Abstract

ConCodeSe ranks the source code files of an application using the details (i.e. summary and description) available on a defect document (i.e. bug report) and aims to place the files that may be relevant to fix the defect at the top-10 position of the result list.

Developed based on Information Retrieval, analogous to web searches, first, the source files of the system are processed to extract the required information. Then, given an error report (e.g. taken from an issue tracking system), it suggests a ranked list of files that may have to be changed to fix the error from most to least likely, as illustrated below diagram. This is achieved by utilising heuristics based on contextual information available in certain positions of the bug report summary and description.



For more details please read the publications at http://www.concodese.com/?cat=3

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1. Download and install

- 1. Ensure that JDK+JRE v11 or higher is installed and JAVA_HOME on the classpath points to it.
- 2. If ConCodeSe is already installed continue with step (4), otherwise download the tool from tools category at <u>http://www.concodese.com/</u>
- 3. Unzip the downloaded file to a location of your choice, e.g. /opt/app/tools/. This creates the subdirectory /concodese. The image below shows the unzipped directory structure.

Name
🕨 📃 bin
ConCodeSe_user_guide.pdf
🔻 📃 config
application.properties
doc
log
README_QuickStart.txt
sample

- 4. Send an email to info@concodese.com asking for a license file. Please include your name/company
- 5. You will receive a license.out file. Place this file into the /config/lic sub-directory under main install directory /concodese

2. Configure server for User Interface and startup

2.1. Startup server in Eclipse

2.1.1. Create New Java project and import the runnable

In Eclipse perform the following steps.

- 1. Create a new Java project using the New Project wizard and specify a name for it.
- 2. In Java settings, select Libraries register, select Classpath then click on Add External JARs button
- 3. In the window that will open, navigate to the install directory as specified in Section 1, Step 5.
- 4. Select ConCodeSe runtime jar file found in directory /concodese/bin to associate it as shown below.

New Java Project	
Java Settings Define the Java build settings.	
Source Projects Libraries Order and Export JARs and class folders on the build path:	Module Dependencies
▼ ⁰ ₀ Modulepath ▶ <mark>ᇓ</mark> JRE System Library [JavaSE-11]	Add JARs
Classpath ConCodeSe-1.1.0.jar - /Users/tezcan/Downloads/concodese/bin	Add External JARs
	Add Variable
Sack Next >	Cancel Finish

5. Click *Finish* button to complete this step and ignore the *new module-info* warning message by clicking on *Don't Create* button. The new project will be in workspace as shown below.



2.1.2. Create New Run Configuration for server

1. Next create a run configuration for ConCodeSe by selecting *Run Configurations* as shown below.



2. Click on New on the left and specify on the right the Project created in Step 1 by browsing it.

3. Click on the *Search* button and browse for class *ConCodeSeJettyServerStarter* as shown below.

Name: ConCodeSeCodeSearchEngine	
🕝 Main 🖉 🖂 Arguments 📑 JRE 😽 Dependencies 🦃 Source 📧 Environment 🔲 Common [P Prototype
Project:	
ConCodeSeCodeSearchEngine	Browse
Main class:	
com.concodese.ConCodeSeJettyServerStarter	Search
Include system libraries when searching for a main class	
Include inherited mains when searching for a main class	
Stop in main	

4. Click on *Dependencies* register tab, select *Classpath Entries* then click *Advanced*... button on the right and select *Add External Folder* radio button as shown below.

Name: ConCodeSeCodeSearchEngine	
🕒 Main (x)= Arguments 🛋 JRE 🔥 Dependencies 👍 Source) 🖾 Environment 🔲 Con	nmon P Prototype
Dependencies	
type filter text	Up
♦ Modulepath Entries ▼ ♥ Classpath Entries	Down
ConCodeSeCodeSearchEngine ConCodeSe-1.1.0.jar - /Users/tezcan/Downloads/concodese/bin/ JRE System Library (JavaSE-11)	Remove
Advanced Options	Add Projects
Select an advanced option:	Add JARs
Add Folders Add External Folder	Add External JARs
	Advanced
Cancel	Override Dependencies
	Restore Default Entries

- 5. From the window displayed, browse to /concodese/config directory and select it by clicking on Open.
- 6. Repeat Steps 4 and 5 for the /concodese/lic directory and select it by clicking on the Open button.
- 7. Move the two directories to the top using the Up button so the final positions are as shown below.



2.1.3. Startup New Run Configuration for server

- 1. Next start the new Run Configuration by clicking on Run button, which will start ConCodeSe server.
- 2. On the Console window of Eclipse, the following output can be seen.

3. Click in the window next to last dashed line and press enter. This will continue the startup and show some info and warning messages that can be ignored. At the end it will show the startup as below.

🖹 Markers 🔲 Properties \, 🤀 Servers 🏙 Data Source Explorer 🛛 Snippets 📮 Console 🔀 🔗 Search 📋 History ConCodeSeCodeSearchEngine [Java Application] /Library/Java/JavaVirtualMachines/jdk-11.0.5.jdk/Contents/Home/bin/java (4 Jan 2020, 16:10:33) this port is in use, please type an alternative port (e.g. 8082) and enter. # Otherwise just press enter to continue. [INF0] 2020-01-04 16:10:38.328 [main] Log.java initialized - Logging initialized @4491ms to org.eclipse.jet [INFO] 2020-01-04 16:10:38,463 [main] Server.java doStart - jetty-9.4.z-SNAPSHOT; built: 2018-08-30T13:59:1 AnnotationParser.java asmVersion - Unknown asm implementation version [WARN] 2020-01-04 16:10:38,573 [main] [INF0] 2020-01-04 16:10:38,574 AnnotationConfiguration.java scanForAnnotations - Scanning elapsed ti [main] [INF0] 2020-01-04 16:10:38,578 [main] StandardDescriptorProcessor.java visitServlet - NO JSP Support for /C [INF0] 2020-01-04 16:10:38,585 [main] ContextHandler.java log - No Spring WebApplicationInitializer types of [INF0] 2020-01-04 16:10:38,589 DefaultSessionIdManager.java doStart - DefaultSessionIdManager worker [main] DefaultSessionIdManager.java doStart - No SessionScavenger set, using [INF0] 2020-01-04 16:10:38,589 [main] HouseKeeper.java startScavenging – node0 Scavenging every 600000ms ContextHandler.java log – Initializing Spring root WebApplicationCont [INF0] 2020-01-04 16:10:38,591 [main] [INF0] 2020-01-04 16:10:38,596 [main] SourceCodeTermExtractionService.java initialize – Property fastDocker ManagementSummaryController.java init – Initializing management [INF0] 2020-01-04 16:10:43,381 [main] [INF0] 2020-01-04 16:10:43,497 [main] SearchAndRankFilesJIRAController.java init - Initializing headers SearchAndRankFilesIDEController.java init - Initializing last DB entr 2020-01-04 16:10:43,500 [INFO] [main] 2020-01-04 16:10:43,503 [TNF0] [main] ConfigurationController.java init - Initializing configuration ContextHandler.java doStart - Started o.e.j.w.WebAppContext@5f9be66c{ 2020-01-04 16:10:43,528 [TNF0] [main] [INF0] 2020-01-04 16:10:45,162 [main] AbstractConnector.java doStart - Started ServerConnector@2a9eedee{HTT [INF0] 2020-01-04 16:10:45,179 [main] [INF0] 2020-01-04 16:10:45,179 [main] Server.java doStart - Started @11344ms

Continue with Section 3 to configure a project.

2.2. Startup server from a Terminal

1. From a terminal (command-line) window, navigate to the /<install-loc>/concodese/bin directory and run the following shell command:

On Unix:/SearchAndRankFilesServer.sh On Windows: SearchAndRankFilesServer.bat

This will start the ConCodeSe Web Server and ask you to choose the runtime port. Press enter to run it on default port 8080 as shown below.

```
ConCodeSe uses port 8080 for its web-browser based UI.
   If this port is in use, please type an alternative port (e.g. 8082) and enter.
Otherwise just press enter to continue.
 Log.java initialized - Logging initialized @1750ms to org.eclipse.jetty.util.log.Slf4jLog
Server.java doStart - jetty-9.4.z-SNAPSHOT
AnnotationConfiguration.java scanForAnnotations - Scanning elapsed time=0ms
StandardbescriptorProcessor.java visitServlet - NO JSP Support for /ConCodeSe, did not fi
ContextHandler.java log - No Spring WebApplicationInitializer types detected on classpath
DefaultSessionIdManager.java doStart - DefaultSessionIdManager workerName=node0
DefaultSessionIdManager.java doStart - No SessionScavenger set, using defaults
HouseKeeper.java startScavenging - Scavenging every 60000ms
ContextHandler.java log - Initializing Spring root WebApplicationContext
SearchAndRankFilesJDEController.java init - Initializing last DB entry key
SearchAndRankFilesJIRAController.java init - Initializing headers
[INF0] 2018-10-09 10:31:50.478 [main]
[INF0] 2018-10-09 10:31:50,664 [main]
[INF0] 2018-10-09 10:31:50,684 [main]
[INF0] 2018-10-09 10:31:50,854 [main]
[INF0] 2018-10-09 10:31:50,873 [main]
[INF0] 2018-10-09 10:31:50,873
[INF0] 2018-10-09 10:31:50,882
[INF0] 2018-10-09 10:31:50,882
[INF0] 2018-10-09 10:31:50,886
[INF0] 2018-10-09 10:31:50,986
[INF0] 2018-10-09 10:32:00,589
[INF0] 2018-10-09 10:32:00,788
                                                                      [main]
[main]
                                                                      [main]
                                                                      [main]
                                                                      [main]
[main]
                                                                                        ContextHandler.java doStart - Started o.e.j.w.WebAppContext@657c8ad9{/ConCodeSe,jar:file
 [INF0] 2018-10-09 10:32:03,373 [main]
[INF0] 2018-10-09 10:32:03,406 [main]
[INF0] 2018-10-09 10:32:03,407 [main]
                                                                                        AbstractConnector.java doStart - Started ServerConnector@54e11c04{HTTP/1.1,[http/1.1]}{0
Server.java doStart - Started @14681ms
```

Continue with the next steps found on the following pages.

2. Alternatively, you can directly specify a different runtime port with SERVER_PORT argument on the startup script as shown.

```
^CTezcan-iMac:bin tezcan$ ./SearchAndRankFilesServer.sh SERVER PORT=8082
ConCodeSe v1.0.0 - Copyright © 2018 Dilshener Consulting. All Rights Reserved.
Started ConCodeSeJettyServer - Tue Oct 09 10:39:36 CEST 2018
[INF0] 2018-10-09 10:39:36,510 [main] LicenseChecker.java checkLicenseDateValidity - Valid license -- continue
SERVER_PORT specified 8082
[INF0] 2018-10-09 10:39:36.642 [main]
                                        Log.java initialized - Logging initialized @700ms to org.eclipse.jetty.util.l
                                        Server.java doStart - jetty-9.4.z-SNAPSHOT
[INF0] 2018-10-09 10:39:36,832 [main]
[INF0] 2018-10-09 10:39:37,023 [main]
                                        AnnotationConfiguration.java scanForAnnotations - Scanning elapsed time=0ms
[INF0] 2018-10-09 10:39:37,030
                                        StandardDescriptorProcessor.java visitServlet - NO JSP Support for /ConCodeSe
                                [main]
[INF0] 2018-10-09 10:39:37,042 [main]
                                        ContextHandler java log - No Spring WebApplicationInitializer types detected
                                        DefaultSessionIdManager.java doStart - DefaultSessionIdManager workerName=nod
[INF0] 2018-10-09 10:39:37,051 [main]
                                        DefaultSessionIdManager.java doStart - No SessionScavenger set, using default
[INF0] 2018-10-09 10:39:37,051 [main]
[INF0] 2018-10-09 10:39:37.055
                                [main]
                                        HouseKeeper.java startScavenging - Scavenging every 660000ms
[INF0] 2018-10-09 10:39:37,070
                                        ContextHandler.java log - Initializing Spring root WebApplicationContext
                                [main]
[INF0] 2018-10-09 10:39:46,625
                                        SearchAndRankFilesIDEController.java init - Initializing last DB entry key
                                [main]
[INF0] 2018-10-09 10:39:46,727 [main]
                                        SearchAndRankFilesJIRAController.java init - Initializing headers
[INF0] 2018-10-09 10:39:49,547 [main]
                                        ContextHandler.java doStart - Started o.e.j.w.WebAppContext@6295d394{/ConCode
ebapp,AVAILABLE}
[INF0] 2018-10-09 10:39:49,593 [main]
                                        AbstractConnector.java doStart - Started ServerConnector@4a5d1a12{HTTP/1.1, [h
[INF0] 2018-10-09 10:39:49,593 [main]
                                        Server.java doStart - Started @13654ms
```

NOTE: You can terminate the running instance of the web server by pressing key combinations Cntrl+C.

Continue with the next Section 3.

3. Create projects and their searchable repository

The user interface to perform a search can be triggered from within an IDE, i.e. Eclipse, as follows.

1. In your IDE, open the <u>internal Web Browser</u>, enter the URL to ConCodeSe in the address field as shown below and then press enter to get to the ConCodeSe configuration page.



NOTE: The port must match the port that was specified previously on startup (Section 1, Step 6).

2. The configuration pages are protected with a user ide and password. You will be asked to enter the userid/password as shown below. Enter the defaults Name: *admin* and Password *adminpass* Please note, you may need to clear session data in your browser before you try with a different user.

	Java EE -	Web Browser - Eclipse	
O + Q + C + C + 29	To view this "JCGRealm Your passwor Name: Password: Rememb	s page, you must log in to area " on localhost:8080. rd will be sent unencrypted. admin •••••••••	Synchronizing 🔐 SVN Re
		Cancel Log In	

NOTE: You can change the defaults in file jcgrealm.txt in /config/lic/ directory.

3. After entering the correct credentials, following configuration panel will be displayed.

ConCodeSe - Con	textual Code	Search and I	Rank Engine
To configure a new project	Click here or to searc	ch Click here or t	o reload Click here
Existing projects and versions	Click below to view	Click below to edit	Click below to delete

4. To configure a new project click on the specified link and the following panel will be displayed.

ConCodeSe ·	- Contextual Code Search and Rank Engine
Configure projec	t
Project name:	* When linking with Jira, ensure the name matches the one in Jira (see user guide).
Project version:	*
Path to source code:	* Please enter as absolute path to the top source folder, e.g. /home/user/myproject/src/
Jira issue URL:	Please enter host, port and uri of the Jira, e.g. http://localhost:8081/rest/api/2/issue/
Jira proxy URL:	If there is a PROXY to your Jira, please enter its host and port only, e.g. proxyhostname:8080
Jira technical user:	
Jira user password:	
Fields with * are required	Click here to save and continue Clear values Return to projects list
	ConCodeSe v1.0.0 - Copyright @ 2018 Dilshener Consulting. All Rights Reserved.

- 5. Enter the name and version of your project followed by the location of its source code file.
- 6. After clicking save and continue, the entered project details will be created in the database and you will be presented with a new panel with the entered info.
- 7. You can choose either to
 - a. Return to the list of projects or
 - b. Choose to start the indexing process for the created projected.
- 8. If you choose to perform indexing you will be warned that this process may take a long time.

ject		
	Javascript	
SWT v3.1	Please note this step may take a long time becasue the source code files will be analyzed and indexed	the one in
Users/tezca	Cancel OK	-

9. During the indexing, you may not be able to perform editing or deletion of a project. Also not be eligible for search on the search panel

Existing projects and versions	Click below to view	Click below to edit	Click below to delete
SWT v3.1 ** INDEXING IN PROGRESS **	View	Edit	Delete

NOTE: If your project has a large number of source code files, e.g. over 2000, it may be advisable to perform the creation and indexing of the repository in batch mode as described in Section 7.

4. Perform a search using one of the following use-cases

4.1 Web-based GUI (aimed for IDE search)

The user interface to perform a search can be triggered from within an IDE, i.e. Eclipse, as follows.

1. In your IDE, open the <u>internal Web Browser</u>, enter the URL to ConCodeSe in the address field as shown below and then press enter to get to the ConCodeSe start page.



NOTE: The port must match the port that was specified previously on startup (Section 1, Step 6).

ConCodeSe - Contextual Code Search and Rank Engine		
Select project name and version:	* If a project and version is not listed then create the repository first as described in the user guid	
Enter bug summary:		
Enter bug description:		
	Click here to search for relevant code files Clear values for restart	
	ConCodeSe v1.0.0 - Copyright © 2018 Dilshener Consulting. All Rights Reserved.	

2. Select the project name and version from the dropdown menu as shown below. If your project and version is not listed then create it by following the steps in Section 3.

Select project name and version:	ECLIPSE v4.11 * If a project and version is not listed then create the repository first (see the user guide).
Enter bug summary:	SWT v3.1 Make detault size of empty composites smaller
Enter bug description:	Could the following two constants in Widget.java be changed to something smaller? /* Default widths for widgets */ static final int DEFAULT_WIDTH = 64; static final int DEFAULT_HEIGHT = 64; Anything less than or equal to 16 would work for us, 0 would be OK too. I have run our tests (JFace, UI, RCP) and they run fine when the constants are 0. Background: When you write an RCP app and enable the cool bar, the cool bar will initially be empty, but 64x64 pixels in size. On Windows, you cannot see the border of the empty coolbar so the user gets a big empty space at the top of their window and might be confused.
	Click here to search for relevant code files Clear values for restart ConCodeSe v1 0.0 - Convright @ 2018 Dilsheper Consulting, All Pichts Reserved

3. Enter the bug report summary and detailed description (e.g. stack trace info etc.) as shown above.

4. Click *"search for relevant code files"* button to get a list of classes ranked in the order of relevance to the entered bug summary and description as shown below.

ConCodeSe - Contextual Cod	e Search and	d Rank Engine 🕱 📄 home.html			
🗇 🔿 🔳 🦑 http://localhos	t:8080/ConC	odeSe/searchAndRankFiles			
Select project name and version:	SWT v3.	1 If your project and versi	on is not listed then click here to configure it (see the user guide).		
Enter bug summary:	Make default size of empty composites smaller				
Enter bug description: Could the following two constants in Widget.java be changed to something smaller? /* Default widths for widgets */ static final int DEFAULT_WIDTH = 64; static final int DEFAULT_HEIGHT = 64; Anything less than or equal to 16 would work for us, 0 would be OK too. I have run our tests (JFace, UI, RCP) and they run fine when the constants are 0. Background: When you write an RCP app and enable the cool bar, the cool bar will initially be empty, but 64x64 pixels in size. On Windows, you cannot see the border of the empty coolbar so the user gets a big empty space at the top of their window and might be confused. Click here to search for relevant code files Clear values for restart					
	Rank	Package name	Source file name (click on it copies into clip-board)		
	01	org.eclipse.swt.widgets	CoolBar		
	02	org.eclipse.swt	SWT		
	03	org.eclipse.swt.widgets	Widget		
	04	org.eclipse.swt.custom	StyledText		
	05	org.eclipse.swt.widgets	Display		

5. Select anyone of the candidate classes by clicking on its name, which will copy the name into the clipboard. Subsequently pasted it into the Open Type window (ctrl+shift+T) to open the source code.

	e vitoto - copyright @ 2019 11 Air 30it	ware Solutions. All Rights P		
Rank	Package name	Source file na	Open Type	
Tank	r ackage name	Cource me m	Enter type name prefix or pattern (*, ?, or camel case):	•
01	org.eclipse.swt.widgets	CoolBar	CoolBar	8
			Matching items:	
02	org.eclipse.swt	SWT	O CoolBar - org.eclipse.swt.widgets	
			org.eclipse.swt.widgets - swt/src_v3.1	_
03	org.eclipse.swt.widgets	Widget		

4.2 JIRA integration with the Web-based GUI

ConCodeSe web based UI can also retrieve the summary and description of an existing issue by automatically accessing the JIRA tool using the issue key. Follow the steps to enable this feature.

- Specify the JIRA user, password and URL in the *application.properties* file. jira.user.name=yourJiraUserId jira.user.password=YourJiraPassWord jira.rest.service.issue.uri=http://localhost:8081/rest/api/2/issue/
 NOTE: Ensure that project.name defined in Section 2 is the same as the project key defined in JIRA.
- 2. Stop the ConCodeSe server job if running (enter Cntrl+C from the terminal where its running)
- Run the following shell command found in /bin directory: ./UpdateContextualRepository.sh On Windows: UpdateContextualRepository.bat
- 4. Restart the server by performing steps 1 and 2 as described in Section 3.1.
- 5. Once the search GUI appears, type in the JIRA issue key into the entry field as shown below.

ÄJIRA Da	shboards - Projects	- Is:		
Swing Ma	widget Tool / SWT-1 ke default size	e of e		
	JIRA Issue key:	SWT-1		Obtain bug details from JIRA
	Select project name and version:	SWT v3.1	≎ * If a project	and version is not listed then create t
	Enter bug summary:			

- 6. Select the project name and version from the dropdown menu as shown below. If your project and version is not listed then create it by following the steps in Section 2.
- 6. Upon pressing "Obtain bug details from JIRA" button, the bug summary and description is automatically retrieved from the JIRA as shown below.

JIRA Issue key:	SWT-1 Obtain bug details from JI
Select project name and version:	SWT v3.1 📀 * If a project and version is not listed ther
Enter bug summary:	Make default size of empty composites smaller
Enter bug description:	Could the following two constants in Widget.java be changed to somethin /* Default widths for widgets */ static final int DEFAULT_WIDTH = 64; stat Anything less than or equal to 16 would work for us, 0 would be OK too. I have run our tests (JFace, UI, RCP) and they run fine when the constant Background: When you write an RCP app and enable the cool bar, the co but 64x64 pixels in size. On Windows, you cannot see the border of the empty coolbar so the use and might be confused. 05/10/18
	Click here to search for relevant code files

7. You can first modify the details, if choose to, and then start a search for relevant source code files.

5. Issue tracking tool integration (currently plug-in for JIRA)

ConCodeSe can be integrated into the JIRA issue-tracking tool to perform an automated asynchronous search for candidate classes and then add them into the issue ticket even before the developer starts working on the reported problem. The below diagram illustrates the integration flow.



In order to set up the flow, ConCodeSe needs to be installed either on a standalone server or on the same server where the JIRA application is currently deployed and running. In either case, both applications must be able to reach each other's URL and port. This mean JIRA must be able to reach ConCodeSe web-service URL to start the search (point 2 in the above illustration) and vice versa ConCodeSe must be able to reach JIRA URL to update the JIRA bug report (point 4 in the above illustration).

NOTE: This step may require ports in the server firewall to be opened for ConCodeSe URL (see below example) to be reachable and the install directory of ConCodeSe may need to be declared in your webserver's configuration file. Please consult your system administrator.

 $e.g.\ http://ip.address.of.the.installed.server:portNumber/ConCodeSe/SearchAndRank/$

Furthermore, you need to be familiar with the following two tasks.

- How to register Webhook in JIRA <u>https://developer.atlassian.com/server/jira/platform/webhooks/</u> Section: Registering a webhook via the JIRA administration console
- Edit your project's workflow to trigger the Webhook upon transition of states, i.e. created, updated. <u>https://confluence.atlassian.com/adminjiraserver/working-with-workflows-938847362.html</u> Section: Editing a project's workflow
 Note: This step may only be necessary if your project's workflow deviates substantially from the standard built in workflows of JIRA.

- 1. Perform steps described in Section 1 and unzip the downloaded ConCodeSe file to a location of your choice on the server, e.g. /opt/app/tools/.
- 2. Create a dedicated user in JIRA for ConCodeSe to update issue tickets. e.g. jira.user.name=ConCodeSe

jira.user.password=SearchAndRank10

4. Configure the project as described in Section 2. You will need to specify the JIRA user, password, URL and the proxy host port (if one used) in the pages and then perform the indexing.

e.g. jira.user.name=ConCodeSe jira.user.password=SearchAndRank10 jira.rest.service.issue.uri=http://localhost:8081/rest/api/2/issue/ jira.rest.service.proxy.uri=localhost:4434

Note: The proxy is needed only if one is used. Also, ensure that project.name property defined in Section 2 is the same as the project name defined in JIRA for which the ConCodeSe is being configured. Otherwise update it in the file.

- 5. Choose to perform one of the following options:
 - a. If the source code of the application is not indexed
 - i. Perform steps described in Section 2 to create the searchable corpus.
 - b. If the source code base is large, i.e. over 2000 code files
 i. Perform steps described in <u>Section 3 to create the searchable corpus in batch</u>.
- 6. Start the ConCodeSe server job by running the shell command: ./concodese_service.sh start This will start the ConCodeSe Web server on port 8080 as headless background job. The process ID and the log info will be written to their dedicated files in the /log sub-directory.
- 7. You can specify a different port using the SERVER_PORT argument on the startup script: On Unix: ./concodese_service.sh start SERVER_PORT=9200
- 8. You can stop the service by running: ./concodese_service.sh stop Other usages are: ./concodese_service.sh { start | stop | restart | status }

9. Login to JIRA tool as an administrator and create a web-hook to ConCodeSe REST service as:

URL: http://localhost:8080/ConCodeSe/searchAndRank/\${project.id}/\${project.key}/\${issue.id}/\${issue.key} Event: issuetype = Bug AND project = <your_project_name> Issue: created AND updated

Note: The host and port that ConCodeSe is running on must be reachable from the JIRA when creating and the order of the arguments on the URL is important as shown in the illustrations below.

WebHooks		
ConCodeSe - Search and Rank files	Name*	ConCodeSe - Search and Rank files
	Status*	Enabled Disabled
	URL*	http://localhost:8080/ConCodeSe/searchAndRank/\${project.id}/\${project.key}/\$
		You can use the following additional variables in the URL: \${issue.id}, \${issue.key}, \${mergedVersion.id}, \${modifiedUser.key}, \${modifiedUser.name}, \${project.id}, \${project.key}, \${version.id} Read more
	Description	Interface to ConCodeSe to search and rank source code files
	Events	Issue related events
		Events for issues and worklogs. You can specify a JQL query to send only events trig
		issuetype = Bug AND project = "CJL"
		Syntax help
		Worklog Issue updated Image: Constant of the second secon
		· vpdated deleted

Note: If ConCodeSe is being configured for multiple JIRA projects, the event JQL can use *in* syntax like: *issuetype* = *Bug AND project in (project_name_1, project_name_2)*

ConCodeSe - S	ConCodeSe - Search and Rank files ENABLED last updated 10/Oct/18 8:24 PM by Tezcan Dilshener				
URL	http://localhost:8080/ConCodeSe/searchAndRank/\${project.id}/\${project.key}/\${issue.id}/\${issue.key}				
Events	Issue related events JQL: issuetype = Bug AND project in ("CJL", "Swing Widget Tool", "Eclipse") Issue: created, updated				
Exclude body	No				
Transitions	No linked transitions.				
	Edit Delete				

10. Create an issue in JIRA by entering a summary and detailed description as shown below.

ConCodeSe GDI+dt	ds • Projects • JIRA Link / CJL-8 rawString is I	Issues → Agile Creat not consistent wi	th GDI 🖊	
Edit Com	ment Assign M	Nore - To Do In Prog	ress Done Admin -	
Details	Bug		Status	TO DO (View Workflow)
Priority:	Dug		Resolution:	
Affects Version/s:	v1		Fix Version/s:	None
Labels:	None			
Description				
If you have a structur But, if a previous visi The chars get expan	re which is rendered t tor has triggered GDI ded and compressed	o a GC, you need to be able +, drawString's behavior is a in funny ways, and generally	to predict things like how larg Itered. y look bad.	ge a String is going to be painted.

6. Upon pressing the create button in JIRA, the ConCodeSe rest service is called in the back ground with the project/issue - key/id values. The rest service asynchronously calls back the JIRA with the issue id to obtain the bug details as shown in the log file.

INFO	- Server	- Started @6823ms
INFO	 archAndRankFilesJIRAController 	– projectId: 10000 / projectKey: CJL / issueId: 10204 / issueKey: CJL-8
INFO	 archAndRankFilesJIRAController 	- JIRA issue info uri: http://localhost:8081/rest/api/2/issue/10204
INFO	 ndRankFilesFrontendServiceImpl 	- bugReport: BugReport[projectId=10000,projectKey=CJL,issueId=10204,issueKey=CJL-8,summary=GDI+ drawStri
ng is	not consistent with GDI, descript:	ion=If you have a structure which is rendered to a GC, you need to be able to predict things like how lar
ge a	String is going to be painted.	
But,	if a previous visitor has trigger	ed GDI+, drawString's behavior is altered.
The o	hars get expanded and compressed	in funny ways, and generally look bad. ,versions=[v1]]
INFO	 ChangeRequestGUIExtractorImpl 	 Extracting Change Request summary and description words.
INFO	 ChangeRequestGUIExtractorImpl 	- Processed Change Requests

7. Subsequently a search is performed in ConCodeSe using the summary and description obtained from the bug details. Finally, the rest service calls back the JIRA rest API to update the comment field of the issue with the candidate classes as shown below in the log file.

INFO	 archAndRankFilesGUIServiceImpl - Searched and ranked files size: 27
INFO	- archAndRankFilesJIRAController - uriUpdate: http://localhost:8081/rest/api/2/issue/10204/comment
INFO	- archAndRankFilesJIRAController - Updated issueId: 10204 - Response from JIRA: 201:Created
TNEO	- archAndPankEilesITPAController - DONE

8. Refresh the JIRA issue to see the comment field updated with the list of classes as shown below.

ivitv —				
,				
All	Comments	Work Log	History	Activity
	onCodeSe - S	ource Code F	Fror Locat	or added a
The	following cand	idate source	code class	es may be
(01)	org.eclipse.sw	t.internal.cart	oon.OS.jav	а
(02)	org.eclipse.sw	t.SWT.java		
(03)	org.eclipse.sw	t.custom.Scro	olledComp	osite.java
(04)	org.eclipse.sw	t.graphics.Te	xtLayout.ja	va
(05)	org.eclipse.sw	t.browser.Bro	wser.java	
(06)	org.eclipse.sw	t.dnd.HTMLT	ransfer.jav	a
(07)	org.eclipse.sw	t.widgets.Dis	play.java	
(00)	org.eclipse.sw	t.custom.CTa	bFolder.ja	/a
(00)				
(08)	org.eclipse.sw	t.widgets.Wid	lget.java	

6. Management information of bug distribution

In conjunction with Jira integration, ConCodeSe offers a break down of bugs created for each project and the number of times a source code file was suggested on reported bugs.

This information can help to identify the hot spots in an application by showing the frequently recommended files, which may be considered as being possible candidates for rewrite.

To access this information, in a browser type in the URL of the server where ConCodeSe is installed followed by /manage for example as shown in the below screen shot.

You will be prompted to enter the security credentials, which by default the user id is *manager* and the password *managerpass* as shown below. Please note that, you may need to clear session data in your browser before you try with a different user.

Iocalhost:8080/ConCodeSe/manag × +		
\leftrightarrow \rightarrow C (i) localhost:8080/ConCodeSe/matrix	inage	
	Sign in http://localho Username Password	manager
		Cancel Sign In

NOTE: You can change the defaults in file jcgrealm.txt in /config/lic/ directory.

Subsequently you will see a list of projects configured in ConCodeSe that interact with Jira as shown below.

• • • S ConCode	eSe - Contextual Code 🗙 🕂					
→ C ① localhost:8080/ConCodeSe/manage						
ConCodeCo	ContorteolC	ada Caanah and Dank Ensina				
ConCodeSe	e - Contextual C	ode Search and Kank Engine				
To perform a searcl	Click here					
Project name	Number of bugs	Click below to view				
ECLIPSE	4	View details				
PPIT	38	View details				
SWT	200	View details				
testProject	2	View details				
ConCodeSe v1.0.0 - Copyright © 2019 IT All Software Solutions. All Rights Reserved.						

Continue with the next steps found on the following pages.

By selecting to view the bug details of a project, you will be presented the list of source code files and the number of bug reports, as shown below, where each file was recommended on as the possible likely candidate to modify to resolve the reported bug.



Additionally, you can select any one of the files and to see the different bug reports were this file was recommended as shown below.



NOTE: Same file may have been recommended multiple times in a single bug report due to updating the description of the bug report with additional information.

7. Batch process of creating the repository for large projects

- 1. From a terminal command line, navigate to the /bin directory where ConCodeSe is installed.
 - e.g. On Unix: cd opt/app/tools/concodese/bin
 - On Windows: cd c:/tools/concodese/bin
- 2. Run the following shell command: ./CreateContextualRepository.sh On Windows: CreateContextualRepository.bat

This will run all the steps and create the searchable repository as shown below.

ConCodeSe v1.0.0 - Copyright © 2018 Dilshener Consulting. All Rights Reserved.
Started ContextualRepositoryCreator - Sun Oct 07 17:55:11 CEST 2018
[INF0] 2018-10-07 17:55:21,480 [main] SearchAndRankFilesIDEController.java init - Initializing last DB entry key
[INF0] 2018-10-07 17:55:21,565 [main] SearchAndRankFilesJIRAController.java init - Initializing headers
[INF0] 2018-10-07 17:55:21,633 [main] ProjectConfigUpdater.java obtainProjectRunParams - Project run parameters: SWT, v3.1, /Users/tezcan/projects/swt/src_v3.1
[INF0] 2018-10-07 17:55:21,754 [main] ProjectConfigUpdater.java loadAndPersistProperties - New project properties will be created for SWT v3.1 /Users/tezcan/pro
[INF0] 2018-10-07 17:55:21,908 [main] ContextualRepositoryCreator.java main - Extracting words from 341
[INF0] 2018-10-07 17:59:16,800 [main] RepositoryCreationService.java createRepositoryFromSourceFiles - Processing source code words took: 234.890 seconds
[INF0] 2018-10-07 17:59:17,756 [main] RepositoryCreationService.java createRepositoryFromSourceFiles - Processing source code comments took: 0.955 seconds
Finished ContextualRepositoryCreator - Sun Oct 07 17:59:17 CEST 2018

NOTES:

- There may be additional information messages regarding parsing some source code files. These messages can be ignored.
- It is advisable to recreate the searchable corpus regularly, for example each time a new version of the source code is available. In order to do this update the file *application.properties* in */config* directory with the relevant project information, i.e. project's name and version, as descried in Section 3 and repeat above Steps 1 through 2.

PERFORMANCE

Computation time for creating the corpus (i.e. parsing java source code files, comments, stemming and indexing) of an application with 6485 source code files takes about 20min on a machine with 3GHz processor and 16GB RAM.

8. Keeping the searchable repository up-to-date

Each time a new version of the source code is checked out into the local repository, i.e. local workspace, it is advisable to rebuild the searchable corpus as follows.

- From a terminal command line, navigate to the directory where ConCodeSe is installed.
 e.g. On Unix: cd opt/app/tools/concodese
 On Windows: cd c:/tools/concodese
- 2. Update the project details, e.g. project name and version, in the *application.properties* file found in */config* directory (see Section 3. Create searchable corpus).
- 3. Repeat steps described in Section 3. Create searchable corpus.
- 4. Perform one of the search options as described in <u>Section 4</u>.

9. How to update your license key

Each time you renew your license please follow the steps below to update the license key file.

- 1. Copy the new license.out file into the following directory, and accept to override the existing one. <concodese-install-dir>/config/lic
- 2. Stop the service by running the following command found in /bin directory <concodese-install-dir>/bin\$./concodese_service.sh stop
- 3. Finally, Start the service by running the following command <concodese-install-dir>/bin\$./concodese_service.sh start
- 4. Check the content of console_output.log file in <concodese-install-dir>/log to see that service is started.

TIP: Before restart, archive the log file (console_output.log) found in <concodese-install-dir>/log directory. The restart will create a fresh new one automatically.

10. How to install a new version of the tool

Each time you receive a notification of a new release, please follow the steps below to update your instance.

- 1. Download the tool from tools category at <u>http://www.concodese.com/</u>
- 2. Unzip the downloaded file to a location of your choice, e.g. /temp/tools/new/. This creates the subdirectory /concodese.
- 5. Go to the installation directory of your current ConCodeSe from a command line.
- 6. Stop the current service by running the following command found in /bin directory <concodese-install-dir>/bin\$./concodese_service.sh stop
- 7. Make a backup copy of the current installation of ConCodeSe to a temp directory. You will need this to restore your license key, the configuration realm passwords file and the projects repository.
- 8. Delete the following directories from your current installation of ConCodeSe.
 - a. <concodese-install-dir>/bin
 - b. <concodese-install-dir>/config
 - $c. \quad <\!\! \text{concodese-install-dir} \!\!\! /\! \text{doc}$
 - $d. \quad <\!\! \text{concodese-install-dir} \!\! >\!\! / \! \log$
 - e. <concodese-install-dir>/sample
- 9. Copy all the directories from the new release directory created in step 2, to your current installation directory, for example, from /temp/tools/new/concodese/ to <concodese-install-dir>/
- 10. Copy the /projects and /config/lic directories from your backup directory (step 5 above) to your current <concodese-install-dir> directory.
- 11. Start the service by running the following command <concodese-install-dir>/bin\$./concodese_service.sh start
- 12. Check the content of console_output.log file in <concodese-install-dir>/log to see that service is started.

11. How to resolve possible problems

In this section, you will find suggestions to resolve any possible problems that may occur.

11.1. The Web-interface is only available on the server

If you have installed ConCodeSe on a central server and want users to access to its UI for performing search, then you may need to

- Open up additional ports to the URL of the server,
 - For example, if it is running on <u>http://your.server:9993/ConCodeSe</u> then port 9993 will need to be accessible from the network. Talk to your network administrator.
- Include mapping to the URL of the tool in the configuration file of the webservers.
 - For example, in the http.conf file of your web-server, provide a declaration to the installation root directory of ConCodeSe and/or proxy. Talk to your system admin.

11.2. The log file shows startup but no interaction with Jira

Please create a dummy issue ticket of type defect (or whatever you specified in the Webhook in step 9 of Section 5), and then refresh your Jira ticket.

If the comments did not get a new entry by the technical user specified in step 2 of Section 5, then have a look at the console_output.log file in directory <concodese-install-dir>/log

If there are no new entries like below then the Jira Webhook call is not reaching ConCodeSe

- Please check the Jira log to see what it says.
- You can usually see the location of the Jira log file in the Jira systems menu
- Log in as a user with the 'Jira Administrators' global permission.
- Choose > System . Select System support > System Info to open the System Info page.
- The name of the field to look is Location of atlassian-Jira.log
- And have a look at the latest entries, e.g. search for "ConCodeSe"
- If there is an exception, correct it accordingly.

Please try again by creating or updating the dummy issue ticket created at the beginning. If still nothing new in the log file, then one of the following is the cause of the problem.

- Webhook is not active
- jql on the webhook is not correct
- URL/port to the tool in webhook is not correct
- The create or update workflow is not triggering the webhook

Please review the Jira configuration steps described in Section 5 and try again. If the problem still persists please contact us by sending support email to <u>info@concodese.com</u>

11.3. The log file shows errors during interaction with Jira

If you installed ConCodeSe locally and you want to obtain details of a bug report by accessing to a Jira instance that is running on a different server, declaring a proxy to that server may be required.

In the configuration of the project, specify the URL of the server where the Jira instance is running with its port number,

For example, your Jira is running on a host called our.remote.jira.server which is accessible on port 334 then enter on **Jira Issue URL**: http://our.jira.server:334/rest/api/2/issue

Also if there is proxy to that Jira server, then enter its host and port on the **Jira proxy host:port** filed For example, your proxy host is proxy.to.our.remote.jira and its port is 8080, and then enter on the field **Jira proxy host:port** as proxy.to.our.remote.jira:8080

NOTE: If ConCodeSe instance is running on the same server where Jira is running, the above steps may not be required. In that case, please enter the **Jira issue URL** without any port.

e.g. http://our.jira.server/rest/api/2/issue

If you receive the following error while communication with a Jira server instance: javax.net.ssl.SSLHandshakeException: Remote host closed connection

The above steps will help to resolve this exception as well. Otherwise, please review the configuration steps described in Section 2 and 3 then try again.

If problems still persist, please contact us by sending support email to info@concodese.com

11.4. The pages of ConCodeSe not found

If you receive the following error indicating that the page is not found as shown below.



Then please check the URL address. It is case sensitive and you must type it in camel-case as below.



11.5. Warnings on server startup in Eclipse

If you receive warning errors indicating as below

WARNING: An illegal reflective access operation has occurred.

Then add the following arguments to JVM in Run Configurations

--add-opens java.base/java.lang=ALL-UNNAMED