Journal for Research in Applied Sciences and Biotechnology
www.jrasb.com

ISSN: 2583-4053
Volume-1 Issue-2 || June 2022 || PP. 97-100
https://doi.org/10.55544/jrasb.1.2.11

Self-Supervised Learning for Demand Forecasting Using Sparse and Noisy Social Media Sentiment Data

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www.jrasb.com || Vol. 1 No. 2 (2022): June Issue

Received: 23-05-2022 **Revised:** 13-06-2022 **Accepted:** 23-06-2022

ABSTRACT

This research work focuses on the foundational principles of SLO monitoring, architectural considerations for high-volume data processing systems, and advanced techniques for implementing and scaling SLO monitoring solutions. The research includes areas like metric selection, instrumentation techniques, data collection strategies, statistical analysis, and emerging trends in the field. It is a synthesis of current literature and industry practices that presents an organized guide for organizations that want to implement robust SLO monitoring in their data processing infrastructure.

Keywords- Distributed Systems, Monitoring, Metrics, Instrumentation, Statistical Analysis, Machine Learning, Scalability, Real-Time Monitoring.

I. INTRODUCTION

This notion of SLOs was popularized with the rise of popularity of large-scale distributed systems and cloud computing. Achievable target for the performance or reliability of a system that an organization establishes so as to ensure alignment with user expectations and business requirements. An SLO is based on the more general idea of Service Level Agreements.

The Google SRE group had a big role in popularizing this SLO-based concept as an essential practice in reliability systems (Beyer et al., 2016). The SLO is distinguished from traditional IT operations metrics because the latter focuses on user-centric performance indicators. That is, business aims have been set in technical measures. on that does not have articulated SLOs.

Some of the best practices that a data processing high-volume system should be using in setting SLOs include

1. In Pursuance of Business Objectives: SLOs should be in direct support of business objectives. For instance, an e-commerce company processing real-time transaction data may identify an SLO by maximum latency of a transaction process so that the customer isn't able to witness any conspicuous latency issues.
2. Use Historical Data. Using historical performance data; objectives set have to be realistic and achievable. Tools like Prometheus and Grafana can help plot trends over time and inform such decisions.
3. Incremental Refinement: Introduce initial conservatively defined SLOs and iterate over them over time in view of system performance and user feedback. It's come to be known as the "SLO Maturity Model" (Sloss et al., 2017), which can continue to improve the systems without burdening the engineering teams.
4. Account for Dependencies: Complicated data processing systems possess interdependent relations between individual components. SLOs should provide an integrated view of the system performance, accounting for these relationships.

This example illustrates very simply how SLOs can be expressed in code and used to automatically monitor and alert over when performance goes below expected levels.

II. ERROR BUDGETS AND WHAT THEY MEAN IN SLO MANAGEMENT

Research carried out by Höttges et al. (2019) revealed that organizations which adopted error budgets

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found this resulted in a 40% decrease in incidents during production and a 25% increase in the velocity of feature release. Error budgets represent the potency of having a culture of calculated risk; calculated risks can only be taken along with concomitant improvement.

The error budget is calculated by subtracting the SLO from perfect reliability, or 100%. For example, using an SLO of 99.9% would mean that this is your error budget: 0.1 percent. This percentage can then be "spent" in planned maintenance or feature releases, unplanned outage6s, and so forth.

III. RECOMMENDATIONS FOR EFFECTIVE SLO MONITORING

Based on the findings of this research, recommendations for organizations intending to implement or improve their SLO monitoring strategy in high volume data processing systems are as follows:A holistic strategy on application-level, infrastructure, and network monitoring be adopted to track the entire system in detail.

Techniques based on the most advanced method of collecting and aggregation of data, in real time stream processing and distributed tracing, to help in withstanding scale and complexity in modern data processing environments

Machine learning-driven techniques in anomaly detection, predictive analytics, adaptive thresholding to make SLO monitoring more sophisticated and proactive Scalable architecture that can handle cardinality metrics in a very efficient manner with an ability of efficient storage and retrieval capability of historical SLO data for long-term trend analysis.

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