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Judgement Prediction of Government Employee's Retirement Benefits Cases using TensorFlow Decision Forests

Abstract: - A judgement prediction model with TensorFlow Decision Forests (DF) is a machine learning model that uses decision trees as the building blocks for classification and forecasting of writ petition. The TensorFlow library provides tools for implementing and training decision forests, which are collections of decision trees, in order to make predictions. In this paper we analyze the basic description of the retirement benefits matters like grant of pension on superannuation, family pension, commutation of pension, gratuity, group insurance saving fund, leave encashment and superannuation, provident fund which are filed in appropriate Courts/Tribunals. The outcome is either "Allowed" or "Dismissed". Rarely "Partly Allowed" petitions are treated as "Allowed". TensorFlow DF looks a better choice which applied on labeled dataset based on factors affecting the outcomes of cases. The objective of this paper is to classify and forecast the outcome whether a filed petition will be 'allowed, or 'dismissed using TensorFlow DF, a supervised learning approach. Classification and forecasting can help the delinquent, learned counsel, and presiding officers finish the petition and understand it. The model for judgement prediction is implemented on retirement benefits cases which are filed in concerned court against different departments in U.P. State in India. The accuracy of the proposed model varies between 94% to 98%. As a result, the effectiveness of models developed in the TensorFlow DF is highly useful in forecasting the outcome of petitions pertaining to the employment related cases of civil servants, as well as employees of local governments and government-owned enterprises.

Keywords: TensorFlow Decision Forests, Ensemble Learning, Machine Learning, Judgement, Supervised Learning, Retirement Benefits.

I. INTRODUCTION

Retirement benefits mean the benefits admissible to the employees after long and outstanding services rendered by him or her during the course of employment and it is always subject to the condition regulated by statutory provisions. It is financial benefits provided by an employer or government to individuals when they reach a certain age or stop working [13]. The purpose of these benefits is to provide a source of income for individuals during their retirement years, when they are no longer earning a regular salary. Retirement benefits can be classified mainly (1) Pensionary Benefits (2) Non-Pensionary Benefits such as grant of pension on superannuation, family pension, commutation of pension, gratuity, group insurance saving fund, leave encashment, provident fund etc. These benefits are designed to provide a regular source of income to the employees after they retire from their job [12]. Pension has been defined by the courts as a set allowance or stipend given in exchange for past service or the giving up of rights or emoluments by someone who has retired from service. So, a government worker's pension comes from having worked for the government for a long time and doing a good job. It can be thought of as a different part of the pay for service.

Pensions aren't just a reward for loyal service in the past; they also have a bigger meaning. In that it is a measure of social and economic security in the later years of life, when both physical and mental abilities start to decline with age. The pension benefits are typically based on a combination of factors such as the employee's length of service, salary, and age at retirement. The aim and object of post-retirement benefits is to ensure the peaceful life and livelihood of retire personnel [11]. The termination or curtailment of retirement benefits caused by service

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matter severely impacts the retired employee's living standards. Such cases which are pending in various courts and tribunals must be decided as soon as possible.

In A.I.R. 1971 SC 1409(1420), the Supreme Court said that the petitioner's right to receive pension is property under Article 31(1) of the Constitution of India and that the State could not take it away with just an executive order. Also, the pension claim is property under Article 19(1)(f), and Article 19(5) did not save it. Reasonable opportunity should be given before the deduction of pension [14].

The constitution having set up the political society which has a welfare socialistic state as its goal and with the obligation created under Article 39(e) ,41,43(13) of the Constitution. Pension as a retirement benefit is in consonance and in furtherance of the goals of the constitution [15].

TensorFlow is a library of open-source software for machine learning and deep learning. It can be used to judge, classify, and make predictions. To make a prediction using TensorFlow, a model is built using a high-level API such as Keras or Estimators, train the model on labeled data, and then use the trained model to make predictions on new, unseen data. The specific steps for building and training a model depend on the type of problem undertaken to solve. But they typically involve the model architecture design, model execution with a loss function, model optimization, and finally training the model with a labeled dataset. After training, the model can be used to make predictions by calling the predict method on the model and passing in the data to be predicted.

Using machine learning for judgment prediction in legal matters have proven to be challenging in terms of classification and forecasting. This is mainly due to the fact that the classification system is based on data that only becomes available after case's verdict is announced. As a result, the final judgment data is utilized for both training and testing purposes. However, when the outcome is unknown, it becomes difficult to determine the actual shape of the data. The complexity of the unseen data makes it difficult making the model correctly to classify and forecast the result accurately and efficiently [7,9].

In this work, important features and factors influencing the outcome of the "Retirement Benefits" cases are identified. These cases are taken from an organization of a government department. A dataset with 3250 cases is created to use these features and factors as descriptors for judgment forecasting. The outcome prediction is considered a binary classification issue for the "Allowed" and "Dismissed" classes of accused employees [1,6].

Our goal is to make interpretable prediction model to improve the performance and robustness of decision methods and provide more reliable tool. The methods we have considered are based on quantitative analysis of those factors and features which are used in judicial proceedings. We apply machine learning and deep learning approaches to help computers to "understand" the relationship between the input information and court outcomes for better support and prediction of the judgements [5].

II. TENSOR FLOW DECISION FOREST (TF-DF)

A tensor is a mathematical entity that describes the geometric relationship between vectors, scalars, and other tensors. Tensors are often represented as multi-dimensional arrays of numbers, and their components transform according to certain rules under changes of coordinate systems. The rank of a tensor is the number of indices required to specify its components, and tensors of different ranks can be combined through various algebraic operations to form new tensors. It is a collection of vectors and convectors combined together using the tensor product.

TensorFlow was created by the Google Brain team and is a free and open-source machine learning framework. It provides a high-level API for building and training machine learning models, as well as lower-level APIs for more fine-grained control. TensorFlow provides a wide range of tools and libraries to help developers for data processing, build, train, evaluate and deploy machine learning models. It includes a powerful Python API, as well as C++, Java, and other language APIs. TensorFlow supports both CPU and GPU processing [2].

TensorFlow Decision Forests are a type of machine learning algorithm that belongs to the decision tree family. They work by training multiple decision trees and aggregating their predictions to make a final prediction for a given input. This approach allows for more robust predictions by taking into account the strengths and weaknesses of individual trees and reduces overfitting, which can occur with a single decision tree. TensorFlow is an open-source software library for machine learning and deep learning that provides a variety of tools for building and

training decision forests, among other models. TensorFlow provides an implementation of decision forests, called the Random Forest Estimator. The Random Forest Estimator is a high-level API built on top of TensorFlow's low-level APIs. It provides an easy-to-use interface for training and evaluating decision forest models [18].

Classification and regression problems are ideal applications of the ensemble learning technique known as Decision Forests. It is a collection of decision trees, where each tree gives a prediction and the final output is the average or majority vote of all trees. Decision forests are typically more robust and accurate compared to a single decision tree.

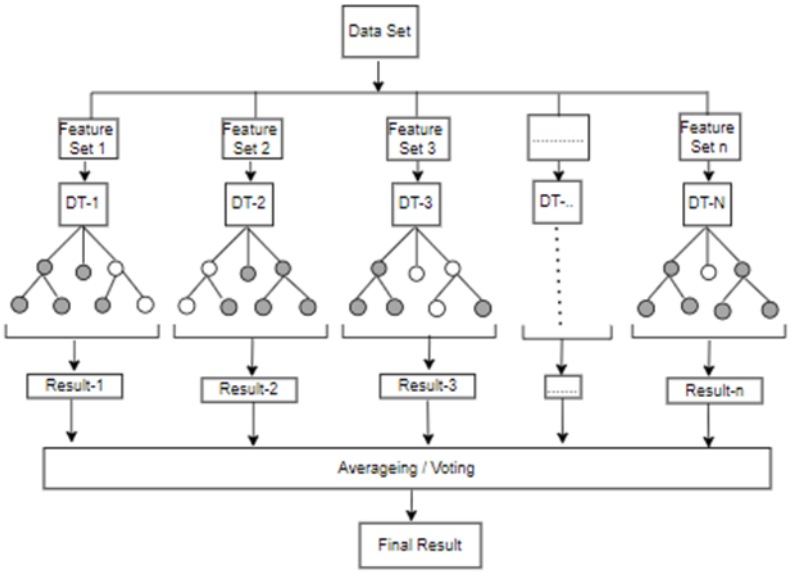


Fig.1: Decision Forest

III. JUDGEMENT PREDICTION MODEL

In retirement benefit matter a judgment prediction model is a machine learning model that uses historical data related to previous decided cases of retirement benefit claim petition to forecast the outcome of the cases. The model depends on variety of factors, including important features, past judgments, case law, legal statutes, and orders of High Courts and Supreme Court of India to generate predictions about the likely outcome of a particular case. One of the key challenges in developing a judgment prediction model is to identify the most relevant factors and features to include in the model [4,8]. TensorFlow decision forest, a supervised machine learning algorithm is used in this model. After preprocessing the dataset is prepared. Split the dataset into training and testing dataset. Keras and TensorFlow functionalities are used to define and fit the model. Model is also evaluated in TensorBoard and accordingly the hyperparameters are set to optimized the prediction.

TensorBoard:

TensorBoard is a visualization tool which is a part of the TensorFlow framework. It allows users to visualize and understand their machine learning models through interactive visualizations of various aspects of the model, such as the training process, the model architecture, and the data used for training and testing. It is used for tracking and visualizing metrics such as accuracy, loss, and learning rate over time during the training process, allowing users to monitor the performance of their model as it trains [16].

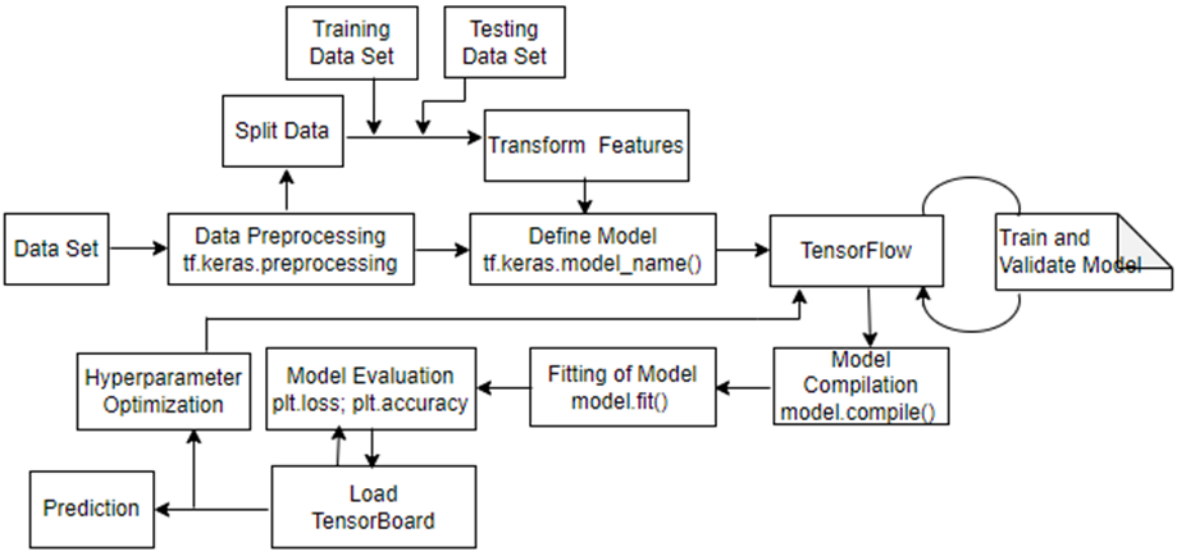


Fig.2: Research methodology

IV. FEATURE IDENTIFICATION, EXTRACTION, AND PREPARING RETIREMENT BENEFITS DATASET

A dataset is prepared using the data collected from the disposal register, judgement files and other concern documents. Important features are identified from Civil Services Regulations (CSR), Uttar Pradesh Retirement Benefits Rules, 1961 and Uttar Pradesh Qualifying Service for Pension and Validation Act, 2021.Other sources are past judgments, case law, and judgements /orders of High Courts and Supreme Court of India. After feature engineering and preprocessing the records are stored in unified data repository [10]. The final dataset is made from this unified data repository for further use [3]. The dataset is splitted into the training dataset and testing dataset with size in ratio of 80%-20%.

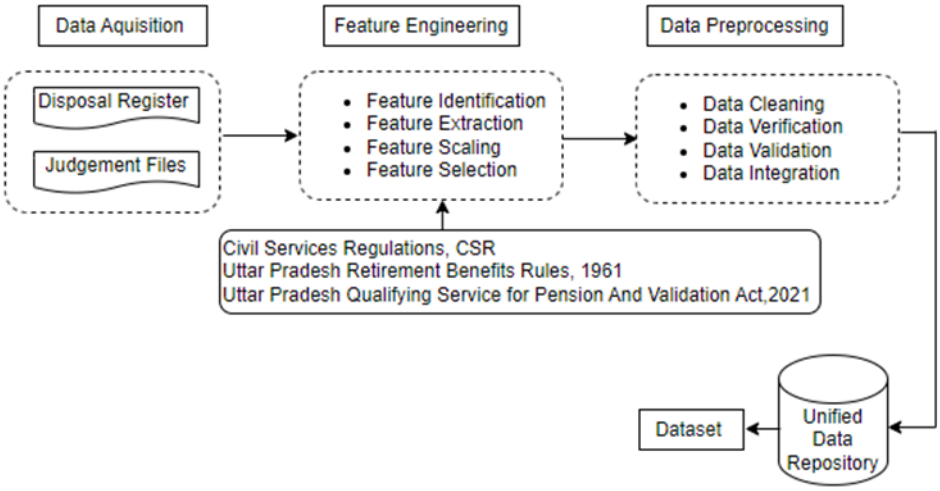


Fig.3: Dataset Preparation

Department Name	WritNo	Petition Name	Advocate Name	Nature	JudgName	JudgeName2	Result
Agriculture	CP0453/2000	RAM NAGINA PRASAD	M.N.TRIPATHI	Retirement Benifi	.....	.....	Dismissed
Agriculture	CP0453/2000	RAM NAGINA PRASAD	M.N.TRIPATHI	Retirement Benifi	.....	.....	Allowed
Agriculture	CP0931/2005	SRI KIRSAN TRIPATHI	AZHAR UDDIN AHAMAD	R.B.S.	.....	.....	Allowed
Agriculture	CP2075/2014	SITA RAM SHARMA	JANARDAN PANDEY	Pensionary Benefi	.....	.....	Allowed
Agriculture	CP2125/2017	GAYA PRASAD VERMA	P C CHAUHAN	R.B.S.	.....	.....	Allowed
Agriculture	CP0711/2017	V.P.L. SRIVASTAVA	RAKESH KUMAR SINGH	Pension	.....	.....	Allowed
Animal Husbandry	CP0549/2012	SMT. CHANDRAWATI	GYANENDRA SINGH	Pensionary Benefi	.....	.....	Allowed
Animal Husbandry	CP0775/2020	MOHD. ARIF	AJAY KUMAR SHARMA	Pensionary Benefi	.....	.....	Allowed
Appointment	CP1570/2013	MOHD. AYUB	MOHD. FATEHUDDIN	Retirement Benifi	.....	.....	Allowed
Basic Education	CP0553/2008	R N PRASAD DWIEDI	Ugrasen Singh	Retirement Benifi	.....	.....	Allowed
Basic Education	CP0471/2010	Anshul Kumar	R. Kumar	Retirement Benifi	.....	.....	Dismissed
Bridge Corporation	CP1371/2012	RAVI SHANKAR	ASHOK SHUKLA	Retirement Benifi	.....	.....	Allowed
Bridge Corporation	CP0254/2020	B K MISHRA	MANISH KUMAR MISHRA	Pensionary Benefi	.....	.....	Allowed
Finance	CP2247/2017	HAR BHAJAN SINGH	HEMENDRA PRATAP	R.B.S.	.....	.....	Allowed
Finance	CP1576/2018	GYANENDRA VERMA	HEMENDRA PRATAP	Pension	.....	.....	Allowed
Forest	CP0323/2016	INDRA BAHADUR	M.A. FARIDI	Pensionary Benefi	.....	.....	Allowed
Gram Vikas	CP1164/2013	RAJ PAL SINGH	P.P.SRIVASTAVA	Pension	.....	.....	Dismissed
Gram Vikas	CP0717/2018	CHANDRA PAL	B.K. YADAV	R.B.S.	.....	.....	Allowed
Higher Enducation	CP0021/2012	DR. MIAN JAN	S.P.SINGH	Pensionary Benefi	.....	.....	Allowed
Higher Enducation	CP1565/2015	DR. USHA SAXENA	S K SRIVASTAVA	Pensionary Benefi	.....	.....	Dismissed
Home	CP0717/2009	Kamar Ahmad,	R.K. UPDHAYAY	R.B.S.	.....	.....	Allowed
Home	CP1885/2010	Sushila Yadav	Ram Autar Singh Yadav	Pension	.....	.....	Dismissed
Home	CP2529/2010	Smt. Shanti Devi	V.K.Sharma	Retirement Benifi	.....	.....	Dismissed
Irrigation	CP0227/2000	G S BHATNAGAR	B.P.UPADHYAY	R.B.S.	.....	.....	Allowed
Irrigation	CP1490/2001	ANJANI KUMAR	D.N. PANDEY	R.B.S.	.....	.....	Allowed
Irrigation	CP1076/2008	SHIV SINGH	HEMENDRA PRATAP	Retirement Benifi	.....	.....	Allowed
Medical & Family W	CP1249/2013	DR. R.S. DUBEY	MANISH MISHRA	Pensionary Benefi	.....	.....	Allowed
Medical & Family W	CP1871/2015	DROPA DEVI	R.N. DWIVEDI	R.B.S.	.....	.....	Allowed
Medical & Family W	CP0249/2017	S.D. SHARMA	SHIV NATH GOSWAMI	Retirement Benifi	.....	.....	Allowed
NAGAR VIKAS	CP1085/2020	G M SRIVASTAVA	SURENDRA KUMAR VERM	Pensionary Benefi	.....	.....	Allowed
P.W.D.	CP1078/2000	D N SAXENA	Ram Lal Kushwaha	R.B.S.	.....	.....	Allowed
P.W.D.	CP0106/2005	VED PRAKASH	Rajeev Narain	Retirement Benifi	.....	.....	Dismissed
Power Corporation	CP0612/2018	GYANENDRA YADAV	RAMESH KUMAR SRIVAST	Retirement Benifi	.....	.....	Allowed
R.E.S.	CP0293/2009	B K Bhadra	Vimal Kumar	Retirement Benifi	.....	.....	Allowed
Revenue	CP0993/2022	TAARE SINGH	SATISH CHANDRA	Pensionary Benefi	.....	.....	Allowed
Rural Development	CP0345/2011	Raj Kishori	K.S. Bisht	R.B.S.	.....	.....	Allowed
Trade Tax	CP1880/2014	HUKUM CHAND	ARUN KUMAR SHUKLA	Pensionary Benefi	.....	.....	Dismissed
U.P.S.R.T.C.	CP0515/2022	PRABHAWATI DEVI	T.S. PREMI	R.B.S.	.....	.....	Allowed
Urban Development	CP0396/2007	Bal Krishna Verma	Ugrasen Singh	R.B.S.	.....	.....	Dismissed
Women Welfare	CP2979/2022	SMT. CHANCHAL CHAM	L.K. PATHAK	Pensionary Benefi	.....	.....	Allowed

Fig. 4: Sample dataset

In retirement benefits claim petitions the important features are Withholding Pension under CSR-351, Violation of CSR 351-A, Disciplinary Proceeding Pending on Date of Retirement, Disciplinary Proceeding is to be Instituted After Retirement, Pensionary Services declared by Government (CSR-361-A), Counting Continuous Services for Pension as per CSR-370, Break in Service Period due to Punishment (CSR-416,418), Break in Service Period Continuation Granted (CSR-417,419), Payment of Pension and Gratuity (CSR-930-961), Amount of Pension Granted as per recommendation of U.P. Pay Commission (2016), Eligibility for Family Pension as per CSR and recommendation of U.P. Pay Commission (2016), Nomination Issue for Family Pension. Details. The details features are shown in Table 1.

Table 1. Features description

Feature Name	**Feature Description**
DPPDR	Disciplinary Proceeding Pending on Date of Retirement
DPIAR	Disciplinary Proceeding is to be Instituted After Retirement
WHP	Withholding Pension under CSR-351
VCSR	Violation of CSR 351-A
RCSR	Recovery as per CSR 351-B
PPS	Provisional Pension Sanctioned (CSR-351-AA as provided in CSR-919-A)
CAG	Compassionate Allowance Granted (CSR-353)
CSCSR	Counting of Services as per CSR-358
SUG	Service must be under Government (CSR-361- First)

ESP	Employment must be Substantive and Permanent (CSR- 361- Second), According Article-12 of Indian Constitution. The Uttar Pradesh Qualifying Service for Pension and Validation Act, 2021.
SPG	Services must be paid by Government (CSR-361- Third)
PSDG	Pensionary Services declared by Government (CSR-361-A)
CCSP	Counting Continuous Services for Pension as per CSR-370
BSPP	Break in Service Period due to Punishment (CSR-416,418)
BSPCG	Break in Service Period Continuation Granted (CSR-417,419)
ISP	Interruption in Service Period (CSR-420)
CIDSP	Condonation of Interruptions and Deficiencies in Service Period (CSR-422)
CAARP	Competent Authority for Award and Reduction of Pension (CSR-470)
ECP	Entitled for Combination of Pension (CSR-492-493)
CPE	Compensation Pension and Entitlement (CSR- 426-440)
AIP	Award for Invalid Pension (CSR-441-457)
GSAP	Granting Super Annuation Pension (CSR-458)
GRP	Granting Retiring Pension (CSR-465)
LQSGP	Length of Qualifying Service Granted for Pension (CSR-468)
APSGG	Amount of Pension and Service Gratuity Granted (CSR-474)
ARPNE	Allowances Reckoned for Pension and Net Emoluments (CSR-486-489)
PPG	Payment of Pension and Gratuity (CSR-930-961)
APG	Amount of Pension Granted as per recommendation of U.P. Pay Commission (2016).
RDG	Retirement and Death Gratuity as per recommendation of U.P. Pay Commission (2016).
EFP	Eligibility for Family Pension as per CSR and recommendation of U.P. Pay Commission (2016).
NIFP	Nomination Issue for Family Pension
SAFP	Sanctioning Amount of Family Pension as per CSR, U.P. Compassionate Fund Rules, U.P. Retirement Benefits Rules, 1961 and recommendation of U.P. Pay Commission (2016).

V. EVALUATING THE RESULT AND INTERPRETATION OF MODELS

Fig.5: Model Accuracy Program

TensorFlow Decision Forests (TF-DF) is a framework for building and training decision forest models using TensorFlow. TF-DF provides a flexible and efficient way to build, train and evaluate decision forest models [17]. It provides an easy way to use high API for training decision forest models, which can be used for both classification and regression tasks. It uses following models to build, evaluate and interpret the trees.

(1) Random Forest Model
(2) Gradient Boost Model and Distributed Gradient Boost Model
(3) Cart Model

These models are specified with TensorFlow decision forest and Keras as:

model_RF = tfdf.keras.RandomForestModel()

model_GB = tfdf.keras.GradientBoostedTreesModel()

To find the accuracy of the models, split the dataset into training and testing dataset in 80/20

ratio and run the python program in Jupiter Notebook to get the following result.

According to given below table 2, the Gradient Boost Model (98%) is more accurate than Random Forest (97%) and CART (94%) models.

Table 2. Model Accuracy

Model Type	**Accuracy**	**INV_MEAN_MIN_DEPTH**	**NUM_AS_ROOT**	**NUM_NODES**	**SUM_SCORE**
Random Forest Model	0.9709	RCSR	APSGG	SAFP	APSGG
Gradient Boost Model	0.9826	PSDG	PPS	PPS	APSGG
Cart Model	0.9477	WHP	PPG	PPG	PPG

Out-of-bag (OOB) Evaluation

This evaluation is based on observations when some samples from original dataset is not included in any of the bootstrap samples used to train a particular tree. Out -of -bag evaluation in case of Random Forest model is about 99% and in Gradient Boost model it is 100%. Details of evaluation is given in Table 3 below.

Table 3. OBB Evaluation

Model Type	**Accuracy**	**Log loss**	**Number of trees**	**Total Number of Nodes**
Random Forest Model	0.988479	0.180347	300	5948
Gradient Boost Model	0.9981237	0.0593951	252	5376

Accuracy is defined as the number of correctly predicted records with respect to the number of out-of-bag samples

$$\text{Accuracy (out-of-bag)} = \frac{Number\ of\ correct\ classification}{Number\ of\ out-of-bag\ samples}$$

Logloss is important classification metric based on probability. It tells closeness of prediction probability

to the actual or true value.

If number of out-of-bag sample is n then

$$\text{Logloss} = \frac{1}{n}\sum_{n=1}^{n} \text{logloss}_i$$

$$\text{logloss}_i = -[y_i \ln p_i + (1- y_i) \ln (1- p_i)]$$

where i is given record, y is true value and p is the prediction probability.

A model with higher accuracy and lower Logloss is better.

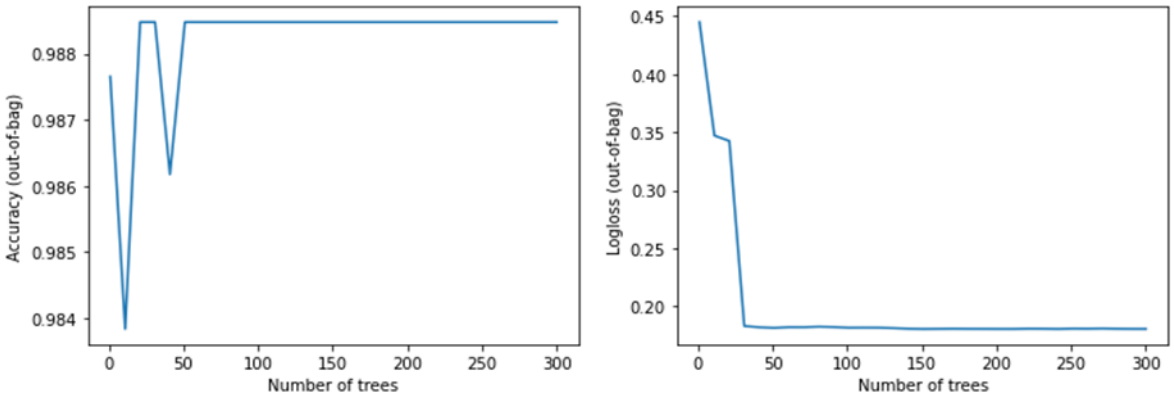


Fig. 6: Random Forest Model Accuracy and Logloss in (out-of-bag)

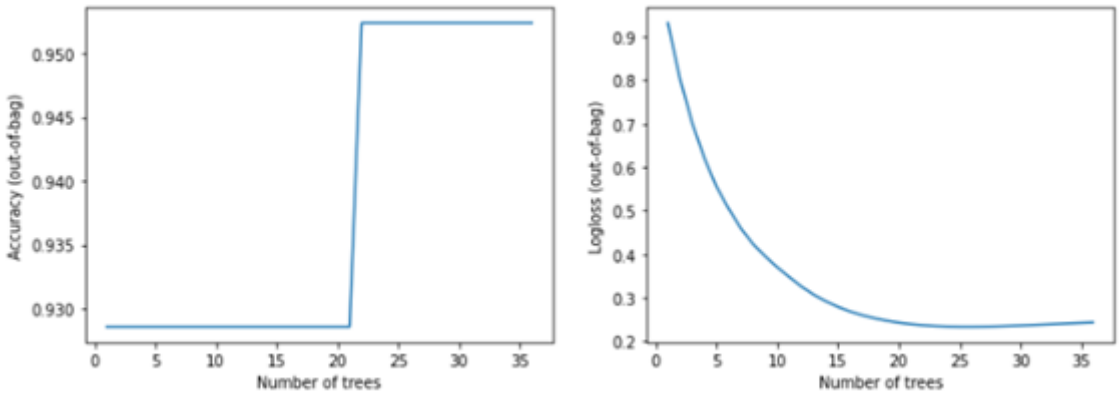


Fig.7: Gradient Boost Model Accuracy and Logloss in (out-of-bag)

Model Summary

The summary of statistical parameters in different models can be given in below tables.

Table 4. Number of Nodes

Number of nodes by tree

Model Type	Count	Average	Std Dev	Min	Max	Ignored
Random Forest Model	300	19.8267	5.46839	5	33	0
Gradient Boost Model	252	21.3333	4.27804	11	27	0
Cart Model	1	5	0	5	5	0

Table 5. Depth by Leaf

Model Type	Count	Average	Std Dev	Min	Max	Ignored
Random Forest Model	3124	4.51633	2.20929	1	11	0
Gradient Boost Model	2814	3.89765	1.05777	1	5	0
Cart Model	3	1.66667	0.471405	1	2	0

Table 6. Training observation by leaf

Number of training observation by leaf

Model Type	Count	Average	Std Dev	Min	Max	Ignored
Random Forest Model	3124	41.6773	55.5925	5	317	0
Gradient Boost Model	2814	35.0149	55.2928	5	310	0
Cart Model	2	195.5	87.5	106	283	0

Plotting Model

```
tfdf.model_plotter.plot_model_in_colab(model_RF, tree_idx=0, max_depth=7)
tfdf.model_plotter.plot_model_in_colab(model_GB, tree_idx=0, max_depth=7)
tfdf.model_plotter.plot_model_in_colab(model_CART, tree_idx=0, max_depth=7)
```

Fig.8: Plotting Model Program

When Random Forest Model is plotted in Colab the root node condition is evaluated 439 records. However, the training dataset contained 475 records. The remaining 36 records were used for validation. The first condition tests the feature value ‘PPG’ i.e., Payment of Pension and Gratuity (CSR-930-961).

Fig.9: Random Forest Model

When Gradient Boost Model is plotted in Colab the root node condition is evaluated 396 records. However, the training dataset contained 475 records. The remaining 79 records were used for validation. The first condition tests the feature value ‘APSGG’ i.e., Amount of Pension and Service Gratuity Granted (CSR-474).

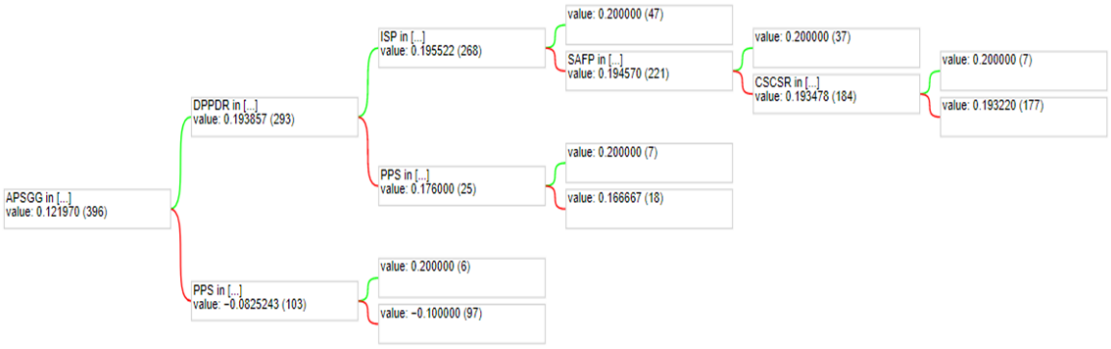


Fig.10: Gradient Boost Model

When Cart Boost Model is plotted in Colab the root node condition is evaluated 396 records. However, the training dataset contained 475 records. The remaining 79 records were used for validation. The first condition tests the feature value 'SAFP' i.e., Sanctioning Amount of Family Pension as per CSR.

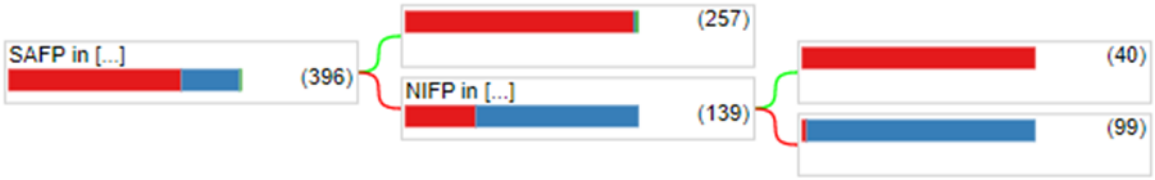


Fig. 11: Cart Model

VI. Experimental Results Analysis with TensorBoard

TensorBoard is a powerful tool for analyzing experimental results generated by TensorFlow models. Log files which are specified in 'log_dir' alias /temp/tensorboard_logs directory. These log files are generated in training process which are used in TensorBoard. These log files contain information about the model's performance during training, such as the loss and accuracy at each epoch.

```
%load_ext tensorboard
rm -fr "/temp/tensorboard_logs"
model_RF.make_inspector().export_to_tensorboard("/tmp/tensorboard_logs")
%tensorboard --logdir "/tmp/tensorboard_logs"
```

Fig.12: TensorBoard Display Program

When TensorBoard started the results of the models can be visualized in a dashboard with various tabs, including "Scalars", "Graphs", and "Histograms". Each tab provides different visualizations of the experimental results.

Scalars: Displays scalar values, such as loss and accuracy, over time.

Graphs: Displays the computational graph of the models.

Histograms: Displays the distribution of weights and biases in the models.

The scalar dashboard in TensorBoard displays the accuracy and loss tags which are commonly used to visualize the progress of a model during training. It helps to track the performance of the model over time. The Num_examples tag is used to track the number of examples processed during training. It is particularly useful when the training data is large and the model is being trained on small group of data samples. Overall, these tags help to optimize the performance of the model.

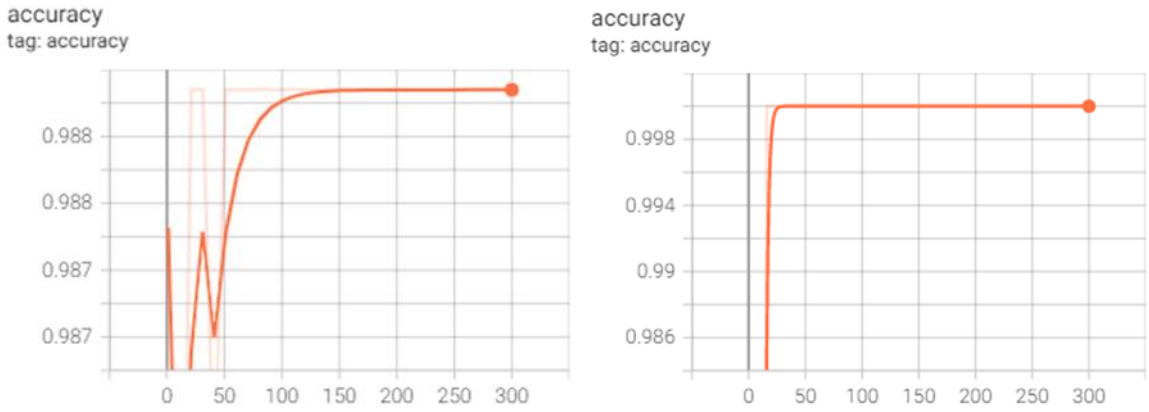
The visualization in TensorBoard scalar can be shown as below:

(i) Accuracy tag: accuracy

(ii) Loss tag: loss
(iii) Num_examples tag: num_examples

Accuracy tag: accuracy

This shows the trend of the accuracy over time, with the x-axis representing the training steps or epochs, and the y-axis representing the value of the accuracy. By looking the accuracy plot, performance of the model is visualized during training and also its improvement over time can be judged in a way better way.

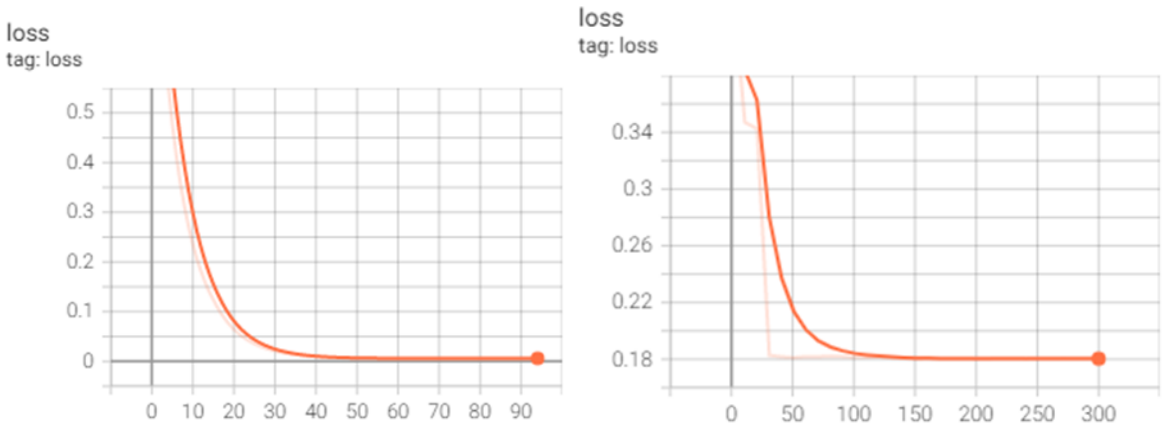


Random Forest Model Gradient Boost Model

Fig.13: Accuracy tag

Loss tag: loss

Model's loss is plotted using the loss tag during training. The x-axis represents the training steps or epochs, and the y-axis represents the loss's value. This plot depicts the loss's trend over time. Visualizing the loss plot it can be determined whether the model is converging toward a satisfactory solution and how well it is fitting the training data. This can assist to find out overfitting or underfitting the data, and thus helps to redesign the model to improve its performance.



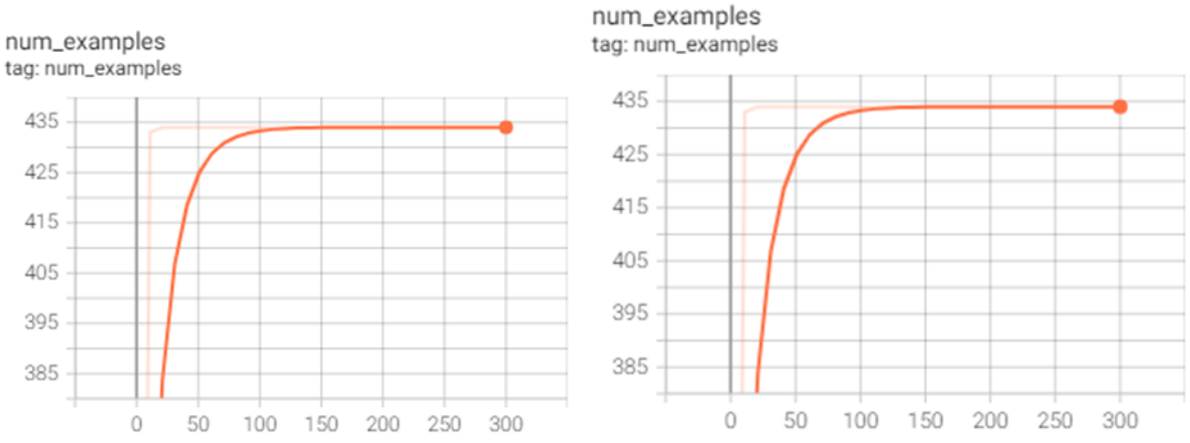
Random Forest Model Gradient Boost Model

Fig.14: Loss tag

Num_examples tag: num_examples

The Num_examples tag shows the total number of examples processed during training, with the x-axis representing the training steps or epochs, and the y-axis representing the number of examples. By visualizing this tag, you can see how many examples the model has processed at each step, and whether the model is processing the data efficiently. This can help you to adjust the batch size or other training parameters to optimize the training process.

The Num_examples tag displays the total number of examples processed during training. The x-axis represents the training steps or epochs and the y-axis represents the number of examples. By visualizing this tag, the number of examples the model is processing at each step and also processing the data efficiently. This can help to optimize the training process by determining the batch size adjustment and other training parameters.



Random Forest Model Gradient Boost Model

Fig. 15: Num_Examples tag

VII. Conclusion and Future Scope for Study

In proposed research study a model is designed with open source TensorFlow library. TensorFlow decision forest is used to classify and forecast service matter related litigations in retirement benefits cases like grant of pension on superannuation, family pension, commutation of pension, gratuity, group insurance saving fund, leave encashment and superannuation, provident fund etc. of employees of U.P. government. With TensorBoard tool test results and trend curves are visualized. TensorBoard verify the validity of the model also. As result we analyze and compare other models with specified dataset. The results are achieved as per objectives by the TF-DT with accuracy of more than 98%. TensorFlow is developed by Google brain team and supported by Google, which makes it a trusted and reliable tool for developing machine learning applications. Its ease of use, scalability, flexibility and adaptability make it better choice for building and deploying machine learning applications in a wide range of contexts.

The model can help the judges to classify and predict the orders and judgements. Using the key characteristics and legal considerations, the algorithm was used to forecast whether to "Allow" or "Dismiss" the case. The results of the performance metrics are excellent and demonstrate the importance of considered features and legal factors in the model. It also helps to shorten the time needed to collect information and resolve the issues. This can help experts in the legal and non-legal fields as well as law enforcement agents from various government agencies that file petitions in appropriate courts and tribunals.

There are numerous areas that could be improved upon by further research and study. The outcomes are based on predetermined characteristics and legal considerations in the cases, which might not be relevant in all situations. Features extraction and identification depend on the types of cases, legal statues and previous judgements. For all types of retirement benefits cases, there is no a single, universal solution. Sometimes decisions made by the Supreme Court and High Courts are not taken into account. By applying NLP techniques to the database and old judgment files of the higher/apex courts and other legal documents, the classification and predictions can be improved.

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Data Availability Statement: Data will be available on request.

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