

PARETO ENVELOPE-BASED SEARCH ALGORITHM-II (PESA-II) FOR AUTOMATED TESTING OF JAVASCRIPT PROGRAMS

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1) Background

Problem

Software contains bugs. Software testing aims to fix these bugs but can be very time consuming and expensive.



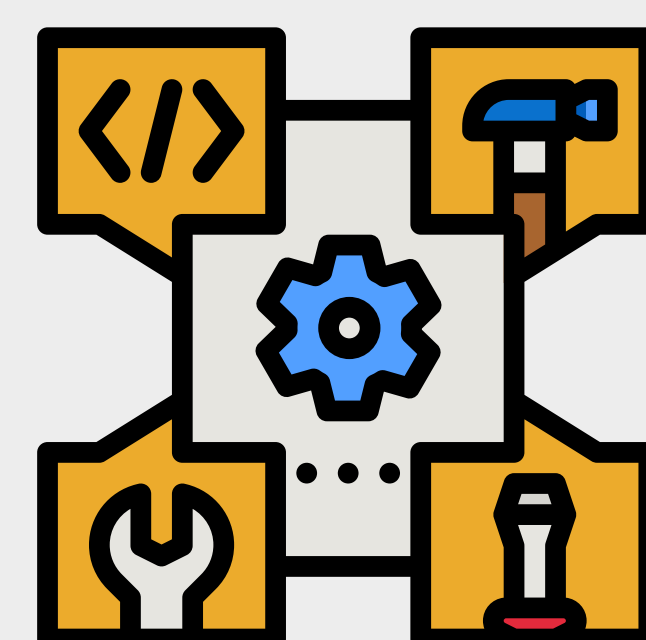
Automation

Search Based Test Case Generation- Using Evolutionary Algorithms to obtain a test suite.



Current State of the Art

Syntest-Javascript [1] for JavaScript test case generation which contains an implementation of DynaMOSA [2]- the best performing Algorithm.



2) Our Research

DynaMOSA is based on NSGA-II and modified for test case generation. We will use the Pareto Envelope-Based Search Algorithm (PESA-II) [3] as the base algorithm and augment it with DynaMOSA features to potentially achieve better performance than DynaMOSA.

Research Questions:

1) Does DynaPESA-II (PESA-II augmented with DynaMOSA features) provide a significant improvement over PESA-II?



2) How does DynaPESA-II perform in generating test cases for JavaScript programs compared to DynaMOSA on branch coverage?

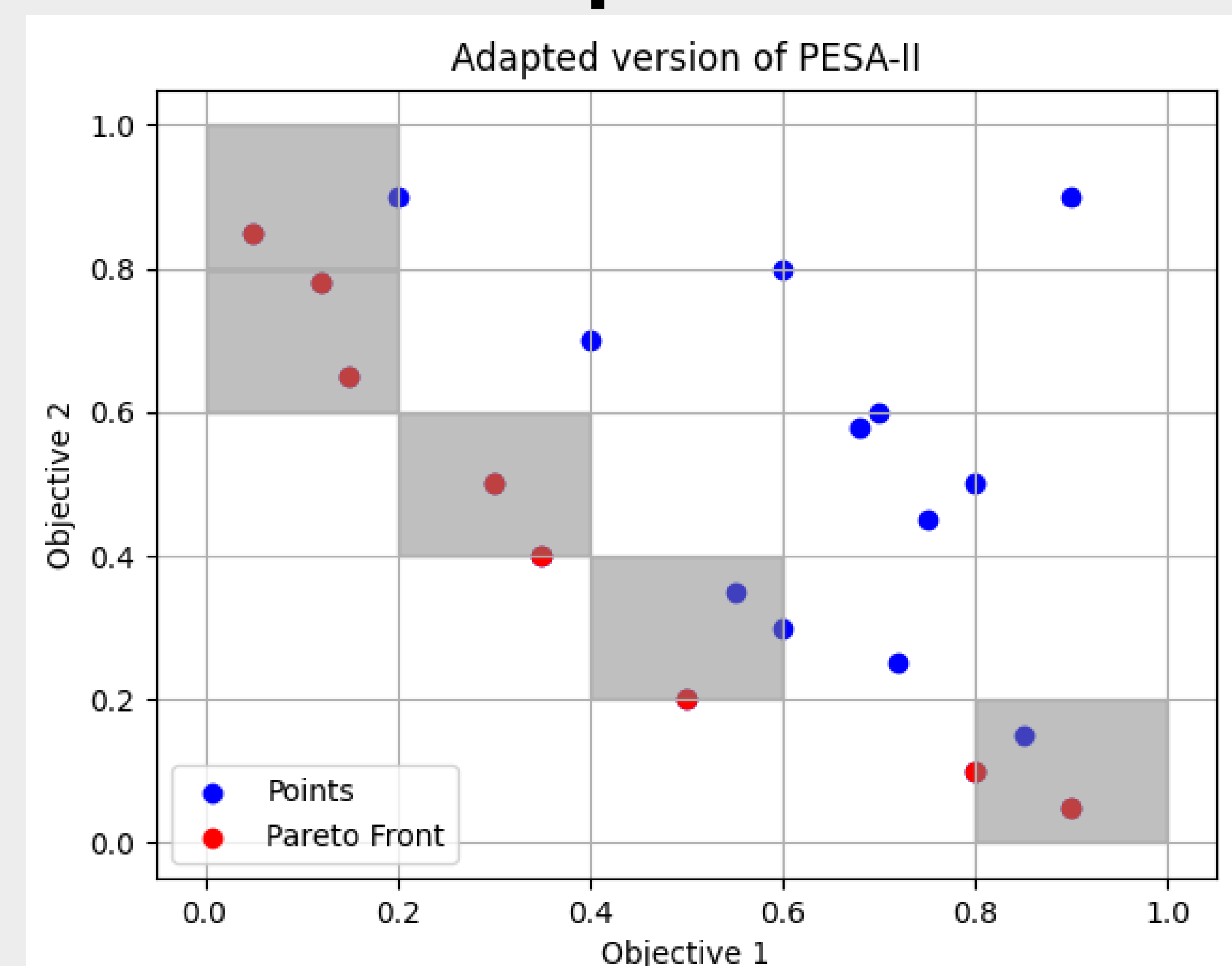
3) Approach

PESA-II: Divides search space into 'hyperboxes'. Biased towards solutions from less dense hyperboxes in order to obtain a diverse Pareto frontier. Selection from Pareto Front.



Does not scale when using many (> 4) objectives.

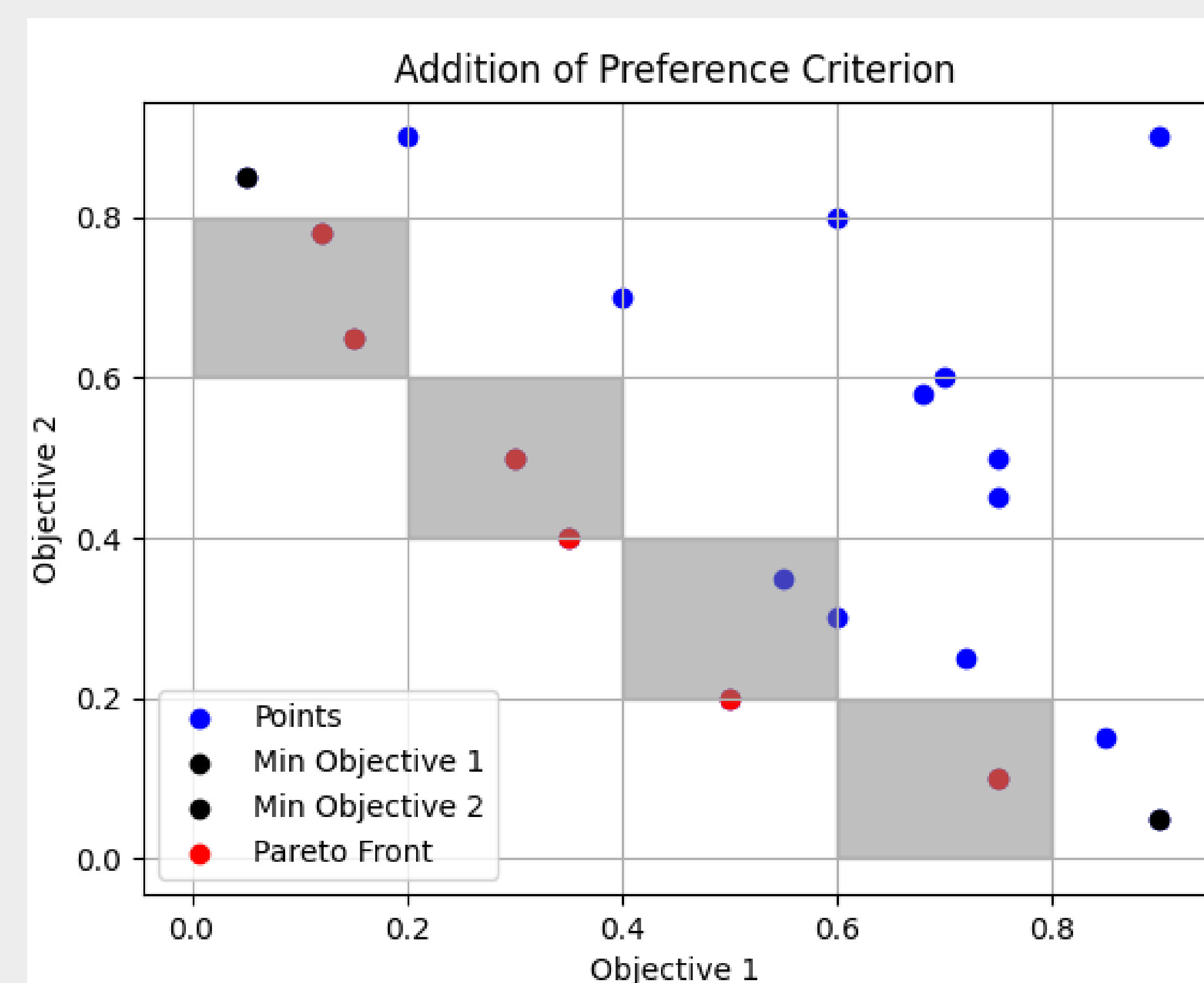
PESA-II Adaptation:



- Iterate over highlighted boxes.
- Randomly select 1 solution from each box.

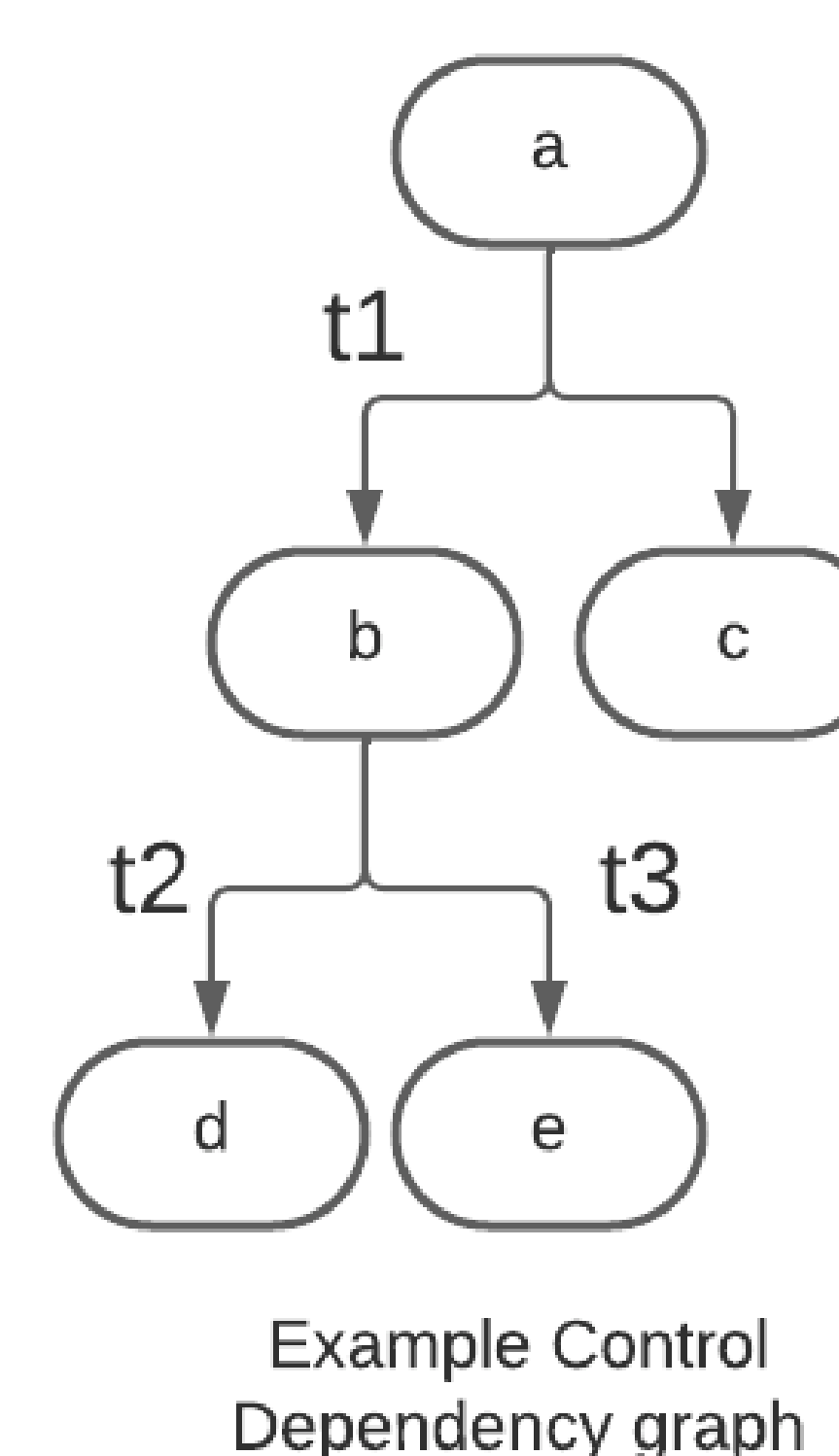
DynaPESA-II features:

1) Selection Based on Preference Criterion



3) Addition of the archive.

2) Dynamic Selection of Optimization Targets



4) Results

The algorithms were compared using a benchmark consisting of a diverse set of JavaScript classes. It included 27 classes from 4 different projects.

	No. of Losses	Same Result	No. of Wins
PESA-II vs DynaPESA-II	15	11	1
DynaMOSA vs DynaPESA-II	1	20	6

The average branch coverage from all the classes are:

- PESA-II: 44.7%
- DynaMOSA: 57.4%
- DynaPESA-II: 55.8%

5) Conclusion

- DynaPESA-II outperforms PESA-II.
- DynaMOSA remains the best performing algorithm with slightly better performance than DynaPESA-II

References

- [1] Dimitri Stallenberg, Mitchell Olsthoorn, and Annibale Panichella. "Guess What: Test Case Generation for Javascript with Unsupervised Probabilistic Type Inference" 2022, pp. 67-82.
- [2] Annibale Panichella, Fitsum Meshesha Kifetew, and Paolo Tonella. "Automated Test Case Generation as a Many-Objective Optimisation Problem with Dynamic Selection of the Targets". In: IEEE Transactions on Software Engineering 44.2 (2018), pp. 122-158.
- [3] David W. Corne et al. "PESA-II: Region-Based Selection in Evolutionary Multiobjective Optimization". In: Proceedings of the 3rd Annual Conference on Genetic and Evolutionary Computation. GECCO'01. San Francisco, California: Morgan Kaufmann Publishers Inc., 2001, pp. 283-290.