# VISVESVARAYA TECHNOLOGICAL UNIVERSITY
**Belagavi-590018, Karnataka**



**An Internship Report On**

"**ML Engineer**"

*Submitted in partial fulfillment for the award of the degree in*

**MASTERS OF TECHNOLOGY**

**IN**

**DATA SCIENCE**

Submitted by

SATHISH M                                    USN: 1AM24SDS08

Under the guidance of
**Mrs. Priyanka K R**
Assistant professor Dept. of ISE
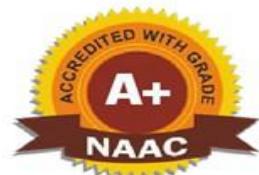


**Department of Information Science and Engineering**
**AMC ENGINEERING COLLEGE**
18 Km, Bannerghatta Road, Bangalore- 560083

**2025-2026**

ACCREDITED BY NAAC A+ & NBA, MINISTRY OF HRD, NEW DELH

## CERTIFICATE

It is certified that the internship Work entitled **"ML Engineer"** carried out by **Sathish M, [1AM24SDS08],** the Bonafide student of **AMC Engineering College**, **Bangalore** in partial fulfillment for the award of **Master of Technology in Data Science** of **Visvesvaraya Technological University, Belagavi** during the academic year **2025-2026**. The Internship report has been approved as it satisfies the academic requirement in respect of internship report prescribed for the said degree.

| | |
|---|---|
| **Mrs. Priyanka K R** | **Ms. Mariya Sneha T** |
| **Internal Guide** | **Internship Co-Ordinator** |
| **Assistant Professor** | **Assistant Professor** |
| **Department of ISE** | **Department of ISE** |
| **AMCED, Bengaluru** | **AMCED, Bengaluru** |

| | |
|---|---|
| **Dr. Rashmi R Deshpande** | **Dr Yuvaraju B N** |
| **Associate Professor & HoD.** | **Principal** |
| **Department of ISE** | **AMCEC, Bengaluru** |
| **AMCEC, Bengaluru** | |

**External Viva**

**Name of the Examiners**                               **Signature with date**

1  …………….........                                    …………………

2  …………..………                                    …………………....

# DECLARATION

I, **Sathish [1AM24SDS08]** student of III Semester, M.Tech in Data Science, AMC Engineering College, hereby declare that the Internship entitled ML Engineer has been carried out by us and submitted in partial fulfilment of the requirements for the award of the degree of Master of Technology in Data Science of Visvesvaraya Technological University, Belgaum during the academic year 2025 - 2026.

Place: Bengaluru
Date:

Sathish M
1AM24SDS08

# INTERNSHIP OFFER LETTER

## CODTECH IT SOLUTIONS PVT.LTD
### INFORMATION TECHNOLOGY SERVICES

8-7-7/2, Plot NO.51, Opp: Naveena School, Hasthinapuram Central, Hyderabad , 500 079. Telangana

## Internship Offer Letter

Date : 20/09/2025
Intern ID:CT06DR1179

**Dear  Sathish M**

Congratulations on being selected for the **Machine Learning.** We at **CODTECH IT SOLUTIONS PVT.LTD** are thrilled to have you join our team. **This Online Internship will span 12 weeks from September 20th, 2025 to December 20th, 2025.**

This internship is designed as an educational experience, focusing on learning, skill development, and gaining practical knowledge. As an intern, we expect you to:

1. Complete all assignments to the best of your ability.
2. Follow any lawful and reasonable instructions provided by your supervisors.
3. Participate actively in team meetings and discussions.
4. Provide regular updates on your progress.
5. Adhere to company policies and maintain a professional demeanor.
6. Collaborate effectively with team members and contribute to group projects.
7. Seek feedback and apply it to improve your performance.

We trust that you will approach all tasks with diligence and enthusiasm. We are confident that this internship will be an enriching experience for you. We look forward to working with you and supporting you in achieving your career aspirations

Best regards,

Neela Santhosh Kumar
Human Resources & Academic Head
CODTECH IT SOLUTIONS PRIVATE LIMITED

www.codtechitsolutions.com

#startupindia

VERIFIED BY
CODTECH IT SOLUTIONS PVT LTD

ISO 9001

+91 9848925128
Hr@codtechitsolutions.com

# INTERNSHIP CERTIFICATE

## CODTECH IT SOLUTIONS PRIVATE LIMITED

8-7-7/2,PlotNO.51,Opp:NaveenaSchool,HasthinapuramCentral,Hyderabad , 500 079. Telangana

# CERTIFICATE
## OF INTERNSHIP EXPERIENCE

### To whom so ever it may concern

This is to certify that **Sathish M** with Intern id: **CT06DR1179** has successfully completed a **12 weeks** Online Internship Program in the domain of **Machine Learning.** in **CODTECH IT SOLUTIONS PRIVATE LIMITED.** from **September 20th, 2025 to December 20th, 2025.**

During the internship, His/Her demonstrated outstanding dedication, creativity, and technical proficiency. His/Her performance in the assigned projects was exceptional, showcasing deep understanding, innovative problem-solving skills, and a strong commitment to excellence.

We appreciate his/her active participation, consistent efforts, and impressive contribution to the overall success of the internship.We wish him/her all the best in future endeavors.

We are confident that his/her dedication and skills will lead to great achievements ahead.

Best Wishes,
NEELA SANTHOSH KUMAR
Human Resources & Academic Head
Hr@codtechitsolutions.com

ISO 9001 CERTIFIED

AICTE

MSME MICRO, SMALL & MEDIUM ENTERPRISES

#startupindia

# ACKNOWLEDGEMENT

Any achievement, be it scholastic or otherwise does not depend solely on the individual efforts but on the guidance, encouragement and cooperation of intellectuals and elders. I would like to take this opportunity to thank them all.

I heartily extend my words of gratitude to my external guide **Mr. Neela Santhosh Kumar,** for the valuable advice, encouragement and suggestion given to me in the course of my internship.

I heartily extend my words of gratitude to my internal guide **Mrs. Priyanka K R**, for her valuable advice, encouragement and suggestion given to me in the course of my internship.

I heartily extend my words of gratitude to my internship coordinator **Ms. Mariya Sneha T**, for her valuable advice, encouragement and suggestion given to me in the course of my internship.

I would like to express my immense gratitude to Head of Department **Dr. Rashmi R Deshpande,** for her unfailing encouragement and suggestion given to me in course of my work.

I would like to take this opportunity to express my gratitude to the Principal, **Dr. Yuvaraju B N,** for giving me this opportunity to enrich my knowledge.

Finally, a note of thanks to the Department of Information Science and Engineering, both teaching and non-teaching staff for their co-operation extended to me.

Last but not least, we acknowledge the support and the feedback of our parents and friends, for their indispensable help at all times.

**SATHISH M**
**1AM21IS006**

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# ABSTRACT

As part of my academic curriculum, I completed a 12-week online internship in Machine Learning at CODTECH IT SOLUTIONS PVT. LTD. The internship was designed to provide hands-on experience in applying machine learning concepts to solve real-world problems and to strengthen my practical understanding of data-driven systems. CODTECH IT SOLUTIONS focuses on skill-oriented training and project-based learning, enabling students to gain industry-relevant exposure in emerging technologies.

During the internship period, I was assigned four technical tasks, all primarily centered on Machine Learning. These tasks involved understanding data preprocessing techniques, implementing supervised and unsupervised learning algorithms, evaluating model performance, and improving model accuracy through optimization techniques. Each task contributed to building a strong foundation in machine learning workflows and problem-solving approaches.

The final task of the internship involved designing and implementing a Machine Learning–based recommendation system for a library. The objective of this project was to recommend relevant books to users based on their preferences, borrowing history, and interaction patterns. This task required applying core ML concepts such as data analysis, feature engineering, and recommendation algorithms, thereby simulating a real-world application scenario.

Overall, this internship significantly enhanced my technical skills in Machine Learning and data analysis while also improving my analytical thinking, coding proficiency, and project implementation abilities. The experience provided valuable insights into how machine learning algorithms are applied in practical systems and prepared me for future academic and professional challenges in the field of Artificial Intelligence and Data Science.

# LIST OF CONTENTS

| CHAPTER | PAGE NO. |
|---|---|

# LIST OF FIGURES

# LIST OF TABLES

**Chapter 1**

# INTERNSHIP OBJECTIVES

## 1.1 INTERNSHIP OBJECTIVES:

1. **Gain valuable work experience**

   The internship aimed to provide hands-on experience in real-world Machine Learning practices by allowing me to work on four ML-based tasks assigned by CODTECH IT SOLUTIONS PVT. LTD. Throughout the 12-week online internship, I was able to apply theoretical concepts learned in my academics to practical scenarios, enhancing my skills in data preprocessing, model development, evaluation, and implementation of machine learning algorithms.

2. **Explore a career path**

   This internship offered an opportunity to explore the field of Machine Learning and Artificial Intelligence and understand its application in solving real problems. By engaging in tasks including the creation of an ML algorithm for a library recommendation system, I gained insight into the responsibilities, challenges, and workflow involved in ML-based roles, helping me evaluate my interest and potential future in this domain.

3. **Give yourself an edge in the job market**

   By successfully completing the internship and contributing to meaningful ML projects, I strengthened my resume with practical achievements and technical competencies. The experience of working with machine learning tools, algorithms, and real datasets has positioned me as a more competitive candidate for future roles in data science, machine learning, and software development.

## 1.2 IMPORTANCE OF INTERNSHIP:

Internships play a crucial role in bridging the gap between academic learning and professional experience. They provide students with the opportunity to apply classroom concepts in real-world scenarios, enabling them to gain practical skills, industry exposure, and workplace discipline. This hands-on experience helps reinforce theoretical knowledge and builds confidence to tackle real challenges in a professional environment.

Through this internship, I not only developed technical expertise in machine learning but also improved essential soft skills such as communication, time management, problem-solving, and

adaptability. These skills are highly valued in any professional setting and enhance employability by equipping students with the capabilities employers seek. Completing a meaningful internship demonstrates initiative, commitment, and a willingness to learn, giving students a competitive edge in the job market and preparing them for future career opportunity.

# Chapter 2

# INTRODUCTION ABOUT THE PROJECT

## RECOMMENDATION SYSTEM:

The core focus of my internship project at CODTECH IT SOLUTIONS PVT. LTD. was centered around designing and developing a Recommendation System for a library using machine learning techniques. Recommendation systems are intelligent tools that analyze user behavior and preferences to suggest items that are most relevant to a user's interests. These systems have become widely used across industries from suggesting movies on streaming platforms to recommending products on e-commerce sites because they enhance user experience by filtering vast amounts of data and presenting personalized choices.

In the context of the library environment, the recommendation system was aimed at helping users discover books and reading materials that best match their preferences based on historical data such as past selections, ratings, or user behavior. A recommendation system simplifies decision-making for users faced with a large collection of books, thereby improving engagement and satisfaction.

The project involved exploring and implementing one or more recommendation techniques such as Collaborative Filtering and Matrix Factorization, which are common approaches used to predict user preferences based on user-item interactions. Collaborative filtering works by identifying patterns among users and items to generate personalized suggestions. Matrix factorization further enhances abilities by decomposing user-item interaction data into lower-dimensional latent features to make more accurate predictions.

As part of this project, I built a working model that analyzes user preferences and generates recommendations tailored to individual users. The deliverable was a fully documented Jupyter Notebook and application demonstrating the recommendation results along with evaluation metrics, showcasing both the implementation process and effectiveness of the system. This project allowed me to apply theoretical ML concepts to a practical and impactful use case, deepening my understanding of both recommendation algorithms and the broader scope of machine learning in real-world applications.

# Chapter 3

# COMPANY PROFILE

## 3.1 ABOUT THE COMPANY



**Fig 3.1 Codtech IT Solitions pvt. Ltd. Logo**

CODTECH IT SOLUTIONS PVT. LTD. is an emerging startup technology company that offers a wide range of digital and IT-based services designed to support businesses, students, and professionals in a rapidly evolving digital world. The company specializes in developing mobile and web applications, crafting user-centric and high-performance digital products that reflect strong brand identity and align with business goals. From initial concept and design to deployment and launch, CODTECH's team focuses on delivering complete digital solutions with innovation and precision.

In addition to software development services, CODTECH places significant emphasis on industry-oriented training and internships. It offers student internship programs that provide hands-on experience through live projects and mentorship from industry professionals, helping students gain practical skills and become job-ready with confidence. The company also conducts advanced industrial training programs, keeping pace with current industry standards and giving trainees real-time project exposure to confidently face real-world challenges.

Overall, CODTECH IT SOLUTIONS PVT. LTD. aims to be a comprehensive technology partner for businesses and learners alike offering tailored digital products, skill-building opportunities, and strategies that help clients and students thrive in the competitive digital ecosystem.. eSthira envisions expanding into a broader range of personal electric mobility solutions in the near future, contributing meaningfully to India's shift toward green transportation.

## 3.2 SERVICES PROVIDED BY THE COMPANY

CODTECH IT SOLUTIONS PVT. LTD. is a startup technology company that offers a range of digital and professional services designed to support businesses, students, and professionals in the modern tech ecosystem. The company's services focus on development, training, and growth solutions tailored to client needs.

1. **Mobile & Web Application Development**

   CODTECH specializes in designing and developing high-performance mobile and web applications that are customized to align with specific business goals. Their services include creating responsive websites with strong brand identity and user-friendly interfaces, as well as developing scalable mobile apps for both Android and iOS platforms. The development process covers the entire lifecycle from concept, design, and coding to testing and deployment.

2. **Student Internships**

   The company offers industry-focused internship programs aimed at equipping students with real-world skills. These internships provide hands-on training on live projects under expert mentorship, allowing participants to gain practical experience and enhance their technical competencies. Through these programs, students become more job-ready and confident in their chosen fields.

3. **Industrial Training Programs**

   CODTECH conducts advanced industrial training aligned with current industry standards. These programs include practical exposure to real-time projects and expert guidance, preparing students and professionals to confidently address challenges in the professional environment. The trainings cover emerging technologies and practical problem-solving techniques valuable for career preparedness.

4. **Marketing and Sales Services**

   The company delivers result-driven marketing strategies designed to boost brand visibility and foster business growth. Their services include digital marketing, lead generation campaigns, and sales solutions aimed at increasing conversions and maximizing revenue. This helps businesses expand their online presence and achieve measurable success.

## 3.3 VISION, MISSION AND OBJECTIVES

**VISION:**

The vision at CodTech IT Solutions is to be a global leader in IT services and consulting. We aim to shape the future of technology with innovation, quality, and a customer-centric approach. Through continuous learning and collaboration, we inspire and lead our clients towards a connected and sustainable future.

**MISSION:**

*"Empowering Businesses through Innovative IT Services and Consulting"* — At CodTech IT Solutions, our mission is to empower businesses with innovative IT services and consulting. We deliver customized, reliable, and cost-effective technology solutions to help clients achieve their goals. Our commitment to excellence builds lasting partnerships and drives success in a digital landscape.

**APPROACH:**

We focus on understanding clients' unique needs, delivering innovative and tailored IT solutions. Through strong partnerships and a commitment to quality, we ensure reliable, high-performance results. Continuously improving, we stay ahead of industry trends to drive client success.

**Chapter 4**

# ORGANIZATION STRUCTURE

1. **Founder & Chief Executive Officer (CEO)**
   - Oversees overall vision, strategy, and leadership of the company.

2. **Chief Technology Officer (CTO)**
   - Heads the R&D division, focusing on product innovation, embedded systems, and battery technology.

3. **Chief Operating Officer (COO)**
   - Manages day-to-day operations including procurement, manufacturing, and logistics.

4. **Marketing & Sales Team**
   - Handles brand building, digital marketing (including SEO), sales strategies, and customer outreach.

5. **Product Development & Engineering Team**
   - Focuses on product design, prototyping, motor control systems, and IoT integration.

6. **Quality Assurance & Testing**
   - Ensures product reliability through rigorous testing and compliance with safety standards.

7. **Customer Support & Services**
   - Manages post-sales support, customer feedback, and warranty services.

8. **Interns & Trainees**
   - Support departments such as digital marketing (SEO), product research, and website optimization.

**Chapter 5**

# TASK PERFORMED

## 5.1. INTRODUCTION

As part of my academic curriculum and career development, I undertook a 12-week online internship in Machine Learning at CODTECH IT SOLUTIONS PVT. LTD., a dynamic startup company offering technology solutions and industry-focused training programs. CODTECH specializes in developing mobile and web applications, industry training, student internships, and marketing and sales services, all designed to help businesses scale digitally and equip learners with real-world skills.

The internship was structured to provide practical exposure to core machine learning concepts and their applications through a set of four progressively challenging tasks. These tasks covered a broad range of areas within machine learning, including decision tree implementation, natural language processing for sentiment analysis, image classification using deep learning, and the development of a recommendation system. Each task required the use of industry-relevant tools such as Scikit-Learn, natural language processing libraries, TensorFlow/PyTorch, and various evaluation techniques to analyze model performance and results.

The primary goal of the internship was to reinforce theoretical knowledge gained from coursework by applying it to real machine learning problems and datasets, and to build practical skills in data handling, model building, and algorithm evaluation. The final task involved creating a recommendation system for a library, aimed at suggesting relevant books based on user preferences, a project that encapsulated the practical application of learned concepts in a real-world scenario.

This report outlines the internship objectives, detailed descriptions of the tasks performed, learning outcomes, technical skills gained, and the overall contributions made during the internship at CODTECH IT SOLUTIONS PVT. LTD.

## 5.2. ABOUT INTERNSHIP

My 12-week online internship at CODTECH IT SOLUTIONS PVT. LTD., a startup focused on technology solutions and industry-oriented training, provided valuable practical exposure to Machine Learning. During this period, I was assigned four key tasks that helped strengthen my understanding of ML concepts and their real-world applications.

The internship began with a Decision Tree implementation, followed by Sentiment Analysis using NLP, and an Image Classification model using a Convolutional Neural Network. The final task involved building a Library Recommendation System using collaborative filtering or matrix factorization techniques. Each task involved end-to-end model development, evaluation, and documentation using tools like Scikit-Learn, NLP libraries, and deep learning frameworks.

Through these tasks, I gained hands-on experience in data preprocessing, model building, evaluation metrics, and performance analysis. This internship significantly enhanced my practical skills in Machine Learning and prepared me for future challenges in AI and data-driven applications.

**Objective of the Internship**

- To gain hands-on experience in Machine Learning through practical task implementation.
- To apply theoretical ML concepts to real-world datasets and problems.
- To understand the complete machine learning workflow, from data preprocessing to model evaluation.
- To develop problem-solving and analytical skills through project-based learning.

**Roles and Responsibilities**

- Implemented supervised learning models such as Decision Trees for classification and prediction tasks.

- Performed text preprocessing, feature extraction, and sentiment classification using NLP techniques.

- Designed and trained a CNN-based image classification model using deep learning frameworks.

- Built a recommendation system using collaborative filtering or matrix factorization approaches.

- Evaluated model performance using appropriate metrics and documented results in Jupyter Notebooks.

- Prepared detailed notebooks showcasing preprocessing steps, model implementation, visualization, and analysis.

**Tools and Technologies Used**

| TOOL NAME | PURPOSE |
|---|---|
| Python | Primary programming language used for implementing machine learning models and data processing. |
| Jupyter Notebook | Interactive environment for writing and documenting code, analysis, and results. |
| Scikit-Learn | Used for traditional machine learning tasks such as Decision Tree implementation and model evaluation. |
| Pandas | Data manipulation and preprocessing (loading, cleaning, transforming datasets). |
| NumPy | Numerical operations and array handling for data processing and mathematical computations. |
| Matplotlib / Seaborn | Visualization libraries for plotting charts, graphs, and model performance results. |
| NLTK / SpaCy | Natural Language Processing (NLP) libraries used for text preprocessing and feature extraction. |
| TF-IDF Vectorizer | Feature extraction technique for converting text data into numerical vectors for sentiment analysis. |
| TensorFlow / PyTorch | Deep learning frameworks used to build and train the Convolutional Neural Network (CNN) model. |
| Collaborative Filtering / Matrix Factorization Libraries | Algorithms and tools used for building the recommendation system. |

**Table No.5.1: Tools and their Purpose**

**Python**

Python was the primary programming language used throughout the internship for writing scripts, building models, handling data, and implementing machine learning workflows due to its simplicity, readability, and extensive ML ecosystem.

**Jupyter Notebook**

Jupyter Notebook provided an interactive environment to write code, document the workflow, display visualizations, and share results in a structured and reproducible manner for each task.

**Scikit-Learn**

Scikit-Learn was used to implement traditional machine learning algorithms such as the Decision Tree model and to handle preprocessing, training, and evaluation steps due to its rich collection of utilities and easy API.

**Pandas**

Pandas was used for loading, cleaning, transforming, and exploring datasets across all tasks. It helped structure data into DataFrames, which made it easier to manipulate features and labels before training models.

**NumPy**

NumPy supported numerical operations and array manipulations, which are fundamental when performing mathematical computations on datasets, especially before applying models.

**Matplotlib / Seaborn**

Matplotlib and Seaborn were used to visualize data distributions, model performance, and results graphs such as accuracy plots, confusion matrices, and other visual insights to interpret the outcomes visually.

**NLTK / SpaCy**

NLTK and SpaCy were used in the Sentiment Analysis task for natural language processing including text cleaning, tokenization, and preparing text data for feature extraction and model training.

**TF-IDF Vectorizer**

TF-IDF Vectorizer converted textual data (customer reviews) into numerical feature vectors that could be used by machine learning classifiers like Logistic Regression in the sentiment analysis task.

**TensorFlow / PyTorch**

TensorFlow or PyTorch was used in the Image Classification task to build and train Convolutional Neural Networks (CNNs) deep learning models capable of recognizing patterns in image data.

**Collaborative Filtering / Matrix Factorization**

Collaborative filtering and matrix factorization techniques were applied in the Recommendation System task to model user preferences and suggest relevant library items based on historical interactions and similarity patterns.

**Chapter 6**
# WORK SCHEDULED

### 6.1 Week 1: Onboarding and ML Orientation

The internship began with an onboarding session where I was introduced to CODTECH IT SOLUTIONS, its services, team structure, and internship expectations. I familiarized myself with the tools, frameworks, and datasets that would be used throughout the internship. Additionally, I reviewed foundational machine learning concepts to prepare for the tasks ahead.

### 6.2 Week 2: Decision Tree Theory & Dataset Preparation

This week focused on understanding the theory behind decision tree algorithms and choosing an appropriate dataset. I performed data cleaning, feature selection, and exploratory data analysis to prepare the dataset for building the decision tree model.

### 6.3 Week 3: Decision Tree Implementation and Visualization

During this week, I implemented the Decision Tree model using Scikit-Learn. I trained and tested the model on the chosen dataset and visualized the tree structure. The results, analysis, and insights were documented in a Jupyter Notebook.

### 6.4 Week 4: Introduction to NLP & Sentiment Analysis Planning

This week was dedicated to gaining a deeper understanding of Natural Language Processing (NLP) techniques and planning the sentiment analysis task. I collected and cleaned the customer reviews dataset, performed text preprocessing, and prepared the data for feature extraction.

### 6.5 Week 5: Sentiment Analysis – Feature Extraction

I focused on extracting textual features using TF-IDF vectorization. This involved converting text data into numerical form while preserving the importance of unique words. I also tested different preprocessing techniques to improve feature quality.

### 6.6 Week 6: Sentiment Classification Model Development

This week involved building and training the sentiment classification model using Logistic Regression. I evaluated model performance using accuracy, precision, and recall metrics, and documented the preprocessing steps and evaluation results.

### 6.7 Week 7: Introduction to Deep Learning & CNN Concepts

I began exploring deep learning fundamentals and Convolutional Neural Networks (CNNs). This week focused on understanding neural network architecture, activation functions, and how CNNs work for image classification tasks.

### 6.8 Week 8: Image Dataset Preparation & Model Architecture Design

This week involved preparing the image dataset, performing data augmentation, and designing the CNN architecture using TensorFlow/PyTorch. I also organized data into training and validation sets for model training.

### 6.9 Week 9: Training the CNN Model

I trained the CNN with the prepared image dataset, monitored training and validation performance, and made adjustments to hyper-parameters to improve accuracy. Visualization of training loss and accuracy curves was also performed.

### 6.10 Week 10: Evaluation & Optimization of CNN Model

This week was focused on evaluating the trained CNN model on a test dataset. I analyzed performance metrics and confusion matrices, and made further optimizations to improve classification results.

### 6.11 Week 11: Recommendation System Design & Implementation

I began working on the final task by selecting an appropriate recommendation algorithm such as collaborative filtering or matrix factorization. I prepared the dataset of user interactions and began building the recommendation model.

### 6.12 Week 12: Finalizing Recommendation System & Documentation

In the final week, I completed the recommendation system model, evaluated it using relevant metrics, and documented the results. I finalized all task notebooks, prepared a summary of findings, and compiled the internship report.
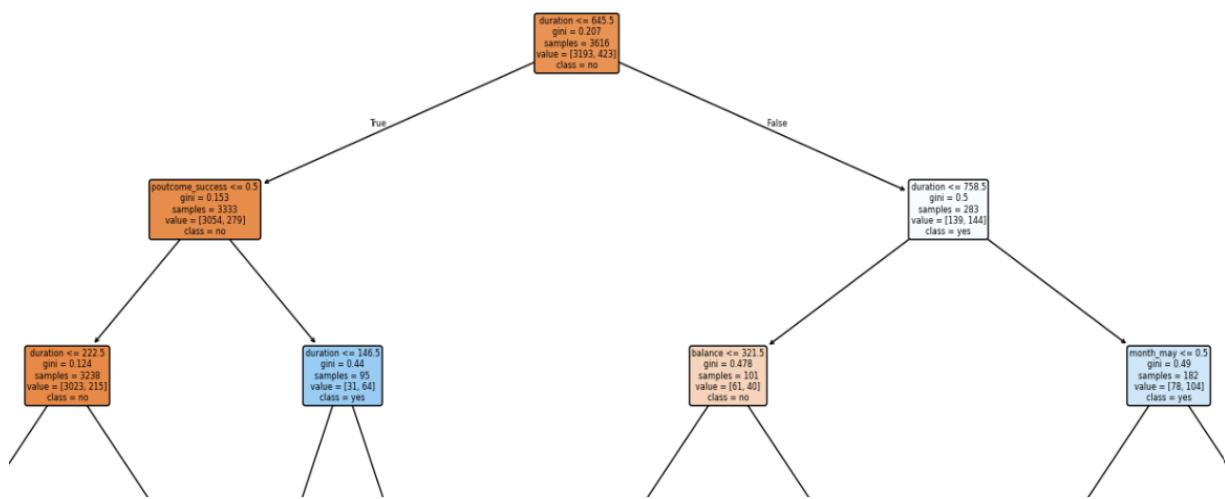
**Fig No: 6.1 Decision Tree**



```python
nltk.download('stopwords')
stop_words = set(stopwords.words('english'))


def clean_text(text):
    text = str(text).lower()
    text = re.sub(r'[^a-z\s]', '', text)
    text = ' '.join(word for word in text.split() if word not in stop_words)
    return text


df['cleaned_review'] = df['Review'].apply(clean_text)
df[['Review', 'cleaned_review']].head()
```

**Fig No: 6.2 Text Preprocessing wit nltk**

```
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.2, random_state=42
)


model = LogisticRegression(max_iter=1000)
model.fit(X_train, y_train)
```

```
  ▼  LogisticRegression  ⓘ  ❓

  ▶ Parameters
```

```
y_pred = model.predict(X_test)
print("Accuracy:", accuracy_score(y_test, y_pred))
```

```
Accuracy: 0.9023861171366594
```

**Fig No: 6.3 Train Logistic Regression Model**
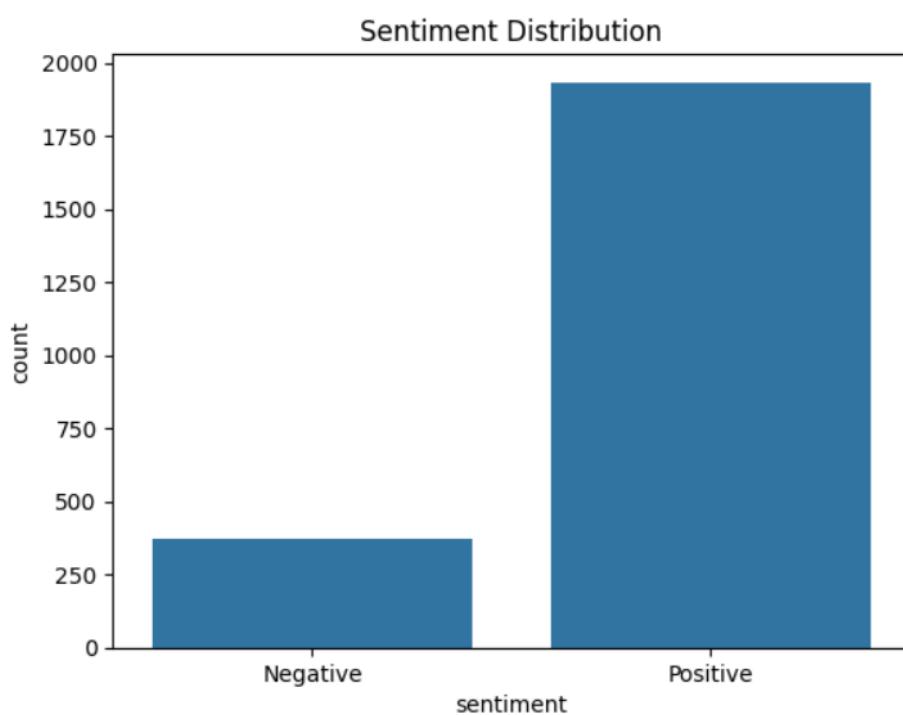


**Fig No: 6.4 Visualize Sentiment Distribution**

```
print(classification_report(y_test, y_pred))

                precision    recall  f1-score   support

           0       0.92      0.36      0.52        67
           1       0.90      0.99      0.95       394

    accuracy                           0.90       461
   macro avg       0.91      0.68      0.73       461
weighted avg       0.90      0.90      0.88       461
```

**Fig NO: 6.5 Model Evaluation**

```
sample_review = ["Battery backup is poor but performance is good"]
sample_clean = [clean_text(sample_review[0])]
sample_vec = tfidf.transform(sample_clean)

prediction = model.predict(sample_vec)

print("Sentiment:", "Positive" if prediction[0] == 1 else "Negative")

Sentiment: Positive
```

**Fig No: 6.6 Test with Custom Review**

```
model = models.Sequential([
    layers.Conv2D(64, (3, 3), activation='relu', padding='same', input_shape=(32, 32, 3)),
    layers.BatchNormalization(),
    layers.Conv2D(64, (3, 3), activation='relu', padding='same'),
    layers.BatchNormalization(),
    layers.MaxPool2D((2, 2)),
    layers.Dropout(0.25),

    layers.Conv2D(128, (3, 3), activation='relu', padding='same'),
    layers.BatchNormalization(),
    layers.Conv2D(128, (3, 3), activation='relu', padding='same'),
    layers.BatchNormalization(),
    layers.MaxPool2D((2, 2)),
    layers.Dropout(0.25),

    layers.Flatten(),
    layers.Dense(256, activation='relu'),
    layers.BatchNormalization(),
    layers.Dropout(0.5),
    layers.Dense(10, activation='softmax')  # 10 classes
])

model.summary()
```

**Fig No: 6.7 CCN Model for image classification**

```
781/781 ──────────── 390s 499ms/step - accuracy: 0.7378 - loss: 0.7566 - val_accuracy: 0.6548 - val_loss: 1.0849
Epoch 12/20
781/781 ──────────── 11s 14ms/step - accuracy: 0.6719 - loss: 0.8260 - val_accuracy: 0.6634 - val_loss: 1.0581
Epoch 13/20
781/781 ──────────── 4013s 5s/step - accuracy: 0.7504 - loss: 0.7169 - val_accuracy: 0.6821 - val_loss: 0.9795
Epoch 14/20
781/781 ──────────── 11s 13ms/step - accuracy: 0.7188 - loss: 0.7196 - val_accuracy: 0.6878 - val_loss: 0.9616
...
Epoch 19/20
781/781 ──────────── 818s 1s/step - accuracy: 0.7843 - loss: 0.6269 - val_accuracy: 0.7752 - val_loss: 0.6923
Epoch 20/20
781/781 ──────────── 11s 14ms/step - accuracy: 0.6406 - loss: 0.9020 - val_accuracy: 0.7729 - val_loss: 0.6986
```

**Fig No: 6.8 Accuracy and Loss**
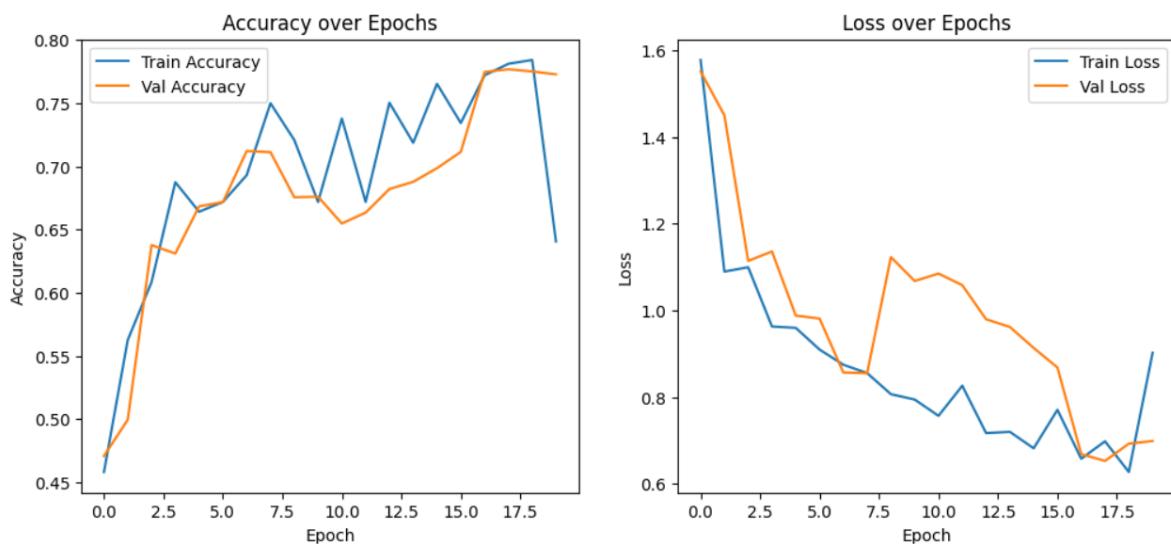
**Fig No: 6.9 Visualizing Accuracy and Loss over Epochs**

```
test_loss, test_acc = model.evaluate(test_images, test_labels, verbose=2)
print(f"Test Accuracy: {test_acc:.4f}")
print(f"Test Loss: {test_loss:.4f}")

✓ 12.6s

313/313 - 11s - 36ms/step - accuracy: 0.7729 - loss: 0.6986
Test Accuracy: 0.7729
Test Loss: 0.6986
```

**Fig No: 6.10 Test Accuracy and Test Loss**

**Fig No: 6.11 Dashboard of book recommendation system**



**Fig No: 6.12 Search by Author name or Book name**

Select User ID for user-based recommendations

| 596 | ▼ |
|-----|---|

Or select a book from search results

| 0525947345 | ▼ |
|------------|---|

Choose Recommendation Type

🔴 User - Item-Based
⚪ Personalized (with age/location)
⚪ Based on Selected Book

[ Recommend ]

## 📖 Recommendations (User-based)

| | ISBN | Book-Title | Book-Author |
|---|---|---|---|
| 15239 | 088240041X | Richard Harrington's Yukon | Richard Harrington |
| 33268 | 0385471378 | COMO AGUA PARA CHOCOLATE | LAURA ESQUIVEL |
| 33271 | 0934770468 | The Last of the Menu Girls | Denise Chavez |
| 33278 | 0688114679 | Growing Up Chicana/O: An Anthology | Tiffany Ana Lopez |
| 33279 | 1566890284 | Bone Truth: A Novel | Anne Finger |
| 33280 | 0393034909 | So Far from God: A Novel | Ana Castillo |

**Fig No: 6.13 Recommending based on user preference**

**Chapter 7**

# CONCLUSION

In conclusion, my 12-week internship at CODTECH IT SOLUTIONS PVT. LTD. has been a highly enriching and rewarding experience. Through the completion of four diverse machine learning tasks including Decision Tree implementation, Sentiment Analysis, Image Classification, and the development of a Recommendation System, I was able to apply theoretical knowledge from my academic studies to practical, real-world problems. This hands-on exposure not only strengthened my technical skills in data preprocessing, model building, and evaluation, but also helped me gain confidence in using industry-relevant tools and frameworks.

The internship enabled me to understand the complete machine learning workflow, from dataset preparation to model deployment, and enhanced my problem-solving, analytical thinking, and technical documentation abilities. I also learned to work independently, manage my time effectively, and adapt to the evolving requirements of each task. These experiences have broad relevance to real-world applications of machine learning and have enriched my overall understanding of the field.

Overall, this internship has significantly contributed to both my technical and professional development. It has given me practical skills that will be invaluable in my future studies and career pursuits in data science and artificial intelligence. I am grateful to CODTECH IT SOLUTIONS for providing this opportunity, and I am confident that the knowledge and experience I gained will continue to support my academic and professional growth.

# REFERNCES

[i] Isinkaye, F. O., Folajimi, Y. O., & Ojokoh, B. A. (2015). Recommendation systems: Principles, methods and evaluation. Egyptian Informatics Journal. A foundational overview of recommendation system approaches including collaborative filtering and content-based methods.

[ii] Anil Kumar & Sonal Chawla (2018). Recommendation Systems, Incorporating Sentiment Analysis with Specific Reference to the Academic Domain. International Journal of Computer Sciences and Engineering, 6(9), 17-22. DOI:10.26438/ijcse/v6i9.1722 — Discusses combining recommendation systems with sentiment analysis.

[iii] Japan Advanced study, Sara Sravani et al. (2025). Intelligent Recommender System Model through Sentimental Analysis. Journal of Computer Allied Intelligence — A recent model combining sentiment analysis and recommendation systems.

[iv] Matrix factorization (recommender systems) — Wikipedia article explaining the matrix factorization technique used widely in recommendation systems.

[v] A Comparative Study of Sentiment Analysis on Customer Reviews Using Machine Learning and Deep Learning (2025). MDPI Computers. This article compares traditional ML and deep learning methods for sentiment classification, showing effectiveness of models like Logistic Regression.

[vi] Sentiment Analysis using Various Machine Learning Techniques: A Review. IEIE Transactions on Smart Processing & Computing — Reviews traditional ML methods (Logistic Regression, Decision Tree, etc.) for sentiment tasks.

[vii] CNNRec: Convolutional Neural Network based recommender systems – A survey A survey article that reviews how CNNs are used in recommendation systems and deep learning contexts.

[viii] A Comprehensive Overview of Recommender System and Sentiment Analysis Research overview on recommender systems and sentiment analysis components, useful for methodology background.

[ix] Kumar, A., & Chawla, S. (2018). Recommendation Systems, Incorporating Sentiment Analysis with Specific Reference to the Academic Domain. International Journal of Computer Sciences and Engineering, 6(9), 17-22.

[x] Isinkaye, F. O., Folajimi, Y. O., & Ojokoh, B. A. (2015). Recommendation systems: Principles, methods and evaluation. Egyptian Informatics Journal.