A Decision Support Platform for Guiding a Bug Triager for Resolver Recommendation Using Textual and Non-Textual Features

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Table of Contents

1 Introduction
   • Bug Triaging at Siemens
   • The architectural design

2 Solution
   • Bug repository Data
   • Bug description pre-processing
   • Ensemble Classifier
   • Initial results
   • Confusion Matrix and Accuracy Results

3 Overview of the Tool
   • Layouts
   • Visualizations

4 References
# Table of Contents

1. **Introduction**
   - Bug Triaging at Siemens
   - The architectural design

2. **Solution**
   - Bug repository Data
   - Bug description pre-processing
   - Ensemble Classifier
   - Initial results
   - Confusion Matrix and Accuracy Results

3. **Overview of the Tool**
   - Layouts
   - Visualizations

4. **References**

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Ashish Sureka, Himanshu kumar Singh, Manjunath Bagewadi, Al: QuaSoQ 2015 Workshop @ APSEC 2015
Bug Triaging at Siemens

Average time needed to solve a bug

\[ T_{\text{pre-CCB}} \times M + T_{\text{CCB}} \]

\[ \frac{N}{} \]

(1)
Challenges in the Bug Triaging process

- Decisions made by the CCB are knowledge intensive:
  - prior knowledge about the software system
  - expertise of the developer
  - team structure and composition
  - developer workload

- Bug resolver assignment is non-trivial in:
  - large and complex software settings
  - globally distributed teams

- Bug Triaging is a Time consuming process. Time equals Money
The architectural design

1. RECOMMENDATION
   - Who should Fix this Bug
     - Rank | Name
     - 1    | Abhishek
     - 2    | Ashish
     - 3    | Himanshu
     - 4    | Manjunath
     - 5    | Rohit

2. JUSTIFICATION
   - OLD BUG REPORT
   - NEW BUG REPORT
   - Similarity
   - Abhishek

3. NETWORK
   - Node Size: Number of Bugs
   - Edge Distance: Strength of Collaboration
   - Node Color: Role
   - Ashish
   - Abhishek
   - Manjunath

4. WORKLOAD & EXPERIENCE
   - Rank | Name | Workload | Experience
   - 1    | Abhishek | 4        | 12
   - 2    | Ashish   | 10       | 24
   - 3    | Himanshu | 7        | 30
   - 4    | Manjunath| 1        | 3
   - 5    | Rohit    | 8        | 2

Ashish Sureka, Himanshu Kumar Singh, Manjunath Bagewadi, Abhishek Mitra, Rohit Karanth

QuaSoQ 2015 Workshop @ APSEC 2015
Table of Contents

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   • The architectural design

2 Solution
   • Bug repository Data
   • Bug description pre-processing
   • Ensemble Classifier
   • Initial results
   • Confusion Matrix and Accuracy Results

3 Overview of the Tool
   • Layouts
   • Visualizations

4 References
The Data - Two projects

- **Project A**:
  - Image processing based product deployed in CT Scan Machines.
  - 2 year old and has 772 bugs reported till November 2014.
  - 345 of them have been solved and validated.
  - 78 members working.

- **Project B**
  - Its a Ultra-Sound Clinical Workflow Management System and relatively larger than A.
  - started in 2005 and 17267 bugs reported till October 2014.
  - 12438 bugs have been resolved.
  - A total of 253 professionals have worked on the project during the past 9 to 10 years.
Data Format

▸ Bug Details:
  ▸ Bug ID.
  ▸ Short description of the bug
  ▸ Long description of the bug.
  ▸ Component to which the bug might belong.

▸ Discussions: Starting from the moment a bug is reported to the time it is closed, all the discussions happening among the team members through emails are recorded.
  ▸ We extracted the names of all team members belonging to the bug.
  ▸ A bug can be in one of the 9 states. Submitted, Qualified, In-decision, Deferred, Terminated, In-observation, In-work, Solved, Validated. The Discussion contained the state transitions as well.
Bug description pre-processing

<table>
<thead>
<tr>
<th>Bug ID</th>
<th>Component</th>
<th>Short description</th>
<th>Long Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1234</td>
<td>GUI</td>
<td>The d3js social network graph does not refresh with new data</td>
<td>Issue with ABT screen. Whenever I click the Social network button, it should refresh the social network graph and the name of the new developers who have joined the team should be visible</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>STOP WORDS / SPECIAL CHARS REMOVAL</strong></td>
<td></td>
</tr>
<tr>
<td>1234</td>
<td>GUI</td>
<td>d3js social network graph refresh data</td>
<td>issue screen click Social network button refresh social network graph name developers joined team visible</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>WORDS STEMMING USING PORTER STEMMER (However Steemr does not modify identified keywords)</strong></td>
<td></td>
</tr>
<tr>
<td>1234</td>
<td>GUI</td>
<td>d3js social network graph refresh data</td>
<td>issu screen click Social network button refresh social network graph name develop join team visible</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>NOISE REMOVAL AND FREQUENCY CALCULATION</strong></td>
<td></td>
</tr>
</tbody>
</table>
Ensemble Classifier

Training and Testing Data

<table>
<thead>
<tr>
<th>Resolvers</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abhishek, Ashish, Manju</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>C1</td>
</tr>
<tr>
<td>Ashish, Rohit, Manisha</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>C2</td>
</tr>
</tbody>
</table>

Ensemble of Classifiers

Naive Bayes

Random Decision Forest

Open bugs

<table>
<thead>
<tr>
<th>Resolver name</th>
<th>Term 1</th>
<th>Term 2</th>
<th>Term 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>??</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>??</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Top K recommendations based on the scores given to each resolver
The initial results were not very good.
Name of the Triagers, test leads and Bug assigners kept on popping up as top recommendations.
We needed to extract the developers from the Discussion data.
We had a meeting with Change control board members from Project A and Project B.
In the discussion with them, We identified 43 valid state transitions, and out of them 22 of the transitions involved team members wearing a "developer’s cap"
Precision and Recall

<table>
<thead>
<tr>
<th>K=1</th>
<th>K=2</th>
<th>K=3</th>
<th>K=4</th>
<th>K=5</th>
<th>K=6</th>
<th>K=7</th>
<th>K=8</th>
<th>K=9</th>
<th>K=10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECALL</td>
<td>0.160</td>
<td>0.337</td>
<td>0.474</td>
<td>0.547</td>
<td>0.599</td>
<td>0.647</td>
<td>0.688</td>
<td>0.721</td>
<td>0.750</td>
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<tr>
<td>PRECISION</td>
<td>0.324</td>
<td>0.353</td>
<td>0.324</td>
<td>0.287</td>
<td>0.254</td>
<td>0.232</td>
<td>0.214</td>
<td>0.199</td>
<td>0.186</td>
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<tr>
<td>F-MEASURE</td>
<td>0.214</td>
<td>0.345</td>
<td>0.385</td>
<td>0.376</td>
<td>0.357</td>
<td>0.342</td>
<td>0.327</td>
<td>0.313</td>
<td>0.298</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>K=1</th>
<th>K=2</th>
<th>K=3</th>
<th>K=4</th>
<th>K=5</th>
<th>K=6</th>
<th>K=7</th>
<th>K=8</th>
<th>K=9</th>
<th>K=10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECALL</td>
<td>0.242</td>
<td>0.644</td>
<td>0.794</td>
<td>0.819</td>
<td>0.848</td>
<td>0.864</td>
<td>0.875</td>
<td>0.890</td>
<td>0.900</td>
</tr>
<tr>
<td>PRECISION</td>
<td>0.437</td>
<td>0.599</td>
<td>0.493</td>
<td>0.408</td>
<td>0.342</td>
<td>0.292</td>
<td>0.255</td>
<td>0.228</td>
<td>0.206</td>
</tr>
<tr>
<td>F-MEASURE</td>
<td>0.312</td>
<td>0.620</td>
<td>0.609</td>
<td>0.545</td>
<td>0.488</td>
<td>0.436</td>
<td>0.395</td>
<td>0.363</td>
<td>0.335</td>
</tr>
</tbody>
</table>
# Table of Contents

1. **Introduction**
   - Bug Triaging at Siemens
   - The architectural design

2. **Solution**
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   - Bug description pre-processing
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3. **Overview of the Tool**
   - Layouts
   - Visualizations

4. **References**
### The Tool - Settings

**Step 2: Components**

**All Components**

Check the check box to remove the component from training model.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Component Name</th>
<th>Remove Component?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Atlas Valves</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Atlas_LVA</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Core CAP Host</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CoreLVA</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CT</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CTS</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>DICOM</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DICOM Integration</td>
<td></td>
</tr>
</tbody>
</table>
The Tool - Recommendations

<table>
<thead>
<tr>
<th>Rank</th>
<th>Resolver Name</th>
<th>Confidence Value</th>
<th>Bugs Solved</th>
<th>Current Load</th>
<th>Filter Social network</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>swantoon-mo</td>
<td>22.52</td>
<td>10</td>
<td>0</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>vahini</td>
<td>11.72</td>
<td>6</td>
<td>0</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>greedhasp</td>
<td>10.54</td>
<td>0</td>
<td>0</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>shwetam@</td>
<td>8.14</td>
<td>0</td>
<td>0</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>tham-mr</td>
<td>7.64</td>
<td>2</td>
<td>0</td>
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<tr>
<td>6</td>
<td>gajrajshkumar</td>
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<tr>
<td>7</td>
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<td>0</td>
<td>✓</td>
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<tr>
<td>8</td>
<td>jayakumaradeycom</td>
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<td>0</td>
<td>✓</td>
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<tr>
<td>9</td>
<td>nizajaymiki</td>
<td>1.8</td>
<td>42</td>
<td>1</td>
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</tr>
<tr>
<td>10</td>
<td>becharaj@</td>
<td>1.67</td>
<td>42</td>
<td>1</td>
<td>✓</td>
</tr>
</tbody>
</table>

Filter Social Network?
Visualizations - Area Plot
Visualizations - Heat Map
Visualizations - Bubble Chart

- Size of the circle denotes component diversity (More the size, more the components affected)
- Green: More than average developers needed to fix the bug during the Three month period
- Purple: Less than average developers needed to fix the bug during the Three month period
Visualizations - Box Plot

Quarterly Project Timeline (July 2012 - September 2014)
Visualizations - Correlation Matrix
Table of Contents

1. Introduction
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   - Confusion Matrix and Accuracy Results

3. Overview of the Tool
   - Layouts
   - Visualizations

4. References
References


References II


Questions?