

Who Can Help Me with this Change Request?

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Motivation

- Given a new developer with a maintenance task who should they ask for assistance?
- Who is the expert for a given piece of code?
- Open source environment:
 - Distributed with no central management
 - Possibly hundreds of volunteers/developers
 - Developers/managers change over time

Overview of the Approach

KDE Bug Tracking System

Bug 173881 - splitting views duplicates the tool op...
Home Report New Wish or Bug

Actions

Reports
 Requests

Reports

 Bugs reported today
 Bugs reported in the last 3 days
 Bug reports with patches
 Weekly Bug statistics
 Most hated bugs
 Most severe bugs
 Most often reported bugs
 Most wanted features
 Junior Jobs
 Report ownership counts and charts

My Account

 New Account
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Bug **173881**: splitting views duplicates the tool options dockers

Alias: koffice	Version: 2.0 Beta 2
Product: general	Priority: NOR
Status: RESOLVED	Severity: normal
Resolution: FIXED	
Target: ---	

Notes: 0

Description From Hanisch Elián 2008-10-30 07:01:32

Version: 2.0 beta-2 (using 4.1.2 (KDE 4.1.2), Kubuntu packages)
 Compiler: gcc
 OS: Linux (i686) release 2.6.24-21-generic

when you split views, you get another tool options dockers even if there's already one, this new dockers has all options grayed out so it doesn't work. Splitting again creates another dockers.

----- Comment #1 From Jan Hambrecht 2008-11-02 20:35:14 -----

SVN commit 879228 by jaham:

fix duplication of tool options dockers when working in split view mode

BUG:173881

M	+1	-2	KoDockerManager.cpp
M	+18	-4	KoToolDockerFactory.cpp
M	+5	-2	KoToolDockerFactory.h



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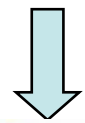
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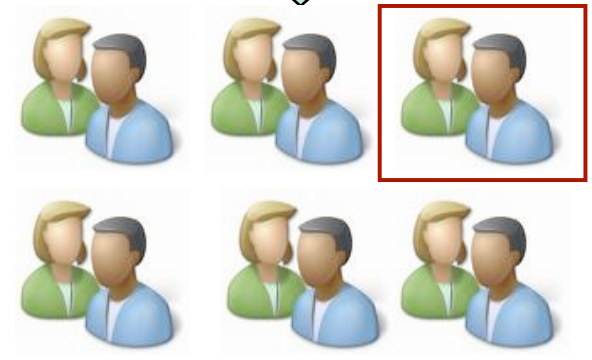
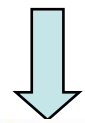
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Our Approach

- Recommend a ranked list of developers to assist in performing changes to a given source code file
- Based on textual analysis of bug reports and similar source code files
 - LSI-based concept location [Marcus'04]
- Based on mining past change records in software repositories (i.e., commits)
 - xFinder [Kagdi'08]

Related Work

- McDonald & Ackerman - use most recent modification date along with user profile information collected separately
- Anvik & Murphy - mine the source and bug repositories
- Minto & Murphy - compute coordination between developers and how files have changed together
- Mockus & Herbsleb - use experience atoms to measure expertise.
- German - studied MR of CVS logs
- Canfora & Cerulo - mine previous change requests for impact analysis

Parsing Source Code Snapshot and Extracting Documents with LSI

- Corpus is a collection of documents (e.g., methods, classes, *files*)

```
public void run(IProgressMonitor monitor)
    throws InvocationTargetException,
        InterruptedException{
    if ( m_iFlag == 0 )
        processCorpus (monitor,checkUpdate ());
    else if ( m_iFlag == 2 )
        processCorpus (monitor,UD_UPDATECORPUS);
    else
        processQueryString (monitor);

    if (monitor.isCanceled())
        throw new InterruptedException("The long running
    )

public void run(IProgressMonitor monitor)
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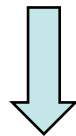
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Removing non-literals

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Removing Stop Words

- Common words in English, programming language keywords

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public void run IProgressMonitor monitor throws  
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Splitting Identifiers

public void run IProgressMonitor monitor **throws** InvocationTargetException
InterruptedException **if** m_iFlag **the** processCorpus monitor checkUpdate **else if**
m_iFlag processCorpus monitor UD_UPDATECORPUS **else a** processQueryString
monitor **if** monitor isCancelled **throw new** InterruptedException **the** long
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- IProgressMonitor = i progress monitor
- InvocationTargetException = invocation target exception
- m_iFlag = m i flag
- UD_UPDATECORPUS = ud updatecorpus

Indexing Current Snapshot of the Software with Latent Semantic Indexing

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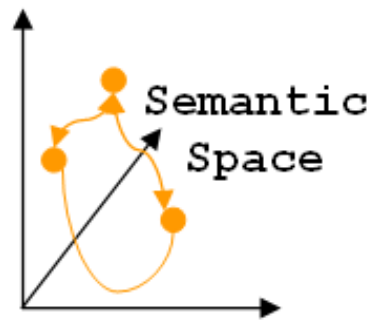
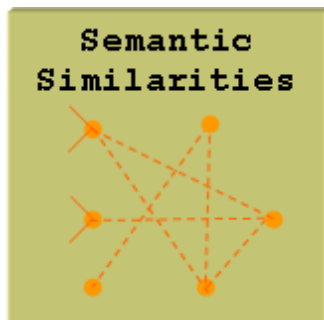
	process	flag	monitor
file1	3	2	6
file2	x	x	x
file3	x	x	x
...	x	x	x



Singular Value Decomposition
(SVD)



Similarity Measure:
Cosine of the contained angle
between the vectors



xFinder

- **Basic premise:**
 - Developers who contributed substantial changes to a specific part of source code in the past are likely to best assist in future changes
- **Levels of expertise:**
 - *File expert*: highest contribution to a specific file
 - *Package expert*: updated the largest number of unique files to a specific package
 - *System expert*: updated the largest number of unique files to the project

xFinder Internals

- Each change is archived via a commit
- These commits are examined to infer the expertise
- Examined data:
 - Committer's ID
 - Date of the commit
 - Files' names and their full paths

xFinder: Contribution Measures

- Number of commits
- Number of workdays
- Most recent workday
- Number of changed files

Determining Expertise using xFinder

- The commit contribution, activity and most recent workday are used to derive a developer-to-code mapping
- Developers are ranked according to this mapping
- If this mapping can't be derived, the number of changed files is used

Example: determining experts for KOffice bug# 173881

- “splitting views duplicates the tool options docker”



Concept Location in Source
code with Information Retrieval

Rank	Class Names	Similarity
1	KoDockManager	0.66
2	ViewCategoryDelegate	0.54
3	ViewListDock	0.51
4	KisRulerAssistantToolFactory	0.49
5	KWStatisticsDock	0.46



xFinder

Rank	File Experts	Package Experts
1	<i>jaham</i>	<i>mpfeiffer</i>
2	<i>boemann</i>	<i>jaham</i>
3		<i>zander</i>

Preliminary Evaluation

- KOffice
 - 911 KLOC
 - 4,756 classes
 - 19,900 unique words
- Sampled 22 bugs out of 128 total between soft-freeze and Beta 04.

Evaluation Methodology

- 1 Select a “fixed” change request
- 2 Select a snapshot of software on or before a day on which change request was reported, but not fixed
- 3 Apply concept location to identify similar files to the change request
- 4 Use xFinder to collect a ranked list of developers
- 5 The developers, who contributed patches are “ground truth”
- 6 Compare 4 and 5
- 7 Repeat above steps for N change requests

Measuring Accuracy of Recommendation for bug# 167009

- “Kword crashes after deleting non existing page”

Files with Relevant Classes	Recommendation Coverage			
	File	Pack	Sys	Ovl
KWFrameDialog.cpp	1	1	0	1
KWShapeConfigFactory.cpp	1	1	0	1
FrameViewTester.cpp	0	1	0	1
KWDocument.cpp	1	1	0	1
KWTextFrameSet.cpp	1	1	1	1
KWFrameSet.cpp	1	1	1	1
FrameSet.h	1	1	0	1
KWFrameConnectSelector.cpp	1	1	0	1
KWGeneralFrameProperties.cpp	1	1	0	1
Accuracy (%)	90	100	20	100

Results for KOffice Bugs

Bug #	Bug description excerpt	Accuracy (%)				Ranking Effectiveness			
		File	Pkg	Sys	Ovl	R _f	R _p	R _s	R _o
124527	Displaying calculation results	20	20	0	20	5	5	–	5
125306	Can't undo 'Insert Calendar' tool	0	30	70	100	–	2	1	1
130922	Import from xls treats borders wrong	0	0	90	90	–	–	1	1
137639	Inverted radial gradient colors	20	60	0	60	1	1	–	1
140603	!= in cell formula is buggy	0	10	50	60	–	4	1	1
141536	Crash when pasting a new layer	0	70	20	80	–	1	1	1
156754	Can't rotate image by less than 0.5°	0	50	0	50	–	2	–	2
162872	Transparent pixels with paintop	10	50	90	100	2	1	1	1
164688	Cut/copy/paste in the selection tool	0	60	20	70	–	1	2	1
166966	Crash: closing unsaved doc	10	10	0	20	8	10	–	8
167009	Crash: deleting non-existing page	90	100	20	100	1	1	5	1
167247	Broken tooltip for resource choosers	60	70	0	90	1	1	–	1
169696	Loaded shapes at wrong place	40	90	40	100	2	1	4	1
171969	Decoration not in sync with shape	50	90	40	100	1	1	3	1
172861	Kspread crashes on find	0	0	0	0	–	–	–	–
173282	Crash on double click into cell	0	0	0	0	–	–	–	–
173354	Sstart presentation from first page	20	50	50	100	1	1	2	1
173630	Format -> Page Layout does nothing	10	70	30	100	10	2	1	1
173732	OpenCalc file importer broken	0	0	0	0	–	–	–	–
173882	Can't set splitter orientation	50	70	30	90	1	1	1	1
175373	Can't edit formulas in tool options	0	0	0	0	–	–	–	–
176278	Crash on loading image	20	40	30	60	6	3	5	3
Average		18.2	42.7	26.4	63.2	3.3	2.1	2.2	1.8

Conclusions

- Proposed and implemented **novel combination** of MSR and IR techniques for identifying expert programmers to incoming change requests
- The proposed approach can recommend relevant developers with relatively **high accuracy**