MockDetector: A technique to identify mock objects created in unit tests

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ABSTRACT

Software dependencies are ubiquitous and may pose problems during testing, because creating usable objects from dependencies is often complicated. Developers, therefore, often introduce mock objects to stand in for dependencies during testing. However, to our knowledge, no static analysis framework provides a tool to automatically identify mock objects created in the unit test cases. The lack of mock object detection can decrease the precision of static analyses, as they are unable to separate methods invoked on mock objects from methods invoked on actual objects.

In this paper, we introduce MockDetector, a technique to identify mock objects. It is able to detect common Java mock libraries' APIs that create mock objects, checking whether there is a call to a mock creation site and then a def-use chain reaching the point of use. Implications of understanding which objects are mock objects include helping static analysis tools identify which dependencies' methods are actually tested, versus mock methods being called.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

KEYWORDS

static analysis, mock objects, unit tests

ACM Reference Format:

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1 INTRODUCTION

2 MOTIVATING-EXAMPLE

In this section, we illustrate how our MockDetector tool finds a mock object created within a unit test case. It considers for two scenarios: 1. there is a direct call to mock creation site; 2. the mock object is created through a def-use chain from the mock creation site.

Listing 1 shows the unit test case *testSimpleResolution()* in the benchmark byte-buddy/byte-buddy-dep (version 1.7.10) where the mock object TypeDescription is created via a direct call on Java mocking library Mockito's *mock(java.lang.class)*. In this example, our MockDetector tool would first take a list of statements in the unit test processed by Soot [**?**] and then locate the statements that are instances of Assignment Statement with an invoke expression at the right operand. It then checks if the method invoked matches with any Java mocking libraries' APIs creating a mock object, using the method's subsignature, consists of method name, parameter types, and the return type.

Meanwhile, Listing 2 illustrates the unit test case *testGetIterator()* in the benchmark commons-collections4 (version 4.3), where the array of Node, consists of mock objects created in the helper function *createNodes()*, under this transitive call scenario. In this example with a def-use chain, our tool would first detect the Java mocking library that is in use within the benchmark, and retrieve the corresponding API creating a mock object from the detected Java mocking library. It then utilizes Soot's ReachableMethods with the input of a constructed call graph and the iterator consists of the specific, and checks if any of the statements in the unit test case's body, contains a method invocation that could eventually reach the API.

We would also like to discuss an example where a method is invoked on a mocked object, differentiating it from a method invoked on an actual object in normal settings. In Listing 3, the method *addAll()* is invoked on the mocked object ...

```
import static org.mockito.Mockito.mock;

...

@Test
public void testSimpleResolution() throws Exception {
        TypeDescription typeDescription = mock(TypeDescription.class);
        ...
```

```
}
```

Listing 1: This example illustrates a direct call to Mockito's *mock(java.lang.class)* function from test case *testSimpleResolution().*

```
private Node[] createNodes() {
        final Node node1 = createMock(Node.class);
        ...
}

@Test
public void testGetIterator() {
        ...
        final Node[] nodes = createNodes();
        ...
}
```

Listing 2: This example illustrates a transitive call to EasyMock's *CreateMock(java.lang.class)* function from test case *testGetIterator().*

```
@Test
public void addAllForIterable() {
        ...
        final Collection<Number> c = createMock(Collection.class);
        expect(c.addAll(inputCollection)).andReturn(true);
        ...
}
```

Listing 3: This code snippet illustrates an example where the method is invoked on a mocked object in unit test case *addAllForIterable())*

3 TECHNIQUE

4 EVALUATION

5 CONCLUSION

6 MATH EQUATIONS

You may want to display math equations in three distinct styles: inline, numbered or non-numbered display. Each of the three are discussed in the next sections.

6.1 Inline (In-text) Equations

A formula that appears in the running text is called an inline or in-text formula. It is produced by the **math** environment, which can be invoked with the usual `\begin ...\end` construction or with the short form `$ ...$`. You can use any of the symbols and structures, from α to ω, available in LaTeX [**?**]; this section will simply show a few examples of in-text equations in context. Notice how this equation: $\lim_{n\rightarrow \infty}x=0$, set here in in-line math style, looks slightly different when set in display style. (See next section).

6.2 Display Equations

A numbered display equation—one set off by vertical space from the text and centered horizontally—is produced by the **equation** environment. An unnumbered display equation is produced by the **displaymath** environment.

Again, in either environment, you can use any of the symbols and structures available in LaTeX; this section will just give a couple of examples of display equations in context. First, consider the equation, shown as an inline equation above:

$$\lim_{n\rightarrow \infty}x=0 \tag{1}$$

Notice how it is formatted somewhat differently in the **displaymath** environment. Now, we'll enter an unnumbered equation:

$$\sum_{i=0}^{\infty} x + 1$$

and follow it with another numbered equation:

$$\sum_{i=0}^{\infty}x_i=\int_{0}^{\pi+2} f \tag{2}$$

just to demonstrate LaTeX's able handling of numbering.

7 FIGURES

Your figures should contain a caption which describes the figure to the reader.

Figure captions are placed *below* the figure.

Every figure should also have a figure description unless it is purely decorative. These descriptions convey whats in the image to someone who cannot see it. They are also used by search engine crawlers for indexing images, and when images cannot be loaded.

A figure description must be unformatted plain text less than 2000 characters long (including spaces). **Figure descriptions should not repeat the figure caption their purpose is to capture important information that is not already provided in the caption or the main text of the paper.** For figures that convey important and complex new information, a short text description may not be adequate. More complex alternative descriptions can be placed in an appendix and referenced in a short figure description. For example, provide a data table capturing the information in a bar chart, or a structured list representing a graph. For additional information regarding how best to write figure descriptions and why doing this is so important, please see https://www.acm.org/publications/taps/describing-figures/.

7.1 The "Teaser Figure"

A "teaser figure" is an image, or set of images in one figure, that are placed after all author and affiliation information, and before the body of the article, spanning the page. If you wish to have such a figure in your article, place the command immediately before the `\maketitle` command:

```
\begin{teaserfigure}
  \includegraphics[width=\textwidth]{sampleteaser}
  \caption{figure caption}
  \Description{figure description}
\end{teaserfigure}
```

8 CITATIONS AND BIBLIOGRAPHIES

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The bibliogrphy is included in your source document with these two commands, placed just before the `\end{document}` command:

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\bibliographystyle{ACM-Reference-Format}
\bibliography{bibfile}
```

where "`bibfile`" is the name, without the "`.bib`" suffix, of the BibTeX file.

Citations and references are numbered by default. A small number of ACM publications have citations and references formatted in the "author year" style; for these exceptions, please include this command in the **preamble** (before the command "`\begin{document}`") of your LaTeX source:

```
\citestyle{acmauthoryear}
```

Some examples. A paginated journal article [**?**], an enumerated journal article [**?**], a reference to an entire issue [**?**], a monograph (whole book) [**?**], a monograph/whole book in a series (see 2a in spec. document) [**?**], a divisible-book such as an anthology or compilation [**?**] followed by the same example, however we only output the series if the volume number is given [**?**] (so Editor00a's series should NOT be present since it has no vol. no.), a chapter in a divisible book [**?**], a chapter in a divisible book in a series [**?**], a multi-volume work as book [**?**], a couple of articles in a proceedings (of a conference, symposium, workshop for example) (paginated proceedings article) [**? ?**], a proceedings article with all possible elements [**?**], an example of an enumerated proceedings article [**?**], an informally published work [**?**], a couple of preprints [**? ?**], a doctoral dissertation [**?**], a master's thesis: [**?**], an online document / world wide web resource [**? ? ?**], a video game (Case 1) [**?**] and (Case 2) [**?**] and [**?**] and (Case 3) a patent [**?**], work accepted for publication [**?**], 'YYYYb'-test for prolific author [**?**] and [**?**]. Other cites might contain 'duplicate' DOI and URLs (some SIAM articles) [**?**]. Boris / Barbara Beeton: multi-volume works as books [**?**] and [**?**]. A couple of citations with DOIs: [**? ?**]. Online citations: [**? ? ?**]. Artifacts: [**?**] and [**?**].

9 ACKNOWLEDGMENTS

Identification of funding sources and other support, and thanks to individuals and groups that assisted in the research and the preparation of the work should be included in an acknowledgment section, which is placed just before the reference section in your document.

This section has a special environment:

```
\begin{acks}
...
\end{acks}
```

so that the information contained therein can be more easily collected during the article metadata extraction phase, and to ensure consistency in the spelling of the section heading.

Authors should not prepare this section as a numbered or unnumbered `\section`; please use the "`acks`" environment.

10 APPENDICES

If your work needs an appendix, add it before the "`\end{document}`" command at the conclusion of your source document.

Start the appendix with the "`appendix`" command:

```
\appendix
```

and note that in the appendix, sections are lettered, not numbered. This document has two appendices, demonstrating the section and subsection identification method.

11 SIGCHI EXTENDED ABSTRACTS

The "`sigchi-a`" template style (available only in LaTeX and not in Word) produces a landscape-orientation formatted article, with a wide left margin. Three environments are available for use with the "`sigchi-a`" template style, and produce formatted output in the margin:

- `sidebar`: Place formatted text in the margin.
- `marginfigure`: Place a figure in the margin.
- `margintable`: Place a table in the margin.

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To Robert, for the bagels and explaining CMYK and color spaces.

A RESEARCH METHODS

A.1 Part One

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A.2 Part Two

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B ONLINE RESOURCES

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