Replication of "Source Code Properties of Defective Infrastructure as Code Scripts" (Rahman & Williams, 2019)

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Abstract—This paper reports a replication of key parts of Rahman and Williams (2019). The replication focuses on (i) reproducing subsections 3.1.1 (Repository Collection) and 3.1.2 (Commit Message Processing) of the original methodology and (ii) answering research questions RQ1 and RQ3 using the authors' released datasets. We describe our mining setup with the GitHub API and caching to respect rate limits, operationalize commit message processing to build extended commit messages, and then use the supplied datasets to analyze source code properties of Puppet scripts (RQ1) and to build defect prediction models (RQ3). We report our findings, compare them against the original study, and discuss deviations and threats to validity.

Index Terms—Replication, Mining Software Repositories, Infrastructure as Code, Puppet, Defect Prediction, Empirical Software Engineering

I. INTRODUCTION

Infrastructure as Code (IaC) enables automated, reliable deployment pipelines. Defects in IaC scripts can undermine these pipelines. Rahman and Williams (2019) investigated which source code properties of Puppet scripts correlate with defectiveness and how those properties can be used to build defect prediction models.

In this project, we replicate part of their study by reproducing Sections 3.1.1 (Repository Collection) and 3.1.2 (Commit Message Processing), and by addressing two research questions: RQ1, which investigates what source code properties characterize defective IaC scripts, and RQ3, which explores how defect prediction models can be constructed using those properties. Our replication relies on the authors' released datasets and compares our findings against the original results.

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Table	Table Column Head		
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^aSample of a Table footnote.

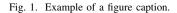


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ACKNOWLEDGMENT

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REFERENCES

- G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955.
- [2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
- [3] I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
- [4] K. Elissa, "Title of paper if known," unpublished.
- [5] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.
- [6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
- [7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

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