A Replication of ‘DeepBugs: A Learning Approach to Name-based Bug Detection’

Jordan Winkler
Purdue University
West Lafayette, Indiana, USA
jwinkler@purdue.edu

Abhimanyu Agarwal
Purdue University
West Lafayette, Indiana, USA
agarw184@purdue.edu

Caleb Tung
Purdue University
West Lafayette, Indiana, USA
tung3@purdue.edu

Dario Rios Ugalde
Lockheed Martin
Arlington, Texas, USA
dugalde@purdue.edu

Young Jin Jung
Purdue University
West Lafayette, Indiana, USA
jung199@purdue.edu

James C. Davis
Purdue University
West Lafayette, Indiana, USA
davisjam@purdue.edu

ABSTRACT

We replicated the main result of *DeepBugs*, a bug detection algorithm for name-based bugs. The original authors evaluated it in three contexts: swapped-argument bugs, wrong binary operator, and wrong binary operator operands. We followed the algorithm and replicated the results for swapped-argument bugs. Our replication used independent implementations of the major components: training set generation, token vectorization, and neural network data pipeline, model, and loss function. Using the same dataset and the same testing process, we report comparable performance: within 2% of the accuracy reported by Pradel and Sen.

CCS CONCEPTS

• **Software and its engineering** → *Software maintenance tools*; *Software verification and validation*.

KEYWORDS

Defect detection, replication, machine learning, deep learning

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1 THE DEEPBUGS ALGORITHM

The DeepBugs algorithm [2] is a means by which to identify *name-based bugs* (1). These bugs are cases where a developer uses the wrong symbols — *e.g.,* variable names — in a context, such as invoking a function with arguments in the wrong order. Supposing that developers choose meaningful variable names [1], name-based bugs can be detected by identifying contexts where variable names are used inconsistently with learned semantic meanings.

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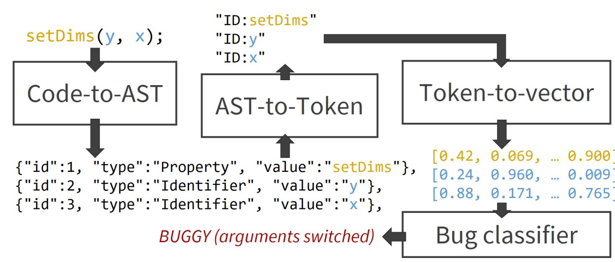

Figure 1: DeepBugs expresses software using an abstract syntax tree, embedded as semantic vectors via Word2Vec. A neural network checks if meanings match usage contexts.

2 REPLICATION

We implemented the DeepBugs algorithm, sharing dependencies on Acorn, TensorFlow/Keras, and the dataset ([3]). The dataset is already partitioned into training and evaluation categories. We used the authors’ hyperparameters where possible, although the authors did not report RNG seeds. Beyond this, due to a clerical error, we used a Word2Vec window size of 200 tokens rather than 20 tokens.

As shown in Table 1, our results [4] match the original [2].

Step	Comparison Metric	Original VS Replication
1 & 2	Token vocabulary size	Close (“10K” vs. 9,994)
	Extracted token values	Identical
3	Generated vectors	Close (possibly affected by window size and RNG seed)
4	Training Loss	Close: ~0.002 VS ~0.002
	Test Error	Close: ~0.04 VS ~0.06

Table 1: Swapped-argument performance in our replication.

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