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Accelerating page loads via streamlining JavaScript engine for distributed learning

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ABSTRACT

Distributed learning based on JavaScript-based frontends is typically implemented at the endpoint to maximize performance. Yet, JavaScript-based frontends often experience suboptimal performance. To reconcile these disparities in performance between EDGE and endpoint deployments, strategic optimization is essential, particularly for preserving privacy in distributed learning. Real-time streaming optimizations are imperative to align the performance of disparate components for smooth integration. The reliance on JavaScript for various web functionalities can lead to increased resource consumption and slower page loads. Thus, we introduce a streamlined JavaScript engine designed to optimize structural patterns in JavaScript code, with three key enhancements. Firstly, we reduce the computational burden of the JavaScript engine necessary for setting up the browser's runtime environment. Secondly, we refine the parsing process for specific code patterns, boosting the efficiency of our lightweight engine. Thirdly, we streamline the Inter-Process Communication (IPC) to maintain high performance, even with limited memory resources. Our evaluations demonstrate that our approach reduces the median Total Computation Time (TCT) by 45.2%, and surpasses existing leading solutions, Siploader and Prepack, with improvements ranging from 1.13× to 1.39×.

1. Introduction

In today's fast-paced digital environment, minimizing page load times is increasingly critical. Any delay in distributed learning response can degrade the user experience, potentially driving users to seek faster services. Research that depends on website analyses also underscores the need for optimized page loads, as evidenced in various studies [47,8,10]. Moreover, platforms hosting distributed learning often measure interaction speed as a key indicator of quality, with slower response times linked to lower user satisfaction and engagement.

A lightweight acceleration framework leveraging edge computing emerges as a powerful solution to ensure secure and privacy-conscious distributed learning. Browsers' computational demands are a significant factor in slow page loading times [32]. Efforts to reduce client-side computation, such as manually rewriting web page code [6], often result in increased labor and temporary

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