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ENHANCING TEST GENERATION THROUGH PRE-TRAINED LANGUAGE MODELS AND EVOLUTIONARY ALGORITHMS: AN EMPIRICAL STUDY

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ABSTRACT

In the fast-moving industry of software engineering, it is becoming more and more challenging to verify the quality, longevity, and performance aspects of a software system through testing. Traditional testing procedures are never able to achieve full coverage, which leads to solutions like hybrid test-generating algorithms. In this work, we focus on test case generation and experiment with pre-trained language models together with evolutionary algorithms for refinements. However, pre-trained language models fine-tuned on large datasets are powerful enough to understand and generate code sequences that provide semantically valid test cases corresponding to the logic of software. The evolutionary algorithm improves these test cases further for any situation by literally crossing the border (crossover), changing it (mutation), and selecting the best fit to be fit. The hybridized method proposed performed better than previous methods such as convolutional neural networks and custom genetic algorithms in accuracy, diversity of datasets, and time taken by the execution process; it also covered more regions across CMR images with heterogenous artifacts on the training data set, which was well benchmarked over fitness scores. The hybrid approach further outperformed classic procedures with 93% accuracy, overall efficiency, and a utilization coverage of 90%. This work demonstrates that the integration of evolutionary algorithms and machine learning is a good adaptive approach to current software testing, as it can circumvent current bottlenecks in test case generation, quality, and diversity efficiency.

KEYWORDS: *Software Testing, Hybrid Algorithm, Pre-trained Language Models, Evolutionary Algorithms, Test Case Optimization, Artificial Intelligence in Testing.*

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