VisCad User Guide

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Introducing VisCad

Introduction

Detection and analysis of similar code fragments ("code clones") has become an integral part of software maintenance. In response, over the last decade a great many clone detection techniques and tools have been proposed. However, identifying useful cloning information from the large volume of textual data produced by these detectors is challenging. VisCad is a tool with which a user can visualize and analyze large volumes of raw cloning data in an interactive fashion. Users can analyze and identify distinctive code clones through a set of visualization techniques, metrics and data filtering operations. The loosely coupled architecture of VisCad allows users to work with the clones of any clone detectors that report source co-ordinates of the found clones. This yields the opportunity to work with the clone detectors of choice, which is important for clone analysis since clone detectors have their own strengths and weaknesses.

1. VisCad requires Java Runtime Environment (JRE) 6 or later. You can download the recent JRE from here .

2. We have successfully tested VisCad on Windows XP, Windows 7, Max OS X(version 10.6) and on some Linux distribution (such as Ubuntu).

4. The more RAM your computer has, the better performance you gain from VisCad. However, 2.0 GB or more is recommended.

5. Display dimension of 1024 x 768 or greater is recommended.

Follow the steps listed below:

- 1. Download the VisCad_beta.zip file from here . You can obtain the most recent version of VisCad, documentation, source code from this location.
- 2. Extract the contents of the archive.
- 3. Double click on the VisCad.jar file to run the program.

VisCad user interface 000 VisCad: Analyzing Clones With Visualization Project (e = □ x) □ Viewer e = x ? _ □ x □ Ove... ? _ x \ 🗖 System Navigatio... 🛛 🤻 🗕 🗙 🔪 (?_OX □ Clo... ? _ X (~ _ O X 🗆 Clone Class Tree 🗛 🗙 (~ _ _ X

Running the viscad.jar file opens the above window.

Importing clone detection result

VisCad requires the subject system and the clone detection result you obtained by running clone detection on the subject system using the supported clone detectors.

Current you can directly import clone detection result of CCFinder, Simian, SimScan, NiCad. If you have clone detection result in RCF format (e.g., iClones result), you can also import and analyze the data in VisCad. For other clone detection tools, you need to convert the result into VisCad input file format. VisCadBeta.zip file contains an example of VisCad input file.

Make the selection



To import clone detection result or RCF data file, click on the *Project* menu. This opens a list of importing operations supported by VisCad.

Import clone detection result of Simian



Suppose your computer contians the source code of JHotDraw(version 7.6) and located in the JHotDraw7.6 directory. You detect the clones using Simian on that directory and stores the result in jhotdrawResultSimian.txt file. To import the result, you need to click on the Project menu and select the *Import Result from Simian* menu item.

Importing clone detection result of Simian(Continued)	
Select the granularity of operation. If you	
Import are not sure, just leave it as default.	
Select the language Getting Result From Simian Language ACTIONSCRIPT Granularity Function	
Source rath	
	_ (

This opens the above dialog box.

Select subject s	ystem				
	000	Open			
Navigatio ₹ _ × \	Look <u>I</u> n:	Simian 🔻			🗆 Ove 🤻
	JHotDraw7	.6			
		3 Click on the open	button		
	File <u>N</u> ame:	/Users/muhammad/880Research/Simian/JHo	tDraw76		
	Files of <u>T</u> ype:	All Files		-	
			Open	Cancel	
00	0	Import Project			
2	Select the I	ocation of the subject system	mi an Click	on this butt	on 2 ?
Lan	iguage JAVA	Granularity	Both	¥	-
lass Tree 👌 💶 :			(Source Path	
	aterproject Clope	15	Ok	Result Fil	e
				Cancer	

Select the clone detection result file	
Open	
io ? = X Look In: Simian T	🗆 Ove 7 💶 ک
JHotDraw7.6 jhotdrawResultSimian.txt 3 Click on the open button File Name: jhotdrawResultSimian.txt Files of Type: All Files	
Import Project	
locate the result file	
2 Getting Result From Simian	č _ >
Language JAVA Granularity Both	•
ee 🝖 💶 : //Users/muhammad/880Research/Simian/JHotDraw7.6 Source Path	
Result File	2
Interproject Clones Click on this button Ok Cancel	

Complete the import opeation

00	Import Project		
	Click on the ok button finish the in	nport op	
Language	JAVA Gra	nularity Both	•
/Users/muh	ammad/880Research/Simian/JHotDraw7.6		Source Path
/Users/muh	ammad/880Research/Simian/jhotdrawResultSim	ilar txt	Result File
🗌 Interproje	ct Clones	Ok	Cancel

L	Loading clone detection result		
	000	Project Loader	
		Please wait while VisCad is indexing code clones.	
		40%	
	_		

VisCad is now loading the clone detection result.

Complete the loading operation

The result is loaded into VisCad.

Import result	from SimScan			
000		Import Project		
		Getting Result From S	imScan	
Language	ACTIONSCRIPT	Granularity	Function	
				Source Path
				Result Folder 🗙
🗌 Interproje	ct Clones		Ok	Cancel

SimScan creates a folder that contains the output of the clone detection. A sample clone detection result (jhotdrawReportSimScan.zip) for JHotDraw (Version 7.6) is included in the VisCadBeta.zip file. You can also find the source code of the subject system in a zip file (jhotdraw-7.6.nested.zip).

Follow the steps listed below:

1. Unzip the jhotdraw-7.6.nested.zip file and rename the folder to JHotDraw7.6.

2. Unzip the jhotdrawReportSimScan.zip file. This will create a folder (jhotdrawReportSimScan) that contains the clone detection results. Put the folder in the same place where JHotDraw7.6 folder resides.

3. Select the 'Import Result from SimScan' menu item from the 'Project' menu (located on the top left of the VisCad interface). This opens a dialog to import the result.

4. Click on the Source Path button and select the source code directory (In this case, JHotDraw7.6 folder). This should be the folder on which you apply clone detection.

5. Now, click on the Result Folder button and select the clone detection result folder (In this case, jhotdrawReportSimScan).

6. Select the language of the subject system and also the granularity of clone detection. If you are not sure, you can leave them as default.

7. Now, click on the Ok button to load the subject system by VisCad. The loading time may vary depending on the size of the system.

Import res	Import result from NiCad				
000	Import Project				
	Getting Result From NiCad				
Languag	e ACTIONSCRIPT Granularity Function	~			
		Source Path			
		Result File			
Interproject Clones Ok Cancel					

A sample clone detection result (JHotDraw7.6_functions-clones-0.3.xml) for JHotDraw (Version 7.6) is included in the zip file. You can also find the source code of the subject system in a zip file (jhotdraw-7.6.nested.zip). Clones were detected using NiCad.

Follow the steps listed below:

1. Unzip the jhotdraw-7.6.nested.zip file and rename the folder to JHotDraw7.6.

2. Put the clone detection result file in the same directory where JHotDraw7.6 folder resides.

3. Select the 'Import Result from NiCad' menu item from the 'Project' menu (located on the top left of the VisCad interface). This opens a dialog to import the result.

4. Click on the Source Path button and select the source code directory (In this case, JHotDraw7.6 folder). This should be the folder on which you apply clone detection.

5. Now, Click on the Result File button and select the clone detection result file (In this case, JHotDraw7.6_functions-clones-0.3.xml).

6. Select the language of the subject system and also the granularity of clone detection. If you are not sure, you can leave them as default.

7. Now, click on the Ok button to load the subject system by VisCad. The loading time may vary depending on the size of the system.

Import RCF/i	Clones result file		
000	Import Project		
	Getting Result From RCF		
Language	ACTIONSCRIPT Granularity	Function	
			Source Path
			RCF File
🗌 Interproj	ect Clones	Ok	Cancel

RCF is a data format that can store clone data for a number of versions of a subject system. iClones also provide clone detection result in RCF format and can be directly imported into VisCad. For this example, we have used GNU Wget. Download both the subject system and the RCF file from here. The RCF file is packaged with the source code of the subject system.

Follow the steps listed below:

1. Extract the content of the archive and rename the folder to rcfResult. You now have two folders inside the rcfResult folder. One is the wget that contains the source code of seven different versions of the system. Another one is the wget.rcf that contains the clone detection results of those systems in the RCF format.

2. Select the 'Import RCF' menu item from the 'Project' menu (located on the top left of the VisCad interface). This opens a dialog to import the result.

3. Click on the Source Path button and select the wget folder located inside the rcfResult folder.

4. Now, click on the RCF File button and select the wget.rcf file.

5. Select the language of the subject system and also the granularity of clone detection. If you are not sure, you can leave them as default.

6. Now, click on the Ok button to load all seven-subject subjects by VisCad. The loading time may vary depending on the number of subject systems.

Import result from CCFinder				
Import Project				
import ridject				
Getting Result From CCFinder				
Language ACTIONSCRIPT Granularity Function	•			
	Source Path			
	Result File			
	Ccfxprep Dir.			
Interproject Clones Ok	Cancel			

During the clone detection, CCFinder creates a directory (.ccfxprepdir). If you apply clone detection on JHotDraw7.6 directory, then the .ccfxprepdir will be created right inside that directory. Follow the steps listed below:

1. Unzip the jhotdraw-7.6.nested.zip file and rename the folder to JHotDraw7.6. Detect clones with CCFinder and then rename the .ccfxprepdir directory to ccfxprepdir.

2. The output file is a binary one (such as a.ccfxd). You need to convert that into a text file (see here). From now, we will refer the text file as the result file.

3. Put the clone detection result file in the same directory where JHotDraw7.6 folder resides.

4. Select the 'Import CCFinder Project' menu item from the 'Project' menu (located on the top left of the VisCad interface). This opens a dialog to import the result.

5. Click on the Source Path button and select the source code directory (In this case, JHotDraw7.6 folder). This should be the folder on which you apply clone detection.

- 6. Now, click on the Result File button and select the clone detection result file.
- 7. Click on the Ccfxprep Dir. button and select the ccfxprepdir directory.

8. Select the language of the subject system and also the granularity of clone detection. If you are not sure, you can leave them as default.

9. Now, click on the Ok button to load the subject system by VisCad. The loading time may vary depending on the size of the system.

Impo	Import VisCad input file			
8	0.0	Import Project		
		Getting Result From VisCad Input File		
L	Language	ACTIONSCRIPT Granularity Function		
		Source Path		
		Result File		
] Interproje	ct Clones Ok Cancel		

For any other clone detection tools, the result file needs to be converted to the VisCad input file format. A sample clone detection result (resultViscadInputFile.txt) for JHotDraw (Version 7.6) is included in the VisCadBeta.zip file. Clones were detected using Simian.

Follow the steps listed below:

1. Unzip the jhotdraw-7.6.nested.zip file and rename the folder to JHotDraw7.6.

2. Put the clone detection result file in the same directory where JHotDraw7.6 folder resides.

3. Select the 'Import VisCad Input File' menu item from the 'Project' menu (located on the top left of the VisCad interface). This opens a dialog to import the result.

4. Click on the Source Path button and select the source code directory (In this case, JHotDraw7.6 folder). This should be the folder on which you apply clone detection.

5. Now, click on the Result File button and select the clone detection result file (In this case, resultViscadInputFile.txt).

6. Select the language of the subject system and also the granularity of clone detection. If you are not sure, you can leave them as default.

7. Now, click on the Ok button to load the subject system by VisCad. The loading time may vary depending on the size of the system.

The main user interface of VisCad can be divided into three parts.

1. Left Part: The left part accommodates the *clone browser*. The clone browser has two parts, one of which displays the distribution of clones over the directories and sub- directories in the subject system, known as *System Navigation Tree*. The other part, located on the bottom of the clone browser, lists all *clone classes* and the number of clone snippets in each class, called *Clone Class Tree*.

2. Middle Part: The middle part of VisCad accommodates different views in separate tabs. We will refers this part as *Viewer*.

3. Right Part: The top- right window shows the clone detection specific information VisCad obtained while parsing the result file for the selected

subject system. For any selected directory in the *system navigation tree*, the bottom-right window shows the distribution of clones in its sub-directories through a pie chart.



It maps clones to files and directories



Clone class tree groups the detected clones into different classes.

Viewer



Depending on the user's selection, it accomodates different views(such as the scatter plot, treemap, hierarchical dependency graph, source code browser etc.)



This part contains information such as tool name, overview of clone detection result.

Click on a directory in the system navigation tree to select it. Based on the selection, the clone distribution window updates and shows the distribution of clones in its subdirectories through a pie chart.

You can analyze the source code of the clone fragments using the *code browser*. The same component is used for analyzing clone code fragments in other places also.

If we want to analyze the clone fragments on the *geom directory*, we need to select the directory, right click on the mouse button to bring up the popup menu and select the *Open clone list* menu item.

The	e code b	rowser										
Viewer	*-×\			. 			alama fil					files
Clone	Files and Fragme	nts - none Pairs	coue	e browser	sr		e cione ni	es and	the trage	nents wit	nin the	mes
status	Name	Path	LOC	CLOC Clone		Status	PCID	CCID	Path	SL	EL	CLOC
	BezierPath.j	JHotDraw7.6/Source/jhotdraw	1,248	248 1	5	r	190	80	JHotDraw7	188	196	9
	BezierPathlt	JHotDraw7.6/Source/jhotdraw	335	172	в	Ľ	542	219	JHotDraw7	835	841	7
	ConvexHull	JHotDraw7.6/Source/jhotdraw	261	20	2		543	219	JHotDraw7	855	861	7
	DoubleStro	JHotDraw7.6/Source/jhotdraw	283	120 1	Б	Ľ	598	243	JHotDraw7	1,233	1,246	14
	Geom.java	JHotDraw7.6/Source/jhotdraw	859	206 1	5	Ľ	799	325	JHotDraw7	819	828	10
	GrowStroke	JHotDraw7.6/Source/jhotdraw	91	28	2	Ľ	800	325	JHotDraw7	875	884	10
	Insets2D.java	JHotDraw7.6/Source/jhotdraw	352	56	2	Ľ	1,070	439	JHotDraw7	492	504	13
	Polygon2D.j	JHotDraw7.6/Source/jhotdraw	1,124	480 2	Þ	Ľ	1,071	439	JHotDraw7	590	602	13
						Ľ	1,072	439	JHotDraw7	540	552	13
-						Ľ	1,466	612	JHotDraw7	386	404	19
						Ľ	1,467	612	JHotDraw7	359	377	19
						Ľ	1,517	635	JHotDraw7	509	536	28
]	Ľ	1,518	635	JHotDraw7	559	586	28
							1 5 5 2	651	IHo+Drow7	574	602	20
C iffe	rencer	1					_					
	20	Clone Files					4 Shov	vs the c	lone frag	gments lo	cated ir	n the
3							selec	ted file	s(on the	e left side)	
We disp	can chang played cloi	ge the file selection. ne fragments in the	This right	also chan side.	ge	the						

The previous selection open the code browser in the *viewer* window in a new tab.

An E	Example	Click	on tł	ne che	eckb	0	x to sele	ct or des	elect a f	file			[* -
Clone Fi	les and Fragmants Clon	e Pairs											
Status	Name	Path	LOC	CLOC	Clo		Status	PCID	CCID	Path	SL	EL	CLOC
	BezierPath.java	JHotDraw7.6/Source	1,248	248	15	i I		1,468	613	JHotDraw7	317	344	
	BezierPathIterator.java	JHotDraw7.6/Source	335	172	8			1,469	613	JHotDraw7	249	276	
	ConvexHull.java	JHotDraw7.6/Source	261	20	2								
	DoubleStroke.java	JHotDraw7.6/Source	283	120	10		7						
	Geom.java	JHotDraw7.6/Source	859	206	16								
	GrowStroke java	HotDraw7.6/Source	91	28	2								
	Insets2D.java	JHotDraw7.6/Source	352	56)								
	lygon2D.java	JHotDraw7.6/Source	1,124	480	20								
	Selected f	ile)			/						
Differe	Only two clone We can also c fragment.	e fragments are hange the selec	e loca	ated ir . Click	n the	e 01	selected n the che	Insets2[eckbox se).java fil elect∕de	le select a	clone		

Suppose, we want to analyze the clone fragments located only in the Insets2D. java file. We need to deselect all files except Insets2D.java file by clicking on the checkboxes. From the right side, we can see that only two code fragments are located in this file.

Examining clo	one pairs
🗆 Viewer 👌 🗕 🗙 🔪	(* - ₽>
Clone Code Browser 🔀	Clone pairs(second tab of the code browser)
Clone Files and Fragment	Clone Pairs
No PCID-1 36 1,468	CCID-1 Path-1 SL-1 EL-1 CLOC-1 PCID-2 CCID-2 Path-2 SL-2 EL-2 CLOC-2 613 JHotDraw 317 344 28 1,469 613 JHotDraw7 249 276 28
	Click on a row to select a clone pair
Differencer	
JHotDraw7.6/Source/jhotdr 317 th 318 th 319 th 320 }	aw7/src/main/java/org/jhotdraw/geom/Insets2D.java is.left = left; is.left = left; is.left = right; is.right = right;
321 322 @Override 323 public 324 re	<pre>254 @Override 255 public double getTop() { 256 return top;</pre>
325 326 327 @Override 328 public 329	Source code of the selected clone pair
330 } 331 332 @Override	262 } 263 264 @Override 265

For the selected clone fragments, the next tab in the code browser shows the clone pairs. Selecting a clone pair also displays the code fragments in the bottom panel.

Source code difference analysis Differencer Click on this button to see the differences in the clone code fragments nain/java/org/jhotdraw/geom/Insets2D.java_jHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/geom/Insets2D.java 1 HotDra b/Source/It tdrawi this.left = left: . 317 000 **Diff Viewer** 318 319 Source Path tDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/geom/Inse Source Path 6/Source/jhotdraw7/src/main/java/org/jhotdraw/ 320 PCID 1468 tart Line 317 End Line 344 PCID 1469 Start Line 249 End Line 276 321 this.top = top; this.top = top; . . 323 this.left = lef this.left = left; 2 324 this.bottom = this.bottom = bottom; 325 thie right right - right 326 A diff viewer shows the differences of the code fragments 327 328 blic double getTop() { PCID is a number that uniquely identifies a clone fragment return top; . 4 •

We can understand the source code differences using the diff viewer. In the above figure, the two clone fragments are exact copy of each other.

Similar to PCID, another number(CCID) is used to uniquely identify each clone class.

You can use this view to analyze and compare clone files with grouping and selection features.

Make selection

Select a target directory. Right click on the selected directory to open the popup menu and select *Open Clone File List* menu item.

We can select a clone file from the list of files.

This view has some advantages. It groups clone fragments located within the selected file(labelled with 1). For the selected clone fragment, it also groups all clone fragments that falls within the same clone class(labelled with 2).

The left and right part shows the same list of clone files. We can change the selection and compare the related clone fragments side by side.

Visualization

Introduction

Visualization plays an important role in code clone analysis since it can provide high level overview of cloning in a system. At present, VisCad supports three different visualizations which are scatter plot, treemap and hierarchical dependency graph.

A scatter plot can be viewed as a two dimensional matrix where each cell represents the cloning status between a pair of files or directories. In VisCad, cells render the clone pairs distributed between a pair of files or directories using a color heatmap. Cells are also labelled in the horizontal and vertical axes.

Opening a scatter plot

Select a directory from the system navigation tree and right click on it to open a popup menu. Click on the *Scatter Plot View* menu item.

An example

Scatter Plot 🔀																	
Level											1 ▲ S	ort(By	CLOC) Sort(By Clones)	Selection Type	⊖ File	Folder	() Both
	JHot Draw 7.6 /Source /Jhot draw	JHot Draw 7.6 /Source (Jhot draw?	JHot Draw7.6 /Source () hot draw2	JHot Draw 7.6 /Source () hot draw?	JHot Draw 7.6 /Source /Jhot draw	JHot Draw? .6 /5 ou rce /] hot draw?	JHot Draw7.6 /Source /Jhot draw2	JHot Draw 7.6 /Source / Jhot draw 2	JHot Draw 7.6 /Source /Jhot draw?	JHot Draw 7.6 /Source /Jhot draw	JHot Draw? .6 /Source () hot draw?	JHot Draw 7.6 /Source /Jhot draw 2					
JHotDraw7.6 /Source/jhotdraw7 /src/main/java/org/jhotdraw/app																	
JHotDraw7.6 /Source/jhotdraw7/src/main/java/org/jhotdraw/beans																	
JHotDraw 7.6 / Source / jhotdraw 7 / src / main / java / org / jhotdraw / color																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/draw																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/geom																	
JH ot Draw 7.6/Source / jh otdraw 7/src/main/java/org/jh otdraw/gui																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/io																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/samples																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/text																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/undo																	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/uti																	
JHot Draw 7.6 /Source/jhot draw 7/src/main/java/org/jhot draw/xml																	

The previous selection opens the above scatter plot on a new tab in the *viewer* view panel (in the middle of the VisCad user interface).

Options	
Scatter Plot	
Level	Sort(By CLOC) Sort(By Clones) Selection Type O File Folder Both
You can change the level to compare more files or directories inside the selected directory	You can compare files, directories or both
1 2 You can sort the cell JHotDraw 6 (56)	
JHotDraw7.6/Source/Jhotdraw7/src/main/java/org/jhotdraw/beans	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/color	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/draw	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/geom	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/gu	
JHotDraw7.6/Source/Jhotdraw7/src/main/Java/org/Jhotdraw/Io	ell colour represent the clone pairs common
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/samples	eteen the directories
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/text	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/undo	
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/uti	
jhot Draw 7.6 /Source/jhot draw 7/src/main/java/org/jhot draw/xml	

Example of Sorting

□ Viewer ₹ _ ×														(×
Scatter Plot 🞇														
Level		1	Sort(B	y CLOC	C) So	rt(By C	Clones)	Se	election	n Type	0	File	Folder	🔿 Both
	JHotDraw7.6/Source/Jhotdra													
lot Draw 7.6 / Source / jhotd raw 7 / s rc / main / java / org / jhotd raw / samples														
JHot Draw 7.6 /Source / jhotdraw 7 /src /main / java / org / jhotdraw / draw														
JH ot Draw 7.6/Source / jhot draw 7/src / main / java / org / jhot draw / app														
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/color														
JHot Draw 7.6 / Source / jhotd raw 7 / src / main / java / org / jhotd raw / gui														
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/geom														
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/util														
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/xml														
HotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/text														
JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/undo														
HotDraw 7.6/Source (ibotdraw 7 (src (main (iava (oro (ibotdraw (beans														▼

Sorting allows to identify cloning patterns easily.

You can hold the right mouse button and move it in the inward or outward direction to perform zoom in or zoom out operations. The above figure shows an example of zoom out operation. You can also identify the files or directories involved with a cell with tooltip by holding the mouse pointer on the cell.

Treemap

Treemap preserves the hierarchical structure of subject systems where each rectangle represents a file or directory. The rectangles representing the files are aggregated to indicate the cloning status of a directory in the system hierarchy.

Select a directory and right clink on it to open the popup menu. Click on the Show TreeMap menu item.

A dialog box appears that can be used to configure thre treemap. Click on the ok button to open the treemap.

An Example

An example of a treemap for the JHotDraw system(Version 7.6). Putting the mouse over any rectangle will provide details information about that using a tooltip.

Zoom in or zoom out

Right click on rectangle representing a directory opens a popup menu. You can then perform zoom in or zoom out operation.

An example of zoom in operation

An example of zoom in operation on the *samples* directory. We can select the zoom out operation to move one step back or can select the *unzoom to root* option to move back to the beginning state.

Obtaining source code of the clone fragment

fi	gures	
	Zoom in	
	Zoom out	
	Unzoom To Root	
	Get Sources	

Right click on a rectangle and select the *Get Source* menu item. This will open the clone code fragments of the file(s) in a new tab using the clone code browser. For details about the code browser, see Analyze Clone Fragments.

You can understand how the clone fragments of a clone class are distributed with the help of a treemap. Select a clone class from the bottom-left panel and the files containing those clones will be marked with red color in the treemap.

Hierarchical Dependency Graph

Clones are more problematic when members of a clone class scattered in different parts of a software system because this requires changes need to be made in different parts of the system. Thus, it is required to discover how clone fragments are distributed across subsystems/directories. Moreover, understanding cloning relationships among different subsystems can also reveal their dependencies. VisCad can render the hierarchical organization of a software system along with the distribution of clones using a hierarchical dependency graph.

Opening the graph

Select a directory from the system navigation tree and right click on it to open a popup menu. Click on the *Hierarchical Dependency Graph* menu item.

Cor	nfigure the graph	
Cor	figure the graph	Number of Common Clone Classes 💌 Number of Common Clone Classes Number of Clone Pairs Common None
	Node Height Coupling 💌 Node Width Cohesion 💌	3 OK Cancel

Edge width can represent number clone classes/clone pairs distribued between a pair of directories. Nodes width and height can represent cohesion and coupling value. Click on the ok button when you are done.

Suppose we want to understand which directories in the system contain the external clones of the color directory. We select the *color* directory from the system navigation tree, open the popup menu and select the *Hierarchical Dependency Graph*.

With the default settings, we get a graph as shown in the above figure. From the figure we can understand that the color directory has external cloning relationship with the *gui*, *undo* and *beans* directories.

VisCad visualizes the graph by filtering those nodes that do not have any cloning relation with the selected directory.

The above figure shows the hierarchical dependency graph for the *jhotdraw/draw* directory. In this case, node's (representing the directory) width and height represent the clone cohesion and coupling value. Node color value represent the external cloning relation level with the target directory.

In the *picking* mode, you can select individual node and move them. In the *transforming* mode, you can move the entire graph.

Right click on a node(representing a directory) opens a popup menu. You can then select the target operation. The clone pairs(internal/external) will be viewed in a new tab using the *clone pair browser* component (see the next figure).

Example of a clone pair browser

🗆 Viewer 🛛	/×_*											(×	
Hierarchic	al Depende	ency Graph		external cl	one pairs	×							
Clone Pai	r Browser												
External clo	one pairs f	or the dire	ctory: /Use	ers/muhamr	mad/880R	esearch/Si	mian/JHotE	Draw7.6/So	ource/jhoto	draw7/src/r	nain/java/	org/jhotdr	
No	PCID-1	CCID-1	Path-1	SL-1	EL-1	CLOC-1	PCID-2	CCID-2	Path-2	SL-2	EL-2	CLOC-2	
1	1,152	473	JHotDra	104	118	15	1,154	473	JHotDra	105	119	15 🔺	
2	1,153	473	JHotDra	109	123	15	1,154	473	JHotDra	105	119	15 🕮	
3	215	92	JHotDra	195	200	6	216	92	JHotDra	221	226	6	
4	215	92	JHotDra	195	200	6	217	92	JHotDra	191	196	6	
5	215	92	JHotDra	195	200	6	218	92	JHotDra	221	226	6	
6	463	185	JHotDra	54	61	8	465	185	JHotDra	163	170	8	
7	464	185	JHotDra	156	163	8	465	185	JHotDra	163	170	8	
8	452	181	JHotDra	45	54	10	454	181	JHotDra	42	51	10	
9	453	181	JHotDra	46	55	10	454	181	JHotDra	42	51	10	
10	195	83	IHotDra	72	77	6	196	83	IHotDra	42	47	6 💌	
Left> JHo	Left> IHotDraw7.6/Source/ihotdraw7/src/main/iava/org/ihotdraw/samples/draw/DrawApplet.iava												
right> JHo	otDraw7.6	/Source/j	hotdraw7	/src/main/j	java/org/	jhotdraw/	samples/p	oert/PertA	pplet.java	L			
6													
Differer	ncer	1											
05		i i	rawing ra <mark>f (</mark> actBou	esuce, compto p(U)	d=+=11.1		20			ysten.vu f (setBo	c.primeto pomoto p(l	Idotolla	
96		K 1											
97			Click	on this	s huto	n to s	oo tho	source	a coda	differe	ncas		
98		}	CIICK		s buto	11 10 5		30u C	e coue	unrere	inces		
99							101			Tuest			
100			try {	stream <mark>in</mark>	= urt.0	penco	101			try {	stream 1	n = urt.q	
102			Na Na	ano XMLDOM)	Input do	mi = 🕅	102			Na Na	anoXMLDO	MInput da	
103			re re	esult = (Drawing)	domi	104			re re	esult =	(Drawing)	
104			<pre>} fina</pre>	ally { 👘			105			<pre>} fin</pre>	ally {		
105			i i	n.close()	;		106			i i	n.close();	
106		1	i also i				107		1	} also {			
107		1	result	t = null:			100		_	resul:	t = null		
109		}					110]	ł			
110		, r	eturn res	sult;			111			r <mark>eturn</mark> res	sult;		
111							112	A 1000000000	1			▼	
								• • • • • • • • • • • • • • • • • • • •	and the second				

Code Clone Metrics

Introduction

For supporting in-depth clone analysis, VisCad can compute a set of metrics. We can divide the metrics into two broard categories. The first set of metrics (*clone system metric set*) relate clones with the organizational structure of the subject system and can be computed for different system boundaries, such as for the entire system, for subsystems/directories or for source files, as per the user's choice. Depending on the granularity of operation, we can again subdivide them into two groups, the *file metric set* and the *directory metric set*. The next set of metrics (*clone class metrics set*) deals with the clone classes.

VisCad supports four operations for each metric set. These are:

Exporting : Results of metric computations can be exported in CSV (comma separated values)format.
 Plotting : Although metrics are important for quantitative analysis, identifying important patterns from a large set of data is difficult. To avoid such difficulties, users can plot the metrics values with a bar chart which helps in identifying an anomaly within clone patterns easily.

3. Browsing Clone Code: Depending on the metrics values, user may be interested to explore the clone fragments located within a file or directory. VisCad also supports such operation.

4. Sorting : Values can be sorted to locate the maximum or the minimum value easily.

This section discusses the steps for obtaining various metrics values for the clone files located in a directory.

Select a directory

Click on a target directory to select it from the system navigation tree. Metrics will be computed for all clone files located within this directory

Right click on the selected directory to open the popup menu. Select Metrics->Metrics for files from the menu.

Result						
■ Viewer そ _ ×		New Tab Panel				(*_8×
Export Metric values	Plot Browse Code	Bath	Total Clong fragments	Tatal10C	Clana LOC	CREI
	leader.java	IHo Draw7.6/Source/ihotdraw7/src/main/iava/net/n3/nanoxml/CDATAReader.iava	4	193	172	0.8911917
2 Content	Reader.java	JHotDraw7.6/Source/jhotdraw7/src/main/java/net/n3/nanoxml/ContentReader.java	2	212	36	0.16981132
3 ІУМІ В	dar iawa	IllatDray 7.6 / Courses liketdraw 7 / see / main / java / not / n2 / nanoven / //VMI Duilder java	1	216	12	0.05555556
4				633	491	0.7756714
5 Dutton	for three one	a vertice to a		157	112	0.7133758
6 Button	s for three ope	erauons		336	12	0.035714287
7 1. Expo	orting 2. Plottir	ng 3. Browsing clone code fragment		696	78	0.112068966
8				627	40	0.06379585
9				422	14	0.033175357
10 XMLAttr	bute.java	JHotDraw7.6/Source/jhotdraw7/src/main/java/net/n3/nanoxml/XMLAttribute.java	1	151	44	0.29139072
11 XMLEler	ient.java	JHotDraw7.6/Source/jhotdraw7/src/main/java/net/n3/nanoxml/XMLElement.java	5	1138	144	0.12653778
12 XMLPar	erFactory.java	JHotDraw7.6/Source/jhotdraw7/src/main/java/net/n3/nanoxml/XMLParserFactory.java	2	150	36	0.24
13 XMLUtil	ava	JHotDraw7.6/Source/jhotdraw7/src/main/java/net/n3/nanoxml/XMLUtil.java	1	763	14	0.018348623

The computed metrics values for all clone files will be displayed as a new tab panel(titled *File metric Values*) in the viewer window.

Sorting metric values File Metric Values × Export Metric values Plot Browse Code Total Clone fra... Clone LOC **V** Total LOC CRFL No. Name 13 633 0.7756714 4 NonValidator.java 1 CDATAReader.java 193 0.8911917 4 172 5 11 XMLElement.java 1138 144 0.12653778 5 112 0 7133758 E PIReader java To sort the rows by a metric values, click on the column header A downward arrow indicates that values are sorted in descending order. An upward arrow indicates sorting in ascending order. IXMLBuilder.java 216 12 0.055555556 1 3 6 StdXMLBuilder.java 1 336 12 0.035714287

Exporting/Saving metric values

File Metric V	alues 🞇							
Export Metr	ic values Plot Bro	owse Code						
	Name	Total Cl	one fra	Total LOC		Clone LOC	CRFL	
12	XMLParserFactory.jav	/a 2		150		36	0.24	JHotDraw7.6
10	XMLAttribute.java	000			Sav	/e		5.
5	PIReader.java							, \$,
1	CDATAReader.java	Save <u>I</u> n:	📑 muha	ammad		-		
2	ContentReader.java							×,
3	IXMLBuilder.java	880 R	esearch	1 D	ownlo	bads	📑 javad	oc 5,
5	StdXMLBuilder.java	Comp	onents	📑 D	ropbe	jtxldb-0.12		
Э	ValidatorPlugin.java	Core		– d	whelm	kdiff3	ann 5,	
8	StdXMLReader.java			u	meip		app i	
4	NonValidator.java	cyclo	ne	e	kamp	atest-api-diffs		
7	StdXMLParser.java	🗖 Deskt	ор	📑 e	xtens	ions	📑 latest	-javadoc 5
13	XMLUtil.java	📑 Docu	ments	📑 Ir	nages	;	📑 lib	5.
11	XMLElement.java							5,
		4 3333333						•
			_			<u> </u>		
		File <u>N</u> ame	: (file)	MetricRes net_jho	draw)		
		Files of <u>T</u> y	pe: All	Files				•
							3 Save	Cancel

To save the result, follow the following steps:

Step-1: To save the result, click on the *Export Metric Values* button. This will open a dialog box. Select

the folder where you want to save the result.

Step-2: Provide the name of the file you want to save .

Step-3: Click on the Save button to complete the operation.

Plotting metric values

File Metric V	'alues 🞇												
Export Metr	Export Metric values Plot Browse Code												
No.	Name	Total Clone fra	Total LOC 🔺	Τ									
12	XMLParserFactory.java	2	150										
10	XMLAttribute.java	1	151	1									
5	PIReader.java	2	157										
1	CDATAReader.java	4	193										
2	ContentReader.java	2	212										
3	IXMLBuilder.java	1	216										
6	StdXMLBuilder.java	1	336										
9	ValidatorPlugin.java	1	422										
8	StdXMLReader.java	2	627	1									
4	NonValidator.java	13	633	1									
7	StdXMLParser.java	4	696	T									
13	XMLUtil.java	1	763										
11	XMLElement.java	5	1138										

To plot the metric values, click the on the *Plot* button.

You can change the selection to plot different metric values. Putting the cursor over a bar provides the detail path information.

Browsing clone code fragments

File Metric Values 🙀										
Export Metric values Plot Browse Code 2										
No.	Name	Total Clone fra	Total LOC 🔺	Clone LOC	CRFL	Τ				
<u>6</u> 2	XMLParserFactory.java	2	150	36	0.24	Þ				
10	XMLAttribute.java	1	151	44	0.29139072	J۲				
5	PIReader.java	2	157	112	0.7133758	JH				
1	CDATAReader.java	4	193	172	0.8911917	Jŀ				
k.	ContentReader.java	2	212	36	0.16981132	J				
3	IXMLBuilder.java	1 1	216	12	0.055555556	JH				
6	StdXMLBuilder.java	1	336	12	0.035714287	JH				
9	ValidatorPlugin.java	1	422	14	0.033175357	JH				
8	StdXMLReader.java	2	627	40	0.06379585	JH				
4	NonValidator.java	13	633	491	0.7756714	JH				
7	StdXMLParser.java	4	696	78	0.112068966	JH				
13	XMLUtil.java	1	763	14	0.018348623	JH				
11	XMI Element.iava	5	1138	144	0.12653778	IH				

Step-1: Select one or more rows by holding the command key in MAC or control key in Windows. Step-2: Now click on the *Browse Code* Button to analyze the clone code fragments in the selected file(s) with the *source code browser*. This section discusses the steps for obtaining various metrics values for all clone directories within a selected directory. A clone directory is a directory that contains at least one clone fragment.

Select a directory

Click on a target directory to select it from the system navigation tree. Metrics will be computed for all clone directories within it.

Right click on the selected directory to open the popup menu. Select *Metrics->Metrics for directories* from the menu.

Result

🗆 Viewer 👌 🗕	.×											r -
Directory Met	tric Values 🙀 🌔		Ne	w tah nar	nel	C	lick on any	/ column h	eader to s	sort the ro	ws with t	
Export Metric	: Values Plot Bro	wse Code										
ame	2	3 Jne	TLOC	TLOC(Clone	TCLOC	PTCLOC	TF	FAWC	PFAWC	Avg. CRFL	ССН	CCP
jhouraw	JHotDraw7.6/	719	126112	91693	152470	27.6754	230	329	50.229008	2.0089977	1.0	0.0
app	JHotDraw7.6/ 1	1.	10705	6942	4478	16.777206	73	33	45.20548	0.78955793	1.0	0.0
action	JHotDraw7.6/ 7	0	4988	3405	2624	18.20369	52	26	50.0	0.8784873	0.98214287	0.017857144
app	JHotDraw7.6/ 10	6	843	573	500	25.622776	8	3	37.5	0.83936954	0.5694444	0.43055558
edit	JHotDraw7.6/ 24	4	1035	882	1303	31.304348	12	9	75.0	1.5976193	1.0	0.0
file	JHotDraw7.6/									49664423	0.6923077	0.30769232
view	JHotDraw7.6/									1186858	1.0	0.0
window	JHotDraw7.6/									3940363	0.75	0.25
osx	JHotDraw7.6/	 Export 	ting, 2. plc	otting met	ric values	and 3. bro	owsing sou	irce code	of the	15339233	1.0	0.0
beans	JHotDraw7.6/	clone fra	aments ar	e suppote	d by thes	e buttons				112	0.5	0.5
color	JHotDraw7.6/		ginenco ai	e ouppore						5891644	0.9066667	0.09333334
draw	JHotDraw7.6/									1725649	0.880657	0.119343
action	JHotDraw7.6/					11.001200			0010	.6736855	0.8648649	0.13513513
connector	JHotDraw7.6/ 3		970	182	56	2.8865979	11	2	18.181818	0.30147058	0.75	0.25
event	JHotDraw7.6/ 10	0	2118	392	284	6.704438	26	4	15.384615	0.7462152	0.8333333	0.16666667
gui	JHotDraw7.6/ 5		972	862	5648	68.6214	7	5	71.42857	5.462257	0.48333335	0.51666665
handle	JHotDraw7.6/ 1	53	5838	4843	5694	36.86194	26	19	73.07692	1.0247235	0.91292524	0.08707483
io	JHotDraw7.6/ 20	0	1449	1210	1034	24.292616	8	5	62.5	0.87536085	0.71833336	0.2816667
layouter	JHotDraw7.6/ 6		445	217	98	11.011236	6	2	33.333332	0.46978492	1.0	0.0
liner	JHotDraw7.6/ 20	0	713	636	853	53.997196	5	3	60.0	1.3474804	1.0	0.0
locator	JHotDraw7.6/ 2		871	239	62	3.5591273	8	1	12.5	0.25941423	1.0	0.0
print	JHotDraw7.6/ 1		170	149	34	10.0	2	1	50.0	0.22818792	0.5	0.5
tool	JHotDraw7.6/ 4	7	4450	3421	1937	21.146067	20	13	65.0	0.654375	0.87820506	0.12179487
geom	JHotDraw7.6/ 7	5	5943	4553	2799	22.37927	13	8	61.53846	0.6186949	0.9722222	0.027777778
gui	JHotDraw7.6/ 8	6	16080	8882	9229	12.978856	89	30	33.707867	1.4307154	0.8474638	0.15253624
fontchooser	JHotDraw7.6/ 13	3	1540	879	614	16.558441	7	4	57.142857	0.69577664	0.9166667	0.083333336

The computed metrics values for all clone directories will be displayed as a new tab panel(titled *Directory Metric Values*) in the viewer window.

Other operations

Various operations such as sorting, exporting and plotting computed metrics values, and browsing source code of the clone fragments are also supported. For details, see those operations in the discussion for files (Obtaining Metrics For Files).

This section discusses the steps for obtaining various metrics values for the clone classes.

Make the selection

Click on the root node of the clone classes to select it from the clone class tree. Metrics will be computed for all clone classes within it.

Open the popup menu and select the operation

Right click on the selected node to open the popup menu. Select *Clone Class metrics* menu item from the popup menu.

Result						
■Viewer そ_×						
Clone Class Metric Details		New tab panel	To se	ort the rows, clic	k on a column h	eader
Export Values Plot B	rowse Code					
	3 ccs	CCL	Max Length	Min length	Avg. Length	Files Associated
	2	18		9	9.0	1
2	2	12	6	6	6.0	1
3		12	6	6	6.0	2
4	2	14	7	7	7.0	2
5	3	18	6	6	6.0	2
6	4	29	10	6	7.25	4
9 10 11 12 12 12	g, 2. Sorting me selected clone cl	trics values and asses are also p	3. browsing the ossible.	source code of	the clone fragme	ents
13	2	12	0	0	0.0	2
14	2	12	6	6	6.0	2
15	5	30	6	6	6.0	4
16	2	42	32	10	21.0	2
17	2	12	6	6	6.0	1
18	2	16	8	8	8.0	1
19	2	12	6	6	6.0	1
20	2	12	6	b	6.0	2
21	2	18	9	9	9.0	2
22	2	12	6	6	6.0	1
23	2	12	6	6	6.0	1
17.4	7	17	16	16	6.0	7

The computed metrics values for all clone classes will be displayed as a new tab panel(titled *Clone Class Metric Details*) in the viewer window.

Other operations

Various operations such as sorting, exporting and plotting computed metrics values, and browsing source code of the clone fragments are also supported. For details, see those operations in the discussion for files (Obtaining Metrics For Files).

Filtering

Introduction

The first and foremost challenge in clone analysis is the large volume of clone detection results. Not all clones are useful to the user and the objective of the analysis at hand governs the set of the useful clones. Here, the term 'useful clones' refers to those clone fragments that the maintenance engineers are looking for or are interested in. For example, when the objective is to analyze the inter-project clones, users may be more interested in the clone classes whose fragments are distributed across different projects and these clone fragments form the set of useful clones. In that case, we can filter out the clone pairs that are not distributed across different projects. VisCad supports a set of filtering operations to remove clones that are not useful/interesting to the users.

Clones may overlapped each other and removing those overlapping clones also reduces the size of the result set.

Analyze overlapping

Click on a directory to selct it. Right click on it to open the popup menu and select *Analyze Overlapping* menu item.

Overlapping Clone pairs list

	ing 😽											
Filter Overlapped Clones												
141	<pre>bounds = getOwner().get(TRANSFORM).createTransformedShape(bounds);</pre>											
142												
143	<pre>bounds = view.getDrawingToViewTransform().createTransformedShape(bounds); Stacks stacks1;</pre>											
145	STROKE STROKE1; Color strokeColor1:											
146	St	rake stra	ke2:									
147												
	The length of the red bar indicates the level of overlapping											
149		strokel	= Strok	el netEdi	tor l det	Handleott	rihute st	rokellenah	led			
151		strokeC	olor1 = (Color) ge	tEditor()	.getHandl	eAttribut	e(stroke)	Color1Enab	led);		
1 52		stroke2	= (Strok	e) getEďi	.tor().get	HändleAtt	ribute(st	roke2Enab	(led);			
153		stroke			18111 / 1	111 15	• • • • •		lor2Enab	oled);		
154	r.	etse (stroke	List of	[:] overla	ppina c	lone pa	airs		ed).			
156		stroke			PP				or1Disa	abled);		
157		stroke2	= (Strok	e) getEďi	tor().get	HandleAtt	ribute(st	roke2Disa	bled);			
No.	Source	LO	PLO	CCID-1	PCID-1	SL-1	EL-1	CCID-2	PCID-2	SL-2	EL-2	
1	IHotDra	6	0.23	28	64	144	150	504	1427	145	1.00	
		0	0.2.5	20	04	144	120	594	1427	145	163	
2	JHotDra	10	0.34	124	314	126	135	594 448	1090	145	163 139	
2 3	JHotDra JHotDra	10 3	0.34	124 289	314 712	126 161	135 169	594 448 594	1090 1427	145 121 145	139 163	
2 3 4	JHotDra JHotDra JHotDra	10 3 1	0.34 0.11 0.02	124 289 448	314 712 1090	126 161 121	135 169 139	448 594 674	1427 1090 1427 1605	145 121 145 93	163 139 163 121	
2 3 4 5	JHotDra JHotDra JHotDra JHotDra	10 3 1 10	0.34 0.11 0.02 0.45	124 289 448 63	314 712 1090 143	126 161 121 483	135 169 139 492	594 448 594 674 265	1427 1090 1427 1605 656	145 121 145 93 483	163 139 163 121 494	
2 3 4 5 6	JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1	0.34 0.11 0.02 0.45 0.05	124 289 448 63 63	314 712 1090 143 143	126 161 121 483 483	135 169 139 492 492	594 448 594 674 265 268	1427 1090 1427 1605 656 664	145 121 145 93 483 492	163 139 163 121 494 500	
2 3 4 5 6 7	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1	0.34 0.11 0.02 0.45 0.05 0.05	124 289 448 63 63 63	314 712 1090 143 143 143	126 161 121 483 483 483	135 169 139 492 492 492	594 448 594 674 265 268 339	1427 1090 1427 1605 656 664 836	145 121 145 93 483 492 492	163 139 163 121 494 500 501	
2 3 4 5 6 7 8	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1 6	0.34 0.11 0.02 0.45 0.05 0.05 0.24	124 289 448 63 63 63 63 202	314 712 1090 143 143 143 503	126 161 121 483 483 483 420	135 169 139 492 492 492 492 430	594 448 594 674 265 268 339 298	1427 1090 1427 1605 656 664 836 736	145 121 145 93 483 492 492 492 412	163 139 163 121 494 500 501 425	
2 3 4 5 6 7 8 9	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1 1 6 1	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04	124 289 448 63 63 63 63 202 202	314 712 1090 143 143 143 503 503	126 161 121 483 483 483 420 420	135 169 139 492 492 492 430 430	594 448 594 674 265 268 339 298 307	1427 1090 1427 1605 656 664 836 736 755	145 121 145 93 483 492 492 492 412 430	163 139 163 121 494 500 501 425 442	
2 3 4 5 6 7 8 9 10	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1 6 1 1 1 1	0.34 0.11 0.02 0.45 0.05 0.24 0.04 0.03	124 289 448 63 63 63 63 202 202 202 203	314 712 1090 143 143 503 506	126 161 121 483 483 483 420 420 519	135 169 139 492 492 492 430 430 535	594 448 594 674 265 268 339 298 307 383	1427 1090 1427 1605 656 664 836 736 755 936	145 121 145 93 483 492 492 412 430 504	163 139 163 121 494 500 501 425 442 519	
2 3 4 5 6 7 8 9 10 11	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 10 1 1 6 1 1 8	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38	124 289 448 63 63 202 202 203 207	314 712 1090 143 143 503 506 514	126 161 121 483 483 483 420 420 519 323	135 169 139 492 492 492 430 430 535 330	594 448 594 674 265 268 339 298 307 383 495	1427 1090 1427 1605 656 664 836 736 755 936 1200	145 121 145 93 483 492 492 492 412 430 504 323	163 139 163 121 494 500 501 425 442 519 335	
2 3 4 5 6 7 8 9 10 11 12	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1 1 6 1 1 8 8 8	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38 0.25	124 289 448 63 63 63 202 202 202 203 207 207	314 712 1090 143 143 143 503 503 506 514 514	126 161 121 483 483 483 420 420 519 323 323	135 169 139 492 492 492 430 430 535 330 330	594 448 594 674 265 268 339 298 307 383 495 658	1427 1090 1427 1605 656 664 836 736 736 755 936 1200 1571	145 121 145 93 483 492 492 412 430 504 323 323	163 139 163 121 494 500 501 425 442 519 335 346	
2 3 4 5 6 7 8 9 10 11 11 12 13	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 10 1 1 6 1 1 8 8 8 6 -	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38 0.25 0.16	124 289 448 63 63 63 202 202 202 203 207 207 207	314 314 712 1090 143 143 503 506 514 514	126 161 121 483 483 483 420 420 519 323 323 323	135 169 139 492 492 492 430 430 535 330 330 330	594 448 594 674 265 268 339 298 307 383 495 658 678	1427 1090 1427 1605 656 664 836 736 755 936 1200 1571 1614	145 121 145 93 483 492 492 412 430 504 323 323 325 492	163 139 163 121 494 500 501 425 442 519 335 346 354	
2 3 4 5 6 7 8 9 10 11 12 13 14 4	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 10 1 1 6 1 1 8 8 8 6 3 -	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38 0.25 0.16 0.14	124 289 448 63 63 202 203 207 207 207 207 205	314 712 1090 143 143 143 503 503 506 514 514 514 656 22.2	126 161 121 483 483 483 420 420 519 323 323 323 483 483	135 169 139 492 492 492 430 430 535 330 330 330 494 424	594 448 594 674 265 268 339 298 307 383 495 658 678 268	1427 1090 1427 1605 656 664 836 736 755 936 1200 1571 1614 664	145 121 145 93 483 492 492 412 430 504 323 323 325 492 492	163 139 163 121 494 500 501 425 442 519 335 346 354 500	
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 16 17 16 17 10 11 12 13 14 15 16 16 16 16 17 16 16 16 16 16 16 16 16 16 16	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 1 6 1 8 8 6 3 3 3	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38 0.25 0.16 0.14 0.14 0.14	124 289 448 63 63 202 203 207 207 265 265	314 712 1090 143 143 503 506 514 514 556 656 656 524	126 161 121 483 483 483 420 420 519 323 323 323 483 483	135 169 139 492 492 430 535 330 330 494 494	594 448 594 674 265 268 339 298 307 383 495 658 678 268 339	1427 1090 1427 1605 656 664 836 736 755 936 1200 1571 1614 664 836 226	145 121 145 93 483 492 492 492 412 430 504 323 323 325 492 492 492	163 139 163 121 494 500 501 425 442 519 335 346 354 500 501	
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	10 3 1 10 1 10 1 1 6 1 1 8 8 8 6 3 3 9 2	0.34 0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38 0.25 0.16 0.14 0.14 0.47 0.22	124 289 448 63 63 63 202 202 202 203 207 207 207 207 207 207 265 265 268	314 314 712 1090 143 143 503 506 514 514 656 664 701	126 161 121 483 483 483 420 420 519 323 323 323 323 483 483 492	135 169 139 492 492 430 535 330 330 494 494 500	594 448 594 674 265 268 339 298 307 383 495 658 678 268 339 252	1427 1090 1427 1605 656 664 836 736 755 936 1200 1571 1614 664 836 836 836	145 121 145 93 483 492 412 430 504 323 325 492 492 492	163 139 163 121 494 500 501 425 442 519 335 346 354 500 501 501 501 501 501 501	

VisCad analyzes and shows the list of overlapping clone pairs.

Set threshold value for overlapping clone filtering

Overlapp	ing 🞇										
Filter Overlapped Clones											
111		boonds	= aetOwne	er <mark>().aet(</mark> T	RANSFORM)	.createTr	ransf orme d	IShape <mark>(</mark> bo	unds):		-
142											
143	At first, click on this button										
145											
146	St	roke stro lan atrok	ike2; cColor2;							_	
147	CO	tor strok	ecotorz;								
149											
150	S S	elect tl	he thre	shold v	alue fo	r ovela	ppina c	lone fil	terina		
151	2	0.000 0.		0.10101			pp				
152	\sim	stroke	olor2 = (Color) ge	tEditor()	.getHandl	eAttribut	e(stroke	Color2Enal	bled):	
154	}	else { 👘				, and the second					
155		stroke1	= (Steel	A) antEdi	tan() an	Upped Lotte	reibuto(ct r	reke1Dis	abled);	1.7 . 15	
156		stroke:		00	Over	oing rite	1		Color1D1sa abled)•	abled);	
107		J SLIUKEZ		Select	overlapping	threshold t	o perform f	iltering	auteu/,	1	
No.	Source	LO	PI õ	ם ן =					PCID-2	SL-2	EL-2
1	JHotDra	6	0.23	0 1	0 20 30	40 50 60	70 80	90 100	1427	145	163
2	JHotDra	2	0.34		01		_	-	1090	121	162
3	HotDra	3	0.11		OK	Cancel		-	1427	03	105
5	HotDra	10	0.02	63	43	483	492	265	656	483	494
6	HotDra	1	0.05	63	143	483	492	268	664	492	500
7	JHotDra	1	0.05	63	143	483	492	339	836	492	501
8	JHotDra	6	0.24	202	503	420	430	298	736	412	425
9	JHotDra	1	0.04	202	503	420	430	307	755	430	442
10	JHotDra	1	0.03	1			-				519
11	JHotDra	8	0.38	ial and			to filts				335
12	JHotDra	8		ICK ON 1	the ok I	button	to filte	r the c	iones		346
13	JHotDra	6				-					354
14	JHotDra	3	0.14	265	656	483	494	268	664	492	500
15	HotDra	3	0.14	265	656	483	494	339	836	492	501
	jiiotera	-				105					
16	JHotDra	9	0.47	268	664	492	500	339	836	492	501

Saving the result

🛞 🛛 Filter (Overlapped C	lones									
141		bo un d s	= getOwne	r().get(T	RANSFORM)	.createTr	ansf ormed	IShape <mark>(</mark> bou	in d s);		-
142	}			.	—		- -		h		
143	<pre>3</pre>										
144	Color strokeColor1:										
146	Stroke stroke2:										
147	Color										
148	⁸ Click on the Yee butten to energy a dialog bey										
149	if (Click on the res button to open a save dialog box.										
150		steelee	alas1 - (Color) co	+Editme()	actUprd1	odttoibut	olotookoC	oloc1Epp	lodly	
151		strokec	= (Strok	e) netEdi	tor() get	Handleått	ribute(st	roke2Enab	led).	(leu);	
153		strokeC	olor2 = (Color) de	tEditor()	getHandl	eAttribut	e(stroke)	olor2Enab	oled):	
154	}	else { 👘				, v					33
155		stroke1	= (Strok	e) getEdi	.tor() get	HandleAtt	ribute(st	roke1Disa	bled);		89
156		strokeC	olor1 = (1000	Result	of filtering	1	strokeC	Color1Disa	abled);	
157		STROKE2	= (Strok	6			,	KeZU1sa	bled);		-
No.	Source	LO	PLO	I 🤈				CCID-2	PCID-2	SL-2	EL-2
1	JHotDra	6	0.23	•	Do yo an	t to export t	he result?	4	1427	145	163 🔺
2	JHotDra	10	0.34	1	Yes	No		8	1090	121	139 🔛
3	JHotDra	2								1	
		2	0.11	1		_		4	1427	145	163
4	JHotDra	1	0.11	448	1090	121	139	4 674	1427 1605	145 93	163 121
4 5	JHotDra JHotDra	1 10	0.11 0.02 0.45	448 63	1090 143	121 483	139 492	4 674 265	1427 1605 656	145 93 483	163 121 494
4 5 6	JHotDra JHotDra JHotDra	1 10 1	0.11 0.02 0.45 0.05	448 63 63	1090 143 143	121 483 483	139 492 492	4 674 265 268	1427 1605 656 664	145 93 483 492	163 121 494 500
4 5 6 7	JHotDra JHotDra JHotDra JHotDra	1 10 1 1	0.11 0.02 0.45 0.05 0.05	448 63 63 63	1090 143 143 143	121 483 483 483	139 492 492 492	4 674 265 268 339	1427 1605 656 664 836	145 93 483 492 492	163 121 494 500 501
4 5 6 7 8	JHotDra JHotDra JHotDra JHotDra JHotDra	1 10 1 1 6	0.11 0.02 0.45 0.05 0.05 0.24	448 63 63 63 202	1090 143 143 143 503	121 483 483 483 420	139 492 492 492 492 430	4 265 268 339 298	1427 1605 656 664 836 736	145 93 483 492 492 412	163 121 494 500 501 425
4 5 6 7 8 9	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	1 10 1 1 6 1	0.11 0.02 0.45 0.05 0.05 0.24 0.04	448 63 63 63 202 202	1090 143 143 143 503 503	121 483 483 483 420 420	139 492 492 492 430 430	4 265 268 339 298 307	1427 1605 656 664 836 736 755	145 93 483 492 492 412 430	163 121 494 500 501 425 442
4 5 6 7 8 9 10	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	1 10 1 1 6 1 1 1	0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03	448 63 63 63 202 202 202 203	1090 143 143 143 503 503 506	121 483 483 420 420 519	139 492 492 492 430 430 535	4 265 268 339 298 307 383	1427 1605 656 664 836 736 755 936	145 93 483 492 492 412 430 504	163 121 494 500 501 425 442 519
4 5 6 7 8 9 10 11	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	1 10 1 1 6 1 1 1 8	0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38	448 63 63 63 202 202 202 203 207	1090 143 143 143 503 503 506 514	121 483 483 420 420 519 323	139 492 492 430 430 535 330	4 265 268 339 298 307 383 495	1427 1605 656 664 836 736 755 936 1200	145 93 483 492 492 412 430 504 323	163 121 494 500 501 425 442 519 335
4 5 6 7 8 9 10 11 12	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	5 1 10 1 1 6 1 1 8 8 8	0.11 0.02 0.45 0.05 0.05 0.24 0.04 0.03 0.38 0.25	448 63 63 202 202 202 203 207 207	1090 143 143 143 503 503 506 514 514	121 483 483 420 420 519 323 323	139 492 492 430 430 535 330 330	4 265 268 339 298 307 383 495 658	1427 1605 656 664 836 736 755 936 1200 1571	145 93 483 492 492 412 430 504 323 323	163 121 494 500 501 425 442 519 335 346
4 5 6 7 8 9 10 11 12 13	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	5 1 10 1 1 6 1 1 8 8 6	0.11 0.02 0.45 0.05 0.24 0.04 0.03 0.25 0.16	448 63 63 63 202 202 203 207 207 207 207	1090 143 143 143 503 503 506 514 514 514	121 483 483 420 420 519 323 323 323	139 492 492 430 430 535 330 330 330	4 265 268 339 298 307 383 495 658 678	1427 1605 656 664 836 736 755 936 1200 1571 1614	145 93 483 492 492 412 430 504 323 323 325	163 121 494 500 501 425 442 519 335 346 354
4 5 6 7 8 9 10 11 12 13 14	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	3 1 10 1 6 1 8 8 6 3	0.11 0.02 0.45 0.05 0.24 0.04 0.03 0.38 0.25 0.16 0.14	448 63 63 63 202 202 202 203 207 207 207 207 207 265	1090 143 143 143 503 503 506 514 514 514 656	121 483 483 420 420 519 323 323 323 483	139 492 492 430 430 535 330 330 330 494	4 2674 268 339 298 307 383 495 658 678 268	1427 1605 656 664 836 736 735 936 1200 1571 1614 664	145 93 483 492 492 412 430 504 323 323 325 492	163 121 494 500 501 425 442 519 335 346 354 500
4 5 6 7 8 9 10 11 12 13 14 15	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	3 1 10 1 6 1 8 8 6 3 3	0.11 0.02 0.45 0.05 0.24 0.04 0.03 0.38 0.25 0.16 0.14 0.14	448 63 63 202 202 202 203 207 207 207 207 207 265 265	1090 143 143 143 503 503 506 514 514 514 656 656	121 483 483 420 420 519 323 323 323 483 483	139 492 492 492 430 535 330 330 330 494	4 2674 268 339 298 307 383 495 658 678 268 339	1427 1605 656 664 836 736 735 936 1200 1571 1614 664 836	145 93 483 492 492 412 430 504 323 323 325 492 492	163 121 494 500 501 425 442 519 335 346 354 500 501
4 5 6 7 8 9 10 11 12 13 14 15 16	JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra JHotDra	3 1 10 1 1 6 1 1 8 8 8 6 3 3 9	0.11 0.02 0.45 0.05 0.24 0.04 0.03 0.38 0.25 0.16 0.14 0.14 0.47	448 63 63 202 202 203 207 207 207 207 265 265 268	1090 143 143 143 503 503 506 514 514 514 656 656 656 664	121 483 483 420 420 519 323 323 323 483 483 483 492	139 492 492 430 430 535 330 330 330 330 494 494 500	4 265 268 339 298 307 383 495 658 678 268 339 339	1427 1605 656 736 736 755 936 1200 1571 1614 664 836 836	145 93 483 492 492 412 430 504 323 323 323 325 492 492 492	163 121 494 500 501 425 442 519 335 346 354 500 501 501

Saving the result(Continued)

_ 1

Overlap	ping 💢										
Filter	Overlapped C	lones									
141		bounds :	= getOwne	er <mark>().get(</mark> T	RANSFORM).create	Transforme	edShape(b	ounds);		^
142	.2 }										
143	<pre>bounds = view.getDrawingToViewTransform().createTransformedShape(bounds);</pre>										
144	4 Stroke strokel;										
145	5 Color StrokeColor1; 6 Stroke stroke2;										
147	Co	lor stroku	eColor2:								
148			,								
149	if		- •								
150		Set	: the na	ame an	d locat	ion of	the file	;			
151	(1)								ed);	
152											
153	τ.	880	Research		Dov 🔁	wnloads		📑 ja	vadoc	ed);	
155		Cor	nponents		📑 Dro	obox		📑 itə	db-0.12		
156										led):	
157			core dwneiper kdiff3.app								-
Na	Courses	cyc	🗖 cyclone 🔰 🔄 examples 📑 latest-api-diffs						61.2	EL 2	
NO.	Source	🗧 📑 Des	ktop		📑 ext	ensions		📑 lat	test-javadoc	3L-2	162
1	JHOLDFa	Doc	uments		Images			📑 lik		45	105 -
2	JHotDra		uniterity			ges		II.		21	139
3	JHotDra	3	00000000000							45	163
4	JHotDra	1 00000								3	121
5	JHotDra	File Nan	ne:							83	494
6 6	JHotDra	1 Files of	Turney	Files						92	500
	HotDra	1 Files of	Type: All	Files					•	92	501
Cliel	on this	huttor		va tha	rocult					12	425
	con this	DULLOI	i to sa	vetne	result				Cancel	30	442
-	-	-					_	-		//.04	519
11	JHotDra	8	0.38	207	514	323	330	495	1200	323	335
12	JHotDra	8	0.25	207	514	323	330	658	1571	323	346
13	JHotDra	6	0.16	207	514	323	330	678	1614	325	354
14	JHotDra	3	0.14	265	656	483	494	268	664	492	500
15	JHotDra	3	0.14	265	656	483	494	339	836	492	501
16	JHotDra	9	0.47	268	664	492	500	339	836	492	501
17	JHotDra	8	0.28	286	701	135	144	552	1330	137	155 🗸

VisCad saves the filtered clone detection result as a VisCad input file format.

Textual filtering

Textual filtering allows to remove clones that are only structurally similar without having any semantic similariy. For each clone class, VisCad determines the clone fragment that maximizes the sum of the textual similarity to all other fragments of that class. We call this fragment as the 'leading clone fragment' for that class. If the textual similarity between the 'leading clone fragment' and any other clone fragment in the clone class falls below a given threshold value, we remove the fragment from the analysis. We discard an entire clone class from the analysis when the textual similarities between the leading clone fragment and all other non-leading clone fragments of that clone class fall below the threshold value.

Make the sele	ection	
	·	
	Clone Class Tree 👌 🔤 🗙 🛛 💎 🦧 🖉	
	JHotDraw7.6 Clone Cla: Browse Source Code view Similarity Filter Clone Class Clone Class Metrics	

Select the *Clone Classes* node from the *Clone Class Tree*. Right click on it to bring the popup menu and select the *Filter Clone Class* option. This open the *similarity browser* view.

Similarity Browser View

Filter the result

Filter the result(Continued)

Similarity Browser	Similarity Browser		e - 0
Sort By Clone Fragment Filter I HotDraw7.6 Circle with blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Circle with blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Circle with blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Circle with blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Circle with blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Circle with blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Circle with the red color represent other clones. Circle Kith blue color indicates leading node for the selected clone Circle With blue color indicates leading node for the selected clone Circle Kith blue color indicates leading node for the selected clone Set the name of the file and the location to save the result Circle Kith blue color indicates leading node for the selected clone Components Javadoc Circle Kith blue color indicates leading node for the selected clone Core Get kith blue color Circle Kith blue color ind	Sort By Clone Fragment: Filter * I HotDraw7.6 Circle with blue color indicates leading node for the selected clone Circles with the red color represent other clones. C CC-101: Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hddraw7 0.0 C CC-201: S Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hddraw7 0.0 C CC-401: S Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hddraw7 0.0 C CC-401: S Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hd 0.0 C CC-6(Fragments: 2) C Main/java/org//hd 0.0 C CC-6(Fragments: 3) C Components D pownloads 0.0 C CC-101: D Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hd C components 0.0 0.0 C CC-101: D Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hd C components 0.0 0.0 0.0 C CC-101: D Path:/HotDraw7.6/Source//hotdraw7/src/main/java/org//hd C core 0.0 0.0 0.0	Similarity Browser	
\diamond		Sort By Clone Fragment Filter JHotDraw7.6 CC-1(Fragments: 2) CC-1(Fragments: 2) PCID: 1 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/c PCID: 2 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhotdraw/c PCID: 3 Path PCID: 5 Path PCID: 5 Path PCID: 6 Path PCID: 7 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhot PCID: 6 Path PCID: 7 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhot PCID: 8 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhot PCID: 9 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhot PCID: 9 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhot PCID: 10 Path: JHotDraw7.6/Source/jhotdraw7/src/main/java/org/jhot<	Circle with blue color indicates leading node for the selected clone Circles with the red color represent other clones.

VisCad saves the filtered clone detection result in VisCad input file format.