

## Proposed Bachelor's Thesis Project

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# Theoretical Comparison of Software Adaptation Mechanisms

### Thesis Information

**Type of Thesis:** Literature review, theoretical comparison

**Application Deadline:** By 01. December 2025 at the latest

**Thesis Start Date:** By 01. April 2026 at the latest

**Prerequisites:** Software engineering, structured literature research, programming concepts

## Motivation

Modern data processing systems are subject to various types of change. For example, the schema of arriving data may evolve over time. Systems that rely on a fixed schema can crash or produce incorrect results when confronted with such schema evolution. In many cases, these issues must be resolved manually by a data engineer. Due to uncertainty regarding when and to what extent schema changes will occur—and how they might impact the system—the maintenance of such systems becomes unpredictable and costly [1].

## Problem

Various mechanisms exist for adapting software and code to changing circumstances, ranging from simple solutions, such as implementing a fallback for common cases to automatically generating new code. Some of these approaches have been proposed in [1] and [2]. However, it remains unclear to what extent these mechanisms can support the concept of a self-adaptive system, *i.e.*, a system that autonomously responds to changing conditions.

Three key criteria should be considered when evaluating such mechanisms. First, their power and flexibility: specifically, how significant the potential changes to the system can be. For example, a fallback implementation is not very powerful because it only addresses a single predefined case. Second, the complexity of the mechanism itself. Semantic patching, for instance, is highly powerful but requires defining rules that become increasingly complex as the problem grows. Third, the ease with which the approach integrates into existing systems. For example, how straightforward it is to extend an existing data pipeline with such capabilities and make it self-adaptive for specific use cases.

## Goal

The primary objective of this thesis project is to conduct a comprehensive literature review of mechanisms that could support the vision of self-adaptive systems. Based on the findings from this initial step, the identified mechanisms will be compared and evaluated from a theoretical perspective. The previously stated criteria will serve as a starting point for this evaluation. The final outcome will be a categorization of all identified mechanisms along with their assessment according to the developed criteria.

## Next steps

If you are interested in the proposed thesis project, please provide the following information and attachments:

- A short statement explaining your motivation for applying to this project.
- Relevant skills and knowledge you possess that would benefit the project.
- Your current transcript of grades.
- An estimated timeframe for completing the project.

## References

- [1] Kevin M. Kramer, Valerie Restat, and Uta Störl. Evolving gracefully: Building robust and self-adaptive data cleaning pipelines for schema evolution and uncertainty. In *VLDB 2025 Workshop: 14th International Workshop on Quality in Databases (QDB'25)*, 2025.
- [2] Kevin M. Kramer, Valerie Restat, Sebastian Strasser, Uta Störl, and Meike Klettke. Towards next generation data engineering pipelines. *CoRR*, abs/2507.13892, 2025.