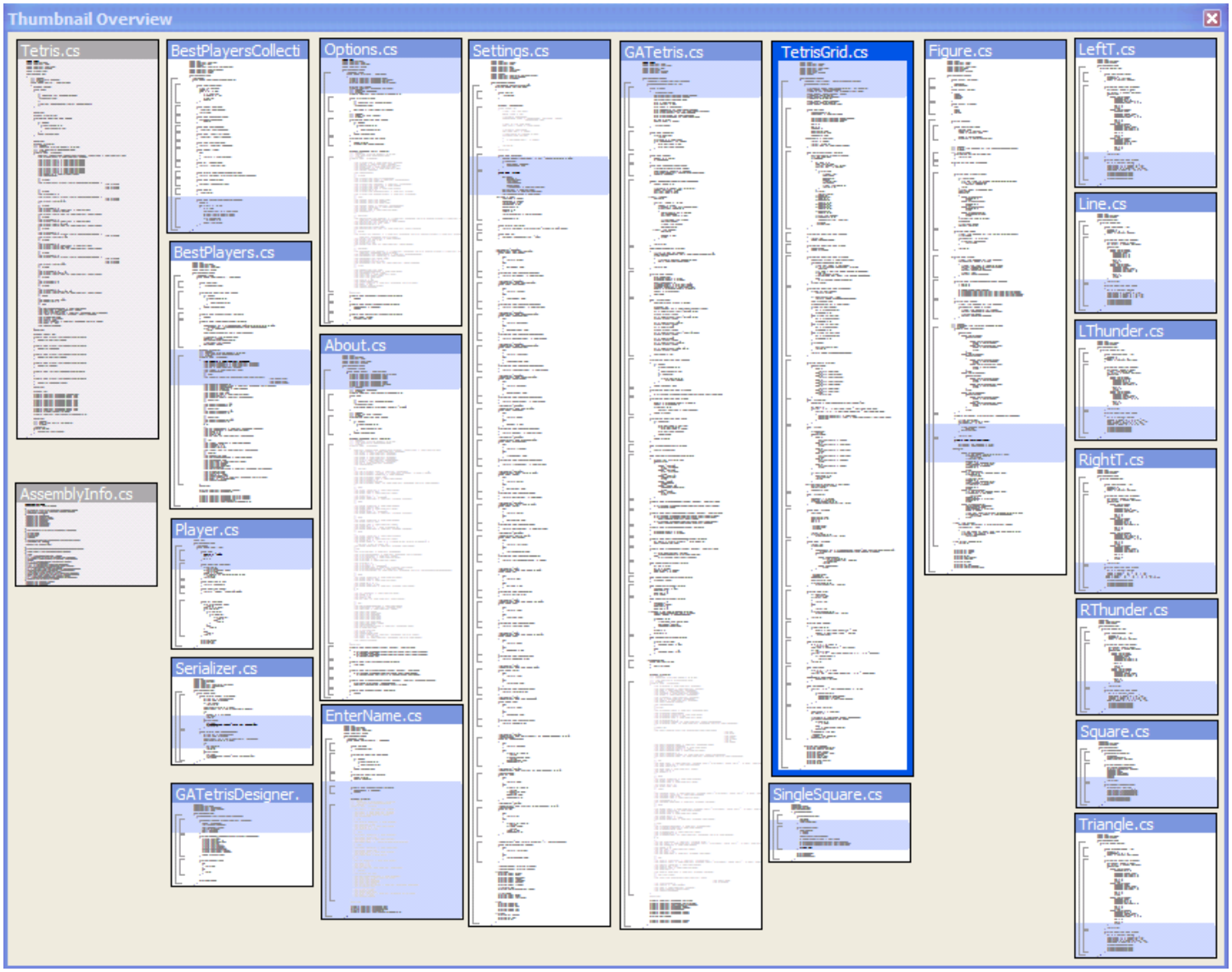

answers


spec

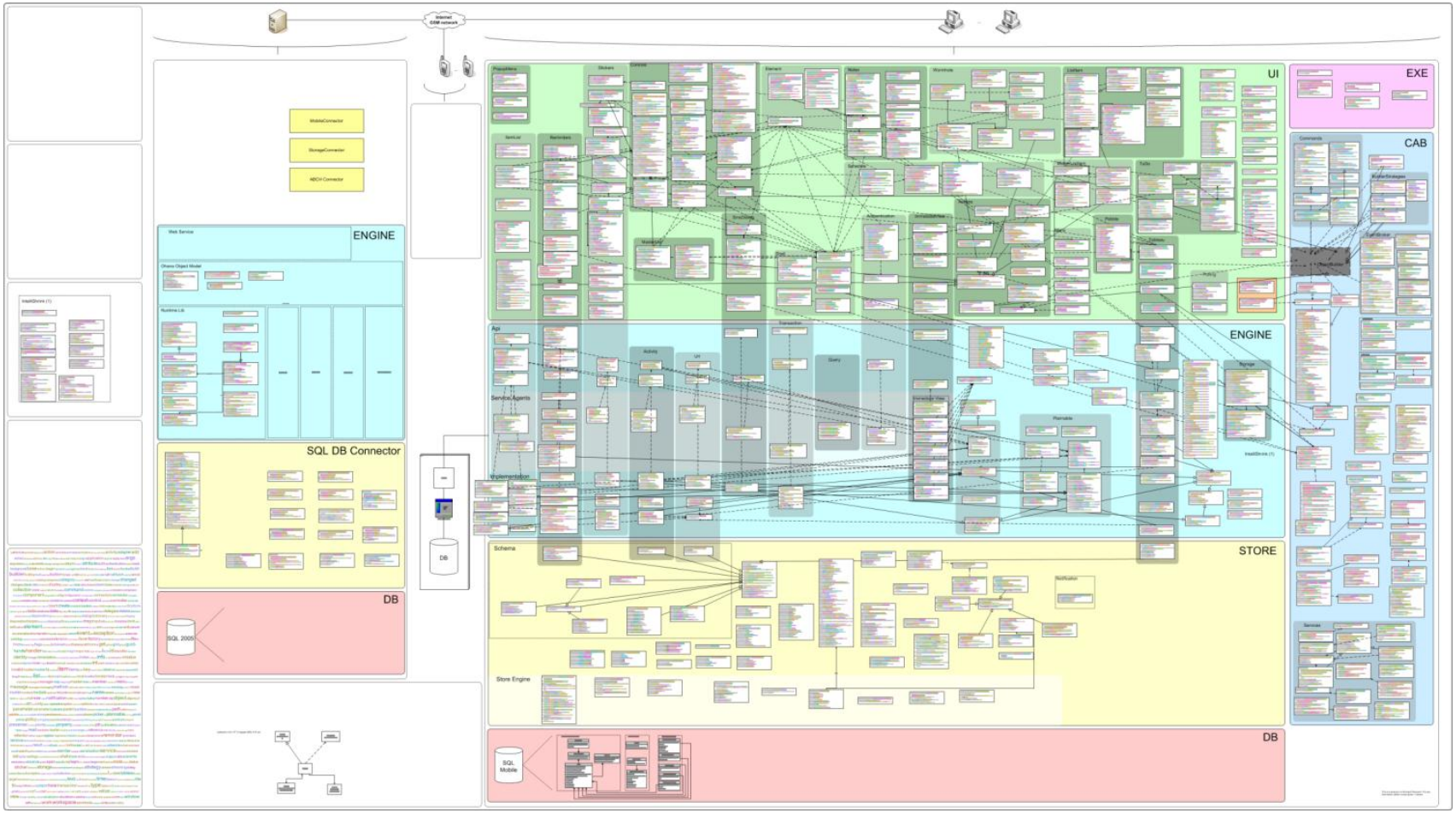

CodeCanvas - Microsoft Visual Studio
File Edit View Project Build Debug Team Data Tools Architecture Test Analyze Window Help
Debug
OpenNonCode
Server Explorer
Data Connections
CodeCanvas.sdf
Tables
Annotation
AnnotationTargetRelationship
Assembly
CodeCoverageReport
CodeCoverageResult
ControlFlowConstruct
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


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
istructor
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
Toolbox
Solution Explorer
Class View
Properties
Error List
Find Symbol Results
Find Results 1
GATetrisControl.TetrisGrid.InitRectangles
Ln 27
Col 10
Ch 5
INS

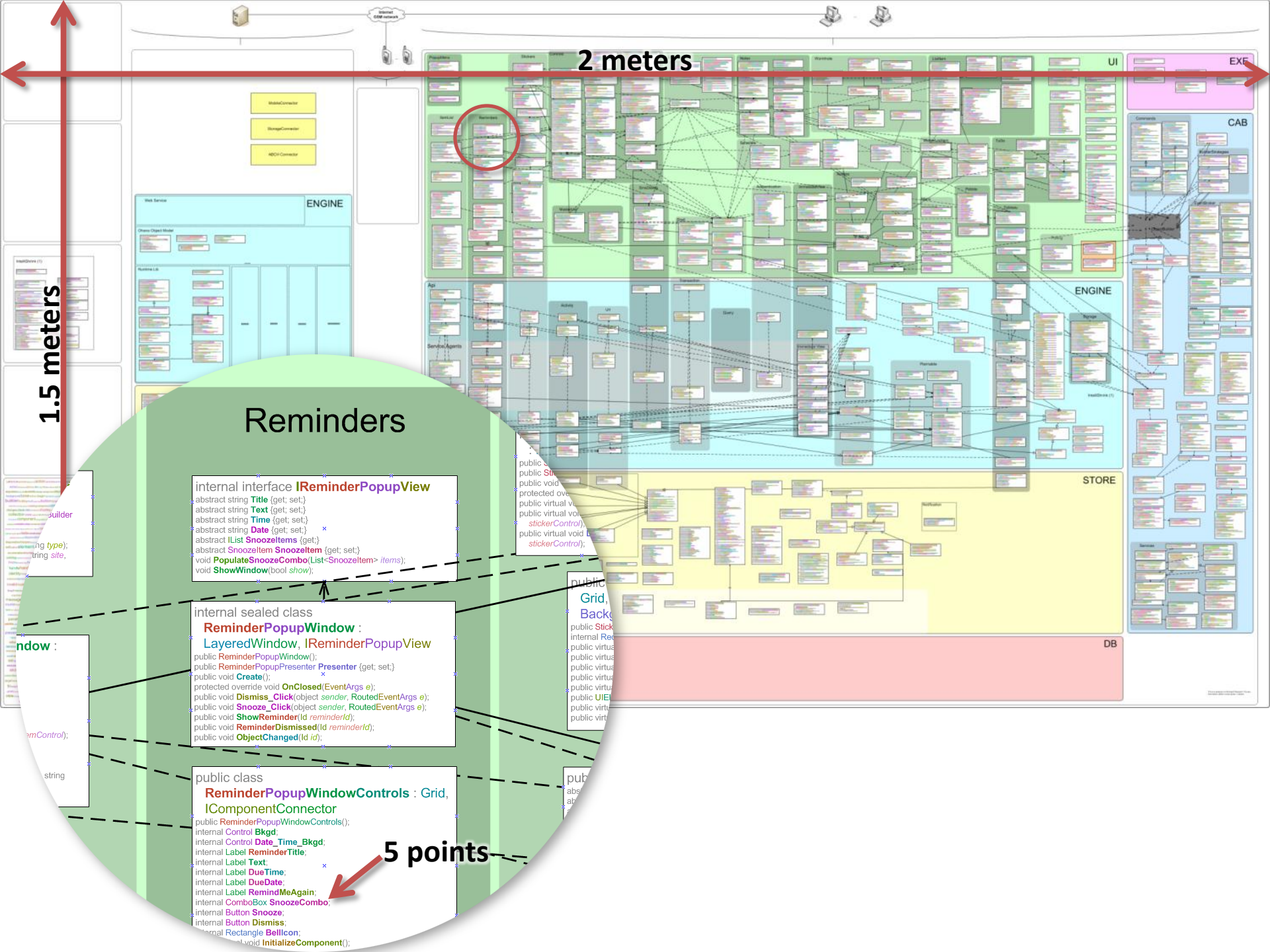


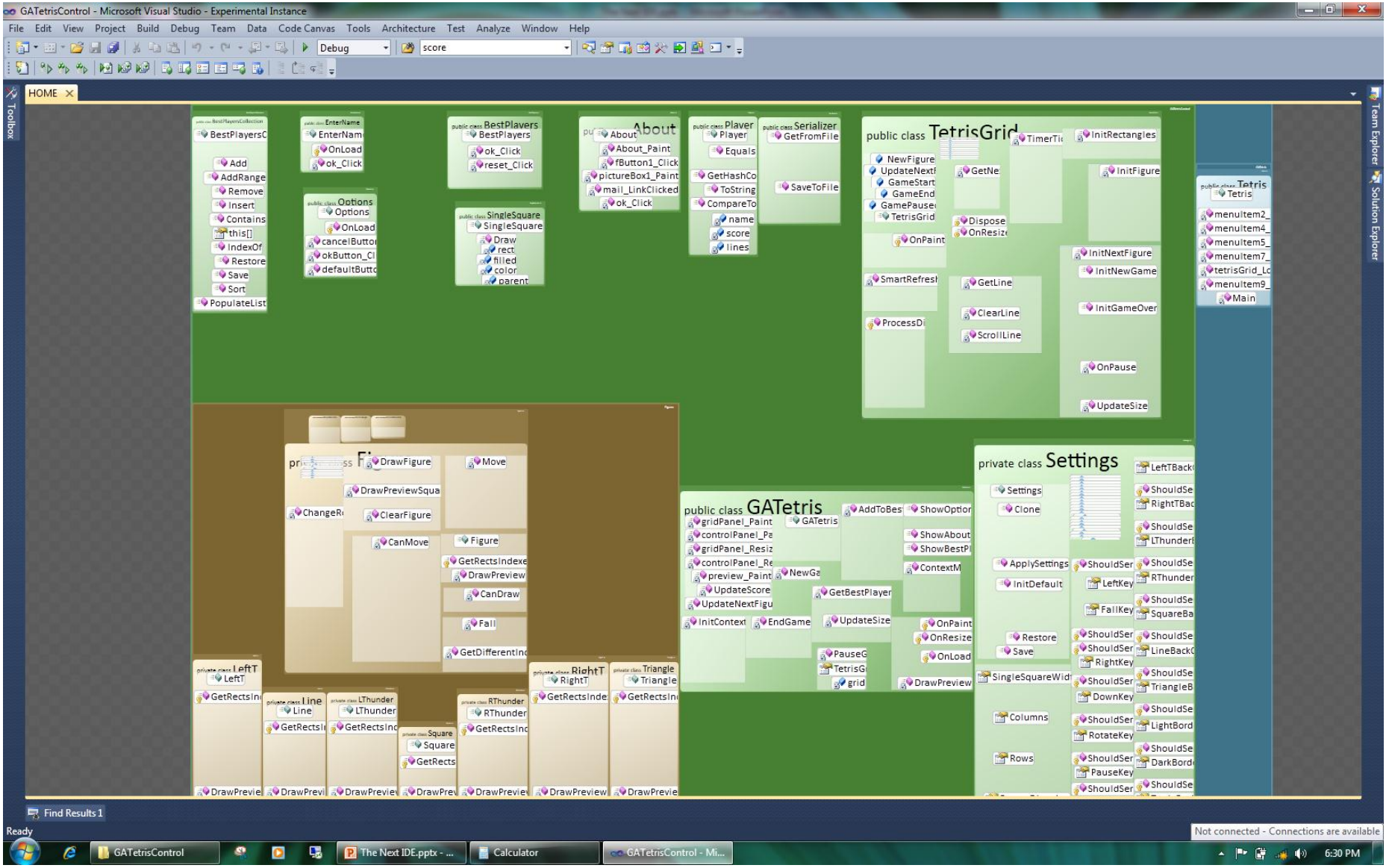
Code Thumbnails
DeLine et al, VL/HCC 06

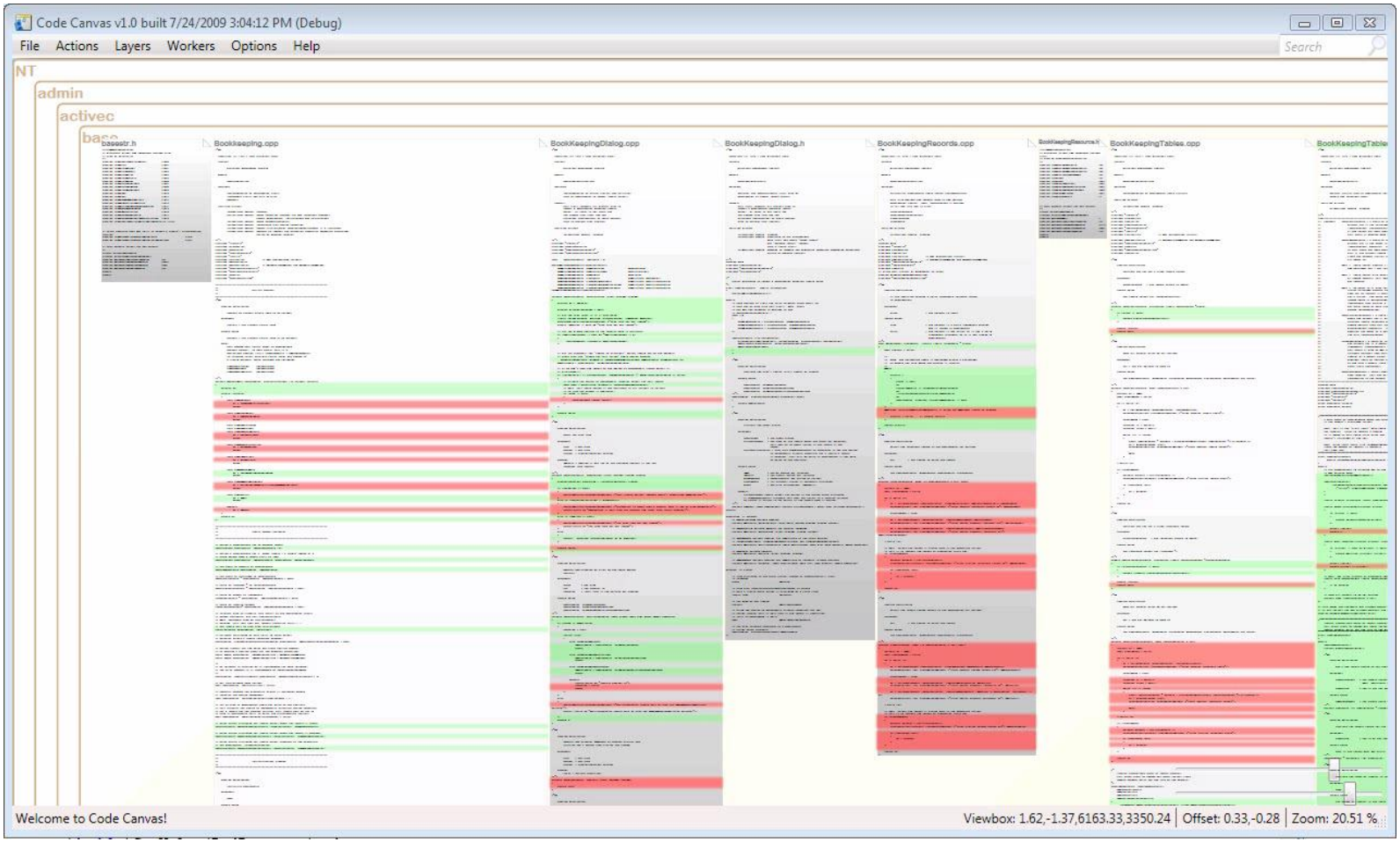
Ohana Map
Cherubini, Venolia, DeLine, VL/HCC 07



Internet
GSM network
MobileConnector
StorageConnector
ABCH Connector
ENGINE
Web Service
Ohana Object Model
Runtime Lib
SQL DB Connector
DB
SQL 2005
DB
UI
EXE
CAB
Commands
ENGINE
Api
Service Agents
Implementation
Schema
STORE
Store Engine
DB
SQL
Mobile


2 meters
1.5 meters
UI
EXE
CAB
ENGINE
ENGINE
STORE
DB
Reminders
internal interface IReminderPopupView
abstract string Title {get; set;}
abstract string Text {get; set;}
abstract string Time {get; set;}
abstract string Date {get; set;}
abstract IList SnoozeItems {get;}
abstract SnoozeItem SnoozeItem {get; set;}
void PopulateSnoozeCombo(List<SnoozeItem> items);
void ShowWindow(bool show);
internal sealed class
ReminderPopupWindow :
LayeredWindow, IReminderPopupView
public ReminderPopupWindow();
public ReminderPopupPresenter Presenter {get; set;}
public void Create();
protected override void OnClosed(EventArgs e);
public void Dismiss_Click(object sender, RoutedEventArgs e);
public void Snooze_Click(object sender, RoutedEventArgs e);
public void ShowReminder(Id reminderId);
public void ReminderDismissed(Id reminderId);
public void ObjectChanged(Id id);
public class
ReminderPopupWindowControls : Grid,
IComponentConnector
public ReminderPopupWindowControls();
internal Control Bkgd;
internal Control Date_Time_Bkgd;
internal Label ReminderTitle;
internal Label Text;
internal Label DueTime;
internal Label DueDate;
internal Label RemindMeAgain;
internal ComboBox SnoozeCombo;
internal Button Snooze;
internal Button Dismiss;
internal Rectangle BellIcon;
void InitializeComponent();
5 points


GATetrisControl - Microsoft Visual Studio - Experimental Instance
File Edit View Project Build Debug Team Data Code Canvas Tools Architecture Test Analyze Window Help
Debug
score
HOME
Toolbox
Team Explorer
Solution Explorer
BestPlayersCollection
BestPlayersC
Add
AddRange
Remove
Insert
Contains
this[]
IndexOf
Restore
Save
Sort
PopulateList
EnterName
EnterNam
OnLoad
ok_Click
Options
Options
OnLoad
cancelButto
okButton_Cl
defaultButto
BestPlayers
BestPlayers
ok_Click
reset_Click
SingleSquare
SingleSquare
Draw
rect
filled
color
parent
About
About
About_Paint
fButton1_Click
pictureBox1_Paint
mail_LinkClicked
ok_Click
Player
Player
Equals
GetHashCo
ToString
CompareTo
name
score
lines
Serializer
GetFromFile
SaveToFile
public class TetrisGrid
TimerTic
InitRectangles
NewFigure
UpdateNextF
GameStart
GameEnd
GamePause
TetrisGrid
GetNe
InitFigure
Dispose
OnResiz
OnPaint
InitNextFigure
InitNewGame
SmartRefresh
GetLine
ClearLine
ScrollLine
InitGameOver
ProcessDi
OnPause
UpdateSize
Tetris
Tetris
menuItem2_
menuItem4_
menuItem5_
menuItem7_
tetrisGrid_Lo
menuItem9_
Main
DrawFigure
Move
DrawPreviewSqua
ChangeR
ClearFigure
CanMove
Figure
GetRectsIndexe
DrawPreview
CanDraw
Fall
GetDifferentInc
public class GATetris
gridPanel_Paint
controlPanel_Pa
gridPanel_Resiz
controlPanel_Re
preview_Paint
UpdateScore
UpdateNextFigu
InitContext
EndGame
GATetris
AddToBes
ShowOption
ShowAbout
ShowBestP
ContextM
NewGa
GetBestPlayer
UpdateSize
OnPaint
OnResize
OnLoad
DrawPreview
PauseG
TetrisG
grid
private class Settings
Settings
Clone
ApplySettings
InitDefault
Restore
Save
SingleSquareWidt
Columns
Rows
LeftTBack
ShouldSe
RightTBac
LThunderI
ShouldSer
LeftKey
RThunder
FallKey
SquareBa
RightKey
LineBackG
TriangleB
DownKey
LightBord
RotateKey
DarkBord
PauseKey
LeftT
LeftT
GetRectsIn
DrawPrevie
Line
Line
GetRectsI
DrawPrevi
LThunder
LThunder
GetRectsInc
DrawPrevie
Square
Square
GetRects
DrawPrev
RThunder
RThunder
GetRectsInc
DrawPrevie
RightT
RightT
GetRectsInde
DrawPreview
Triangle
Triangle
GetRectsIn
DrawPrevie
Find Results 1
Ready
Not connected - Connections are available
GATetrisControl
The Next IDE.pptx - ...
Calculator
GATetrisControl - Mi...
6:30 PM


Code Canvas v1.0 built 7/24/2009 3:04:12 PM (Debug)
File
Actions
Layers
Workers
Options
Help
Search
NT
admin
activec
basestr.h
BookKeeping.cpp
BookKeepingDialog.cpp
BookKeepingDialog.h
BookKeepingRecords.cpp
BookKeepingTables.cpp
Welcome to Code Canvas!
Viewbox: 1.62,-1.37,6163.33,3350.24
Offset: 0.33,-0.28
Zoom: 20.51 %

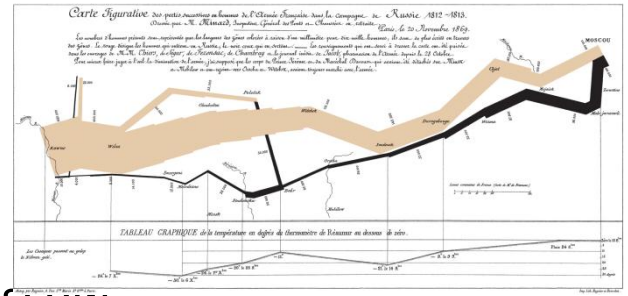
Future Visualizations

Check-in history with pop-up diffs

Code churn heat map

Watson crash reports

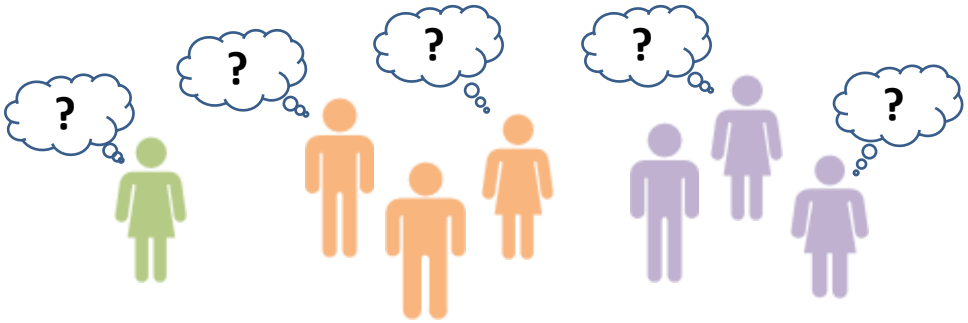
- heat map of last stack frame
- collected stacks à la Napoleon's march on Moscow



Execution traces

Team awareness: code check-outs

Annotations: text, images, screenshots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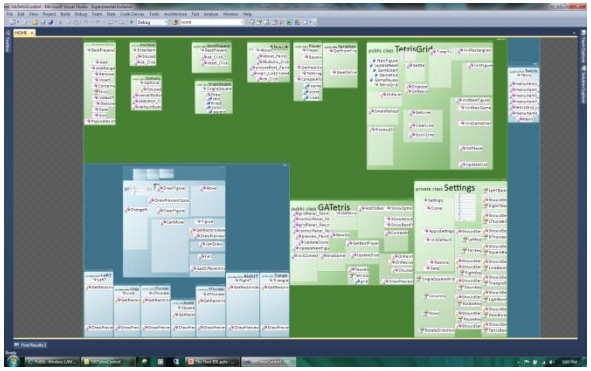

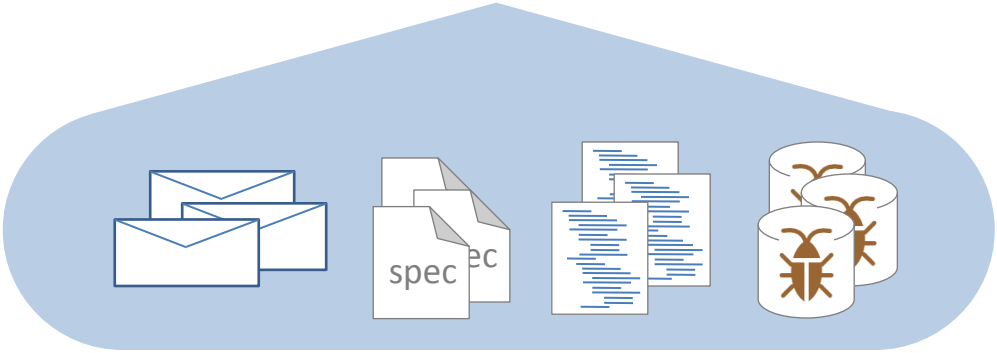
spec

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 documentation?

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

Data is dangerous!

Archive data is biased and full of errors!

- See Prem's talk yesterday.
- 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?