# A REVIEW ON EXPLAINABLE ML-BASED APPROACH FOR SKILL BASED EMPLOYMENT PREDICTION

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**Abstract**

In modern era of Higher education, skill based education is very important for a student to get a better employment in IT industry. IT industry provides different types of employment opportunity for students based on their skill. Early prediction of the skill of a student will help them to provide a skill based training adequate for current needs of the IT industry. Skill based Employability Prediction is not enough for giving proper training for students. Therefore, to make a judgment on machine learning systems, prediction alone insufficient and explain ability also needed. The use of explainability Machine Learning (Explainable ML) model is to increase transparency. This survey shows different machine learning algorithms used in prediction and the importance of explainability in employability predictions. It also focuses how to build an Explainable ML model for skill based employment prediction of Computer Science Learners for future possible research.

**Keywords:** Employment; Higher Education, Skill based, Prediction; Explainable ML.

## I INTRODUCTION

The ability to obtain and keep meaningful work is referred to employability. Different category of IT jobs such as Software Developer, Database Administrator, Network Administrator, and Ethical Hacking are available for computer science learners. Early identification of their skills and prediction of their suitable jobs will help the students a lot. Early prediction helps the student to get enough time for improving their skills and prepare well to get the predicted job[1,2]. Individual are satisfied if they get suitable job and can make high performance in that field. The proposed system not only makes prediction but also explain the reasons of the prediction, it will give more convince about the prediction.

Explainability means the interpretation of predictions of machine learning models. It is used to make transparent models and also solves the black box problems.

## II RELATED WORKS

In 2019, the authors in [3] present a hybrid algorithm, HLVQ to predicted academic performance and employability chances of students. This system was implemented in three stages, first they calculated the student's academic performance then Adaboost algorithm was used to generate a weight vector based on the samples of training data. In the second stage, they use LVQ algorithm for classification and finally different algorithms are applied to the test data and then compute a new model. In HLVQ, the space complexity is O(μN2) and time complexity is O(mμN2).

In this paper [4], the authors examined critical attributes of computer learners using integrated supervised and unsupervised ML approaches. They examined different attributes of self-efficacy beliefs and the weekly progress in the class. They analyzed Naïve Bayes is the best model for predicting students' final performance.

In this research work [5], the authors predicted the employability of students using ML algorithms. They collected data from students of various Engineering colleges in Hyderabad and applied Decision Tree, Support Vector

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Machine, Naive Bayes and K-Nearest Neighbor algorithms predicted the employability of students. They analyzed Decision tree and Support Vector Machine algorithms were more accurate than the other two. They concluded the accuracy of Decision tree and Support Vector Machine algorithms for predicting the employability of students is 98%.

In this review paper [6], they analyzed the past and the current data mining developments in educational research. They discussed various studies in Educational Data Mining.

In this research paper [7], the researchers presented a new model of predicting student's employability using various machine learning approaches. They first collected data on the Job Training students and normalized the data and merged with different offices dataset. Decision tree, Random forest and support Vector Machine algorithms are used for this predicting student's employability. They concluded Support Vector Machine had the highest accuracy of 91.22%.

In this paper [8], the researchers predicted the student's career from their present graduation level using machine learning models. They used machine learning models like DT (Decision Tree) and RF (Random Forest) .The researchers collected data from various colleges and DT and RF algorithms are applied on the preprocessed data. After that they trained and tested the data with 16 various attributes like age, father and mother‘s education status, health condition, family economy level etc. then the researchers draw a correlation heat map. Then the preprocessed data can be classified by using decision tree and the next level DF classifier .The researchers concluded Random Forest classifier produced better result than the Decision Tree classifier.

In this paper [9], the researchers handled issues in imbalanced dataset. They used synthetic minority over sampling techniques (SMOTE) for finding the issues. They are used various algorithms with SMOTE such as Decision trees, Random Forest, Support Vector Machine, K-Nearest Neighbor and Logistic Regression to understand how students, get employed. The researchers concluded SVM is more accurate than others. The accuracy level is 91.22%.

In this paper [10], the researchers implemented a new system based on Desktop application to predict the student performance and placement of the students. This model used for Machine Learning algorithms like K- Nearest Neighbor, Support Vector Machine, and Naïve Bayes. They concluded that when the dataset size increases the performance of neural network increases.

In this article [11], the authors described numerous machine learning interpretability methods classified such as explaining difficult black box models, building white box models, promoting fairness and limiting prejudice, and measuring the sensitivity of model predictions.

## III METHODOLOGIES

### A. Educational Data Mining

Educational systems have specific type of data. Data mining technique can be applied data for understanding the system and students.

### B. Machine Learning

Machine learning is a data analysis technique that automates the development of analytical models. It uses past data as input to predict a new model. Machine learning algorithms[12] are mainly classified into three, which are supervised, unsupervised and reinforcement learning. Various ML methods are used for predicting employability.

### C. Deep Learning

Deep learning is a subset of artificial intelligence. Deep learning uses a neural network that makes use of complex

algorithms. Deep learning follows the structure of a human brain[13,14]. Deep Learning produces accurate result from large volume of data.

**D. Explainable Machine Learning**

Explainable ML or Explainable AI is the application of artificial intelligence technology. The output of Explainable ML algorithms can be understood by humans.

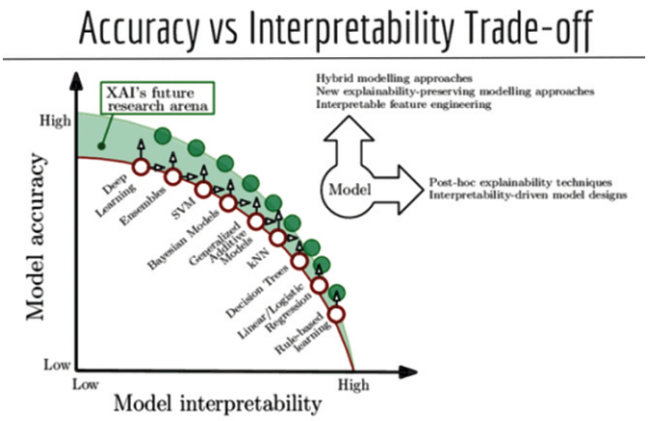


*Fig.1. Model Works Using Explainable AI*

**Source:** DPhi Advanced ML Bootcamp — Explainable AI

**E. Supervised Learning Algorithms in ML and Deep Learning**

**a) Decision Tree :**

Decision Tree is used for regression and classification problems. Decision Tree follows supervised learning approach. The Decision Tree uses a decision rule for forecasting a target from dataset. Fig.2 shows the pictorial representation of Decision Tree.

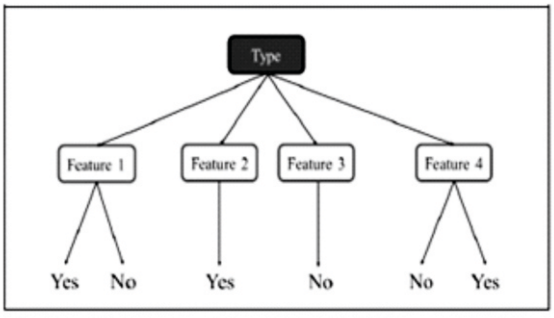


*Fig.2. Representation of Decision Tree*

**b) Random Forest :**

A random forest model is made by a number of decision trees. This model averages the forecast results made by the trees. This algorithm follows three random ideas. During the training process a random sample of the dataset is used by the basic tree for learning purpose. Fig.3 shows the pictorial representation of Random Forest.

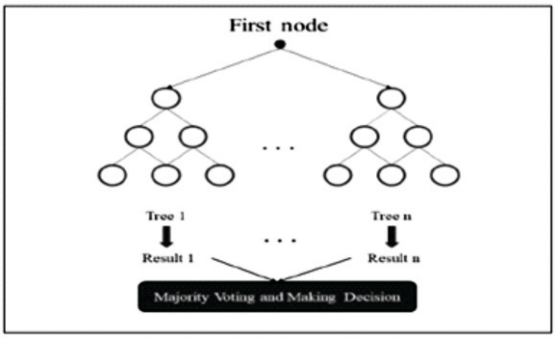


*Fig.3. Representaion of Random Forest*

**c) Ada Boost**

Boosting method is the process of converting slow learners to advanced learners. Adaboost is a form of boosting method that uses an ensemble model to improve learning process predictions. The fundamental purpose of boosting is to instruct slow learners in a systematic manner so that they can progress to advanced learners.

**d) Support Vector Machines**

The Support Vector Machine (SVM) is a combination of classification and regression supervised learning approach. This method is used to determine a decision boundary between two vector classes. Fig.4 shows the pictorial representation of Support Vector Machine.

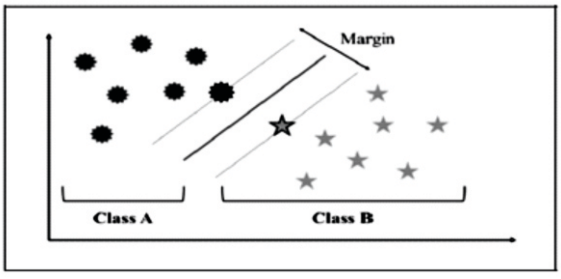


*Fig.4. Pictorial Representation of SVM*

**e) Naive Bayes**

Naive Bayes model is working in the basis of Bayes theorem with strong assumptions between every pair of features are given the value of the class variable. It is highly fast compared to other classifiers. This classifier contains set of supervised learning algorithms.

**f) K-Nearest Neighbors**

One of the most basic supervised learning algorithms is K-Nearest Neighbors (KNN). It can be used for both regression and classification; however, it is more commonly employed for classification. This technique saves all accessible data and categorizes a new dataset based on similarity. It has two characteristics: sluggish learning and non- parametric learning. When the training dataset is huge, it is more effective. Fig.5 shows the pictorial representation of KNN.

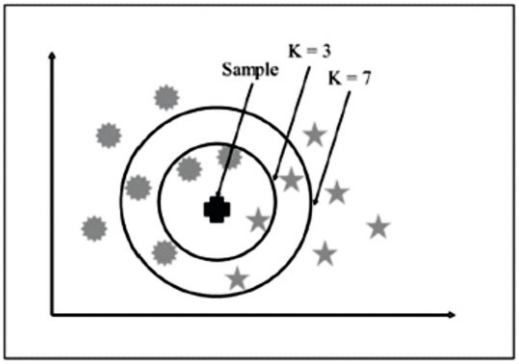


*Fig.5. Representation of KNN*

**g) Logistic Regression**

Logistic Regression uses sigmoid function to predict the target by using probability concept. Logistic regression add observation as a classifier to a separated class sets

**h) Artificial Neural Network**

Artificial Neural Networks (ANNs) are a popular subset of machine learning techniques that consist of single or multi-layer nets that are completely connected. Each node (in a layer) is linked to the rest of the layer's nodes (in the next layer). It can construct a deeper network by increasing the number of hidden layers. Fig.6 shows the pictorial representation of ANN.

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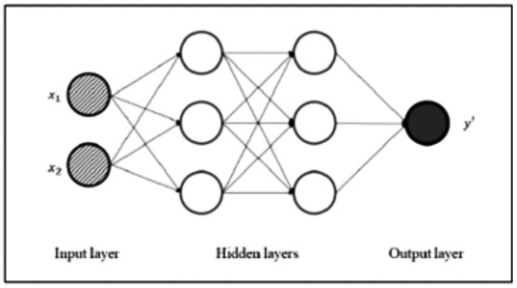


*Fig.6. Representation of ANN*

**i) Recurrent Neural Network**

Recurrent Neural Network (RNN) is a version of Artificial Neural Network. It is suited for processing time series data and other sequential data. In this method the output of the previous step is used to the input of the present step. The issues are solved by using the hidden layers. The main feature of RNN is hidden layers. RNN has a specific memory so that information can be remembered on time. Fig.7 shows the architecture of RNN.

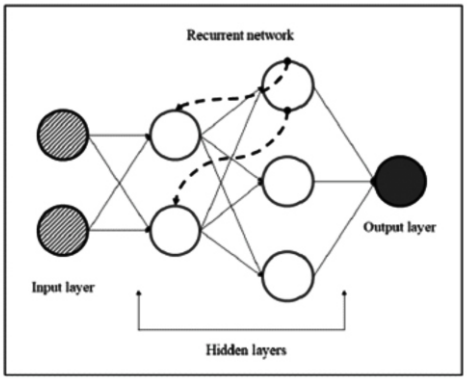


*Fig.7. Architecture of RNN*

**F. Interpretation Techniques**

**a) Local Interpretable Model-Agnostic Explanations (LIME)**

LIME is an interpretation tool to explain what machine learning models are doing. It can be used on tabular, text and image data. The output is a list of explanations that reflect the features of prediction and also determine which feature changes will have most impact on the prediction.

b) **Shapley Additive Explanations (SHAP)**

SHAP is a method for the interpretation of predictions of machine learning models through shapely values.

Fig.8. shows a ML Life-Cycle in Conjunction with Explainable ML.

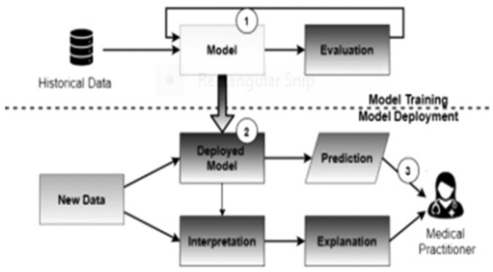


***Fig.8. ML Life-Cycle in Conjunction with Explainable ML***

## IV CONCLUSION

This paper is a review analysis of Educational Data Mining techniques and different ML models for prediction and interpretability techniques. Each study has been categorized as EDM techniques for finding skill set of students; ML algorithms for prediction of employability and learner's skill-set could be improved through making explanation.

The aim of this survey paper is to enlighten researchers on the understandability and interpretability of Explainable ML systems using a variety of techniques available which can be very advantageous in the field of Skill based employment prediction.

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