2023-10-10

An Undergraduate Internship on Software Engineering (Artificial Intelligence)

Rahman, Mahfuzur

Independent University, Bangladesh

An Undergraduate Internship on Software Engineering (Artificial Intelligence)

By

Mahfuzur Rahman

1811077

Summer, 2023

Supervisor

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Adjunct Lecturer

Department of Computer Science & Engineering

Independent University, Bangladesh

10th October, 2023

Dissertation submitted in partial fulfillment of the degree of

Bachelor of Science in Computer Science & Engineering

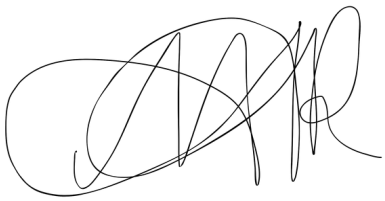
Department of Computer Science & Engineering

Independent University, Bangladesh

Attestation

I certify that the contents of of this dissertation are the original intellectual property of Mahfuzur Rahman, student in Independent University, Bangladesh. I understand that full academic integrity is necessary for acceptance of this paper and have created this document accordingly over the course of Summer, 2023.

Sincerely,



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Mahfuzur Rahman

1811077

Date: 10/10/2023

Acknowledgement

We extend our heartfelt gratitude to several entities and individuals who have been instrumental in the successful completion of this internship program and the development of this report.

First and foremost, we would like to express our sincere appreciation to the World Bank for their generous funding support to ADN Diginet. This financial support has not only enabled ADN Diginet to offer this valuable internship program but has also contributed significantly to the growth of the technology sector in Bangladesh.

We would also like to acknowledge the Department of Information Technology (IIT) at Dhaka University for their invaluable assistance in designing the learning material that formed the foundation of our training. Their expertise and resources played a crucial role in equipping us with the knowledge and skills necessary for this internship.

Our gratitude extends to the entire team at ADN Diginet, who welcomed us as trainees and interns into their development team. Their guidance, mentorship, and commitment to our growth have been exemplary. The immersive training and grooming provided by ADN Diginet were pivotal in helping us acquire the relevant skills and adapt to the dynamic industrial environment. We are especially grateful for the insights into the professional world, which eased our transition from academia to a professional setting.

In conclusion, this internship experience has been a transformative journey, and we are deeply appreciative of all those who have played a part in our learning and development. Your support and contributions have been invaluable, and we look forward to applying the knowledge and skills gained during this program in our future endeavors.

Letter of Transmittal

7th October, 2023

To:

Internship Evaluation Committee
Department of Computer Science & Engineering
Independent University, Bangladesh
Plot 16, Aftab Uddin Ahmed Road, Dhaka 1229

From:

Mahfuzur Rahman
Trainee Software Engineer (Artificial Intelligence)
ADN DigiNet

Dear Mr. Mahir Al Kamal Sir,

This document reports the technical and academic details of my involvement with ADN DigiNet during my internship period of Summer 2023. I have joined ADN DigiNet of 7th May as a trainee software in the field of AI, and therefore the internship period is valid till 31st July, 2023. During this period, I received training on machine learning techniques and how we can utilize them in commercial products and also received valuable insights of the industry that help in the future as software developer.

I hope this sequence of reports creates a legitimate and high quality instance of an IUB intern.

Sincerely,
Mahfuzur Rahman
1811077

Evaluation Committee

Supervision Panel

Mahir Al Kamal Academic Supervisor Name: Mahir Al Kamal	Industry Supervisor Name: Dodul Haque Khan

Panel Members

Panel Member-1 Name: Sanzar Adnan Alam	Motiur Rahman Panel Member-2 Name: Mohammad Motiur Rahman

Panel Members

Panel Member-3 Name: Md. Mahmudul Peyal	Marzan Panel Member-4 Name: Marzan Binte Hasan

Office Use

Program Coordinator Name: Subrata Kumar Dey	Head of Department Computer Science & Engineering Name: Mahady Hasan

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Abstract

This is report provides an overview of my enriching three-month internship at ADN DigiNet, where I was selected to participate in a specialized program aimed at developing prototypes and proof of concept projects utilizing Machine Learning (ML) and Aritificial Intelligence (AI) techniques. The internship commenced with an intensive two-month training phase, immersing us in ML concepts, tools, and available libraries. Subsequently, the final month was dedicated to applying our newly acquired knowledge and skills to work on individual projects.

My Project centered around the creation of a Book Recommendation System, designed to enhance user experience by delivering personalized book suggestions based on their preferences and platform interactions. As part of this projects, I played a pivotal role in building the backend server using Django, a widely-used web framework. Specially, I was responsible for implementing crucial functionalities, including user authentication, order placement, and review management, ensuring a seamless user experience and fostering greater engagement and satisfaction.

Chapter 1: Problem Statement

The primary objective of the internship was to identify real-world problems that could be effectively solved or improved through the application of machine leaning techniques. Participants were encouraged to explore domains such as data analysis, image recognition, natural language processing, recommendation systems, and more. The focus was on practical, impactful solutions that align with ADN DigiNet's vision and can contribute to the technological advancement of Bangladesh.

Chapter 2: Literature Review

The literature review phase of the internship played a crucial role in building a strong foundation of ML knowledge. Participants extensively researched scientific journals, blogs, and articles related to machine learning. Key topics covered in the literature review included:

- **Overview of Machine Learning:** Understanding the fundamentals, types, and applications of ML techniques.

- **Supervised Learning:** Studying algorithms such as Linear Regression, Decision Trees, Random Forests, Support Vector Machines, etc., and their use cases.

- **Unsupervised Learning:** Exploring algorithms like K-Means Clustering, Hierarchical Clustering, and Principal Component Analysis, and their applications.

- **Reinforcement Learning:** Understanding the principles and applications of reinforcement learning in various fields.

- **Machine Learning Models:** Reviewing different ML models like neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs) and transformer models (BERT, GPT-3, etc).

- **Natural Language Processing (NLP):** Investing NLP techniques for text analysis, sentiment analysis, and language generation.

- **Computer Vision:** Exploring image recognition, object detection, and image generation methods.

Chapter 3: Methodology

The internship program followed a structured methodology to ensure effective learning and problem-solving. The key steps of the methodology were as follows:

3.1 Lectures and Training Sessions

Throughout the ML internship at ADN Diginet, industry experts and trainers played a pivotal role in shaping our understanding of machine learning. They conducted a series of lectures and hands-on sessions, effectively introducing us to a diverse range of ML concepts, techniques, and models. What made this experience truly enriching was the specific emphasis on real-world case studies. These case studies provided tangible examples of how ML is applied across various domains, highlighting its practical relevance and paving the way for us to connect theory to real-world application seamlessly.

3.2 Research and Review

During the internship, participants were encouraged to explore and review recent research papers, blogs, and articles related to ML. The focus was on actively identifying innovative approaches and breakthroughs within the ML landscape that could be directly applicable to real-world problem-solving scenarios. This approach ensured that participants' understanding of ML was not only grounded in theory but also informed by the latest developments in the field.

3.3 Seminars and Consultations

During the internship, seminars were organized where industry specialists and senior professionals shared their experiences and knowledge in applying ML to solve complex problems. These sessions enriched our understanding of practical ML applications. Additionally, regular consultation sessions with mentors and trainers provided invaluable guidance, helping us navigate problem identification and solution development effectively.

3.4 Problem Identification

During the problem identification phase, participants worked collaboratively in teams, engaging in brainstorming sessions to analyze a wide range of potential problems suitable for ML solutions. This collaborative approach encouraged creativity and critical thinking. A central emphasis was placed on selecting challenges that not only demonstrated the potential of ML but also aligned closely with ADN Diginet's overarching vision and Bangladesh's socio-economic development goals. This careful alignment ensured that the solutions pursued during the internship had a profound and lasting impact, benefiting both the company and society at large.

3.5 Solution Development

Following the identification of challenges, participants proceeded with the development of ML-based solutions. Leveraging the knowledge and skills acquired during the internship, they adeptly employed a repertoire of suitable algorithms, models, and techniques. These tools served as the building blocks for crafting innovative prototypes and minimum viable products (MVPs), providing tangible solutions that could be further refined and scaled to address the identified problems effectively.

3.6 Lessons Learned

3.6.1 Comprensive Understanding of Machine Learning

During the internship, we delved deep into the fundamentals of machine learning. Through lectures, training sessions, and self-study, we gained a comprehensive understanding of the different types of ML techniques, including supervised learning, unsupervised learning, and reinforcement learning. This foundational knowledge formed the basis of our subsequent explorations.

3.6.2 Proficiency in Machine Learning Models

One of the significant takeaways from the internship was our proficiency in various machine learning models. We studied and experimented with diverse models such as Linear Regression, Decision Trees, Random Forests, Support Vector Machines, K-Means Clustering, Hierarchical Clustering, Neural Networks, Convolutional Neural Networks (CNNs), and more. Understanding these models equipped us to identify suitable solutions for different problem domains.

3.6.3 Insights from Literature Review

The literature review phase allowed us to explore the latest research papers, blogs, and articles on machine learning. This process exposes us to cutting-edge advancements and innovative approaches within the field. We gained insights into state-of-the-art algorithms and techniques, enabling us to stay abreast of the rapidly evolving ML landscape.

3.6.4 Practical Application through Case Studies

The integration of real-world case studies into the lectures and training sessions proved invaluable. By examining practical ML applications in diverse domains like healthcare, finance, e-commerce, and natural language processing, we developed a pragmatic approach to problem-solving. Understanding how ML is used to tackle real-world challenges deepened our appreciation for the technology's potential impact.

3.6.5 Learning from Industry Specialists

The seminars and interactions with industry specialists and senior professionals were enriching experiences. Their valuable insights and first-hand experiences provided us with

a broader perspective on the challenges and opportunities in applying ML to address real-world problems. Hearing about successful ML implementations inspired us to think innovation and creatively.

3.6.6 Problem Identification and Solution Development

Working collaboratively in teams, we engaged in brainstorming sessions to identify problems suitable for ML-based solutions. This process sharpened our problem-solving skills and honed our ability to assess the feasibility and impact of potential projects. As we progressed to develop ML solutions, we learned to leverage the appropriate algorithms, models, and techniques to address identified problems effectively.

3.6.7 Evaluation and Iterative Improvement

The iterative development and evaluation of ML solutions taught us the importance of continuous improvement. By analyzing feedback from mentors and stakeholders, we learned to iterate and fine-tune our solutions for enhanced performance and accuracy. This iterative approach is a critical aspect of the ML development process, and we now possess hands-on experience in its application.

3.6.8 Practical Implications and Societal Impact

Throughout the internship, we were exposed to the practical implications of ML technologies in various sectors. This knowledge has given us a heightened awareness of the ethical considerations and societal impact of implementing ML solutions. Understanding the potential consequences of AI and ML applications enables us to advocate for responsible and ethical use of these technologies.

3.6.9 Personal Growth and Skill Development

The ML internship at ADN Diginet facilitated our personal growth and skill development in numerous ways. We have strengthened our analytical skills, problem-solving abilities, and critical thinking. Moreover, our proficiency in programming languages commonly used in ML, such as Python, and libraries like TensorFlow and PyTorch, has significantly improved.

3.6.10 Future Outlook

Having completed the ML internship program, we are now equipped with a strong foundation in machine learning techniques, models, and applications. Our exposure to real-world problem-solving, coupled with the guidance from industry experts, has prepared us for a promising career in the field of ML and AI. The skills and knowledge gained during this internship will undoubtedly contribute to the advancement of technology in Bangladesh and beyond. As we continue our journey, we have the potential to drive innovation and make a positive impact on society through our expertise in machine learning.

Chapter 4: Project Management & Financing

Effective project management played a crucial role in the successful development of the book recommendations system. The team embraced collaborative and agile practices to ensure a well-structured and organized workflow throughout the project.

4.1 Team Roles and Responsibilities

Each team member was assigned specific roles and responsibilities based on their expertise and interests. As the backend developer, my responsibilities involved designing and implementing the backend infrastructure using Django, integrating ML models with the frontend, and ensuring seamless data flow.

4.2 Agile Methodology

Our team adopted an agile approach to software development, with regular meetings and sprint planning. This iterative methodology allowed for flexible adjustments based on feedback and emerging requirements.

4.3 Task Breakdown and Coordination

The project was divided into smaller tasks, and our progress was tracked using project management tools. Regular coordination meetings ensured that each team member was aware of the progress and challenges faced by others, promoting a cohesive development process.

4.4 Planning

A comprehensive planning phase was undertaken to define project milestones, timelines, and resource allocation. The planning phase involved careful consideration of the project's scope, objectives, and technical requirements.

4.4.1 Scope Definition

The scope of the project was defined as developing a book recommendations system that utilized ML models to provide personalized book suggestions based on user preferences and historical data.

4.4.2 Milestone and Timelines

The team established specific milestones to track progress. The project was divided into multiple sprints, each lasting one week. This approach allowed for a systematic development process and timely completion of key deliverables.

4.4.3 Resource Allocation

Resources, including team members' time and computing resources, were allocated based on the complexity of tasks and individual expertise. 4.5 Financing

The internship program, funded by the Bangladesh government through the EDGE program, provided the necessary financial support for the project's execution. The financing covered expenses related to hardware, software, data acquisition, and other essential components.

4.5.1 Resource Budgeting

Our team efficiently managed the provided resources by utilizing open-source tools and libraries for ML model training and data engineering. The budget was allocated to acquire relevant datasets for training and testing the book recommendations system.

4.5.2 Cost-Effective Solutions

To ensure cost-effectiveness, our team explored free or low-cost options for cloud computing resources, data storage, and project management tools. This approach enabled us to focus on the project's core development without incurring unnecessary expenses.

4.6 Project Outcome

The successful implementation of the book recommendations system prototype within four weeks was a testament to the team's dedication, collaboration, and effective project management during the ML internship at ADN Diginet. The system showcased the seamless integration of backend Django infrastructure with ML models, delivering personalized book recommendations based on user preferences. This achievement, achieved through a well-structured planning phase, efficient resource allocation, and adherence to timelines, highlighted the potential of ML applications in real-world scenarios. The completion of the working prototype within the allotted time frame demonstrated the team's technical prowess and commitment to delivering a valuable product for the company. The knowledge and skills gained during the internship, along with the successful project outcome, undoubtedly serve as a stepping stone for a promising career in the field of machine learning and AI.

Chapter 5: Body of the Project

During my internship at ADN Diginet, I had the privilege of being part of a visionary approach to training and project development. ADN Diginet, recognizing the transformative potential of AI and ML, had initiated a comprehensive training program. The objective was to equip interns with the knowledge and skills needed to contribute to AI/ML-powered solutions that align with the company's forward-looking vision. Instead of immediate production work, we were immersed in a rigorous training curriculum. Our mission was to create a demo project that embodied the power of AI/ML in a tangible way.

For this project, we undertook the development of a book recommendation system from scratch. This system was designed to showcase the capabilities of collaborative filtering, utilizing cosine similarity, alongside a popularity-based recommendation approach. While the project focused on the ML aspect, it also had a distinct e-commerce flavor, allowing users to interact with the recommendation system by adding books to their cart, placing orders, and even rating books. However, the payment system was not added.

ADN Diginet's vision was not just about completing tasks but fostering a deep understanding of AI/ML's potential impact. The training process encouraged creativity, problem-solving, and an interdisciplinary approach. It aimed to produce not just developers but innovators who could pioneer transformative AI/ML solutions. My role in building the project's backend with Django was pivotal, as it ensured the seamless integration of our AI/ML models.

This project, along with the entire internship experience, was a testament to ADN Diginet's commitment to nurturing the next generation of AI/ML professionals. It allowed me to apply theoretical knowledge in a practical setting and contributed to ADN Diginet's vision of advancing AI/ML-powered solutions for the future.

5.1 Requirement Analysis

The requirement analysis phase of our demo project was thoughtfully streamlined to align with our primary goal of showcasing an ML-powered recommendation system. We recognized the need to keep the project focused and agile, emphasizing a basic e-ommerce interface with features commonly found on typical e-commerce platforms. This decision allowed us to allocate more time and effort to the core task of implementing collaborative filtering using cosine similarity and a popularity-based recommendation system. By consciously simplifying our requirements to essential e-commerce functions, we ensured that our demo project effectively demonstrated the capabilities of our recommendation system while maintaining clarity and efficiency throughout the development process.

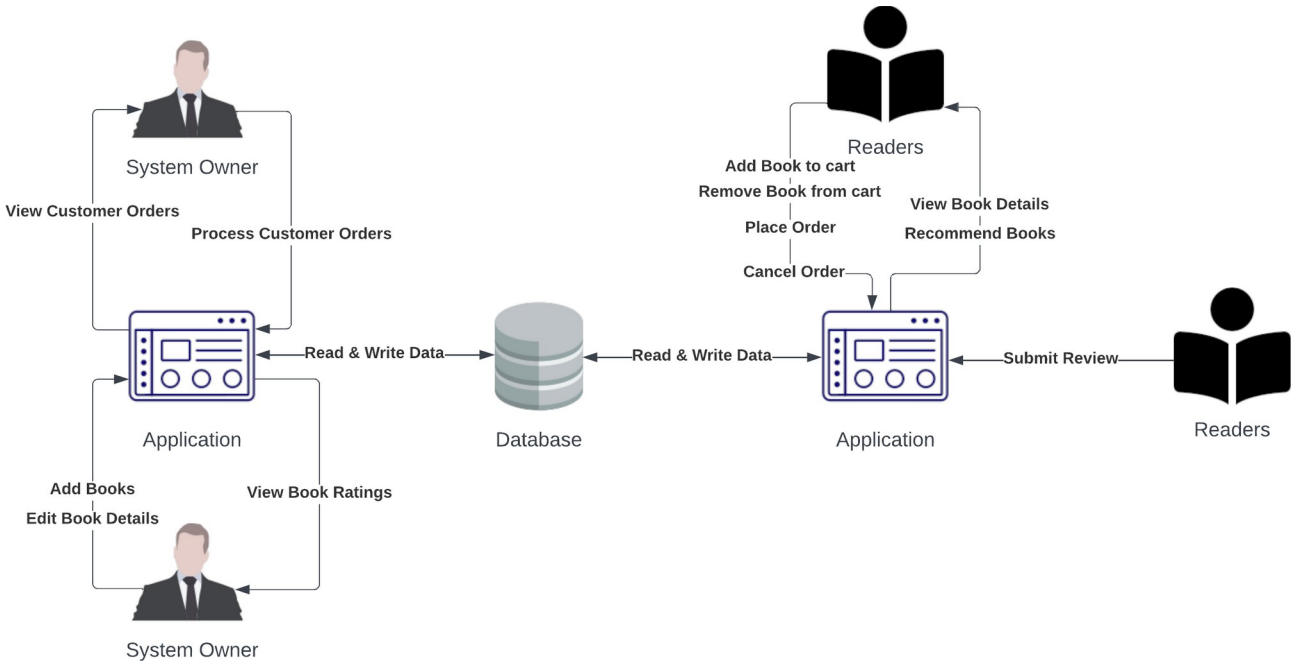

Figure 1: Rich Picture of Functionalities

5.2 Six Element Analysis

Table 1: Six Element Analysis of System Functionalities

Process	System Roles					
	Human	Non Computing Hardware	Computing Hardware	Software	Database	Networking & Communication
Add Books	**System Owner:** System owners will be able to add a new book to the database through the django admin panel.	**Book:** The book whose data will be added. **Paper:** Book details might come printed on a sheet of paper.	**Computer:** Computer or smartphone might be used to access the system or read or create book details in word processing software or spreadsheet software that will be added to the system. **Printer:** It might be used to print out book details.	**Book Recommendation & Ecommerce System:** To input new book details. **Office Suite:** Read or write word document or spreadsheet containing book details.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*
Edit Book Details	**System Owner:** System owners will be able to edit book details in the database through the django admin panel.	**Book:** The book whose data will be edited. **Paper:** Book details might come printed on a sheet of paper.	**Computer:** Computer or smartphone might be used to access the system or read or create book details in word processing	**Book Recommendation & Ecommerce System:** To edit book details. **Office Suite:** Read or write word	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*

			software or spreadsheet software that will be added to the system. **Printer:** It might be used to print out book details.	document or spreadsheet containing book details.		
View Book Ratings	**System Owners:** System owners will be able to view individual reader's ratings to book through the django admin panel. **Readers:** Readers will be able to view the average rating of a book in the book details page.	**Not Applicable**	**Computer:** Computer or smartphone might be used to access the system to view book ratings.	**Book Recommendation & Ecommerce System:** To view book ratings.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*
View Customer Orders	**System Owners:** System owners will be able to view individual reader's orders to book through the	**Not Applicable**	**Computer:** Computer or smartphone might be used to access the system to view orders.	**Book Recommendation & Ecommerce System:** To view orders.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*

	django admin panel.					
Process Customer Orders	**System Owners:** System owners will be able to process orders and initiate different processes for the delivery system, like fetching books from the warehouse, handing over to delivery service and updating the order as delivered upon delivery was completed successfully.	**Paper:** Customer details and order details might be printed on paper while the order is being processed.	**Computer:** Computer or smartphone might be used to access the system to view orders and generate printable customer detail and order detail. **Printer:** To print customer details and orders on a paper.	**Book Recommendation & Ecommerce System:** To view orders.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*
Recommend Books	**Readers:** Readers will be able to view book recommendations on their homepage and individual book pages.	**Not Applicable**	**Computer:** Computer or smartphone might be used to access the system.	**Book Recommendation & Ecommerce System:** To view book recommendations.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*

View Book Details	**Readers:** Readers will be able to view book details like book title, author(s), book summary, average book rating, book price, adding book to the cart and related books generated by the book recommendation system.	**Not Applicable**	**Computer:** Computer or smartphone might be used to access the system.	**Book Recommendation & Ecommerce System:** To view book details.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*
Add Books to Cart	**Readers:** Readers will be able to add books to the cart from the homepage and/or book details page.	**Not Applicable**	**Computer:** Computer or smartphone might be used to access the system.	**Book Recommendation & Ecommerce System:** To add book(s) to the cart.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*
Remove Books from Cart	**Readers:** Readers will be able to remove books from the cart from the cart page.	**Not Applicable**	**Computer:** Computer or smartphone might be used to access the system.	**Book Recommendation & Ecommerce System:** To remove book(s) to the cart.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommendation & ecommerce system.*
Place Order	**Readers:** Readers will be able to place an	**Not Applicable**	**Computer:** Computer or smartphon	**Book Recommendation & Ecommerc**	**MySQL:** Store book details, user	**Internet:** To access the *book recommen*

	order of the books that have been added to the cart from the cart from the cart page.		e might be used to access the system.	**e System:** To place orders.	orders, and buying history, user reviews.	*dation & ecommerc e system.*
Cancel Order	**Readers:** Readers will be able to cancel the order that has not been placed yet from the cart page.	**Not Applicable**	**Computer:** Computer or smartphon e might be used to access the system.	**Book Recomme ndation & Ecommerc e System:** To cancel orders.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommen dation & ecommerc e system.*
Submit Review	**Readers:** Readers will be able to rate books that have been delivered to the readers.	**Not Applicable**	**Computer:** Computer or smartphon e might be used to access the system.	**Book Recomme ndation & Ecommerc e System:** To submit review.	**MySQL:** Store book details, user orders, and buying history, user reviews.	**Internet:** To access the *book recommen dation & ecommerc e system.*

5.3 Functional & Non-functional Requirements

5.3.1 Functional Requirements

1. **Add Books (System Owners):**
   a. The system should allow the system owners to add new books to the database

   b. Mandatory book information fields, such as title, author(s), ISBN, publishing year, thumbnail, summary (optional), price and quantity available.

2. **Edit book details (System Owners):**
   a. System owners should be able to edit existing book details, including title, author(s), ISBN, publishing year, thumbnail, summary (optional), price and quanitity availble.

b. The system should validate and update the edited information while ensuring data integrity.

3. **View individual user ratings to a book (System Owners):**
   a. System owners should have the access to view individual user ratings for each book in the system

   b. Ratings should be displayed in a clear and organized manner.

4. **View customer orders (System Owners):**
   a. System owners should be able to view list of customer orders.

   b. Each order should include details such as order id, customer information, book id, quantities ordered and discounts.

5. **Process customer orders (System Owners):**
   a. System owners should have the capabilities to process customer orders by confirming, packing and shipping items.

   b. An order status shoud be updated accordingly (e.g., NOT_PLACED, ORDER_PLACED and DELIVERED).

6. **Recommend books (Readers):**
   a. Readers should receive personalized book recommendations based on their previously bought books ratings and popularity index.

   b. Recommendation should be relevant to the readers' interests.

7. **View books details (Readers):**
   a. Readers should have the ability to view detailed information about each book, including author(s), summary, book price, average rating and related book recommendations.

8. **Add books to cart (Readers):**
   a. Readers should have the ability to add books to their shopping cart for later purchase.

   b. Added items in the cart should be persistent and readers be able to view the cart items from different devices.

9. **Remove books from cart (Readers):**
   a. Readers should have the ability to remove books from shopping carts.

   b. Removed items should be updated across readers' devices.

10. **Place order (Readers):**
    a. Readers should be able to place orders for the books in their shopping cart.

11. **Cancel order (Readers):**
    a. Readers should have the option to cancel orders that have not been placed yet.

    b. Cancelling an order should remove all the books from the cart.

12. **Submit rating to books (Readers):**
    a. Readers should be able to submit ratings for books they have purchased and received.

5.3.2 Nonfunctional Requirements

1. **Security:**
   a. The system should ensure data security and protect user information.

   b. User authentication and authorization mechanism should be in place.

2. **Performance:**
   a. The system should be responsive and able to handle a reasonable number of concurrent users.

   b. Recommendation algorithms should provide quick and relevant results.

3. **Scalability:**
   a. The system should be designed to scale if the number of books and users grows.

   b. It should accommodate an increasing volume of data.

4. **Usability:**
   a. The user interface should be intuitive and user-friendly for bot system owners and readers

   b. Proper navigation and clear labeling should be implemented.

5. **Reliability:**
   a. The system should be available and reliable, minimizing downtime.

   b. Data backups and recovery mechanisms should be in place.

6. **Data Integrity:**
   a. The system should maintain data integrity, preventing dat acorruption or loss.

   b. Proper data validation and error handling should be implemented

7. **Compatibility:**
   a. The system should be compatible with common web browsers and devices used by system owners and readers.

   b. Cross-browser and cross-device testing should be conducted.

8. **Response Time:**
   a. The system should provide quick responses to users actions, such as adding items to the cart or submitting ratings.

   b. Response time should meet acceptable thresholds

9. **Privacy:**
   a. The system should respect user privacy and adhere to data protection regulations

   b. User data should be handled security and in compliance with privacy laws.

5.4 Feasibility Analysis

5.4.1 Technical Feasibility

Technical feasibility for the project is robust, primarily due to the strategic technology choices. Python was a logical choice for the backend given its prominence in the ML ecosystem, with a wide array of libraries and frameworks for ML integration. Django, as the web framework, enhances technical feasibility through its scalability, security features, and ease of development.

Moreover, Python's extensive support for ML libraries like scikit-learn, TensorFlow, and PyTorch ensures seamless integration of ML capabilities into the project. The existing expertise of ADN Diginet's Python developers further bolsters technical feasibility by providing a skilled workforce familiar with the chosen technologies.

Django's built-in security features and stability add an extra layer of assurance, particularly when handling e-commerce functionalities and user data. This ensures that the technical foundation is not only strong but also capable of meeting security and performance requirements.

In summary, technical feasibility is a strength of the project. The choice of Python and Django, supported by the expertise of ADN Diginet's developers, ensures a solid technical framework for effectively showcasing ML capabilities and e-commerce functionalities.

5.4.2 Operational Feasibility

Operational feasibility for the project is notable, stemming from the development of a demo e-commerce site that incorporates ML-based book recommendations. Although the primary aim was to showcase the capabilities of ML, the inclusion of practical ecommerce features like adding books to the cart, placing orders, and submitting ratings demonstrates the project's adaptability to real-world operational scenarios.

This integration of e-commerce functionalities suggests the potential for operational enhancement within ADN Diginet. While the project's primary focus was educational and exploratory, these features showcase how ML can effectively complement and improve operational aspects in a business context.

5.4.3 Financial Feasibility

The financial feasibility of the project is robust primarily because of its strategic cost management approach. The project's core objective was to create a demo that showcased various ML use cases without incurring significant costs. To achieve this, the project leveraged open-source components and ML libraries, eliminating the need for costly proprietary software licenses. This cost-conscious strategy aligns well with the project's goal of staying within the budget provided by the government through the EDGE program.

By utilizing open-source resources, the project not only minimized expenses but also ensured accessibility and flexibility in adopting ML technologies. The availability of external funding from the EDGE program further reinforced the project's financial feasibility. This funding source covered project-related expenses, ensuring that the initiative remained well within budgetary constraints.

It's important to note that the project's primary aim wasn't generating direct revenue but rather acquiring knowledge, developing skills, and exploring the potential applications of ML within ADN Diginet's solutions. In this context, the financial feasibility is closely tied to the value derived from knowledge acquisition and the long-term benefits of integrating ML into the organization's offerings. Overall, the project's financial management strategy, reliance on open-source tools, and external funding combine to make it financially feasible while achieving its core objectives.

5.4.4 Schedule Feasibility

The project’s timeline was limited to just one month, placing a premium on efficient planning and execution. With a team of four members, each assigned specific roles, resource allocation was a strong point. However, the project’s unique demands, which include development of an ML model, an e-commerce-like frontend and a backend system, required close collaboration between backend and frontend developers.

The project wisely harnessed the capabilities of the Django framework, utilizing pre-built components for both backend and frontend development. While this approach accelerated development, the complexity of integrating machine learning, e-commerce functionality, and maintaining close coordination across teams introduced challenges.

Milestone planning was crucial to track progress, and the oversight provided by an ADN Diginet employee added valuable guidance and timely issue resolution. Overall, the project’s scheduling feasibility was promising, but the team’s ability to manage interdependencies and effectively communicate across components was pivotal for successful completion with the given timeline.

5.5 Problem Solution Analysis

In the pursuit of unraveling the capabilities of machine learning within the realm of real-world challenges, ADN Diginet embarked on an enlightening journey that extended beyond the confines of their product offerings. While the primary objective was to explore ML applications, the project also took on the task of providing personalized book recommendations to their users. Traditional recommendation systems often fell short in delivering personalized experiences, prompting the integration of ML models, particularly collaborative filtering using cosine similarity, to analyze user preferences and behaviors. This strategic move enhanced user engagement by tailoring book recommendations to individual tastes and interests. The choice of Python and Django for the backend proved pivotal, aligning seamlessly with ADN Diginet's existing expertise and streamlining ML model integration. Beyond solving the book recommendation problem, this endeavor served as a compelling real-world showcase of ML's potential, fostering exploratory learning within the team and promoting knowledge sharing across the organization. This

project underscored the transformative impact of ML on diverse real-world challenges, illustrating how it can elevate user experiences, align with organizational goals, and explore the boundaries of innovation across a spectrum of applications.

5.6 Effect and Constraints Analysis

The project was essentially an "out-of-the-box" implementation, primarily designed to serve as a demonstrator of ML capabilities. It was initiated from the ground up, with the advantage of not having to deal with any existing components that could be disrupted during implementation. However, while the project's core functionality was stable, questions might arise regarding its adaptability for future modifications or the incorporation of additional features. This is because the primary objective was to expedite the creation of a demo within the constraints of a limited timeframe.

Regarding constraints, our project faced limitations in both time and budget. We had a strict one-month timeline for implementation, necessitating a swift development process. Furthermore, because the project was essentially a demonstration, financial resources were constrained, compelling us to operate within these limitations.

Chapter 6: Results & Analysis

The project's outcomes and analysis reflect a successful exploration of machine learning (ML) capabilities in a practical context, particularly in the development of a personalized book recommendation system. One of the standout results was the project's ability to serve as a compelling showcase of ML's potential, exemplified by the effective implementation of ML algorithms, such as collaborative filtering using cosine similarity. This not only transformed user engagement through personalized book recommendations but also opened the doors to innovative solutions in various domains. Furthermore, the project contributed to an enriched skill set among team members who gained hands-on experience in ML model integration, Python, Django, and interdisciplinary collaboration. This expanded expertise positions the team for future projects and equips them to confidently address multifaceted challenges.

Another noteworthy result was the project's practical demonstration of ML's real-world applications, effectively bridging the gap between theoretical knowledge and tangible implementation. This experience proved to be invaluable, providing insights into how ML can be harnessed to solve complex, everyday challenges. Additionally, the project fostered a culture of knowledge sharing within ADN Diginet, encouraging cross-team collaboration and a deeper understanding of ML concepts. This collaborative environment augments the organization's collective knowledge and sets the stage for further innovation and the integration of ML across various projects.

On the development front, the project adhered to budget constraints by wisely utilizing open-source components and libraries, effectively managing costs. However, future endeavors may consider allocating resources for exploring advanced ML tools and services, depending on project goals. The project also successfully met the stringent one-month timeframe, showcasing efficient project management and resource allocation. This achievement underscored the team's ability to meet deadlines while creating a functional ML-based solution, albeit with a focus on expediency. Nonetheless, future projects should evaluate scalability requirements, as the current project may face challenges if expanded to accommodate larger user bases or extensive datasets.

One area for consideration is the project's alignment with ADN Diginet's product scope. Designed primarily as a demo, it did not directly integrate with the company's existing product offerings. While this approach allowed for innovative exploration, future projects should consider how ML applications can directly enhance ADN Diginet's product line, ensuring a more seamless integration of ML capabilities. In summary, the project achieved its primary objective of showcasing ML's potential in a real-world context, delivering valuable insights, enhanced skills, and a culture of knowledge sharing within ADN Diginet.

Chapter 7: Project as Engineering Problem Analysis

7.1 Sustainability of the the Project

The sustainability of the project is not limited to its immediate outcomes; it extends to the lasting impact it has had on ADN Diginet's organizational culture and innovation capacity. The project served as a catalyst for knowledge transfer and skills enhancement, equipping team members with valuable expertise in ML, Python, Django, and interdisciplinary collaboration. This knowledge is sustainable and can be leveraged in future projects, enabling ADN Diginet to continue exploring ML applications independently. Moreover, the project instilled a culture of learning and innovation within the organization, encouraging cross-team collaboration and knowledge sharing. It demonstrated how ML can be practically applied to real-world problems, bridging the gap between theory and practice, which is a sustainable understanding that can lead to identifying and addressing future opportunities for ML integration. The scalability considerations from the project are sustainable knowledge, guiding ADN Diginet in planning and executing larger-scale ML initiatives. The interdisciplinary nature of the project, combining ML with web development, fosters cross-disciplinary innovation, encouraging adaptability and creativity. Additionally, the project's core achievement of enhancing user engagement through personalized recommendations is sustainable, offering ADN Diginet the opportunity to further refine and expand ML-driven recommendations. Lastly, the project provides a demonstrable value proposition for stakeholders, garnering support for future ML initiatives and ensuring continued investment in innovative projects. In essence, the sustainability of the project lies in the enduring knowledge, skills, and culture of innovation it has cultivated within ADN Diginet, positioning the organization for continued growth and success in a rapidly evolving technological landscape.

7.2 Social & Environmental Effects & Analysis

The project, primarily centered on unveiling the potential of machine learning (ML) and enhancing user experiences, yielded significant social and environmental effects. On the social front, the implementation of a personalized book recommendation system powered by ML significantly improved user experiences, fostering heightened user satisfaction and engagement within ADN Diginet's community. In an unforeseen manner, the project also encouraged knowledge sharing among team members, cultivating a collaborative work culture and facilitating continuous learning and innovation.

From an environmental standpoint, the project's emphasis on digital solutions and software development contributed to a reduced physical footprint. This approach minimized the environmental impact typically associated with physical infrastructure and materials. By prioritizing digital over physical resources, the project inadvertently reduced resource consumption, underscoring its alignment with environmentally conscious practices.

However, while the project's digital focus inherently reduces resource consumption, it is essential to recognize that broader environmental considerations extend beyond the immediate project scope. Future endeavors in scaling ML solutions should be approached with caution, as they may entail increased computational resources, potentially impacting energy consumption and carbon footprint. Therefore, a holistic perspective, encompassing responsible resource management and environmental awareness, remains pivotal in the continued deployment of ML solutions.

7.3 Addressing Ethics and Ethical Issues

The project, focused on enhancing user experiences through machine learning (ML), raises significant ethical considerations. Data privacy and consent are paramount, requiring responsible data handling and explicit user consent. Additionally, vigilance is needed to prevent biases in ML algorithms, particularly in recommendation systems, ensuring fairness and impartiality. Ethical AI deployment demands transparency, clear accountability, and user understanding of ML algorithms. These considerations extend beyond the project, emphasizing the ethical use of ML knowledge in broader contexts. Lastly, a continuous ethical review process is crucial to adapt to evolving standards and regulations and ensure responsible AI deployment.

Chapter 8: Lessons Learned (Through Challenges)

8.1 Data Collection Challenges

Gathering a comprehensive and high-quality dataset for ML can be challenging. Problems might include obtaining sufficient and diverse data, ensuring data accuracy, and dealing with missing or noisy data. Since we want to build a web application that uses the ML model and proper UI, we had to go through a large collection of real world datasets that had necessary information for our use case.

8.2 Data Cleaning and Preprocessing Complexities

Preparing the dataset for training can be time-consuming. Data cleaning and preprocessing tasks, such as handling outliers, imputing missing values, and scaling features, can introduce errors if not managed effectively.

8.3 Feature Engineering Issues

Creating relevant and informative features is critical for ML model performance. The challenge lies in identifying which features are most relevant and designing them to capture meaningful information.

8.4 Model Selection Dilemmas

Choosing the most suitable ML model can be tricky. Different algorithms have different strengths and weaknesses, and selecting the wrong one may lead to suboptimal results. Proper model selection involves thorough evaluation and comparison. We also had the time constraint, so we had to choose a tried and tested model that had been utilized in the relevant fields and one that code was implemented in a short amount of time and requires relatively less powerful model training workstations. Therefore, our choice was to use a cosine similarity based recommendation system.

8.5 Hyperparameter Tuning

During the model training phase, we exercised meticulous discretion in selecting the data from the dataset. We deliberated on which reader ratings should be prioritized over others and which books should be included in the training process to ensure that the resulting recommendations from our trained models are coherent and meaningful. Additionally, we took care to prevent overfitting or underfitting of the model, aiming for strong generalization capabilities across the dataset. This was done with the overarching goal of enhancing the predictive accuracy of the model.

8.6 Deployment Challenges

Transitioning from a successful ML model to a real-world deployment can introduce challenges, including maintaining model performance, ensuring data consistency, and managing model updates.

Chapter 9: Future Work and Conclusion

9.1 Future Works

Future work in the context of this project opens up several exciting possibilities and avenues for exploration. One of the key areas of focus is the enhancement of recommendation algorithms. Further research and development can delve into advanced collaborative filtering techniques, content-based recommendations, and hybrid models, all aimed at refining recommendation accuracy and personalization.

Additionally, the project can evolve towards providing dynamic and real-time recommendations. Future endeavors might involve the development of systems that adapt to changing user preferences and offer instant recommendations based on user behavior, thereby significantly enhancing user experiences.

The integration of explainability into the recommendation system is another promising direction. Future work can include the implementation of Explainable AI (XAI) techniques to provide users with insights into why specific recommendations are made, fostering trust and transparency.

Expanding the recommendation system to support multimodal recommendations, encompassing various data types such as text, images, and audio, could cater to a broader range of content and user preferences, particularly in multimedia and e-commerce applications.

Furthermore, future work may entail the development of personalized user interfaces that adapt based on user preferences and browsing behavior. This approach can provide users with a more tailored and engaging experience by seamlessly integrating recommendation systems with front-end design.

The ongoing consideration of ethical concerns and bias mitigation remains crucial. Future work can involve the implementation of fairness-aware algorithms, regular bias audits, and the pursuit of ethical guidelines to ensure recommendations are equitable and unbiased.

Additionally, collecting and analyzing user feedback to assess recommendation quality and user satisfaction is an ongoing process. Future research can delve into advanced evaluation methodologies to measure recommendation effectiveness more comprehensively.

Scalability and performance optimization are paramount as user bases grow. Future work can involve algorithmic optimizations for efficiency and exploration of distributed computing solutions to ensure recommendations remain responsive and effective.

Cross-domain recommendations, cross-platform recommendations, and the integration of recommendation systems with AI assistants represent exciting opportunities for expanding the reach and impact of recommendations in various contexts.

Lastly, future work can encompass the exploration of monetization strategies while maintaining a positive user experience, as well as research into privacy-preserving recommendation techniques to address growing concerns about data privacy. All these potential directions align with the project's goals and hold the potential to enhance the recommendation system's capabilities and value for both users and the organization.

9.2 Conclusion

In conclusion, the Machine Learning (ML) internship program at ADN Diginet, funded through the EDGE program by the Bangladesh government, has been a valuable and transformative experience. Over the course of the internship, participants have delved deep into the realm of ML, acquiring essential knowledge and skills in supervised learning, unsupervised learning, reinforcement learning, and various ML models.

The journey began with a rigorous educational phase, including lectures, hands-on sessions, and real-world case studies, where industry experts and trainers provided insights into ML concepts and practical applications across diverse domains. This foundational knowledge laid the groundwork for the subsequent phases of the internship.

The research and review phase saw participants engaging with cutting-edge research papers, blogs, and articles related to ML. The emphasis on identifying innovative approaches and breakthroughs demonstrated the commitment to staying at the forefront of ML advancements. Seminars with industry specialists and regular consultation sessions with mentors enriched the learning experience and guided participants in problem identification and solution development.

One of the highlights of the internship was the collaborative effort in problem identification, aligning with ADN Diginet's vision and Bangladesh's socio-economic development. This phase highlighted the practicality of ML in solving real-world challenges and provided a valuable learning experience.

The subsequent solution development phase was marked by the creation of a working prototype—a book recommendation system. The successful integration of backend Django infrastructure with ML models showcased effective project management, teamwork, and technical prowess. This achievement, completed within a tight timeframe, underscored the potential of ML applications in real-world scenarios.

The project also exemplified the importance of effective project management, careful planning, and budget-consciousness. While the focus was on ML, participants acquired skills in various areas, including data cleaning, feature engineering, model selection, and ethical considerations, which are vital in any ML project.

Looking forward, the project offers opportunities for further enhancement, including refining recommendation algorithms, implementing dynamic and real-time recommendations, and addressing ethical concerns. The commitment to ongoing learning and ethical deployment of ML remains a cornerstone of ADN Diginet's journey in the field of ML and AI.

Overall, the ML internship at ADN Diginet has been an enriching experience, equipping participants with knowledge, skills, and a holistic understanding of ML's practical applications. It serves as a stepping stone towards promising careers in the ever-evolving field of machine learning and artificial intelligence, contributing to both personal growth and the advancement of technology in Bangladesh and beyond.

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An Undergraduate Internship on Software Engineering (Artificial Intelligence)

By

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Summer, 2023

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