**Example of evolution of a SATD comment**

Starting from a list of technical debt comment to be used for manual validation, selected from the project Apache Jmeter, we executed the command:

git log -S’comment text’ -- path/to/file [--oneline]

where -S<string> is used to look for differences that change the number of occurrences of the specified string (i.e. addition/deletion) in a file. The command is useful for searching an exact block of code and knowing the history of that block since it first came into being. To search for a block that matches a regular expression, instead of a specific string, the command -G<regex> may instead be used.

path/to/file refers to the class where the SATD comment was found and is used to limit the search to the history of the current class.

This is an optional parameter in many cases, since a SATD comment is often very specific to a single block of code. However, in our work some instances of SATD - usually more generic comments such as //TODO replace with proper Exception or //TODO make static? - occurred more than once in a single project, therefore the file path was always included to limit the research to the class that first contained the comment.

Finally, --oneline is also an optional parameter that may be used to print relevant results on a single line, i.e. the short SHA and the message of the commit. By omitting the parameter, the result would include additional information, e.g. the author of the commit, the date and the git subversion id (git-svn-id). For our purpose, --oneline was used to handle results more easily.

$ git log -S'// TODO: should this just call super()?' --oneline

-- src/jorphan/org/apache/jorphan/gui/ RateRenderer.java

2633ade66 sonar: fix errors

bb63ad9f5 Initial version of JTable rendering utility classes

The results of the git log command are the short SHAs of the commit that introduced the SATD comment and the commit that removed the comment. By viewing the version of the file at the point of the introductory commit, we can notice:

...

+ if (! (value instanceof Double)) {

+ setText("#N/A"); // TODO: should this just call super()?

+ return; }

…

While the version where the TODO was removed will look like this:

...

if (!(value instanceof Double)) {

- setText("#N/A"); // TODO: should this just call super()?

+ setText("#N/A");

return; }

…

We tried removing part of the comment - mainly the *//TODO* - to test if the SATD comments also change across different version in some cases.

Relevant cases:

*// TODO only called by UserParameterXMLParser.getXMLParameters which is a deprecated class*

By running the command git log -S using the whole comment above, the results are the commits where the comment was introduced and then removed, as expected.

$ git log -S'// TODO only called by UserParameterXMLParser.getXMLParameters which is a deprecated class' --oneline

**0c80f9588** deprecate some methods in JMeterUtils Contribution by Benoit Wiart #resolve #148 https://github.com/apache/jmeter/pull/148/

**c932ee6a2** Tidy; add usage comments

However, few lines lines before the removal in the file version when the comment was deleted, the following code displays:

[commit **0c80f9588**, Mar 18 2016]

...

+ \* @deprecated (3.0) was only called by UserParameterXMLParser.getXMLParameters which has been removed in 3.0

\*/

- // TODO only called by UserParameterXMLParser.getXMLParameters which is a deprecated class

+ @Deprecated

public static XMLReader getXMLParser() {

...

The //TODO was removed, but not the method the comment was referred to. In fact, another comment is introduced: it specifies that the method below is now deprecated and was only called by a function that has been removed in a previous version of the application. By running again the git log, this time inserting the comment without the //TODO and also removing the final words, so that it matches the newly added @deprecated comment, we obtain the version where the latter is also removed:

$ git log -S'only called by UserParameterXMLParser.getXMLParameters which' --oneline

**3392c7314** sonar: fix errors **Remove deprecated methods**

c932ee6a2 Tidy; add usage comments

[commit **3392c7314**, Dec 28 2016]

…

- \* @deprecated (3.0) was only called by UserParameterXMLParser.getXMLParameters which has been removed in 3.0

- \*/

- @Deprecated

- public static XMLReader getXMLParser() {

...

The whole method is removed at this point, while it was only marked as deprecated before this version.

Therefore, the history of the SATD comment may be retraced as follows:

* The //TODO was added to point out that a method was only called by a deprecated function (commit **c932ee6a2** on May 16 2012);
* The //TODO portion was then deleted, but part of the comment remained to mark the function getXMLParameters, which was deprecated and has now been removed (commit **0c80f9588** on March 18 2016). Also the method referred to by the initial comment was marked as deprecated;
* Finally, the whole comment, together with the now deprecated method, is suppressed (commit **3392c7314** on December 28 2016).

From the case described above, we realised that not always a SATD comment is introduced and then removed as it is, but there are examples of comments that ‘evolve’ together with the code. Searching through the history of a project considering portions rather than a whole comment is a technique to identify those changes and retrace the evolution of a SATD comment.