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A literature review focused on current trends and practices in web application development

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Introduction

As time has progressed, web application development has experienced accelerated growth, becoming an essential component for companies looking to provide high quality technology solutions. The proper use of technologies such as Angular, Node.js, JWT, Bcrypt and MySQL has proven to be essential to create scalable, efficient and secure systems.

Recent studies such as (Effendy et al., 2021) have provided a comparative view of performance between backend and database technologies, highlighting crucial differences that affect overall system performance. The relevance of tools such as MySQL Workbench for the effective management of critical data has also been important (Krogh, 2020).

Despite these advances, there is still a need for a deeper understanding of how these technologies can be synergistically integrated. In this context arises the relevance of exploring and developing a prototype ecosystem that allows an effective integration of these popular technologies in the development of web systems.

Based on the above context, the main objective of this review is to provide a theoretical framework to support the proposed research. It seeks to analyze the evolution of web systems development, examine the relevance of the specific technologies mentioned and review the existing literature on the effective integration of these technologies.

This paper impacts the literature review since it focuses on understanding how these technologies have been used in studies of relevant work, highlighting their advantages and challenges.

Likewise, its rationale seeks to identify success stories and areas where current research can be expanded. This analysis will establish the necessary context for the design and implementation of the prototype, as well as for the subsequent evaluation of its effectiveness in terms of agility, standardization, security, and efficiency in the development of web projects.

Finally, the main objective of this paper is to contextualize and substantiate the proposed research on the development of a prototype ecosystem for the effective integration of popular technologies in the development of web systems, including Angular, Node.js, JWT, Bcrypt and MySQL. This paper arises in response to the fast-paced evolution of web application development and the growing importance of specific technologies in this area.

State of the Art

Historical evolution of web systems development

In the context of the historical evolution of web systems development, a major milestone occurred in November 1990 with the proposal by Tim Berners-Lee and Robert Cailliau of a hypermedia system called "The World-Wide Web". This proposal marked the beginning of the creation of the first web application. Subsequently, in 1991, Tim Berners-Lee implemented the first web server and the first web browser, giving rise to the practical operation of the World Wide Web.

This innovation enabled the creation of the first web pages and laid the foundations for the subsequent development of web systems. The initial web application, although rudimentary compared to today's technologies, introduced the notion of interconnected documents through hypertext links, paving the way for the expansion and continued evolution of web systems over the decades. This historical milestone is crucial to understanding the emergence and transformation of web applications and systems in today's technological landscape (Dene & James, 2021).

The first generation of the Web, which emerged in 1991, was characterized as an information environment where users could only read and share static data. Although it offered advantages such as unique access and autonomy for content creators, it presented technological challenges and interactivity limitations. The inability of users to edit data and lack of participation led to less traffic and advertising. Web 1.0 is considered a closed and less user-friendly stage, marking the beginning of the need to transform to a more interactive and participatory web (Nath, 2022).

Due to the need to interact and share knowledge, Web 2.0 was born around 2003. Web 2.0 was used especially through Virtual Communities of Practice (VCoPs), which are innovative groups that take advantage of information technologies to create and share knowledge. At that time, knowledge management, knowledge creation and the crucial role of information techno-

logies and Web 2.0 in transforming the way people interact and share knowledge in various organizational, educational and political contexts were important (Ziegler, 2022).

In 2007, the well-known Web 3.0 emerged, proposing a change towards a decentralized Internet, where users are the main creators and arbiters of value. It arises as a response to the criticisms of centralization in Web 2.0. Proponents seek a blockchain-based structure, highlighting social, economic, and cultural changes. Socially, it redefines interactions and communities; economically, it introduces user-centric value creation with technologies such as NFT and DeFi; culturally, it empowers creators (Chohan, 2022).

The latest generation is the web 4.0, which has its first impressions at the beginning of 2016, and represents a revolution in the way people interact with online information. Web 4.0 is envisioned as an intelligent and symbiotic network that involves interaction between humans and machines. It is expected to integrate technologies such as big data, augmented reality, machine-to-machine communication, cloud computing and artificial intelligence with intelligent agents. Web 4.0 is perceived as a revolutionary technology that connects the Internet with new objects, enabling advanced interactions in various contexts (Ersöz et al., 2020).

The evolution of web systems, from the conception of "The World-Wide Web" in 1990 to the present day, has marked significant milestones. From Web 1.0, focused on static information, to participatory Web 2.0 and decentralized Web 3.0, each phase reflects the increasing interactivity and transformation of the online experience. Web 4.0, emerging since 2016, promises a revolution by integrating technologies such as artificial intelligence and augmented reality. Together, these generations outline a story of constant innovation and change in the technological landscape.

Methodologies in the development of web systems

In the evolution of software development, methodologies emerged in the 1970s to address problems inherent in the lack of control in the development stages, resulting in deficient products (Molina et al., 2017). With the rise of web applications, the implementation of methodologies has significantly improved the quality of development. The comparison of web methodologies stands out, where OOHDM is identified as the most compliant (Molina et al., 2018). In addition, agile methodologies such as XP and Scrum are being implemented to adapt to changing requirements, bringing flexibility and efficiency to web application development (Carrasco, 2022).

The Extreme Programming (XP) methodology is a response to the growing demand in the software development market, especially in web design, which requires systems that are adaptable and responsive to various devices. The XP methodology, developed by Kent Beck, focuses on addressing the complexity of changing requirements and is based

on proven software engineering principles (Bautista-Villegas, 2022). It is characterized by promoting effective communication, simplicity in design, continuous feedback with the client, respect within the team and the courage to face changes. Its characteristics include a dynamic cycle, work in pairs and 10 to 15 iterations in a typical project. Among its advantages are efficiency in planning and testing, applicability to any programming language and ease of implementation in current technologies, although it may have limitations in long-term and complex projects, as well as the lack of evidence in frequent dynamic changes (Carrasco, 2022).

The Scrum methodology is an agile strategy for project development that seeks to adapt to dynamic environments and encourage team collaboration. It is organized in sprints, development periods of two to four weeks, with planning and review at the end of each one. The methodology is based on roles such as Scrum Master, Product Owner, Stakeholders and Development Team. Scrum is characterized by its focus on team self-organization, flexibility to adapt to changes and systematic risk management. Its advantages include early results, flexibility and adaptation to different contexts, and systematic risk management. However, it can have limitations in small teams and requires intensive task and deadline management, as well as a highly skilled team for successful implementation (Carrasco, 2022). The Scrum methodology has gained widespread acceptance and has been adapted to various disciplines, although these adaptations have generated a variety of modifications and contextual approaches. Its popularity makes it a methodology for adaptations in diverse contexts and objectives, and a key component for other methods. Despite extensive documentation, the lack of integration with a method-centered approach limits the cumulative generation of knowledge (Hron & Obwegeser, 2022).

OOHDM (Object-Oriented Hypermedia Design Methodology) is an object-oriented methodology that follows a five-phase development process, combining UML graphical notations with others specific to the methodology. Initially designed for hypermedia applications, OOHDM was adapted for developing web-oriented hypermedia applications, such as virtual libraries, educational sites and search engines. This methodology focuses on simplifying and improving the efficiency of web application design, using specialized models such as conceptual, navigation and user interface. The five stages of OOHDM include requirements elicitation, conceptual design, navigational design, abstract interface design and implementation, addressing from planning to implementation of the web application (Molina et al., 2018).

Methodologies such as OOHDM, XP and Scrum have been essential in the evolution of software development, improving the quality and adaptability of applications. OOHDM stands out for its focus on hypermedia web applications, simplifying design through phases such

as requirements elicitation and conceptual design. XP, focused on adaptability, promotes effective communication and simplicity. Scrum, with its sprint-based agile management, emphasizes early results. Each methodology contributes uniquely to the dynamic web application development landscape.

MATERIALS AND METHODS

An empirical-analytical research methodology with a quantitative approach is used. The PRISMA data flow is used to select relevant papers.

The definition of the research question is a clear and precise statement that addresses the fundamental PICO (Population, Intervention, Comparison, and Outcome) elements when inquiring about trends and best practices in web application development. The question focuses on the general population of web application development and seeks to understand how different elements, such as architecture, workflows, security and specific technologies such as Node.js, Angular, Bcrypt, JWT, MySQL and other frameworks, impact these processes. The formulation of the research question towards a comprehensive assessment of current practices and trends in the mentioned field is set out in the question: What are the current trends and best practices in web application development, considering aspects such as architecture, workflows, security, and the use of specific technologies such as Node.js, Angular, Bcrypt, JWT, MySQL and other frameworks?

In the process of searching for studies, relevant databases were identified to obtain academic information related to the development of web applications and agile methodologies. A general search was performed from the database provided by Google Scholar, in which some results were obtained from IEEExplore, Scopus, Dialnet among others. To optimize search efficiency, specific search terms were registered, such as ‘web applications’, ‘agile methodologies’, ‘application development’, ‘web frameworks’, ‘Web Security’, among others. In addition, temporal restrictions were implemented to ensure the relevance of the results, limiting the search to studies published in a range of years 2019 - 2023. These steps were essential to ensure that relevant and up-to-date information in the field of interest was obtained (see Table 1).

Table 1
Pre-defined requirements

Criteria	Description
Date of Publication	Studies published in the years 2019-2023 are included. Studies published before 2019 are excluded.
Type of Study	Empirical studies, systematic reviews and case studies are included. Case studies that do not indicate implementation recommendations are excluded.
Methodology	Only studies using a qualitative or quantitative methodology are included. Studies that do not comply with the terms of inclusion are excluded.
Thematic Relevance	Studies that address specific aspects of a topic or technology are included. Studies that are not directly related to the research focus are excluded.
Quality of the Study	Only studies with high methodological standards are included. Studies with significant methodological limitations are excluded.

In the literature review process, predefined inclusion and exclusion criteria were applied to select the most relevant studies aligned with the research objectives. Inclusion criteria were established based on specific aspects, such as relevance of content, methodological quality, and date of publication. On the other hand, exclusion criteria were used to discard studies that did not meet the predefined requirements.

The workflow for selecting search was carried out systematically. Initially, a review of the titles and abstracts of the identified studies was conducted, applying the inclusion and exclusion criteria. Subsequently, the selected articles were read for a more detailed evaluation. During this process, a protocol for eliminating duplicates was used, guaranteeing the integrity and uniqueness of the information collected.

Technology integration in web development

Web development projects that highlight the integration of various technologies to address specific challenges are explored. From improving medical records management in healthcare using the Angular framework, to creating complete web applications using Node.js to manage client Internet connections, each project demonstrates the effectiveness of technology integration in web development. In addition, the implementation of MySQL in a CodeIgniter-based application and the use of JSON Web Token (JWT) and bcrypt to secure user authentication in web applications highlight the diversity of approaches and technologies used in modern web development.

In (Ccolque, 2019), the problem of inefficient medical records management in the Peruvian health sector is addressed through the development of a web-based system using the Angular framework and rest, specifically in the city of Juliaca. It is highlighted that most of the managers of health organizations are unaware of the benefits of an adequate administration of medical records. Given the need to manage medical records electronically, it is mentioned that Angular was in-

tegrated into the project as a JavaScript framework that facilitates the creation of web applications. Angular provides features such as data binding, routing, and animations, simplifying the development of modern applications. In addition, it is explained that the adoption of Angular seeks to improve the accessibility and management of information in medical records, optimizing the process of diagnosis and treatment of patients in the Dermacenter Rios Clinic in Juliaca.

On the other hand, Node.js is used by (Kinnunen, 2023), as a JavaScript runtime environment to build secure and versatile web servers. In this case, it was used to develop a complete web application for an Internet service provider. Thanks to its extensive ecosystem, Node.js enabled the construction of a robust and versatile server, along with an API to access the database. The resulting application, designed to run on a variety of devices, was successfully deployed on the company's intranet, giving employees the ability to manage and control customers' Internet connections. This full-stack approach demonstrates the effectiveness of Node.js in creating scalable and secure web applications. MySQL integration plays a key role in the development of the Aplikasi Website Portal Manajemen Informatika, based on the CodeIgniter framework. The application, designed to provide up-to-date information on IT management, leverages the capabilities of MySQL as a database management system to efficiently manage diverse data sets. The implementation of MySQL allows for an organized and accessible structure, thus contributing to the speed and efficiency in obtaining information for both computer science students and the community at large (Ramadhan et al., 2020).

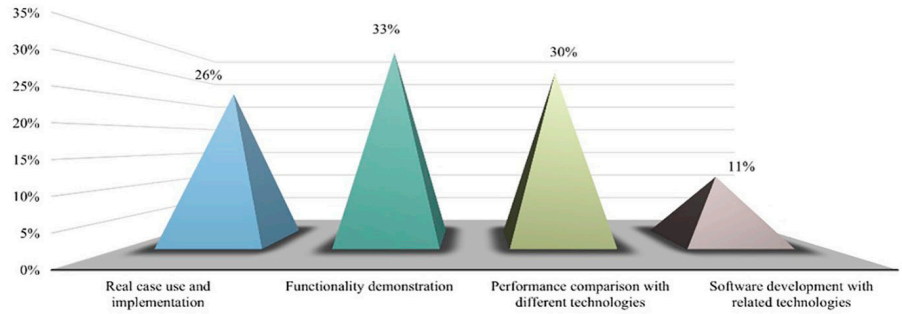
In relation to user authentication in web applications (Kujala, 2023), used JSON Web Token (JWT) to ensure the security of sensitive data, such as passwords, and implemented bcrypt to hash user passwords. At registration, the application verifies the non-existence of the provided username and email in the database before adding the user with the corresponding password hash. When using bcrypt for password hashing, the developer must determine the number of salt rounds used to calculate the complexity and processing time of the hash operation. The salt rounds represent the cost factor, determining how long it takes to compute a single bcrypt hash, with each additional round increasing the cost factor and doubling the computation time.

Projects that exemplify the integration of various technologies in web development have been explored. From optimizing medical records management with Angular to building complete web applications using Node.js, these cases highlight the effectiveness of combining technologies to address specific challenges. The use of MySQL in CodeIgniter and the implementation of security measures such as JSON Web Token (JWT) and bcrypt reinforce the idea that technology integration is key in modern web development. These examples underscore the versatility and positive impact that the strategic combination of tools can have on problem solving and process improvement in a variety of contexts.

Results

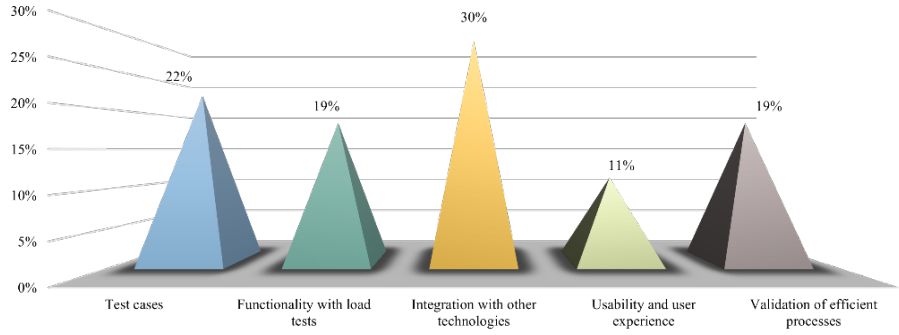
According to the 27 studies analyzed, the following results were obtained.

Figure. 1
Percentage of jobs related to existing thematic areas



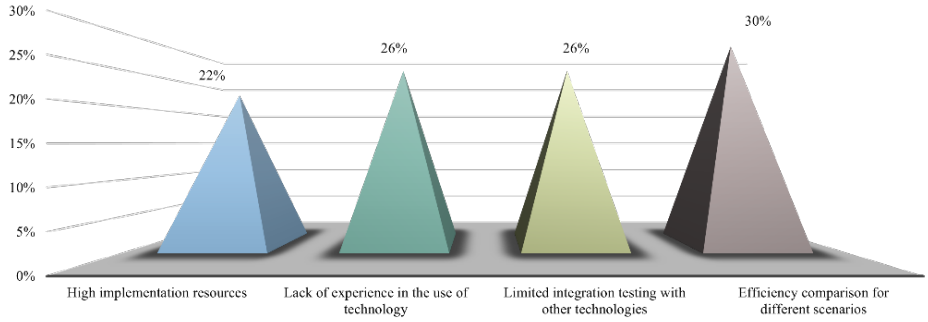
According to the analysis of topics and objectives, the works related to the use and implementation in a real case resulted in 26%, demonstration of functionality 33%, performance comparison with different technologies 30% and software development with related technologies 11% (see Fig. 1).

Figure. 2
Percentage of work related to the formulation of existing problems



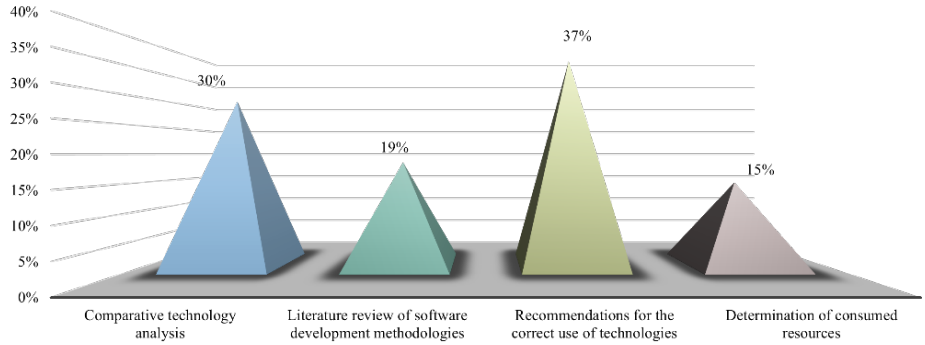
According to the analysis of the problem formulation and data involved, it was obtained that the work related to test cases resulted in 22%, functionality with load testing 19%, integration with other technologies 30%, usability and user experience 11% and validation of efficient processes 19% (see Fig. 2).

Figure. 3
Percentage of jobs that determine an existing constraint



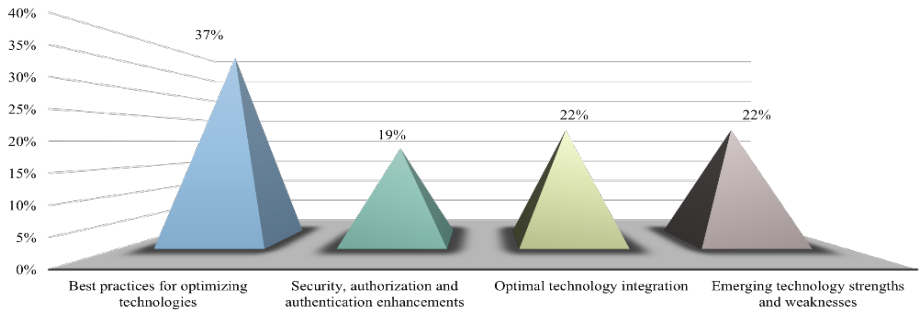
According to the analysis of the limitations encountered, it was found that the works related to high resources for their implementation were 22%, lack of experience in the use of the technologies 26% and comparison of efficiency in different scenarios 30% (see Fig. 3).

Figure. 4
Percentage of related work according to the analysis of proposals and methodologies used



According to the analysis of proposals and methodologies used, it was obtained that the works related to the comparative analysis of technologies were 30%, review of literature on methodologies for software development 19%, recommendations for the correct use of technologies 37% and determination of resources obtained 15% (see Fig. 4).

Figure. 5
Percentage of papers related to the results and challenges encountered



According to the analysis of the solutions found, results and challenges, the works related to best practices for the optimization of technologies were 37%, improvements in security, authorization, and authentication 19%, optimal integration of technologies 22% and strengths and weaknesses of emerging technologies 22% (see Fig. 5).

Finally, the relevant technological trends are presented according to the analysis of the works found (see Table 2).

Table 2
Relevant technological trends

Trends	Relevance	Reference
Angular	It allows the creation of services, directives, and various essential elements for the development of web applications	(Ccolque, 2019;)Cincovic et al., 2019;) (Saini & Jasrotia, 2023)(Ghimire, 2020) (Kaluža et al., 2019)
Node.js	Service implementation follows a separate layered structure for more secure and understandable code	(Kinnunen, 2023)(Pardo et al., 2018) (Sharma et al., 2019)(Huynh, 2020) (Pant et al., 2022)
JSON Web Token	The tokens encode and verify their own assertions, allowing them to be self-contained for short durations and without the need for database access, simplifying design and eliminating database overhead.	(Ramadhan et al., 2020)(Mahindrakar & Pujeri, 2020)
Bcrypt	In a first step, an initial key is established using eksblowfish and then encrypted with OrpheanBeholderScryDoubt using a previously generated 192-bit key. This approach provides additional security by using a structure that makes potential attacks more difficult	(Kujala, 2023)(Giffary & Ramadhani, 2022)
MySQL	Its popularity among programmers is due to its cross-platform capability, ease of use and reliable security system	(Sotnik et al., 2023)(Nagpal et al., 2020)
Scrum	Agile methodology for developing applications that generates a climate of responsibility, progress and effective communication in the work team	(Krogh, 2020)(Dene & James, 2021)(Nath, 2022)(Ziegler, 2022)(Chohan, 2022)(Ersöz et al., 2020) (Molina et al., 2017)(Molina et al., 2018)(Carrasco, 2022)(Bautista-Villegas, 2022)(Hron & Obwegeser, 2022)

DISCUSSION

Web systems development is undergoing a rapid evolution driven by emerging technology trends. The Internet, as a powerful medium of communication and influence, has unleashed significant advances that require continuous adaptation by both users and developers. This dynamism is reflected in the constant search for more efficient and advanced web models and services. The intersection of different programming languages, tools and platforms has given rise to a diversified technological landscape that optimizes speed and precision in the development of web applications. In this context of digital transformation, we explore the most important trends that are shaping the present and future of web systems development.

In relation to JavaScript, it is highlighted its position as the most widely used interpreted language in the construction of web pages, with a syntax similar to Java and C. Its ability to run on the client side is highlighted, which contributes to agility and efficiency in web development. In addition, it is emphasized that, unlike PHP, JavaScript does not involve data exchange with the server, which influences performance (Pardo et al., 2018). HTML is mentioned as a fundamental hypertext markup language for the development of static web applications, although its combination with other languages allows the creation of dynamic applications. HTML5 is introduced as an evolution that introduces dynamic elements to configure the web environment and its contents (Pardo et al., 2018).

Regarding authentication and authorization, JSON Web Token (JWT) is considered especially suitable for serverless applications. Because JWT allows additional information to be stored directly in the token, beyond just the user's credentials, the server no longer needs to look up that information in the database. When a user logs in withhis/her credentials, these are sent to the Authorizer, and the JWT is returned in case of success. The platform validates the JWT before granting access to protected resources. This streamlined process improves security and efficiency in managing user authentication in serverless architectures (Huynh, 2020). Continuing with security, Bcrypt is used as a hashing algorithm in the context of password-based authentication in web applications. This choice of Bcrypt is justified by its ability to add an additional layer of security using "Salt", a random string appended to the password. This procedure strengthens security by preventing direct and indirect attacks on the password stored in the database. When a user attempts to log in, the credentials entered are compared with the information in the database using the comparison function provided by the Bcrypt package. The implementation of Bcrypt ensures that even if someone gains access to the database, passwords remain safe and secure (Pant et al., 2022).

The current landscape of web systems development reflects a dynamic transformation driven by emerging technology trends. The constant evolution, moved by the influence of the Internet, has led to the search for more efficient and advanced models and services. In this context, JavaScript stands out as the most widely used interpreted language, providing agility and efficiency in web development. The combination of HTML and HTML5 continues to be fundamental for creating web applications, offering both static and dynamic structures. In the area of authentication and authorization, JSON Web Token (JWT) is introduced to improve security and efficiency in the management of user authentication. In addition, the implementation of Bcrypt for password hashing reinforces security by adding an additional layer using "Salt", mitigating risks associated with direct and indirect attacks on stored passwords. Thus, these trends reflect a continued commitment to innovation and security in the development of web systems.

CONCLUSIONS

This paper highlights the importance of integrating specific technologies, such as An-gular, Node.js, JWT, Bcrypt and MySQL, for the effective development of web systems. The historical evolution from Web 1.0 to Web 4.0 has demonstrated the constant need to adapt to new technologies to meet the changing demands of the technological landscape. The review of methodologies, such as XP, Scrum and OOHDM, highlights how they have contributed to improving the quality and adaptability of web application development. In addition, current trends in web development, such as the predominant use of JavaScript, HTML5, JWT and Bcrypt, reflect the constant evolution and commitment to innovation and security. The projects reviewed demonstrate that effective integration of these technologies in web development is essential to address specific challenges and improve efficiency in a variety of contexts.

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