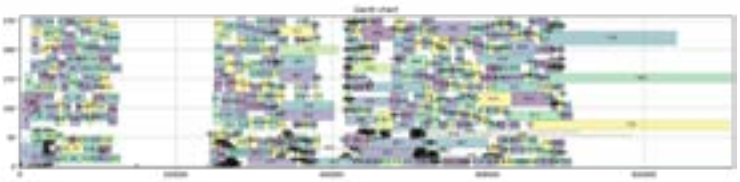
Digital Twin Development for Optimizing HPC in Car Manufacturing

Overview

In collaboration with a leading car manufacturer, a digital twin of their HPC system was developed. The aim was to understand how various system settings impact idle and waiting times for computational tasks.

Machine learning was employed to generate synthetic loads and queues, allowing for simulation under multiple scenarios, such as cluster failure or unexpected workload spikes.



Keywords

digital twin
high-performance computing (HPC)
idle time
queue management
machine learning
synthetic data generation

Situation

The car manufacturer utilized an HPC system where idle and waiting times for computational tasks were less than optimal. The challenge was to adjust system parameters,Äîincluding CPU count, software licenses, and setup configurations,Äîto maximize efficiency. An added complexity was the need to anticipate varying scenarios that the system might face.

Requirements

Create a digital twin of the existing HPC system to simulate the impact of various configurations.

Use machine learning to generate synthetic loads and queues to test a wide range of scenarios.

Analyze how adjustments to parameters like CPU numbers, software licenses, and setup configurations affect system efficiency.

Solution

A digital twin was developed to precisely emulate the car manufacturer's HPC system. Machine learning algorithms were utilized to create synthetic loads and queues, enabling realistic simulations. This allowed for in-depth analyses of how different settings would affect idle and waiting times, providing actionable insights for optimization.

Benefits and Results

- Achieved a deeper understanding of how system settings influence idle and waiting times, thereby enabling targeted optimizations.
- The synthetic loads and queues generated by machine learning provided a powerful tool for simulating a wide array of scenarios, thus preparing the HPC system for unforeseen events.
- The system proved that licence fees could be cut by 5% without increasing waiting time.
- The digital twin served as a sandbox for experimentation without impacting the real-world HPC system, leading to informed decision-making.
- The success of this project opens the door for broader applications of digital twins and machine learning in optimizing computational systems.
- The methodologies developed can be adapted for similar challenges in other industries, thereby demonstrating the robustness and versatility of the approach.