Bachelor Thesis Topic Proposal

Title: Adaptive Tuning of PID Controllers for VM and Container Admission Using Reinforcement Learning in Edge Computing Environments

Abstract: This thesis aims to investigate the adaptive tuning of Proportional-Integral-Derivative (PID) controllers for the admission of virtual machines (VMs) and containers by utilizing Reinforcement Learning (RL) in edge computing environments. Given the dynamic nature of edge computing, where system changes are frequent and unpredictable, there is a crucial need for adaptive control mechanisms that can ensure high performance and efficiency. This study will explore how RL can be employed to automatically adjust the parameters of a PID controller in real time, thereby optimizing the admission control process to accommodate varying workloads and operational conditions without manual intervention.

Introduction: The project addresses the challenge of efficiently managing access to computing resources in edge environments, where demands can change rapidly. The focus is on Reinforcement Learning (RL), a smart technique that can help fine-tune control systems automatically, making them more efficient in complex and changing situations.

Literature Review: A critical examination of existing strategies for admission control and PID controller tuning should be conducted. The literature review should also cover foundational RL concepts and how they have been applied to control systems, particularly focusing on scenarios where system dynamics are subject to change.

Methodology: The methodology will outline the approach for integrating RL with PID controllers, detailing the creation of an environment that represents an edge computing ecosystem. It will describe the RL framework for tuning PID controller parameters, including the definition of the state space (e.g., server load, request queue length), action space (e.g., PID parameter adjustments), and the reward function (e.g., latency).

Practical Deployment:

1. Implementation of the RL-enhanced PID controller within an edge computing environment.

2. Iterative testing and tuning of the RL agent to ensure effective adaptation to system changes.

3. Comprehensive evaluation of the system's performance under various operational scenarios.

Challenges and Solutions:

1. Exploration of the unique challenges involved in applying RL to the tuning of PID controllers for admission control.

2. Development of solutions to overcome the slow convergence of RL and ensure reliable performance under system changes.

Conclusion: A synthesis of the findings demonstrating the viability of using RL for the adaptive tuning of PID controllers in edge computing environments. Reflection on the implications for future resource management in edge systems and potential areas for further research, particularly in improving the efficiency and adaptability of admission control mechanisms.