Navigating the Paradigm Shift: Machine Learning Applications in Monolithic to Microservice Migration Techniques*

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Abstract. Monolithic systems are not able to continuously provide development and maintenance to the ever adapting, scaling and evolving applications. These architectures deteriorate and degrade over time and require modernization. For this digital transformation the software engineering practices are to shift the monolithic system to microservice. This highly complex migration task has several phases in which only software engineering is not enough, and we need to take advantage of the Machine Learning (ML) techniques. This article is a navigation of the state-of-the-art ML Applications in Monolithic to Microservice Migration Techniques. This guides the applications of ML techniques in various migration approaches and outlines potential future agendas based on current ML based migration practices.

Keywords: microservices · artificial intelligence · machine learning · migration approaches · systematic study

1 Introduction

With technology's widespread acceptance, software engineering evolved to continuously scale and maintain applications, often within monolithic architectures, to meet growing user demands [5]. Due to extensive maintenance and outdated technology, these architectures deteriorate and degrade over time [11]; and require digital transformation. Organizations increasingly migrate existing enterprise applications to the cloud, or cloud computing, to achieve enhanced agility, streamlined development and operational workflows, high availability, automatic scaling, simplified infrastructure management, and compliance with the latest security standards. To prepare existing monolithic applications for integration into cloud technology, they need to transform into flexible, loosely coupled

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compositions of specialized services—a paradigm known as the microservices architecture.

To deliver features and updates rapidly and reliably, the IT industry is evolving with a surge in new technologies, including APIs, componentization [5], containers, cloud Computing [3], and microservices [9]. This stress has scrutinized the current software engineering practices to fully exploit this paradigm shift, to improve software evolution and maintenance beyond existing SE practices. The prominent resurgence of machine learning algorithms in software engineering has become a dominant topic in discussions among researchers now [10]. Addressing common obstacles, researchers aim to uncover synergies and enhance collaborations between academia and industry practitioners.

This led to investigate the usage of machine learning approaches in addressing such key challenges within software engineering related to software reuse [4], software repository mining [12, 1], static code analysis [7], program execution monitoring and visualization [8], microservices architecture [7, 6], and intelligent cooperative systems [2]. By leveraging ML, developers aim to enhance the effectiveness and efficiency of the migration process, offering new insights and automatic solutions to complex problems associated with the paradigm shift in software architecture.

This report systematically investigates the utilization of ML approaches in migrating monolithic applications to highly available microservices architecture, delving into cutting-edge advancements and applications of artificial intelligence within the migration process from monolithic to microservices. Our objective is to spotlight current ML approaches, identify limitations, pinpoint gaps, and to suggest future agenda to address open challenges based on the existing literature. Following Table 1 depicts our research goals in this systematic study:

Table 1. Goals and Research Questions.

no.	Research Questions
G1	What kind of ML practices are being exploit for the migration of monolithic to microservices systems?
G2	What ML techniques are being applied in what category of migration approach?
G3	What future agenda we can have from existing ML practices for the migration approaches?

2 Future Work

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