

Academic Atlas: A Platform for Rich Resource Sharing for Academics

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Abstract—Academic Atlas is a tool developed to facilitate access to academic materials such as previous year’s question papers, capstone projects, and research papers. Of major concerns for the students would be that they cannot access the necessary materials and resources needed for academic development and to prepare for upcoming examinations. This application is designed and built upon the MERN stack: Mongo DB, Express JS, React JS, and Node JS, resulting in the total scalability and efficiency of the platform. Controlled contributions feature guaranteed data integrity and reliability since only valid holders of institutional email ID’s are allowed to submit new materials. The security of this application and platform lies in the hashing of passwords stored in the database. Using pre-trained T5 (Text-to-Text Transfer Transformer) model. The arXiv dataset consists of large number of summarized articles, so it will use this dataset for both the model and testing purposes to verify how reasonable its obtained metric scores are as regards ROUGE. So, Academic Atlas seeks to revolutionize the academic experience with a well-organized, accessible, and even interactive learning environment.

Index Terms—ROUGE Metrics, Text Summarization, React JS, User Experience, Authentication, Mongo DB, MERN Stack.

I. INTRODUCTION

The reason behind the need for an Academic Atlas is to provide students with an organized means of access to the most important academic resources. Most university students often struggle to find valuable materials such as past question papers, capstone projects, and research papers that contribute greatly to their academic growth. These help understand the formats of exams, project guidelines, and current research trends, thus making the students understand what is expected and how best to study. Without a centralized hub, it might take them too long to locate most of the materials required for exams and could negatively impact their preparation and performance. Therefore, the Academic Atlas solves the problem by collecting and categorizing all these resources in one place, saving them time and thus allowing students to engage more deeply with the study. The Academic Atlas further proliferates an enhanced experience in wider understanding and adds to the culture of research and learning, thereby providing easy accessibility to information.

The Academic Atlas is relevant to the students because it brings a balanced approach between an open access and secure contribution of materials. Among the features of the

platform are that any material it boasts is free to browse through and view its contents, which may include past question papers, capstone projects, and research papers. This open access would be helpful to the student to get relevant resources to support their study, making them ready for exams, projects, and research work. However, regarding the addition of contents, the platform follows a secure and controlled procedure. Only authorized users having a valid college e-mail ID can upload and share new academic material. This ensures that the content provided to the platform is credible and relevant to an academic community that it serves as well as reliable.

Limiting contribution to only verified users helps maintain the high quality and reliability of Academic Atlas, and the students and faculty can confidently seek relevant information on it. Controlled contributions also enable accountability since only members of the institution can make contributions, thus maintaining the integrity of the platform. At the same time, this open access for viewing of the resources means students can receive assistance from it regardless of their background because it is open while only its content contributors can create content in it. Thus, this kind of wide access and safe creation of content allows for collaborative knowledge research since the valuable material is exposed to the relevant use while remaining accurate. With this thoughtful balance, the Academic Atlas may then truly become a great academic support and growth tool within the institution.

Academic Atlas has met the great demand of an organized access to academic resources by university students, so that those can easily search for vital materials, like past question papers, capstone projects, and research papers on which effective study and preparation often rely. The centralized system of resources keeps saving students time and eventually enhances their overall academic performance. The Academic Atlas balances open access and secure contributions where any one can browse and view materials but only the users with a valid college email ID can upload materials, thereby ensuring that the contribution is of quality and reliable. In addition, the Academic Atlas provides summaries of research papers. It promotes a community feel and peer-to-peer learning. Generally, it is an academic atlas—a source of all academic writings, and also it is an open, interactive tool for personal knowledge

sharing and support among students.

II. BACKGROUND STUDY

[1] The MERN stack is a strong framework for developing solid web applications since the building blocks are four technologies that include MongoDB, Express JS, React JS, and Node JS. According to Bafna et al. (2022) [2], MongoDB is a NoSQL database providing flexible document based data storage that serves well with modern web application architectures. Express JS is a Node JS web application framework that makes the server side development easier, providing a comprehensive suite of features for web and mobile application development. Node JS, based on V8 JavaScript engine, allows the development of server-side JavaScript and makes it possible to run JavaScript on the server-side, thereby unsealing the gates for the production of scalable and high-performance applications. Finally, [7] React is a popular front-end library developed by Facebook for the purpose of building user interfaces. It enables the use of component-based architectures for the creation of interactive, dynamic web applications.

The MERN stack serves as the ideal choice for developing modern education systems because it supports dynamically changing content and real-time data interactions. Bhalla et al. (2020) [5] explain React JS in depth, highlighting that it represents the leading front-end JavaScript library in modern web development. As noted above, [7] React JS enables developers to build reusable components of the user interface while focusing on dynamic and interactive web applications. With React, developers can create engaging user interfaces that respond seamlessly to user inputs, hence enhancing the overall learning experience. Additionally, the architecture for the stack will support an integration of real-time features, including both collaborative tools and live updates, which are essential for fostering communication and collaboration among students. Through the MERN stack, with it comes, friendly interfaces offered by web applications, better access to data, and rich interactivity, helping to achieve more effective learning environments.

A centralized platform provides significant advantages for students by offering a single access point for academic materials. This streamlined approach enhances efficiency, as students can quickly find and retrieve resources such as previous year's question papers, capstone projects, and research articles without navigating multiple sources. [1] The MERN stack is particularly effective in facilitating fast data retrieval and efficient resource management, ensuring that information is accessible in real time. Furthermore, a centralized platform promotes collaboration among students, encouraging the sharing of insights and discussions around academic materials. By fostering an environment of interaction and collective learning, a centralized platform allows students to engage deeply with their studies, benefiting from diverse perspectives and collaborative problem-solving.

Digital learning is fundamentally transforming education by facilitating a shift towards online learning and enhancing ac-

cessibility to academic resources. [18] As educational institutions increasingly adopt digital platforms, students can access a wealth of materials and courses from anywhere, breaking down geographical barriers and creating opportunities for diverse learning experiences. This transition has highlighted the need for well-organized, user-friendly resources that cater to the varying needs of learners. Additionally, features like peer-to-peer learning, and real-time collaboration are becoming integral to modern education. These tools encourage active engagement among students, allowing them to discuss concepts, share insights, and collaborate on projects, thereby enriching the learning experience. By fostering a community-driven approach to education, these interactive elements not only enhance understanding but also build vital communication and teamwork skills necessary for the future.

A basic understanding on why a summary is required before moving on to the text summarization [19]. Text summarization is increasingly important in today's information-rich environment, where the large volume of data can overwhelm users. It encompasses various methods, primarily extraction and abstraction, to shorten the information effectively [13] [14]. Extraction methods focus on extracting key sentences or phrases from the original text. Abstraction methods, however derive new summaries that carry the main ideas without using any of the original phrases [14]. This is necessary as this capacity enhances readability and comprehension, especially in contexts like news and research, where timely access to information is very crucial [16]. Advances in such technologies as neural networks and transformers have greatly improved summarization performance [14], achieving more accurate and fluent summaries [15]. Additionally, methods like the Long-Short Transformer model have proven to be highly effective by handling unregistered words and making the summary more clear [15]. Finally, summarization tools help make better decisions and retrieve information effectively, which is crucial for our data-driven world [16] [17].

III. METHODOLOGY

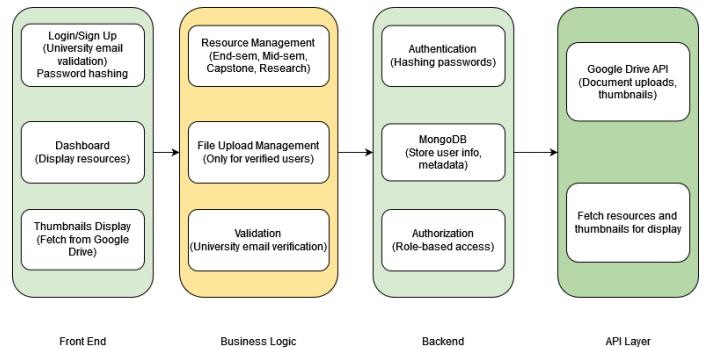


Fig. 1. Architecture diagram of application.

A. Technology Stack

After assessing various front-end technologies that were available, React JS was settled for the framework of this project because of several reasons. Rawat and Mahajan (2020) [6] presented a detailed analysis of React JS as a contemporary front-end JavaScript library focusing on its applications in building single-page web applications. This is achieved by smooth navigation from one view to the next without page reloads using React Router and thus, provides a fluid user experience. Further, lightweight nature of React along with the virtual DOM's concept has resulted in efficient rendering and made the application more responsive and faster overall. Furthermore, React's component-based architecture promotes modularity and reusability, which significantly streamlines the development process and facilitates easier maintenance and scalability. These advantages made React.js the most suitable choice for our frontend development needs.

B. Database and Storage Solution

According to Dhanke et al. (2023) [1], MongoDB, a NoSQL database, offers flexible schema design, making it suitable for both structured and unstructured data. In our search for the optimal database solution, we selected MongoDB for several key reasons. Its schema flexibility, as a document-oriented database, allows for efficient management of diverse data types, which is essential when dealing with a wide range of academic resources. While academic PDFs typically occupy only kilobytes of storage, we also considered scalability and the potential need to handle large datasets. Given these requirements, we opted for a hybrid model that combines MongoDB with Google Drive for storage.

For capstone projects and research papers, we decided that storing GitHub repository URLs within MongoDB would suffice, as plain text URLs require minimal storage space. However, for midterm and final exam papers, we implemented a solution where the PDFs are uploaded to Google Drive, and the corresponding URLs are stored in MongoDB. This hybrid model allows us to efficiently manage and scale the application for a large number of users while ensuring that both research documents and academic papers are easily accessible. Users can download files directly from the user interface using the stored URLs, enhancing the overall experience on our platform.

C. User Authentication and Security Measures

We implemented a robust secure authentication system to ensure that anyone can register on the platform, but only users with valid institutional email addresses can contribute. This selective contribution process is essential for several reasons. First and foremost, securing user credentials is vital in today's digital landscape, where data breaches and unauthorized access to sensitive information are increasingly common. To safeguard user passwords, we employ bcrypt.js to hash them before storing them in MongoDB. This means

that plaintext passwords are never exposed in our database, significantly reducing the risk of credential theft. Even in the unfortunate event of a data breach, attackers would not gain access to user's actual passwords, making it considerably more challenging to exploit user accounts. Upon registration, users receive a verification email to confirm their email address. This additional layer of security serves multiple purposes: it ensures that the email provided is valid and actively monitored by the user. By implementing this email verification step, we further enhance the integrity of our user base and maintain the platform's overall quality.

When a user attempts to log in, their password is checked against the hashed password stored in MongoDB. This mechanism not only safeguards user credentials but also allows us to ensure that only users with valid institutional email addresses can contribute content to the platform. By restricting contributions in this manner, we foster a community of legitimate users who are affiliated with the institution, thereby enhancing the quality of contributions and reducing the risk of spam. This multi-layered security approach is crucial in minimizing potential vulnerabilities and protecting user data from unauthorized access or attacks.

In conclusion, our secure authentication system not only upholds the privacy and security of our users but also promotes a responsible and trustworthy environment for collaboration and knowledge sharing within the academic community. This is increasingly important in a world where digital security is paramount, and user trust is foundational to the success of any online platform.

D. Document Management

In our document management system, we implemented strategies to prevent duplication and promote transparency among contributors. To ensure that each uploaded resource is unique, we established criteria that combine the file type and category and academic year. This approach guarantees that no identical resources can be submitted to the platform, thus maintaining the integrity of our resource library. Additionally, we emphasized Contributor's Transparency by displaying the name of each resource's contributor. This feature fosters accountability and enables open communication regarding discrepancies or issues that may arise with any resource. By linking each resource to its contributor, we encourage a collaborative environment where users can engage with one another, ask questions, and resolve concerns efficiently. These measures not only enhance the quality of the resource database but also create a trustworthy platform that values contributor input and facilitates clear communication.

E. Research Paper Summarization

We have integrated a Summarization Model that utilizes the T5 (Text-to-Text Transfer Transformer) framework to automatically summarize the contents of published research papers. This model is built upon advanced natural language processing techniques, designed to handle the complexities of

lengthy research papers into concise, informative summaries. The summarization process aims to enhance the usability of academic resources, allowing users to quickly identify key insights from research papers without the need to read through entire documents. The dataset chosen for this implementation is the arXiv dataset, consisting of approximately 200,000 scientific papers across various fields such as engineering, biotechnology, mathematics, and more. It includes three main categorical features: `article`, `abstract`, and `section_names` as shown in Fig. 2. These features represent textual data, with no continuous or binary features present, focusing entirely on textual analysis. The `article` field contains the full text of each research paper, while the `abstract` provides a concise summary of the findings and contributions. The `section_names` detail the structure of each paper, outlining sections such as Introduction, Methods, Analysis, and Conclusion. Fig 4 presents a sample entry from the dataset, illustrating the relationships between these fields and highlighting the contents of both the article and its corresponding abstract. This dataset will be utilized to analyze various patterns in research papers, offering insights into their structure and scientific writing styles. Since the `section_names` column does not contribute to the summarization task, it was removed during preprocessing. Additionally, we performed several preprocessing steps to clean the dataset, removing unwanted characters such as `@`, `-`, and other special symbols, ensuring cleaner and more structured input data for the model.

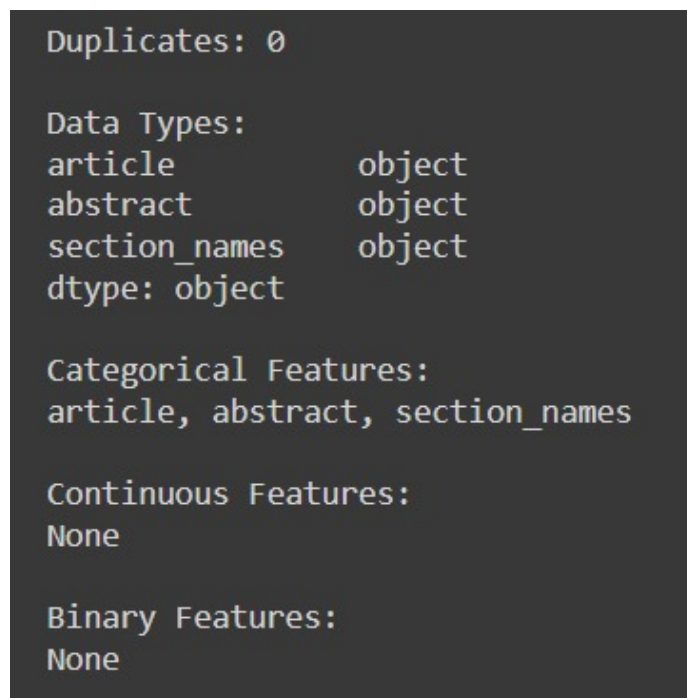


Fig. 2. Overview of the arXiv dataset structure

Given that T5 is a pre-trained model, we were able to leverage its existing knowledge and capabilities without the need for extensive retraining, allowing us to efficiently gener-

[illegible]

Fig. 3. Sample Entry in arXiv Dataset

ate high-quality summaries. To test the model’s performance, we selected 100 research papers from the arXiv dataset. The results of these tests, including the quality and accuracy of the generated summaries, are discussed in the following sections. The arXiv dataset’s structure, which consists primarily of article text and abstracts, was highly suitable for this task, and the combination of the T5 model with effective preprocessing enabled us to deliver concise, reliable summaries that enhance the overall academic research experience.

F. Other Features

In addition to our core functionalities, we have implemented several features that enhance the user experience and facilitate effective resource management. First, we introduced User Storage Options, which allow for local or session storage of a user's login details. This feature eliminates the need for users to repeatedly log in, streamlining the access process and significantly improving overall efficiency. We are able to provide a much more seamless experience by remembering user credentials thus pushing users to use the platform more frequently. The next major enhancement is Contributions Dashboard, which empowers a user to keep track of all his contributions very easily. What is unique in this dashboard is that it gives each user a summarised view of their academic submissions to share high quality academic resources and feel ownership in the contributions to the platform. Collectively, they add a lot of value to the platform by encouraging user interaction, enhancing accessibility and usefulness of scholarly resources. By making contributions more accessible, and providing tools to understand them quickly, we improve on this user-friendlier context, thereby encouraging scholarly collaboration and knowledge-sharing activities.

IV. RESULTS

In order to assess the quality of generated summaries, ROUGE was used. The ROUGE metric is a quantitative measure to assess the quality of the automatically generated summaries against reference summaries. The following metrics will summarize the results of the evaluation. The Fig.4 illustrates the ROUGE scores for each metric. The heights of the bars correspond to the respective F1 scores, allowing for a quick visual assessment of the performance across the different ROUGE metrics. The ROUGE-1 scores achieved

0.23, demonstrating a decent level of agreement with the reference summaries. The ROUGE-L score of 0.14 reflects the challenges in maintaining phrase-level accuracy, highlighting areas for potential improvement. Confidence Interval The mean ROUGE-1 score, calculated using bootstrapping methods, was found to be 0.23, with a 95% confidence interval ranging from 0.23 to 0.23. This indicates a high degree of reliability in the ROUGE-1 score, further reinforcing the effectiveness of the generated summaries.

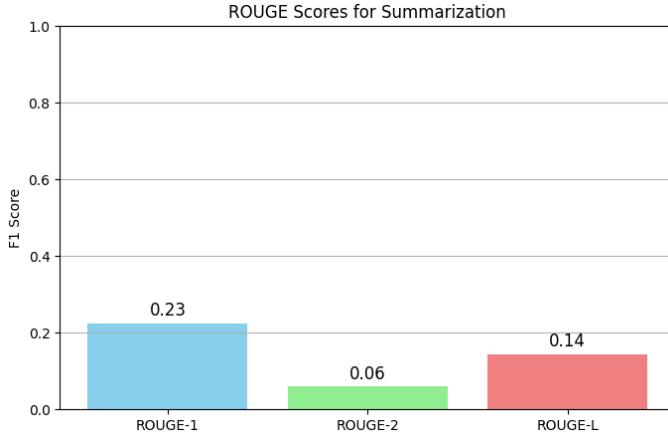


Fig. 4. ROUGE Scores for Generated Summaries

The quality of the generated summaries was rigorously evaluated using a combination of qualitative and quantitative metrics, allowing for a comprehensive assessment of their effectiveness. Our model consistently produced summaries that accurately captured the main arguments, findings, and conclusions of the research papers while effectively filtering out unnecessary details that could distract or confuse the reader. This ability to distill essential information is crucial, particularly in academic contexts where clarity and precision are paramount. To quantitatively measure the performance of our summarization model, we employed the ROUGE (Recall-Oriented Understudy for Gisting Evaluation) metrics, which are widely recognized in the field of natural language processing for evaluating summarization tasks.

By dividing large documents into chunks, the model efficiently handled the complexity of academic texts. The summaries of individual chunks were well-structured and, when combined, provided a coherent overall summary. This approach ensured that no significant information was lost during the summarization process. Manual evaluation by domain experts confirmed that the final summaries reflected the main content of the papers accurately. The preprocessing steps, such as the removal of unwanted characters and noise, significantly improved the model's performance. Cleaned input text allowed the model to focus more on meaningful content, leading to clearer and more relevant summaries. Papers with complex formatting, such as mathematical expressions and citations, also benefited from this preprocessing, reducing distractions in the output. In terms of processing time, the chunking approach,

combined with transformer-based architecture, led to efficient summarization, even for documents with thousands of words. The model was able to generate summaries in significantly less time than traditional manual methods, making it a practical tool for users who need quick insights from large volumes of academic literature.

The MongoDB collections utilized in the Academic Atlas platform are critical for managing and providing access to a variety of academic resources. The logical data size of the database is 67.56 KB, with a total storage size of 284 KB and an index size of 304 KB. The database comprises 7 collections, each serving distinct purposes within the platform. A significant aspect of the MongoDB structure is its efficient organization, which enhances both storage management and data retrieval performance. The collections contain varying numbers of documents, with each collection tailored to specific functionalities. For example, the tracks collection, containing 315 documents and a logical data size of 23.98 KB, plays a crucial role in tracking academic courses. The capstones collection, with 4 documents and a logical size of 4.43 KB, focuses on housing student capstone projects, and research papers. The consistent use of indexing across all collections is vital for optimizing query performance. Each collection maintains a dedicated index, ensuring rapid access to the necessary data. For instance, despite having fewer documents, the capstones collection has a significant index size of 36 KB, indicating a well-structured indexing approach that facilitates quick searches and data retrieval.

The visual representation in Fig. 5 illustrates the distribution of documents and sizes across the collections, highlighting their relative importance and structure within the database. This graphical depiction serves to reinforce the efficient data organization principles applied within the Academic Atlas platform, ultimately enhancing user experience and resource accessibility.

atlas							
LOGICAL DATA SIZE: 67.56KB		STORAGE SIZE: 284KB		INDEX SIZE: 304KB		TOTAL COLLECTIONS: 7	
Collection Name	Documents	Logical Data Size	Avg Document Size	Storage Size	Indexes	Index Size	Avg Index Size
capstones	4	4.43KB	1.1KB	36KB	1	36KB	36KB
contributions	7	1.3KB	191B	36KB	1	36KB	36KB
developers	4	1.7KB	435B	36KB	1	36KB	36KB
exams	35	11.99KB	350B	36KB	1	36KB	36KB
feedbacks	16	2.2KB	140B	36KB	1	36KB	36KB
tracks	315	23.98KB	78B	52KB	1	44KB	44KB
users	115	21.96KB	194B	52KB	2	80KB	40KB

Fig. 5. Visualization of MongoDB Collection Statistics

V. CONCLUSION & FUTURE WORK

Academic Atlas is the platform that smoothes academic resource sharing between members of the university. The system has authenticated access that allows only authenticated contributors into the source, providing a prospective solution to one of the main gaps in educational resource accessibility. Future improvements should enhance user engagement and

expand the platform's features to accommodate a more extensive range of resources. Our transformer-based summarization model enhances the usability of academic resources by providing concise summaries of research papers. By breaking down lengthy documents into chunks and applying advanced preprocessing techniques, we optimize the summarization process and deliver high-quality outputs. This approach not only saves time for researchers but also makes academic literature more accessible to a wider audience.

A chatbot would significantly expand the scope for improving and refining the Academic Atlas platform. It can be enhanced to handle a wider range of queries related to academic resources, thereby improving its natural language processing capabilities for better comprehension and response to student inquiries. By using machine learning algorithms, the chatbot could learn from user interactions, thereby generating personalized recommendations tailored for individual academic needs and preferences, which would make the search easier. Furthermore, integrating the chatbot with other institutional services like course registration and event notices would, create a comprehensive support system for students. A robust feedback mechanism would help students voice their opinions about their experience of using the chatbot, facilitating continuous improvement and adaptation to user needs. In addition, the chatbot's 24/7 availability would make sure that more students get instant help hence enhancing the overall learning experience. Through these developments, the Academic Atlas aims to create an academic environment that is efficient and user friendly towards all students.

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