Molina, F., Aguirre, N., Gorla, A.: State Field Coverage: A Metric for Oracle Quality. In: Cetina, C. (ed.) Actas de las XXX Jornadas de Ingeniería del Software y Bases de Datos (JISBD 2026). Sistedes (2026). https://hdl.handle.net/11705/JISBD/2026/142

State Field Coverage: A Metric for Oracle Quality*

Facundo Molina[1], Nazareno Aguirre[2], and Alessandra Gorla[3]

[1] Complutense University of Madrid, Madrid, Spain
facundom@ucm.es
[2] University of Rio Cuarto and CONICET, Rio Cuarto, Argentina
naguirre@dc.exa.unrc.edu.ar
[3] IMDEA Software Institute, Madrid, Spain
alessandra.gorla@idmea.org

Keywords: software testing, test oracle, oracle assessment
Published in: 2025 40th IEEE/ACM International Conference on Automated Software Engineering (ASE), pp 2707-2719, 2025.
Impact Factor: ICORE Rank A*
DOI: https://doi.org/10.1109/ASE63991.2025.00222

Abstract. The effectiveness of testing in uncovering software defects depends not only on the characteristics of the test inputs and how thoroughly they exercise the software, but also on the quality of the oracles used to determine whether the software behaves as expected. Therefore, assessing the quality of oracles is crucial to improve the overall effectiveness of the testing process. Existing metrics have been used for this purpose, but they either fail to provide a comprehensive basis for guiding oracle improvement, or they are tailored to specific types of oracles, thus limiting their generality. In this paper, we introduce *state field coverage*, a novel metric for assessing oracle quality. This metric measures the proportion of an object's state, as statically defined by its class fields, that an oracle may access during test execution. The main intuition of our metric is that oracles with a higher state field coverage are more likely to detect faults in the software under analysis, as they inspect a larger portion of the object states to determine whether tests pass or not. We implement a mechanism to statically compute the state field coverage metric. Being statically computed, the metric is efficient and provides direct guidance for improving test oracles by identifying state fields that remain unexamined. We evaluate state field coverage through experiments involving 273 representation invariants and 249,027 test assertions. The results show that state field coverage is a well-suited metric for assessing oracle quality, as it strongly correlates with the oracles' fault-detection ability, measured by mutation score.

* This work is supported by the Ramón y Cajal fellowship RYC2020-030800-I, by the Spanish Government through grants TED2021-132464B-I00 (PRODIGY), PID2022-142290OB-I00 (ESPADA), and CEX2024-001471-M/funded by MICIU/AEI/10.13039/501100011033 and by the Comunidad de Madrid as part of the ASCEND project co-funded by FEDER Funds of the European Union.

This work is licensed under a Creative Commons "Attribution-NonCommercial-NoDerivatives 4.0 International" license.