

Towards Automated Experiments in Software Intensive Systems

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Context: Delivering software that has value to customers is a primary concern of every software company. One of the techniques to continuously validate and deliver value in online software systems is the use of controlled experiments. The time cost of each experiment iteration, the increasing growth in the development organization to run experiments and the need for a more automated and systematic approach is leading companies to look for different techniques to automate the experimentation process.

Objective: The overall objective of this thesis is to analyze how to automate different types of experiments and how companies can support and optimize their systems through automated experiments. This thesis explores the topic of automated online experiments from the perspectives of the software architecture, the algorithms for the experiment execution and the experimentation process, and focuses on two main application domains: the online and the embedded systems domain.

Method: To achieve the objective, we conducted this research in close collaboration with industry using a combination of different empirical research methods: case studies, literature reviews, simulations and empirical evaluations.

Results and conclusions: This thesis provides five main results. First, we propose an architecture framework for automated experimentation that can be used with different types of experimental designs in both embedded systems and web-facing systems. Second, we identify the key challenges faced by embedded systems companies when adopting controlled experimentation and we propose a set of strategies to address these challenges. Third, we develop a new algorithm for online experiments. Fourth, we identify restrictions and pitfalls of different algorithms for automating experiments in industry and we propose a set of guidelines to help practitioners select a technique that minimizes the occurrence of these pitfalls. Fifth, we propose a new experimentation process to capture the details of a trustworthy experimentation process that can be used as basis for an automated experimentation process.

Future work: In future work, we plan to investigate how embedded systems can incorporate experiments in their development process without compromising existing real-time and safety requirements. We also plan to analyze the impact and costs of automating the different parts of the experimentation process.