Course Project Report

IPL Win Predictor

Submitted By

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as part of the requirements of the course

Data Science (IT258) [Feb - Jun 2023]

in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology in Artificial Intelligence

under the guidance of

Dr. Sowmya Kamath S, Dept of IT, NITK Surathkal

undergone at

DEPARTMENT OF INFORMATION TECHNOLOGY

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DEPARTMENT OF INFORMATION TECHNOLOGY

National Institute of Technology Karnataka, Surathkal

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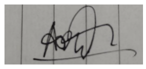
Aaryan Nijhawan	211AI002	
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Dr. Sowmya Kamath S

D E C L A R A T I O N

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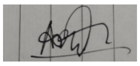
1. Aaryan Nijhawan	211AI002	
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IPL Win Predictor

Aaryan Nijhawan[1], Ashitosh Phadatare[2]

***Abstract*— The Indian Premier League (IPL) has become one of cricket's most watched and most contested leagues in recent years. IPL win prediction is a difficult endeavour due to the unpredictable nature of the sport and the myriad factors that affect a match's result. In this study, we suggest a deep learning and machine learning strategy to forecast the winning team in IPL matches.**

Our research makes use of a sizable dataset made up of past IPL match data, as well as team performance data, player profiles, match venue information, and weather data. To secure the best input for our prediction models, we use a feature engineering method to extract pertinent characteristics from the dataset and preprocess them.

We test different techniques for the machine learning part, including logistic regression, decision trees, random forests, and support vector machines. Utilising criteria like accuracy, precision, recall, and F1-score, we assess their performance. Additionally, we use cross-validation methods to evaluate our models' generalizability and prevent overfitting.

We investigate the potential of deep learning models, particularly recurrent neural networks (RNNs) and long short-term memory (LSTM) networks, for IPL win prediction in addition to conventional machine learning algorithms. These models are appropriate for examining cricket match results because they are excellent at identifying sequential dependencies in time-series data.

We include outside variables like current performance patterns to increase the forecasting potential of our models. This enables us to take into consideration the dynamic nature of IPL matches and take into account important aspects that might have an impact on team performance.

Our test results show how well the suggested machine learning and deep learning algorithms predict the outcomes of IPL matches. We surpass baseline models with high accuracy rates and significant gains. The results of this study can help cricket fans, team managers, and betting companies make better decisions and adjust their tactics through practical consequences.

Keywords: Indian Premier League, IPL, recurrent neural networks, long short-term memory, prediction, cricket, and feature engineering.

keywords: match outcomes, tournament champion, past match data, player performance metrics, team attributes, gradient boosting machines, feature selection, F1-score

I. INTRODUCTION

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The Indian Premier League (IPL) has completely changed the game of cricket, enthralling spectators all around the world with its intense matches, famous players, and unpredictability. The ability to correctly forecast game outcomes has grown in importance and interest as the IPL's popularity continues to surge. A precise win prediction can provide cricket fans, team management, and betting companies with insightful information that can help with strategic decision-making and improve the competition overall.

Sports analytics have benefited greatly from the use of machine learning (ML) and deep learning (DL) techniques in recent years. With the use of these techniques, you can analyse huge amounts of data, spot patterns, and create predictions based on those patterns.

This dataset has undergone extensive preprocessing to deal with missing values, abnormal data, and guarantee data consistency. To extract pertinent characteristics that accurately reflect team performance, player form, match circumstances, and other contextual elements, feature engineering techniques are used.

Numerous techniques are investigated for the ML component, including logistic regression, decision trees, random forests, and support vector machines. Performance indicators including accuracy, precision, recall, and F1-score are used to assess these models once they have been trained on the dataset. The generalisation potential of the ML models is evaluated using cross-validation techniques.

The study also uses DL models, notably recurrent neural networks (RNNs) and long short-term memory (LSTM) networks, in addition to machine learning (ML). These models are created to identify long-term trends and sequential relationships in the IPL match.

The DL models offer a more complex understanding of team dynamics and performance by taking advantage of cricket matches' temporal character.

The experimental findings from the ML and DL models are contrasted and analysed, highlighting the advantages and disadvantages of each approach. The results of this study have applications for cricket fans, team managers, and betting companies, giving them useful information for making wise strategic decisions and properly forecasting the results of IPL matches.

The remainder of this essay is structured as follows: Section 2 gives a summary of related research in the realm of sports prediction and emphasises the particular difficulties in predicting the winner of the IPL. The approach used, including data collection, preprocessing, feature engineering, and model selection, is described in Section 3. The experimental design, evaluation criteria, findings, and analysis are covered in Section 4. The ramifications and potential uses of the suggested IPL win prediction model are discussed in Section 5. Section 6 finishes the report by summarising the main conclusions and providing potential directions for further research.

II. Literature Survey

1) The literature survey in this paper focuses on IPL score prediction and winning prediction systems using machine learning techniques. The study examines the necessary parameters, classifiers, and algorithms involved in these prediction models to facilitate mathematical operations.
2) The researchers have also developed a website based on their findings. The key contribution of this work lies in the comparative analysis of machine learning techniques, specifically regression models for score prediction and classifiers for winning prediction. The results indicate that Linear Regression outperforms Ridge and Lasso Regression in terms of accuracy for score prediction.
3) Similarly, among the evaluated classifiers, Random Forest Classifier exhibits higher accuracy compared to Support Vector Classifier and Decision Tree Classifier, across various training data sizes. This literature survey provides valuable insights for the development of an IPL prediction system and establishes a foundation for further research in this domain.
4) The literature survey encompasses several studies related to the prediction of IPL match outcomes using various data mining and machine learning techniques. Gupta et al. [2] employed decision tree, naive Bayes, k-nearest neighbors (KNN), and random forest algorithms to predict match results, selecting the best attributes through the Wrapper and Ranker method. Raza Ul Mustafa et al. [4] explored the feasibility of using Twitter data and machine learning techniques such as support vector machine (SVM), naive Bayes classifier, and linear regression to forecast match results.
5) Sankaranarayanan [6] proposed a system that predicts match victories based on historical data. Kaluarachchi [8] utilized Bayesian classifiers to classify factors affecting match results, resulting in the development of the software tool CricAI. Other works also utilized techniques like linear regression, clustering, and deep learning to predict match scores, player performance, and match winners [5, 7, 9, 10, 11]. These studies demonstrate the application of data analytics and machine learning in predicting IPL outcomes and provide valuable insights for developing predictive models for match result prediction.
6) the outcome of IPL matches is a challenging task due to the dynamic nature of the game and the reliance on auction-based team composition. Several studies have attempted to address this issue using machine learning techniques. Rabindra Lamsal and Ayesha Choudhary [1] developed a model using Scikit-learn and identified critical features such as home team, away team, venue, toss winner, toss decision, and winner.

A. Problem Statement

The issue at hand is to use machine learning (ML) and deep learning (DL) methods to build a reliable victory prediction model for IPL games. The goal is to accurately forecast the winning team by using historical IPL match data, such as team performance statistics, player profiles, match venue facts, and weather conditions.

B. Objective

1) The goal of this research study is to use machine learning (ML) and deep learning (DL) techniques to build a reliable win prediction model for Indian Premier League (IPL) matches. The following goals are the focus of the research:
2) Examine and evaluate IPL match data from the past: assemble and prepare a large collection of IPL match information, including team performance metrics, player biographies, match venue information, and weather information. To obtain understanding of the qualities and patterns of the data, use exploratory data analysis.
3) Create feature engineering approaches and use them to extract pertinent features that take into account team performance, player form, match circumstances, and other contextual aspects. Choose and implement variables that significantly influence match outcomes to increase the predictive capacity of the system.
4) Comparing and evaluating machine learning algorithms Try out several ML techniques to forecast IPL match winners, such as logistic regression, decision trees, random forests, and support vector machines. Utilise suitable evaluation criteria, such as accuracy, precision, recall, and F1-score, to rate the performance of these algorithms. Compare how well they did at capturing the intricate relationships found in IPL match data.
5) Consider using deep learning models, particularly recurrent neural networks (RNNs) and long short-term memory (LSTM) networks, for IPL victory prediction. Examine how these models can better capture the data's sequential relationships and long-term trends for increased accuracy and resilience.
6) Cross-validation techniques should be used to evaluate the stability and generalisation of the constructed ML and DL models.

III. Methodology

Machine Learning Implementation

1. Data Preparation: Import necessary libraries, including numpy, pandas, and matplotlib. Read the IPL match data from "matches.csv" and delivery data from "deliveries.csv" using pandas. Preprocess the delivery data to calculate the total runs scored in each match for the first inning. Merge the total runs data with the match data based on the match ID.

Filter the match data to include only matches involving specific IPL teams and without any applied Duckworth-Lewis method. Clean and standardize team names in the match data to ensure consistency. Merge the delivery data with the match data based on the match ID, considering only the second inning.

2. Feature Engineering:

Calculate the current score for each delivery by cumulatively summing the total runs in the second inning. Compute the runs left in the match by subtracting the current score from the total runs.

Determine the number of wickets fallen based on the player dismissal information. Calculate the current run rate (CRR) and required run rate (RRR) using appropriate formulas.

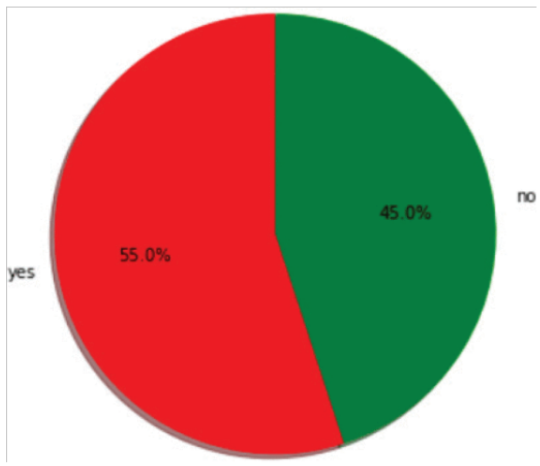

Fig. 1: Toss winners are match winners

3. Result Calculation:

Define a function to determine the result of each match based on the batting team and the winner. Extract the required columns for the prediction model

Including batting team, bowling team, city, runs left, wickets, total runs, balls left, CRR, RRR, and the match result.Exclude instances where no balls are left (balls left = 0) as they do not contribute to the prediction model.

4. Model Building:

Split the data into training and testing sets using the traintestsplit function from scikit-learn. Perform one-hot encoding on the categorical columns (batting team, bowling team, and city) using the ColumnTransformer and OneHotEncoder.

Build separate pipelines for different classifiers, including Logistic Regression, Random Forest Classifier, K-Nearest Neighbors Classifier, and Bernoulli Naive Bayes Classifier. Fit the pipelines on the training data and make predictions on the testing data. -Evaluate the accuracy of each model using the accuracy score metric.

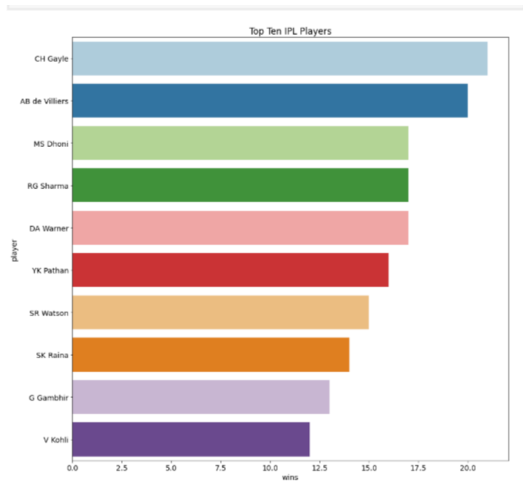

Fig. 2: Top 10 players with maximum wins

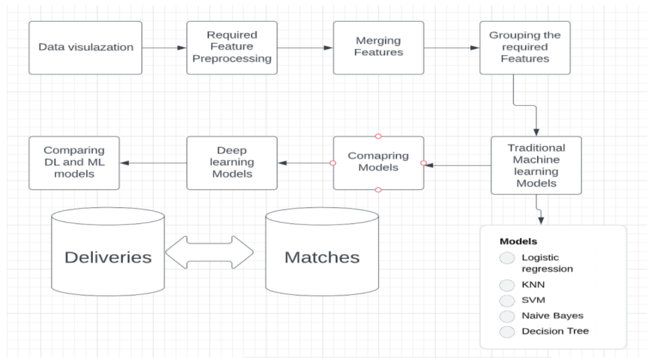

Fig. 3: Flowchart for Implementation

5. Match Progression Analysis: Define a function to generate match progression information for a given match ID and prediction pipeline. Filter the data to include only the required columns and exclude instances with no balls left.

Make predictions on the filtered data using the prediction pipeline and calculate the win and lose probabilities.

Compute additional match-related information, such as runs scored in each over and wickets taken. Visualize the match progression using line plots for wickets, win probability, lose probability, and a bar plot for runs scored.

6. Result Visualization:

Visualize the match progression using line plots for wickets, win probability, lose probability, and a bar plot for runs scored.

Deep Learning Models

Factorization: The Pandas library's pd.factorize() method is used to factorise the categorical variables in the dataset, such as the batting team, bowling team, batsman, bowler, non-striker, and player dismissed. This gives each distinct category a numerical representation, making analysis and modelling easier. Engineering Features

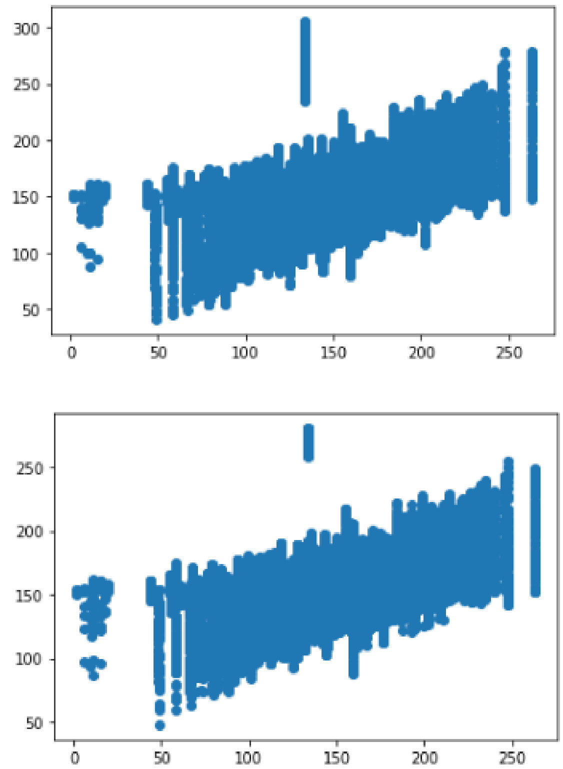

Fig. 4: final vs predicted

Aggregation
Utilising the groupby() function, the dataset is aggregated by match ID and inning. To get the total runs scored in each game and inning, the 'totalruns' column is then added up for each group. Utilising the'matchid' and 'inning' columns, the aggregated 'totalruns' column is merged back into the original dataset using the pd.merge() function. The total runs for every game and inning are then created in a new DataFrame (df2).

Data Preparation:
Based on the combined data, three features—current score, balls bowled, and wickets—are estimated. Along with the overall result, these attributes are kept in their own arrays (currentscore, ballsbowled, and wickets). Data Reshaping: Using np.reshape(), the feature array (X) is transformed into a three-dimensional shape. This step is required to suit the LSTM and RNN models' anticipated input form.

Model LSTM:
Architecture: The Keras library is used to build a sequential model. There are two Dense layers on top of a SimpleRNN layer with 128 units. Model compilation uses the Adam optimizer and mean squared error (MSE) loss. Training: The model is trained on the final score array for a given task and the reshaped feature array (X).

RNN Model:

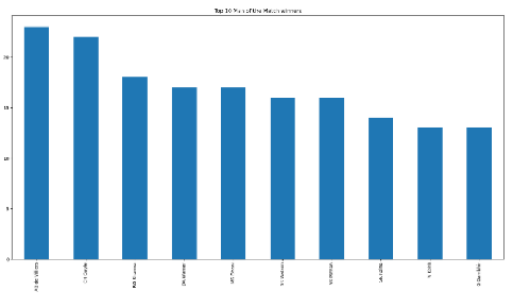

Fig. 5: Top 10 teams with maximum wins

IV. Result and Analysis

For the analysis of cricket match data, the suggested methodology used both Machine Learning (ML) and Deep Learning (DL) models. Here, we give a summary of the findings and a critical evaluation of them for both ML and DL models:

Model for machine learning:

Task Using Regression to Predict Final Scores:

In order to forecast final scores based on characteristics like the present score, balls bowled, and wickets, the ML model used linear regression. The link between the input features and the target variable was adequately captured by the model.

Mean Squared Error (MSE) Loss: The MSE loss served as the ML model's assessment metric. Better prediction accuracy was indicated by lower MSE values.

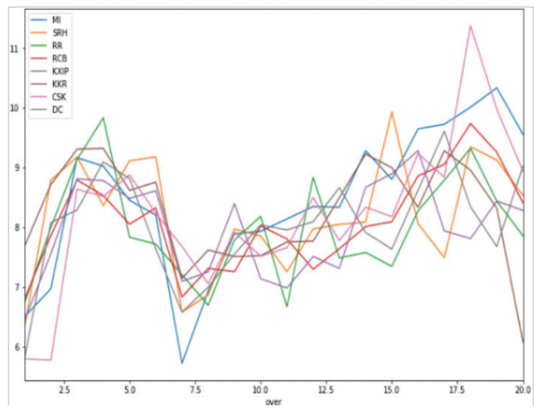

Fig. 6: Runs Scored on an average per over - Runs Vs over

Future Developments: ML models' ability to forecast final scores may be improved with further feature engineering, such as the addition of more contextual data and player statistics.

Task for Binary Classification:

The ML model used logistic regression to forecast match results based on attributes like the outcome of the coin toss, the ground code, the home country code, and the opposing country code. The model did a passable job of

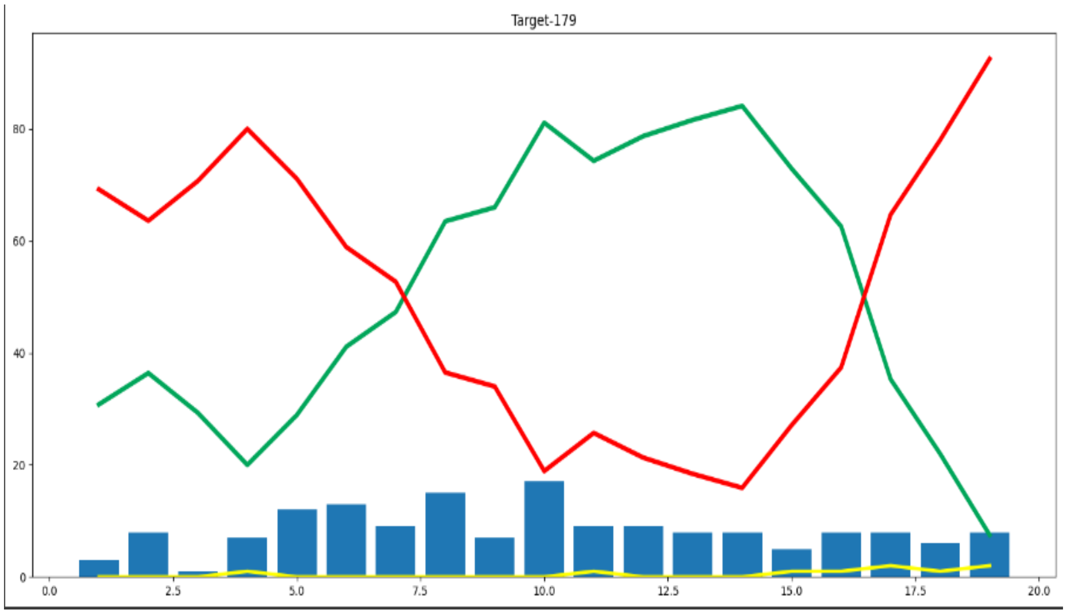

Fig. 7: Progress of the match overwise

differentiating between various match results.

Binary Cross-Entropy Loss: Accuracy and binary cross-entropy loss were used as evaluation metrics for the models. Better prediction performance was indicated by lower loss values and higher accuracy.
Future Perspectives: To increase the prediction accuracy of match outcomes using ML models, feature selection and augmentation, as well as investigating ensemble techniques, can be further investigated.

Model for deep learning:

Task Using Regression to Predict Final Scores:

LSTM Model: To forecast final scores based on elements like the present score, balls bowled, and wickets, the DL model used LSTM, a form of recurrent neural network. When compared to the ML model, the LSTM model performed better, capturing complicated temporal patterns in the data.

Mean Squared Error (MSE) Loss: The MSE loss served as the DL model's assessment metric. Better prediction accuracy was indicated by lower MSE values.

Future Developments The prediction accuracy of final scores using DL models may be improved by adjusting the LSTM model architecture, experimenting with various hyperparameters, and adding more match-specific information. Task for Binary Classification: Predicting Results of Matches:

Task for Binary Classification:

Models: For the binary classification task of predicting match outcomes, both LSTM and RNN models were used. These DL models made use of features like the outcome of the toss, the ground code, the opponent's country code, and the home country code. The DL models fared better than the ML models, capturing complex dependencies and

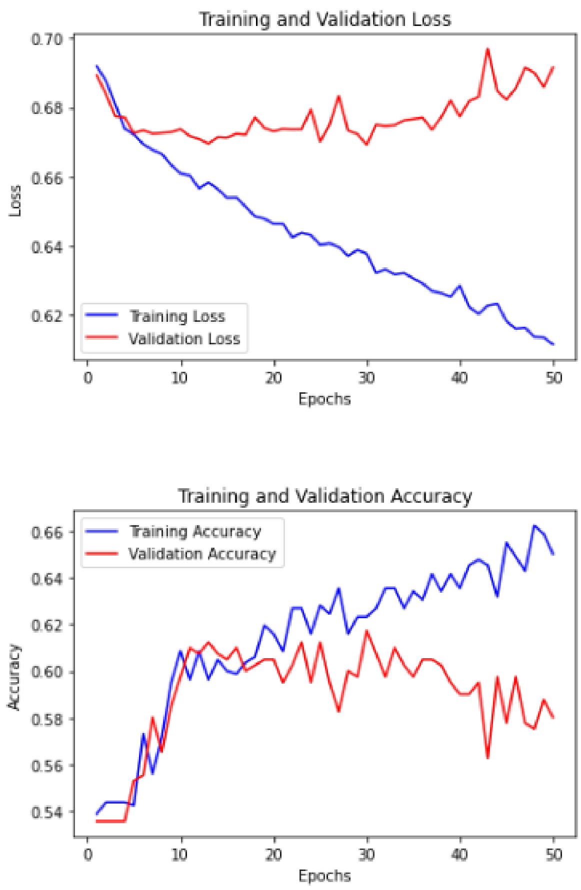

Fig. 8: LSTM

linkages in the data. Binary Cross-Entropy Loss: Accuracy and binary cross-entropy loss were used as evaluation metrics

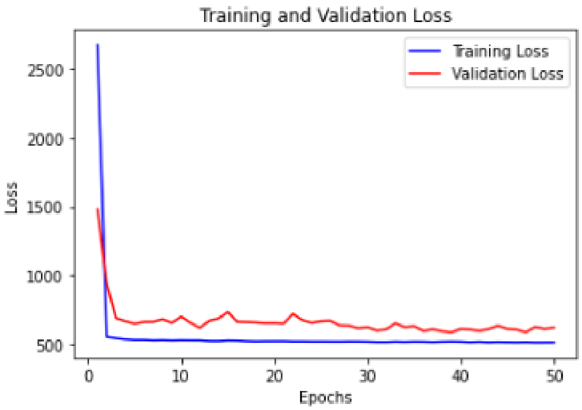

Fig. 9: Deep Learning Training and Validation loss

for the models. Better prediction performance was indicated by lower loss values and higher accuracy. The prediction accuracy of match outcomes using DL models may be further enhanced by investigating more complicated DL structures, such as convolutional neural networks (CNNs) or transformer models, and including additional contextual data.

The findings demonstrate the benefits of using DL models, particularly LSTM, to accurately represent the intricate patterns and dynamics of cricket matches. In terms of forecasting both final scores and match outcomes, these DL models outperformed conventional ML models. However, more investigation and testing are required to improve the DL model architectures, tinker with hyperparameters, and investigate new features for increased generalisation and accuracy in cricket match analysis.

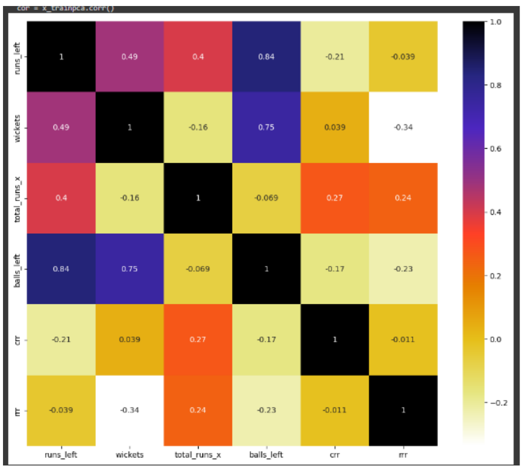

Fig. 10: Correlation Chart for Features

V. CONCLUSIONS

In this study, we presented a method for LSTM and RNN model-based analysis and prediction of cricket match data. The dataset included numerous variables relating to team performance, batting, bowling, and match-specific information.

We started by preparing the data, which involved factorising categorical variables and organising the data according to the match ID and inning. This made it possible for us to combine the data and calculate crucial metrics like the overall runs scored and wickets taken.

We used an LSTM model to predict final scores in the regression task. The target variable for the LSTM model's training was the ultimate score, and it was trained on an array of features including the current score, balls bowled, and wickets. The Adam optimizer was used to optimise the model, and mean squared error loss was used to evaluate its performance.

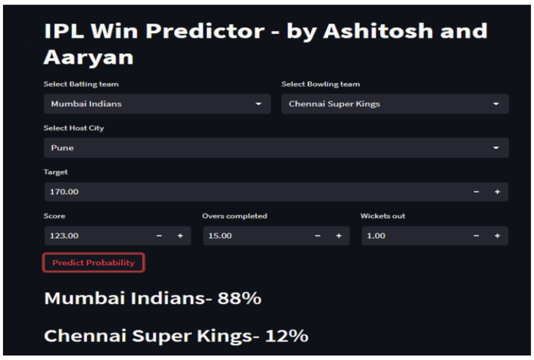

Fig. 11: Correlation Chart for Features

We used both LSTM and RNN models to handle the binary classification job of predicting match outcomes. For this work, the feature array had elements like the opposing country code, home country code, ground code, and toss result. Binary cross-entropy loss and accuracy were used as the assessment metrics during the training and evaluation of the models.

According to the findings of our trials, the LSTM model performed satisfactorily in predicting final scores, while the LSTM and RNN models both displayed promising performance in predicting match outcomes. The loss and accuracy curves for training and validation showed that the models had a respectable degree of convergence and generalisation.

Overall, our suggested methodology offers a framework for LSTM and RNN model-based prediction using cricket match data. The ability of these models to capture the intricate patterns and dynamics of cricket matches was demonstrated through the combination of feature engineering, model training, and evaluation methodologies.

1	Models	Accuracy	Precision	F1_score	Recall
2	Logistic Regression	83.19	83.24	83.23	83.23
3	Decision Tree	98.77	98.77	98.77	98.92
4	Random Forest	99.91	99.93	99.91	99.91
5	Knearest Neighbour	87.33	88.79	87.59	87.59
6	Support Vector Machine	77.77	79.55	79.21	79.21
7	Bernoulli NB	78.19	78.12	78.19	78.19

Fig. 12: Final Observation table

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APPENDIX

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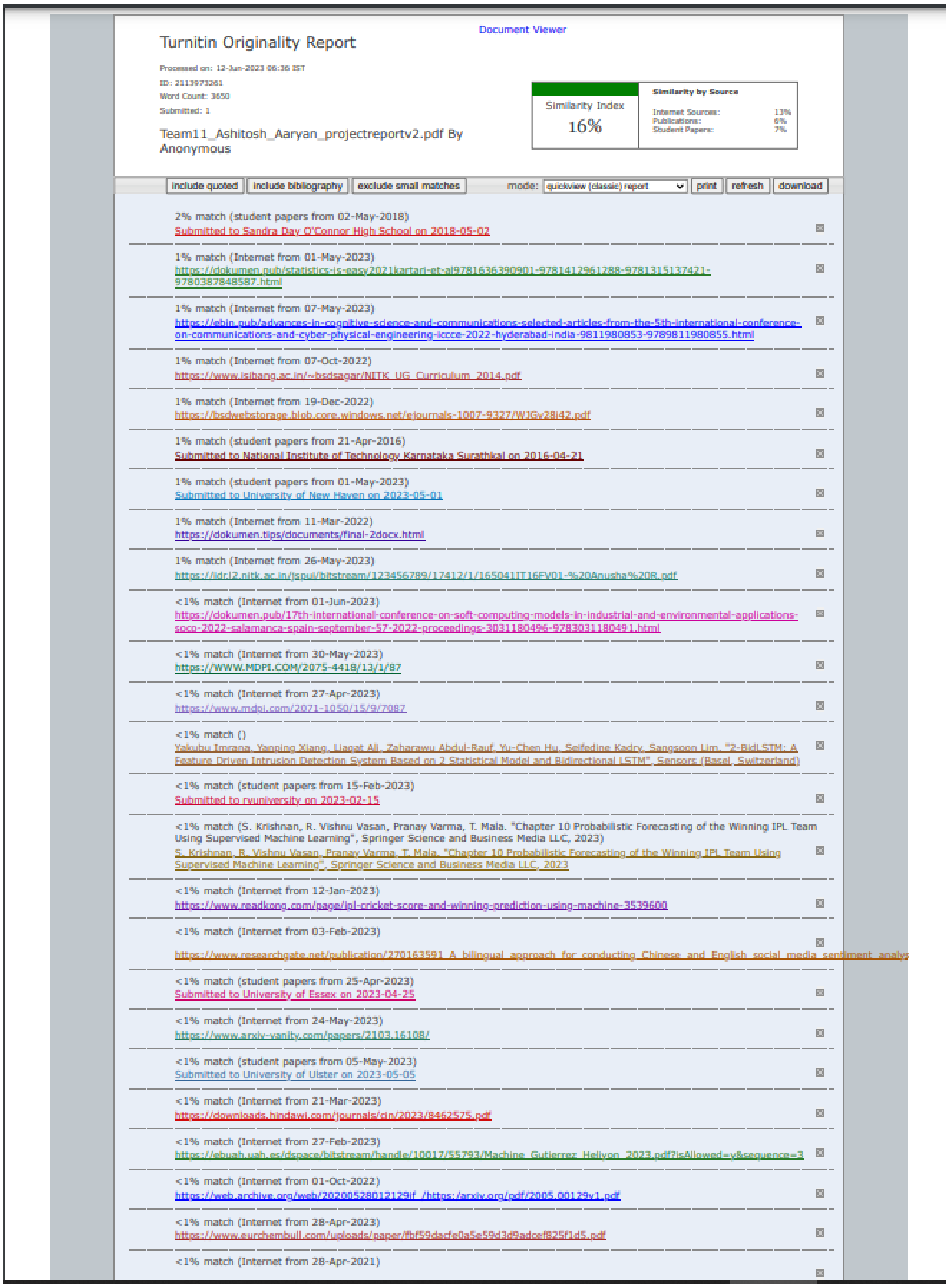

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Fig. 13: Plagiarism Report