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Predictive Analytics in Resource Allocation for Digital Libraries

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Abstract - **Although there has been a change in the digital library landscape regarding content, demand, and even the lack of computing and storage bandwidth, all of this suggests a high requirement for the allocation algorithms. This study will focus on optimizing the demand for accessing digital libraries using predictive analytics. Machine learning algorithms can help analyze the access demand, peak usage, and operational prediction of content demand by relating to the history of the demand. Predictive analytics could be used to help in optimal dynamic resource allocation which is more resourceful in bandwidth use, less server workload and enhance efficiencies of content caching. The methodology of the algorithms applied in the current research will be time series forecasting, regression and classification algorithms as the most effective and accurate method or the best dynamic forecasting. In one case study of a university digital library, say, the effect of predictive analytics influenced the latency, user satisfaction and cost of operation. These effects are the possible forecasting analytics can do to enhance decision and resource designation in economics in the digital ecosystem. This research adds new knowledge to how digital libraries function and allocate information technology resources, combining intelligent allocation functions through predictive expectancies in creating a networked digital library. Future work will develop algorithms to allocate resources in real-time adaptive methods that are more efficient, responsive, and provide quality services to users.**

Keywords: **Predictive Analytics, Resource Allocation, Digital Libraries, Machine Learning, User Demand Forecasting, Data-Driven Decision Making, Dynamic Resource Management**

I. Introduction

Predictive analytics involves utilizing past behaviors or results to predict future events and relies on historical data, as well as statistical models and algorithms drawn from machine learning (Shmueli & Koppius, 2011; Kamble et al., 2023). Predictive analytics gives organizations the ability to provide a more detailed insight to influence their operations and strategy, allowing organizations to anticipate events, behaviors, or trends, proactively. Within information systems, predictive analytics has quickly emerged as a powerful forecasting tool to forecast user demand, loads on system, and service usage (Witten et al., 2017; Casado et al., 2008). With modern computing capabilities, large amounts of data are analyzed; relationships or patterns which represent correlates or anomalies can often be identified which could otherwise only be identified through predictive modeling (Han et al., 2022; Tang et al., 2016; Jagan, 2024). Digital libraries have become an essential infrastructure for the education system, research, and public access to information. There are more intricate issues to consider in digital libraries involving computational resources, server capacities, bandwidth, and storage as compared to traditional libraries since the consumption of digital content is an emerging reality (Kumar, 2023). The temporary overload when the bandwidth is necessary most is also a stressor on the bandwidth, latency, and a systematic loss of user satisfaction (Arms, 2000; Prasanna et al., 2024). Efforts