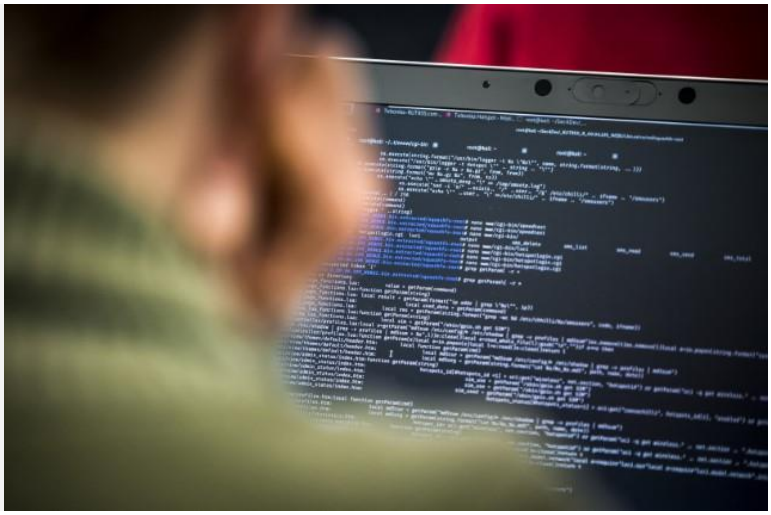
SUCCESS STORY

SBA-K1
SBA Research GmbH



Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Centre K1

Type of project: strategic

SUPERIOR SOFTWARE TESTING EFFICIENCY WITH QUALITY GUARANTEES

TOOL COMPETITION AT LEADING COMBINATORIAL TESTING CONFERENCE CROWNS CAGEN AS BEST GENERAL-PURPOSE COVERING ARRAY GENERATOR

Testing is an essential step in modern development lifecycles, allowing vendors, evaluators, and customers to identify bugs and vulnerabilities in software-intensive products. The importance of implementing testing procedures early and continuously to help save costs, protect the reputation of businesses, and ensure the security of organisations has garnered increasing recognition throughout industries in recent times.

However, testing is not always cheap. For most software-intensive products, it is simply not feasible to evaluate the correct handling of all possible inputs and configurations. Combinatorial testing is a model-based methodology that offers a mathematically guaranteed level of input space coverage while minimizing the amount of test cases that must be executed. This enables researchers to save time and money while ensuring that a specified target level of assurance is established. To reach these goals, combinatorial testing relies on mathematical structures called covering arrays, which provide an abstract representation of test sets. Based on a model of the possible inputs to a software-intensive research prototypes and a chosen degree of assurance (called the *strength*), these objects can be created by specialized algorithms devised for this purpose – but not all algorithms are created equal.

Since 2016, the MATRIS group at SBA Research has been working on new and improved methods to generate covering arrays. In 2018, MATRIS introduced a high-performance implementation of IPO, one of the most popular algorithms in this field. Following

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numerous improvements that aim to reduce both the time required to generate these arrays as well as their size they publicly released the tool CAgen in 2020.

As international partnerships facilitate high-quality improvements in new technologies, our collaboration with NIST in this project and numerous other projects has been central to the development and improvement of CAgen, along with the various other innovative research tools, for increasing, software quality and ensuring efficient state of the art research. The MATRIS group lead, Dimitris Simos, points out that CAgen and our collaboration with NIST will provide essential advancements in research for software engineering use-cases for digitalized modern society.

Rick Kuhn and Raghu Kacker, Senior Scientists at Information Technology Lab at NIST emphasize that CAgen's success is an important demonstration of the practicality of advanced test methods. They highlight that "'NIST's combinatorial testing project focuses on developing research tools and methods to improve test quality while at the same time reducing cost, and our collaboration with SBA Research has been tremendously valuable towards reaching this goal. We believe CAgen and related tools can have a significant impact on improved software quality throughout the industry.'"

In April 2022, the 11th International Workshop on Combinatorial Testing, a leading combinatorial testing conference, hosted a tool competition that pitted bleeding-edge covering array generators against each other. Powered by novel improvements to boost concurrent computations, CAgen outperformed its competitors both in terms of speed and overall ranking, proving to be the best general-purpose covering array generation currently available.

Impact and effects

Covering array generation is an algorithmically complex task and no single approach can achieve optimal results in all situations. However, it is essential to point out that contrary to its counterparts in software testing, the latest version of CAgen offers an advanced test method based on the combinatorial testing approach that improves testing quality and minimizes the cost and time invested in testing of software-intensive products to a significant effect. Moreover, CAgen has numerous high-level and low-level optimizations enabling it to produce various CAs in a matter of seconds., aiming to help researchers. The recent optimization through combinatorial methods made CAgen faster for the strength of more than four and generated more extensive CAs with hundreds of factors especially when compared to other combinatorial test generators like ACTS or PICT.

By lowering the entry barrier to combinatorial testing, the MATRIS group at SBA Research enables any software-intensive productto achieve mathematically guaranteed assurances of the quality, improving their safety, correctness, and security for the good of modern society.

Project coordination (Story)
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