International Journal of Engineering & Technology, 7 (x) (2018) xxx-xxx

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET
doi:
Research paper, Short communication, Review, Technical paper

Student Career Prediction Using Advanced Machine Learning Techniques

K. Sripath Roy [1], K.Roopkanth [2*], V.Uday Teja [3], V.Bhavana[4], J.Priyanka [5]

[1] *Asst Professor, Department of Electronics and Communication Engineering, Koneru Lakshmaiah Education Foundation,Vaddeswaram, Guntur, Andhra Pradesh, India-522502*
[2,3,4,5] *Student, Department of Computer Science & Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India-522502*
**Corresponding author E-mail: kurraroopkanth@gmail.com*

Abstract

As students are going through their academics and pursuing their interested courses, it is very important for them to assess their capabilities and identify their interests so that they will get to know in which career area their interests and capabilities are going to put them in. This will help them in improving their performance and motivating their interests so that they will be directed towards their targeted career and get settled in that. Also recruiters while recruiting the candidates after assessing them in all different aspects, these kind of career recommender systems help them in deciding in which job role the candidate should be kept in based on his/her performance and other evaluations. This paper mainly concentrates on the career area prediction of computer science domain candidates.

Keywords: *Student Career Prediction, Decision Tree, Machine Learning, SVM, OneHot Encoder, XGBoost*

1. Introduction

Competition in today's society is heavily multiplying day by day. Especially it is too heavy in present day's technical world. So as to compete and reach the goal students need to be planned and organized from initial stages of their education. So it is very important to constantly evaluate their performance, identify their interests and evaluate how close they are to their goal and asses whether they are in the right path that directs towards their targeted. This helps them in improving themselves, motivating themselves to a better career path if their capabilities are not up to the mark to reach their goal and pre evaluate themselves before going to the career peek point.

Not only that recruiters while recruiting people into their companies evaluate candidates on different parameters and draw a final conclusion to select an employee or not and if selected, finds a best suited role and career area for him. There are many types of roles like Database administrator, Business Process Analyst, Developer, Testing Manager, Networks Manager, Data scientist and so on. All these roles require some prerequisite knowledge in them to be placed in them. So, recruiters analyze these skills, talents and interests and place the candidate in the right job role suited for them. These kind of prediction systems make their recruitment tasks very easy because as the inputs are given, recommendation is done based on inputs. Already these type of various career recommendation systems and job role recommendation, prediction systems are being used in various third party performance evaluation portals like Co-Cubes, AMCAT. They only take factors like technical abilities and psychometry of students into consideration. These portals asses the students technically and suggest the students and companies job roles suited on their performance. But here various factors including abilities of students in sports, academics and their hobbies, interests, competitions, skills and knowledge are also taken into consideration. Considering all the factors the total number of parameters that were taken into consideration as inputs are 36. And the final job roles are fixed to 15 in number. As the input parameters and final classes of output are large in number typical programming and normal algorithms cannot give the best possible output classification and prediction. So advanced machine learning algorithms like SVM, Random Forest decision tree, OneHot encoding, XG boost are used.

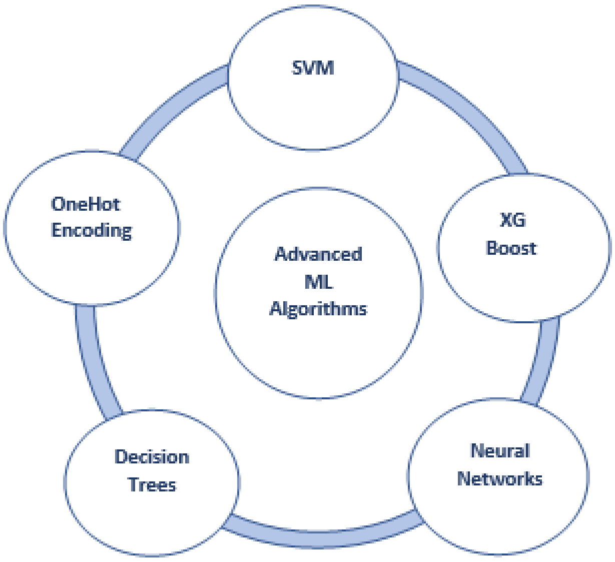


Figure 1: Overview of various Advanced Machine Learning Algorithms

Machine Learning is a technique where the machines are trained in such a way that it gains the ability to respond to a particular input or scenario based on the previous inputs it has learnt. Simply it the giving computers the ability to learn by using statistical techniques. Machine learning helps the computers to act without explicitly being programmed. This aims at reducing the human intervention in the machine dependable problems and scenarios. This helps in solving very complex tasks and problems very easily and without involving much human labor. Various applications of machine learning include NLP, classification, prediction, image recognition, medical diagnosis, algorithm building, self-driving cars and much more. In this paper classification and prediction are being done. Let us see what is classification and prediction. Majority of problems in machine learning can be solved using supervised and unsupervised learning. If the final class labels are previously know and all the other data items are to be assigned with one of the available class labels, then it is call supervised. And if the final output classes and sets are not known and it is done by identifying the similarity between data point and their characteristics and finally they are made into groups based on these characteristics then it is called unsupervised. Classification falls under supervised. Input parameters are given and based on their properties a predefined class label is assigned. There are other alternatives like clustering and regression. Based on the type of problem the apt model is chosen.

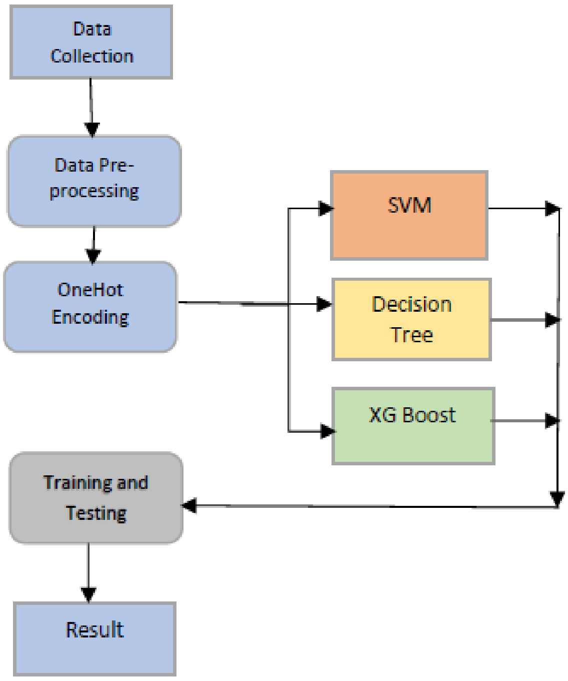


Figure 2: Process Flow Diagram of proposed system

However here algorithms like SVM, OneHot encoding, Decision tree and XG boost are used. After training and testing the data with these we take into consideration the most accurate results given algorithm for our further processing. So, initial task done is predicting the output using all algorithms proposed above and later analyzing the results and there on continued with the most accurate algorithm. So finally, this paper deals with various advanced machine learning algorithms that involves classification and prediction and are used to improve the accuracy for better prediction, reliability and analyzing these algorithms performance.

2. Implementation

2.1 Data Collection:

Collection of data is one of the major and most important tasks of any machine learning projects. Because the input we feed to the algorithms is data. So, the algorithms efficiency and accuracy depends upon the correctness and quality of data collected. So as the data same will be the output. For student career prediction many parameters are required like students academic scores in various subjects, specializations, programming and analytical capabilities, memory, personal details like relationship, interests, sports, competitions, hackathons, workshops, certifications, books interested and many more. As all these factors play vital role in deciding student's progress towards a career area, all these are taken into consideration. Data is collected in many ways. Some data is collected from employees working in different organizations, some amount of data is collected through LinkedIn api, some amount of data is randomly generated and other from college alumni database. Totally nearly 20 thousand records with 36 columns of data is collected.

2.2 Data Pre-processing:

Collecting the data is one task and making that data useful is another vital task. Data collected from various means will be in an unorganized format and there may be lot of null values, invalid data values and unwanted data. Cleaning all these data and replacing them with appropriate or approximate data and removing null and missing data and replacing them with some fixed alternate values are the basic steps in pre processing of data. Even data collected may contain completely garbage values. It may not be in exact format or way that is meant to be. All such cases must be verified and replaced with alternate values to make data meaning meaningful and useful for further processing. Data must be kept in a organized format.

2.3 OneHot Encoding:

OneHot Encoding is a technique by which categorial values present in the data collected are converted into numerical or other ordinal format so that they can be provided to machine learning algorithms and get better results of prediction. Simply OneHot encoding transforms categorial values into a form that best fits as input to feed to various machine learning algorithms. This algorithm works fine with almost all machine learning algorithms. Few algorithms like random forest handle categorical values very well. In such cases OneHot encoding is not required.

Process of OneHot encoding may seem difficult but most modern day machine learning algorithms take care of that. The process is easily explained here: For example in a data if there are values like yes and no., integer encoder assigns values to them like 1 and 0.This process can be followed as long as we continue the fixed values for yes as 1 and no as 0. As long as we assign or allocate these fixed numbers to these particular labels this is called as integer encoding. But here consistency is very important because if we invert the encoding later, we should get back the labels correctly from those integer values especially in the case of prediction. Next step is creating a vector for each integer value. Let us suppose this vector is binary and has a length of

2 for the two possible integer values. The 'yes' label encoded as 1 will then be represented with vector [1,1] where the zeroth index is given the value 1.Similarly 'no' label encoded as '0' will be represented like [0,0] which represents the first index is represented with value 0.

For example [pillow, rat, fight, rat] becomes [0,1,2,1]. This is here imparting an ordinal property to the variable , i.e. pillow < ret < fight. As this is ordinally characteristic and is usually not required and desired and so OneHot encoding is required for correct representation of distinct elements of a variable. It makes representation of categorial variables to be more expressive.

2.4 Machine Learning Algorithms

2.4.1 SVM:

SVM denotes Support Vector Machine. It is a supervised machine learning algorithm which is generally used for both regression and classification type of problems. The main applications of this can be found in various classification problems. The typical procedure of the algorithm is first each data item is plotted in a n-dimensional space, where n is the number of features and the value of each feature being the value of that particular coordinate. Next step is to classify by getting the hyper-plane that separates the two classes very finely.

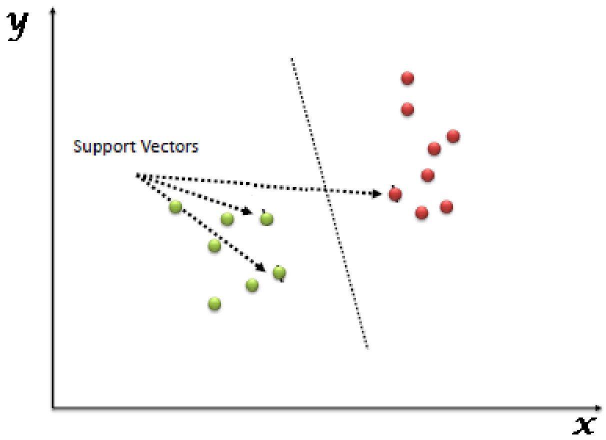


Figure 3: Support Vector Machines Example

SVM algorithms practically are implemented using kernels. There are three types of SVM's and in linear SVM hyperplane is calculated or found by transforming the problem using linear algebra. The insight is that SVM can be rephrased by using the inner product of two observations. The sum of the multiplication of each pair of inputs is called inner product of two vectors. The equation for dot product of a input x_i and support vector x_i is:

f(x) = B0 + sum(ai * (x,xi)).

Instead of using the dot-product, a polynomial kernel can be used, for example:

K(x,xi) = 1 + sum(x * xi)^d

And not only that a more complex radio kernel is also there. The general equation is:

K(x,xi) = exp(-gamma * sum((x – xi^2))

2.4.2 XG Boost:

XGBoost denotes eXtreme Gradient Boosting. XGBoost is implementation of gradient boosting algorithms. It is available in many forms like tool, library et cetera. It mainly focuses on model performance and computational time. It greatly reduces the time and greatly lifts the performance of the model. It's implementation has the features of scikit- learn and R implementations and also have a newly added features like regularization. Regularized gradient boosting means gradient boosting with both L1 and L2 type regularizations. The main best features that the implementation of the algorithm provides are: Automatic handling of missing values with sparse aware implementation, and it provides block structure to promote parallel construction of tree and continued training which supports further boost an already fitted model on the fresh data. Gradient boosting is a technique where new models are made that can predict the errors or remains of previous models and then added together to make the final prediction. they use gradient descendent algorithms to reduce loss during adding of new models. They support both classification and regression type of challenges. In the training part generally an objective function is defined. Define an objective function and try to optimize it.

obj=i=1 ∑l(yi,yi^(t))+ i=1 ∑ Ω(fi)

2.4.3 Decision Tree:

Decision Trees are extremely popular and one of the simple and easy to implement machine learning classification problems. Decision trees laid basic foundation for many advanced algorithms like bagging, gradient boosting and random forest. The XG Boost algorithm discussed above is the advanced version of this general decision tree. The commonly used decision trees are CART,C4.5,C5 and ID3.A node denotes a input variable (X) and a split on that variable, assuming the variable is numerical. The leaf which are also called the terminal nodes of the tree possess an output variable (y) which is vital for prediction.

The typical scenario that a decision tree follows is first selecting a root node. Calculate information gain or entropy for each of the nodes before the split. Select the node that has more information gain or less entropy. Further split the node and reiterate the process. The process is iterated until there is no possibility to split or the entropy is minimum. Entropy is the metric to measure uncertainty or randomness of data. Information gain is the metric that measures how much entropy is reduced before to after split.

$$H(S) = \sum_{x \in X} -p(x) \log_2 p(x)$$

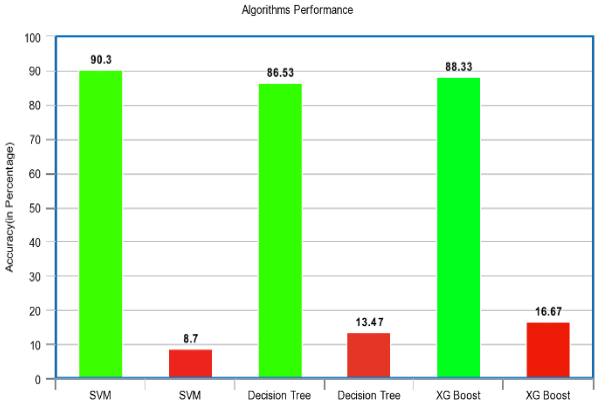
$$IG(A,S) = H(S) - \sum_{t \in T} p(t)H(t)$$

2.5 Training and Testing:

Finally after processing of data and training the very next task is obviously testing. This is where performance of the algorithm, quality of data, and required output all appears out. From the huge data set collected 80 percent of the data is utilized for training and 20 percent of the data is reserved for testing. Training as discussed before is the process of making the machine to learn and giving it the capability to make further predictions based on the training it took.Where as testing means already having a predefined data set with output also previously labelled and the model is tested whether it is working properly or not and is giving the right prediction or not. If maximum number of predictions are right then model will have a good accuracy percentage and is reliable to continue with otherwise better to change the model. Also further new set of inputs and the predictions made by the model will be keep on adding to the dataset which makes dataset more powerful and accurate.

2.6 Result:

The data is trained and tested with all three algorithms and out of all SVM gave more accuracy with 90.3 percent and then the XG Boost with 88.33 percent accuracy. As SVM gave the highest accuracy, all further data predictions are chosen to be followed with SVM. So, finally a web application is made to give the input parameters of the student and the final prediction is generated and displayed. The background algorithm being used is SVM and the new prediction are keep on adding to the dataset for further more accuracy.



🟩Correctly Predicted 🟥 Incorrectly Predicted

Figure 4: Final Output Graphs

2.7 Future Scope:

A more powerful web application can be developed where inputs are not given directly instead student parameters are taken by evaluating students through various evaluations and examining. Technical, analytical, logical, memory based, psychometry and general awareness, interests and skill based tests can be designed and parameters are collected through them so that results will be certainly accurate and the system will be more reliable to use.

References:

[1] P.KaviPriya, **"**A Review on Predicting Students' Academic Performance Earlier, Using Data Mining Techniques", International Journal of Advanced Research in Computer Science and Software Engineering

[2] Ali Daud, Naif Radi Aljohani, "Predicting Student Performance using Advanced Learning Analytics", 2017 International World Wide Web Conference Committee (IW3C2).

[3] Marium-E-Jannat,SaymaSultana,Munira Akther, "A Probabilistic Machine Learning Approach for Eligible Candidate Selection", International Journal of Computer Applications (0975 – 8887)Volume 144 – No.10, June 2016

[4] Sudheep Elayidom, Dr. Sumam Mary Idikkula, "Applying Data mining using Statistical Techniques for Career Selection", International Journal of Recent Trends in Engineering, Vol. 1, No. 1, May 2009.

[5] Dr. Mahendra Tiwari ,Manmohan Mishra, "Accuracy Estimation of Classification Algorithms with DEMP Model", International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 11, November 2013.

[6] Ms. Roshani Ade,Dr. P. R. Deshmukh, "An incremental ensemble of classifiers as a technique for prediction of student's career choice", 2014 First International Conference on Networks & Soft Computing

[7] Nikita Gorad ,Ishani Zalte, "Career Counselling Using Data Mining", International Journal of Innovative Research in Computer and Communication Engineering.

[8] Bo Guo , Rui Zhang, "Predicting Students Performance in Educational Data Mining",2015 International Symposium on Educational Technology

[9] Ali Daud , Naif Radi Aljohani , "Predicting Student Performance using Advanced Learning Analytics"

[10] Rutvija Pandya Jayati Pandya , "C5.0 Algorithm to Improved Decision Tree with Feature Selection and Reduced Error Pruning", International Journal of Computer Applications (0975 – 8887) Volume 117 – No. 16, May 2015.

[11] Comparative Analysis of Decision Tree Algorithms: ID3, C4.5 and Random Forest Shiju Sathyadevan and Remya R. Nair

[12] Yu Lou, Ran Ren, "A Machine Learning Approach for Future Career Planning"

[13] Gareth James ,Daniela Witten ,Trevor Hastie, "An Introduction to Statistical Learning with Applications in R"

[14] Anuj Karpatne, Gowtham Atluri, "Theory- Guided Data Science: A New Paradigm for Scientific Discovery from Data", IEEE transactions on knowledge and data engineering, vol.29, no. 10, october 2017.