

# Summary of "CEDAR: Continuous Testing of Deep Learning Libraries"

## Aim of the Research Study:

This study aims to tackle the challenges posed by the rapid development and frequent updates in Deep Learning (DL) libraries such as PyTorch and TensorFlow, which require continuous testing to identify and fix software bugs. The research introduces CEDAR, a continuous testing framework that integrates advanced DL testing tools (DocTer and EAGLE) to enhance the efficiency and effectiveness of bug detection in these libraries.

## Methodology of the Study:

CEDAR combines two cutting-edge DL testing tools, DocTer and EAGLE, optimized for continuous testing. DocTer uses fuzz testing based on constraints extracted from API documentation, while EAGLE employs differential testing by comparing outputs from equivalent execution graphs to detect inconsistencies. The framework conducts nightly tests on the latest versions of PyTorch and TensorFlow, utilizing optimization strategies like parallelism, test case reduction, and redundancy removal to improve performance. CEDAR was tested on 20 versions of PyTorch and TensorFlow, including both nightly and official releases.

## Results:

CEDAR identified 83 bugs across 140 APIs in the 20 tested versions of PyTorch and TensorFlow, with 23 of these bugs being previously unknown and 21 confirmed or fixed by developers. The framework significantly reduced the average bug detection latency by 338.6 days. Additionally, CEDAR effectively detected regression bugs and masked bugs that are hard to identify with single-version testing. The implemented optimization strategies reduced time and space overheads by factors of 15.4 and 9.7, respectively.

## Implications for Research and Practice:

For research, CEDAR offers valuable insights into integrating DL-specific testing tools within continuous testing workflows, emphasizing the importance of domain-specific optimizations for efficiency. It demonstrates how continuous testing can enhance the reliability and performance of DL libraries by facilitating quicker bug detection and addressing newly introduced issues. For practical application, CEDAR provides a robust solution for developers to maintain the quality of DL libraries in dynamic development environments, ensuring the robustness and reliability of DL systems across various applications.