

# Automated Bug Report Field Reassignment and Refinement Prediction

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# A Bug Report

## Bug 227547 - Unit test org.netbeans.modules.cnd.classview.QuoteTestCase.testQuote failed

Status: RESOLVED FIXED

Issue Type: DEFECT

Reported: 2013-03-16 07:31 UTC by Alexander Simon

Product: cnd

Priority: P2 (vote)

Modified: 2013-04-02 09:31 UTC ([History](#))

Component: -- Other --

Target Milestone: 7.4

CC List: 3 users ([show](#))

Version: 7.4

Assigned To: Alexander Simon

Hardware: All All

Alexander Simon 2013-03-16 07:31:46 UTC

[Description](#)

Test filed since change set:

<http://hg.netbeans.org/main-golden/rev/e7e9a8f3cea7>

Commit for ~~bug #227050~~

# Fields in A Bug Report

- Product
- Component
- Priority
- Severity
- Assignee
- Status (reopen or not)
- Platform
- Version
- .....

# Fields Get Reassigned

vv159170	2013-03-18 09:17:10 UTC	Priority	P2	P1
vv159170	2013-03-18 09:19:38 UTC	Priority	P1	P2
jtulach	2013-03-18 13:57:23 UTC	Assignee	jtulach	vv159170
mmirilovic	2013-03-20 08:00:55 UTC	CC		mmirilovic
		Whiteboard	73patch-candidate	73patch2-candidate
vv159170	2013-03-20 14:23:03 UTC	Component	Options&Settings	Code
		Assignee	vv159170	issues
		Product	platform	cnd
		QA Contact	issues	issues

# Previous Findings

- Approximately 80% of bug reports have their fields reassigned
- Bug report field reassignments could cause a delay in the bug fix

Xin Xia, David Lo, Ming Wen, Emad Shihab, Bo Zhou: An empirical study of bug report field reassignment. CSMR-WCRE 2014: 174-183

When a bug report is submitted, can we automatically **predict which bug report fields will be reassigned or refined?**



# Comments from Developers

- Considering a lot of “**raw**” **users** would submit bug reports in our community, there would be many errors (**wrongly assigned fields in the bug report**), the tool would be possible to evaluate a “raw” user submitted report and predict what fields will be changed.
- A tool which assists whether a fields would get reassigned and refined still **relief the workload** for a developer

# Research Challenge

- A bug report could have more than one fields get reassigned or refined simultaneously
- Traditional supervised learning techniques only categorize an instance into one label

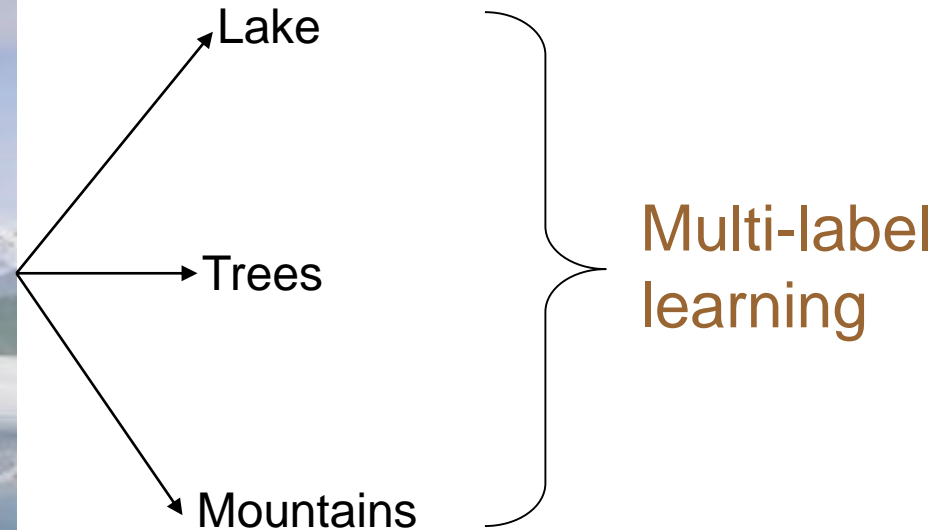


**Multi-label Learning**



# Multi-Label Objects

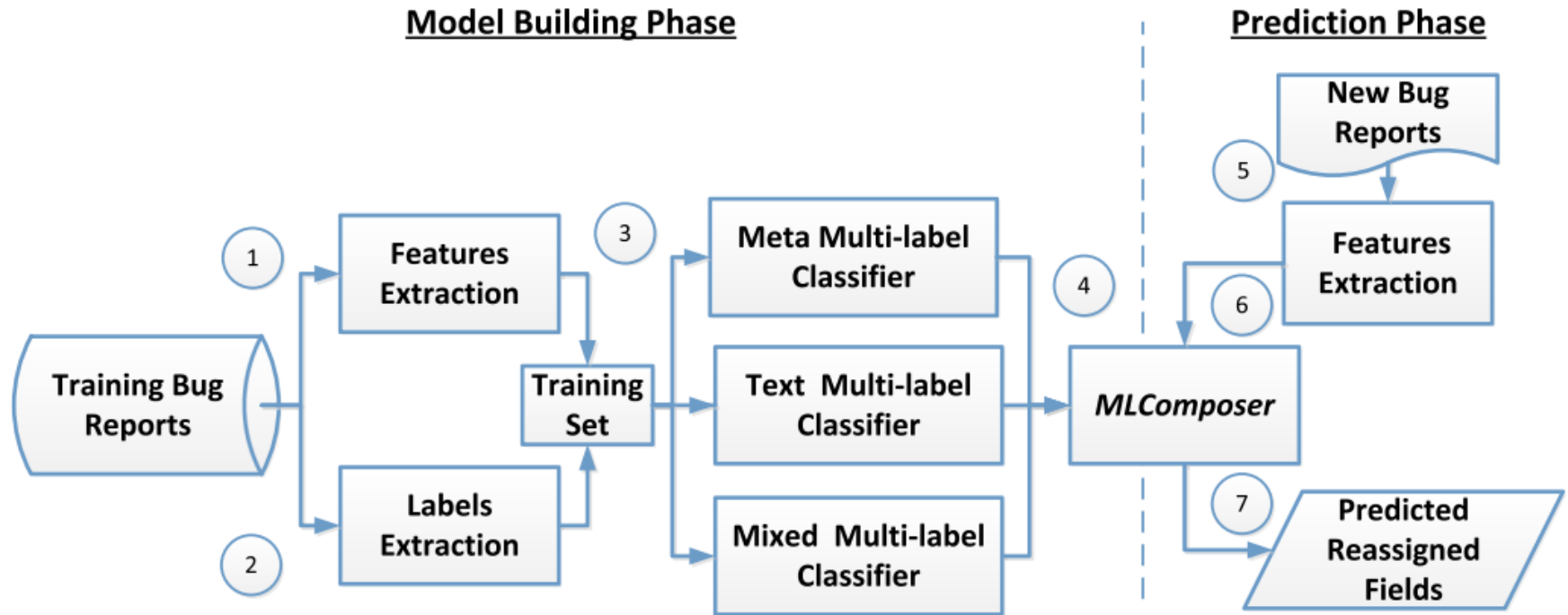
e.g. natural scene image



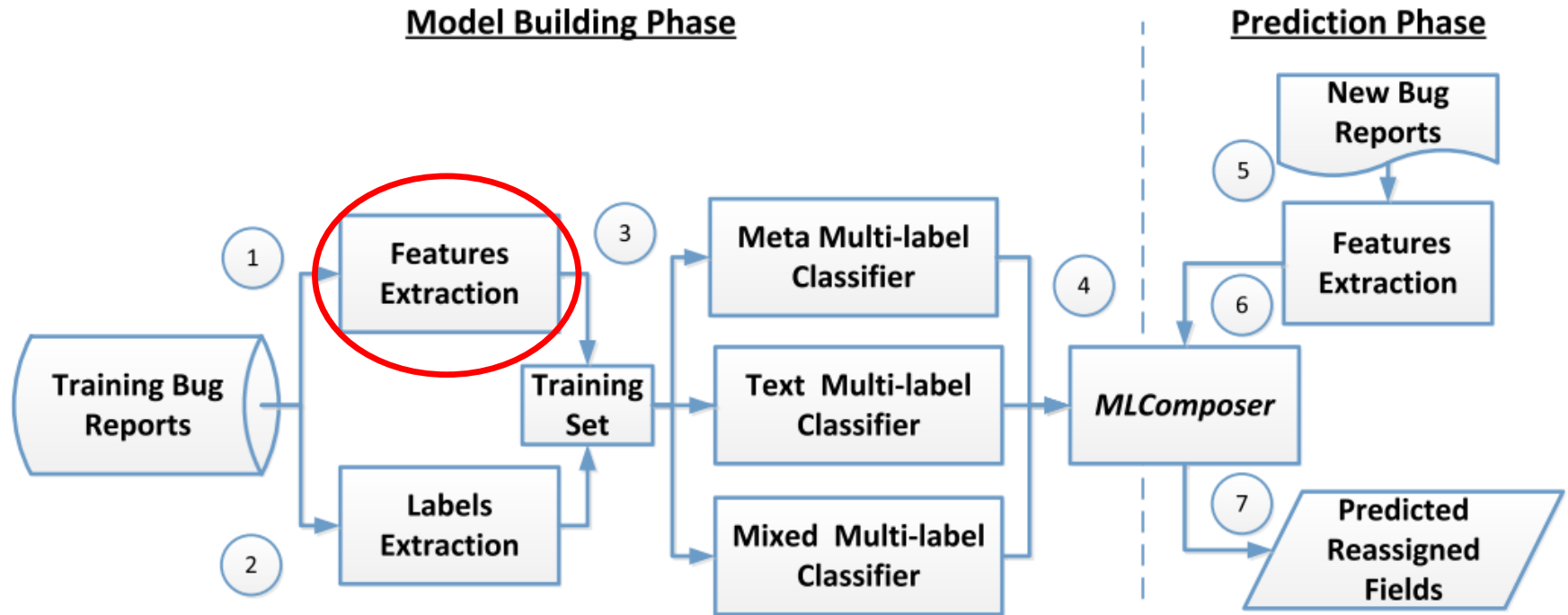
Ubiquitous

Documents, Web pages, Molecules.....

# Overall Framework



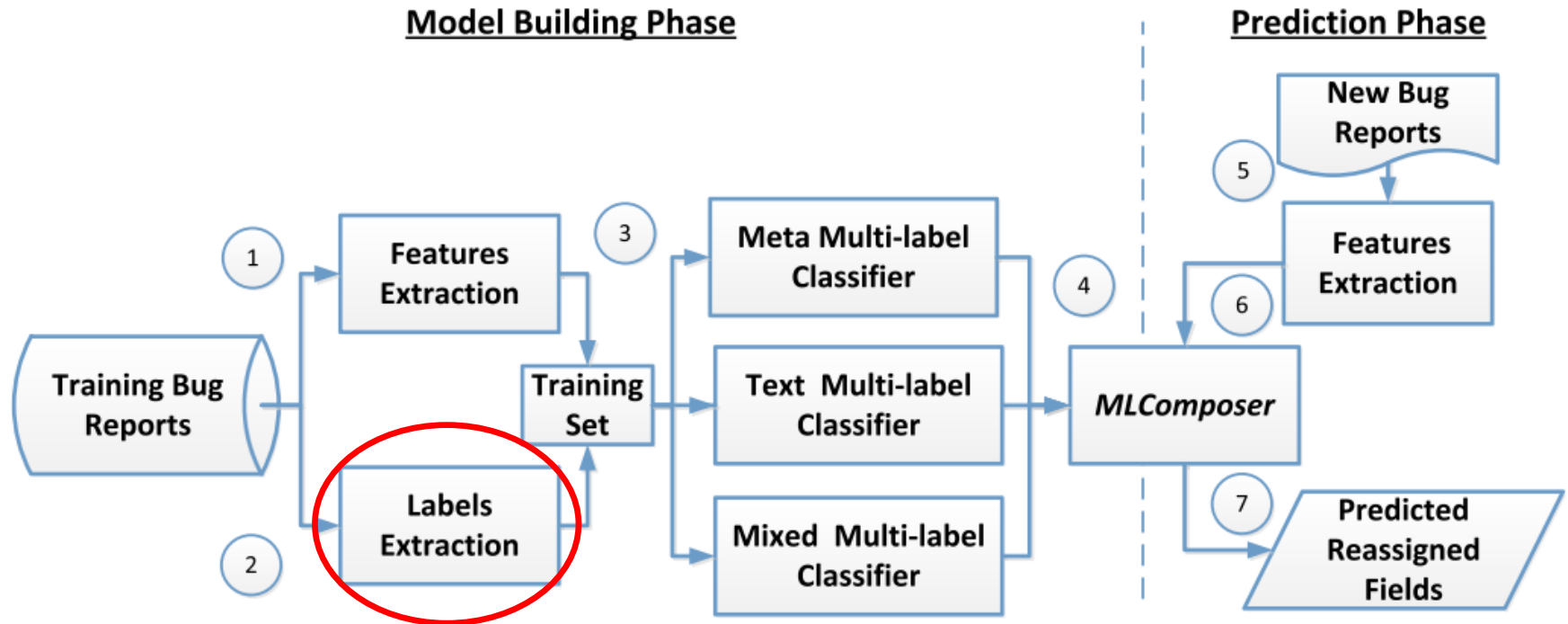
# Overall Framework



# Features

- Meta Features
  - Fields of a bug report except from the text in summary and description, e.g., reporter, assignee, product, and component.
- Textual Features
  - Text in the summary and description
  - Tokenize, remove the stop words, stemming

# Overall Framework

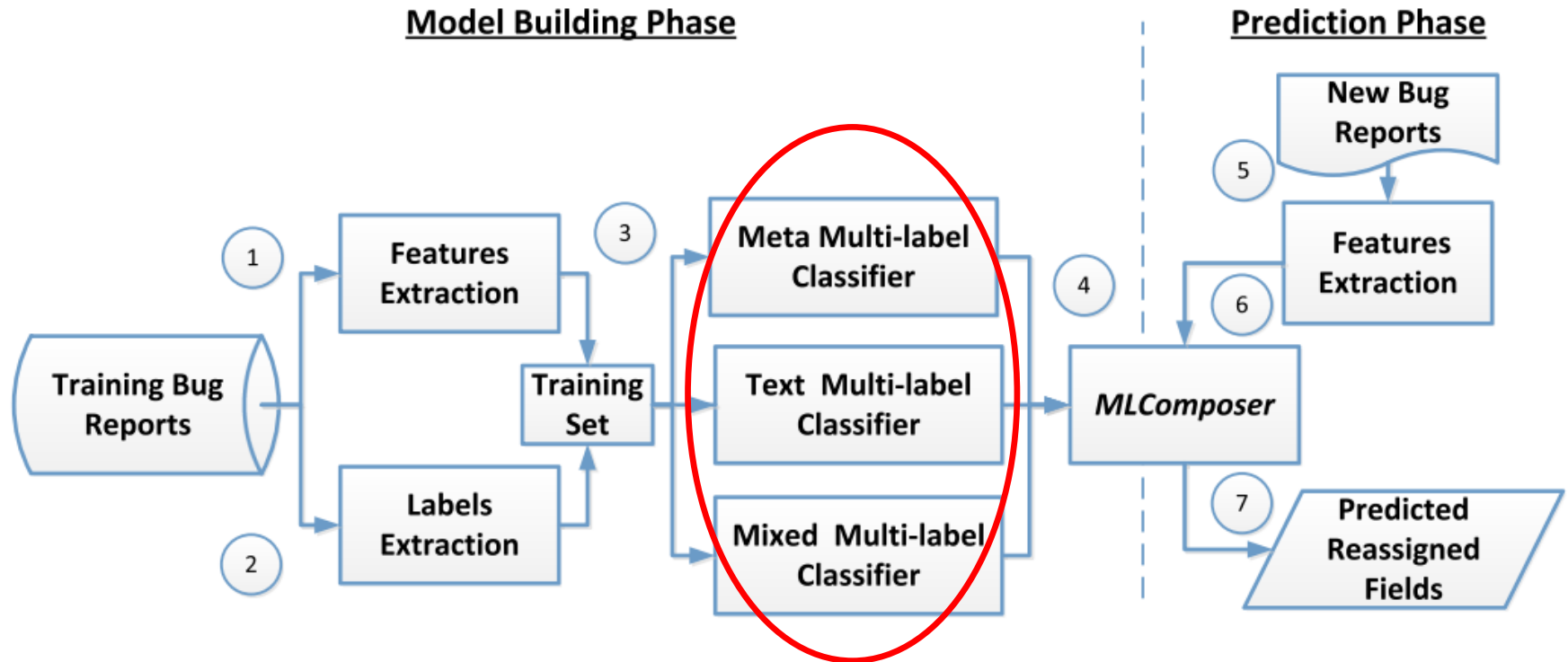


# Label Extraction

- Eight types of reassignment and refinement:
  - component, product, severity, priority, OS, version, fixer, and status
- Parse bug report history, and check whether any of the 8 fields got reassigned and refined

vv159170	2013-03-18 09:17:10 UTC	Priority	P2	P1
vv159170	2013-03-18 09:19:38 UTC	Priority	P1	P2
jtulach	2013-03-18 13:57:23 UTC	Assignee	jtulach	vv159170
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		Assignee	vv159170	issues
		Product	platform	cnd
		QA Contact	issues	issues

# Overall Framework

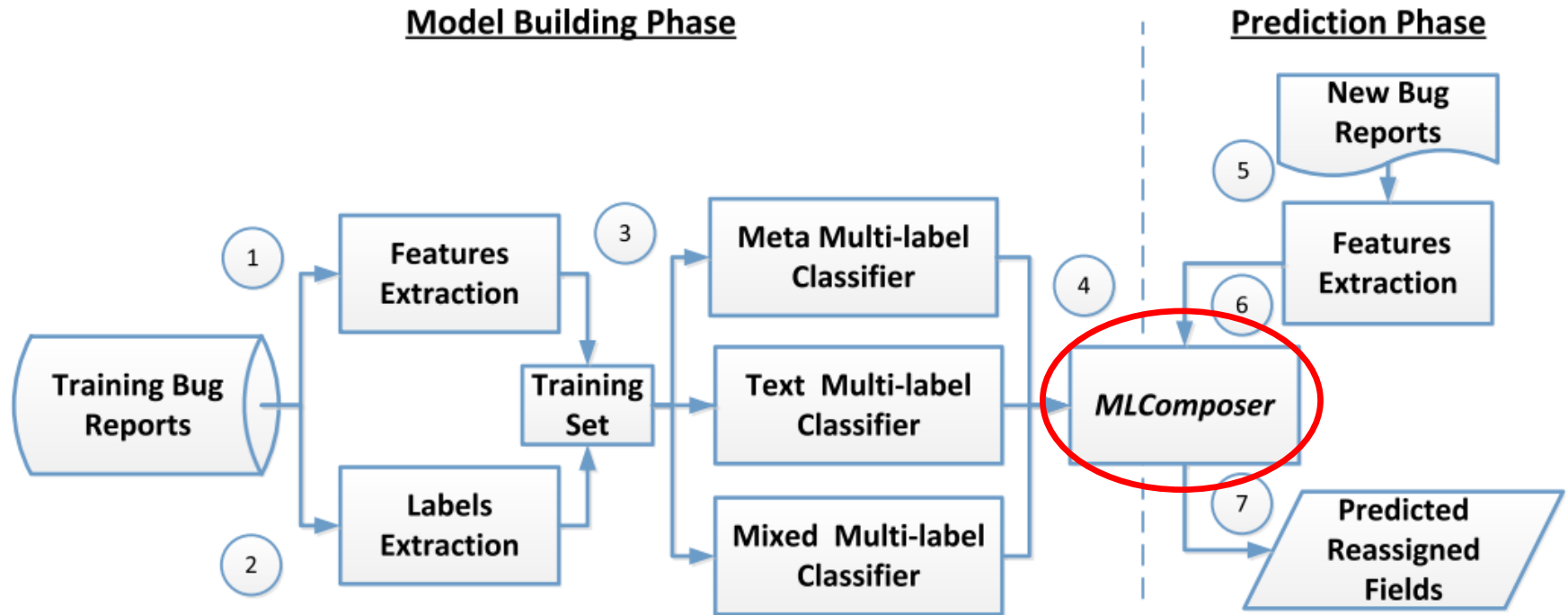


# Multi-label Classifier

- We build three multi-label classifiers (ML.KNN) based on three types of features
- Given a bug report  $br$ , and a field  $l$ , each classifier will output the confidence score that field  $l$  will get reassigned or refined :
  - Meta Classifier:  $Meta(br, l)$
  - Textual Classifier:  $Text(br, l)$
  - Mixed Classifier:  $Mixed(br, l)$



# Overall Framework



# MLComposer

- $MLComposer(br, l) = \partial \times Meta(br, l) + \beta \times Text(br, l) + \gamma \times Mixed(br, l)$

How to tune good  $\partial, \beta, \gamma$ , and  $threshold_l$  values?

reassigned or refined by:

$$Label_{br}(l) = \begin{cases} 1, & \text{if } MLComposer(br, l) \geq threshold_l \\ 0, & \text{otherwise.} \end{cases}$$

# Evaluation Metrics

- F1-score for a label  $l$ :

- $F1_l = \frac{2 \times Precision_l \times Recall_l}{Precision_l + Recall_l}$

- Average F1-score for all labels  $L$ :

- $AveF1 = \frac{1}{L} \sum_{l \in L} F1_l$

# Estimation of Good $\alpha, \beta, \gamma$ , and *threshold<sub>l</sub>* Values

- Divide BR into two subsets BR1(80%) and BR2 (20%)
- Build meta, text, and mixed multi-label classifiers based on BR1
- Increase  $\alpha, \beta, \gamma$ , and *threshold<sub>l</sub>* from 0 to 1, and find the best combination which achieves the best **average F1-scores** (*AveF1*) on BR2

# Datasets

<b>Project</b>	<b>Time</b>	<b># Reports</b>
OpenOffice	2002-05-17 – 2013-04-07	42,169
Netbeans	2008-01-01 – 2013-03-13	46,345
Eclipse	2008-01-01 – 2011-07-19	50,639
Mozilla	2009-06-23 – 2012-02-23	51,405

# Baselines

- Lamkanfi *et al.* 's approach:
  - Naive Bayes to predict whether a component field would be reassigned and refined
- ML.KNN
  - A KNN implementation for multi-label learning
- HOMER
  - builds a hierarchy of multi-label classifiers by leveraging a balanced clustering algorithm

# Average F1 of Our Approach Compared with the Baselines

Approach	OpenOffice	NetBeans	Eclipse	Mozilla
<b>Our</b>	<b>0.62</b>	<b>0.60</b>	<b>0.56</b>	<b>0.58</b>
<b>Lamkanfi</b>	0.27	0.30	0.23	0.27
<b>ML.KNN</b>	0.61	0.52	0.51	0.52
<b>HOMER</b>	0.23	0.24	0.19	0.24

# Average F1 of Our Approach Compared with Sub-Classifiers

Approach	OpenOffice	NetBeans	Eclipse	Mozilla
<b>Our</b>	<b>0.62</b>	<b>0.60</b>	<b>0.56</b>	<b>0.58</b>
<b>Meta</b>	0.62	0.53	0.51	0.51
<b>Textual</b>	0.20	0.27	0.20	0.24
<b>Mixed</b>	0.61	0.52	0.51	0.52



# Summary

- A tool which leverages **multi-label learning** algorithms to automatically predict which **bug report fields would be reassigned and refined**
- Our proposed approach improved the state-of-the-art by a **substantial margin**

# Future Work

- We only recommend **which fields get reassigned or refined**, and we plan to recommend **what these fields will be reassigned or refined to**.
- Leveraging the idea of multi-label learning to solve other software engineering tasks

# Multi-label Recommenders for SE

# Tag Recommendation

I have the following code -

```
1 int lat = System.Convert.ToInt16(latTextBox1.Text);
```

This is happening on a changed event.

However my code is breaking on this line saying -

```
Input string was not in a correct format.
```

Where `latTextBox1.Text = ""` which is an empty string. I think this is breaking because it cannot convert an empty string into a null value.

How can I modify my code to account for null values?

c# asp.net null

## actionpoll

Actionpoll is a simple PHP script which provides the standard functionality such as unlimited options, IP tracking of users, easy installation, and HTML and WML output. An event can be triggered if a certain number of votes is reached. Surveys can be stored either in a MySQL database or in text files.

Tags

Internet Web Dynamic Content CGI Tools/Libraries

Licenses

GPL

Operating Systems

OS Independent

Implementation

PHP

# Multi-label Software Behavior Learning

- When a program fails, a crash report would be sent to the software vendor for diagnosis
- A failure could be caused by multiple types of faults simultaneously
- Predict the fault types of a crash

# Developer Recommendation for Bug Resolution

## Frequent "invalid thread access"

I'm not sure 100% where the problem lies with this (hard to say if it's SWT, or JFace, or what), but since upgrading to 3.4 M4 I've been having invalid thread accesses like crazy.

### Steve Northover

Fixed > 20080220 We can keep following up with whoever as necessary but in the meantime, people can't use this VM

### Steffen Pingel

These startup warnings are most likely unrelated to the problem you are experiencing

### Mik Kersten

all Mylyn-related parts of the stack traces have been addressed and should not have been related to the invalid

### Felipe Heidrich















\*\*\* [Bug 215791](#) has been marked as a duplicate of this bug. \*\*\*

# Recommending Affected Packages for a Bug Report

Wallpaper is loaded twice with different alignment by gnome-session and nautilus (Oneiric)

Bug #804435 reported by  LucaZade on 2011-07-01

This bug affects 4 people

Affects	Status	Importance	Assigned to	Milestone
▶  GTK+	Fix Released	Medium	 gnome-bugs #659241	
▶  unity-2d	Invalid 	High	 Gerry Boland	unity-2d 4.10
▶  Ubuntu	Fix Released 	Low	 Chris Coulson	
▶  nautilus (Ubuntu)	Invalid 	Low	Unassigned	
▶  unity (Ubuntu)	Invalid 	Low	Unassigned	
▶  unity-2d (Ubuntu)	Fix Released 	Undecided	Unassigned	

# Lessons

- The multi-label learning approaches (e.g., ML.KNN) proposed in ML cannot be directly used to solve SE tasks
- Extract the domain-specific features



# Conclusions

- A case study on how to use multi-label learning approaches to predict which bug report fields get reassigned or refined
- Multi-label Recommenders for SE

# Acknowledgment



David Lo



Emad Shihab



Thank you!

**Questions? Comments?**

# Additional Slides

# Average Precision and Recall

Project	Algorithms	Ave. Precision	Ave. Recall
OpenOffice	Im-ML.KNN	0.6090	0.6406
	Lamkanfi el al.'s	0.2237	0.8379
	ML.KNN	0.8030	0.5491
	HOMER-NB	0.2711	0.4115
Netbeans	Im-ML.KNN	0.6113	0.5914
	Lamkanfi el al.'s	0.2636	0.6010
	ML.KNN	0.7352	0.4697
	HOMER-NB	0.3378	0.2996
Eclipse	Im-ML.KNN	0.5671	0.5613
	Lamkanfi el al.'s	0.1929	0.8154
	ML.KNN	0.6923	0.4318
	HOMER-NB	0.2279	0.3788
Mozilla	Im-ML.KNN	0.5739	0.5899
	Lamkanfi el al.'s	0.2194	0.2194
	ML.KNN	0.7776	0.4775
	HOMER-NB	0.2588	0.4664

# Weights

<b>Projects</b>	<b>Meta Classifier</b>	<b>Text Classifier</b>	<b>Mixed Classifier</b>
OpenOffice	0.35	0.14	0.51
Netbeans	0.24	0.16	0.60
Eclipse	0.28	0.18	0.54
Mozilla	0.30	0.23	0.47