

Chapter 19

A Study on Advanced Applications of Mathematics and AI in Library Science

S. Durga Devi

Sri Krishna Arts and Science College, India

R. Mohanapriya

Sri Krishna Adithya College of Arts and Science, India

N. Sarumathy

Sri Krishna Arts and Science College, India

ABSTRACT

In the rapidly evolving field of information management, libraries are actively embracing the transformative potential of mathematics and artificial intelligence (AI). This chapter explores how established mathematical frameworks, such as the vector space model, together with cutting-edge natural language processing (NLP) techniques, are fundamentally altering how libraries organize information, facilitate retrieval, and ultimately, enhance user experience. The research suggests a symbiotic relationship between these seemingly distinct disciplines. By combining the strengths of mathematical models and probabilistic AI algorithms, this study aims to illuminate paths toward a more efficient and user-centric library ecosystem. This convergence has the potential to reshape resource management, information retrieval, and ultimately, transform the information landscape for library patrons, empowering them to navigate the vast ocean of knowledge with greater ease and effectiveness.

1. INTRODUCTION

Library science is undergoing a profound transformation due to advancements in mathematics and AI. These technologies are being increasingly leveraged to address the challenges faced by libraries, such

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as information organization, retrieval, and user engagement. This chapter explores the various ways in which mathematics and AI are being applied in library science, highlighting their benefits and potential future impact.

In the past, libraries relied heavily on manual processes for classification and cataloging, which were often time-consuming and prone to errors. Information retrieval was primarily based on keyword matching, which could be imprecise and lead to irrelevant search results. User engagement was limited to physical interactions with library staff and resources, with little personalization or customization. In contrast, modern library systems leverage mathematics and AI to automate and optimize these processes. Classification and cataloging are now more efficient and accurate, thanks to mathematical models and machine learning algorithms that can analyse and categorize vast amounts of information. Information retrieval has been transformed by AI-powered search engines that use natural language processing to understand user queries and provide relevant results. Personalized recommendation systems use machine learning to suggest resources based on user preferences, improving user engagement and satisfaction.

Overall, the integration of mathematics and AI has revolutionized library science, making information more accessible, personalized, and efficient. As these technologies continue to evolve, the possibilities for their application in library science are endless, promising a future where libraries are more dynamic, user-centric, and impactful than ever before.

2. APPLICATIONS OF MATHEMATICS IN LIBRARY SCIENCE

2.1 Classification and Cataloging Systems

Classification and cataloging are essential functions of libraries, enabling users to locate resources efficiently. Mathematical models play a crucial role in creating and maintaining these systems, ensuring that information is organized in a structured and accessible manner.

(i) Mathematical Models In Classification

Classifications systems, such as the Dewey Decimal Classification (DDC) or Library of Congress Classification (LCC), use mathematical models to assign unique identifiers to resources based on their subject matter. These identifiers, typically represented as numbers or alphanumeric codes, help libraries organize resources into categories and subcategories, making it easier for users to locate them.

Mathematical models are also used in faceted classification systems, which allow resources to be classified based on multiple criteria or facets. Faceted classification systems use mathematical relationships to link different facets and provide users with a flexible and intuitive way to browse library collections.

(ii) Mathematical Models In Cataloging

Cataloging involves describing resources in a standardized format, typically using metadata standards such as MARC (Machine-Readable Cataloging) or Dublin Core (Kitchin, 2014). Mathematical models are used in cataloging to create consistent and structured descriptions of resources, making it easier for users to search and access them.

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