IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-3, March 2019 E-ISSN: 2347-2693

Application of Machine Learning Algorithm for Predicting Students Skill

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DOI: https://doi.org/10.26438/ijcse/v7i3.286290 | Available online at: www.ijcseonline.org

Accepted: 15/Mar/2019, Published: 31/Mar/2019

Abstract: The accurate prediction of student cognitive skill is important, for improving student academic performance.In this paper, a model is proposed to predict the students' performance in an academic organization. A machine learning algorithm Naïve Bayes is used for prediction. Further, the importance of different cognitive factor is considered, in order to determine which of these are correlated with student performance. Result proves that Naïve Bayes algorithm provides more accuracy over other methods for comparison and prediction.

Keywords **–** Cognitive skills, Students' performance, Machine learning, Naïve Bayes.

I.INTRODUCTION

Cognitive science is the interdisciplinary, scientific study of the mind and its processes. It inspects the functions of cognition and deals with study of cognition in humans, animals, and machines. It incorporates various disciplines such as psychology, computer science, neuroscience, anthropology, linguistics and philosophy. Study deals with intelligence and behavior, it also focus on how nervous systems transform information[1]. The main objective of cognitive science is to recognize human cognition. The models of cognition can be *predictive*which means that how people react in different scenarios and *prescriptive* which means thatdescribing potentially ways in which the limitations might be overcome.

Cognitive processes is the process that involve knowledge, attention, memory, producing and understanding the language, problem solving and decision making. In cognitive complexity, the tasks can be assessed by analysing the number of entities that have to be related in a single representation.

The hypothesis ideas such as collecting the personal data, family background, academic details, extracurricular activities, activities while during studies etc., are the basic attributes for analyzing the performance skill for required person[2].

In our proposed method cognitive factors such as age, famsize, traveltime, studytime, schoolsup, famsup, famrel, freetime, Dalc, Walc and health are taken into account for prediction.The dataset is trained and tested using machine learning technique i.e., Naïve Bayes for more accurate prediction of cognitive skill.

Moreover, section II presents the related work. Methodology is explained in section III while the result and discussed in section IV. The paper is concluded in section V.

II. RELATED WORK

A. Cognition and Emotions

Machine Learning is actually originated from the theoretical studyof teaching dimensions of the optimal training set. The research formulated machine learning as a teacher and student where teacher is the encoder and student is the decoder.

The decoder will act according to the machine learning algorithm. This shows that machine learning algorithm depend on strategies we want to adopt. So the proposed research is to find association among emotions, age, gender and cognitive skills and then produce a machine learning algorithm for advance cognitive skills measurement of pilot, train as well as public transport driver.

The mental ability of a person is referred to as cognitive skill. Cognitive ability is a human brain functions through which he/she can process thoughts. For example, in a school/university class some students quickly pick as the teacher teaches while other can't pick quickly. Cognitive skills are the combination 163 of set of different brain processes. In [3], the authors attempted to define a reference model that is known as Layered Reference Model of the Brain (LRMB) that properly explains functional mechanism and cognitive processes (CPs) of human natural intelligence that are already defined by cognitive informatics, cognitive

science, psychology and neuro-philosophy. LRMB is an integrated model which perform modeling the brain and mind by including 37 different cognitive processes at six different layers as memory, perception, sensation, action, meta cognitive and higher cognitive layers.

In this paper Wange and his co-authors have focused on natural intelligence, fundamental cognitive processes and their methods which have been integrated in six different layers.

Emotion of a person can play a great role in influencing human perception as well as their behavior[4]. Emotion can influence human perception up to great extinct. To study human emotion we must concentrate over cognitive computing and human psychology.

Emotion processes of a human being canned answer the question that how human perceive their internal and external condition. In this research Yingxu Wang focused on a cognitive and computation model of emotions which provided a comprehensive survey report. As according to LRMB model the main cognitive processes at the perception layer are emotion, motivation and attitude. When we analyzethe perception layer of any individual then we willunderstand these are the basic phases during perception of a human being. When any individual interact with their environment then first of all perception layer are evaluated.
The future computer which is named as cognitive computer is referred to as perceptual engine because it will copy the natural intelligence of human being.

Emotions, motivation and attitude are also said to be natural intelligence because it can influence the cognitive functions and mental processes of a human being [5].

Emotions can greatly affect human cognitive skills and decision making by altering our process of perception, planning and attention. Emotions have been studied by multiple disciplines, i.e. neuroscience, psychology, human computer interaction, artificial intelligence, cognitive informatics and cognitive science. These contributions have led us to the effectively formulation of cognitive computation of emotions.

According to [6], [7] and [8] the performance of a person is significantly related to cognitive abilities. By analyzing the research of psychology and neuroscience, the researcher from computer science, cognitive informatics, and computational intelligence became interested in the development of a formal computational model of emotions which can further bring novelties in cognitive or social robots as well as artificial intelligence systems. In this approach, the author supposed that this model can further test and refilled the theories of psychology and neurosciences. The discipline of Autonomous Agents (AAs) has focused by exemplifying human-like behaviors in the autonomous agent systems.

Autonomous Agents have been used the mechanism thatare capable to simulate human-behaviors by applyingcognitive computation model of emotion (C2MEs).

B. Computation Models of Emotions

The study of emotions is necessary for humancomputer interaction as well as for cognitive robotsand artificial intelligent disciplines. It providesbasic information about the perception of any individualand their interaction with environment becausecognitive functions depend on perceptual, sensory andmotor resource of a human being [9]. Thestudy of different discipline as psychology,neuroscience and cognitive computing shows that avariety of theories are contributing to word explaininghuman perception and intelligence. In differenttheories are reviewed and studies from computationalperspective. The researcher compared different modelwhich have been constructed by using multiple theories.

C. Age Gender and Cognition

1. M. Tien and 1. P. Burnes [10] analyzed theperception of time by conducting experiment on 36subjects of different ages. They concluded that agehas a great relation with human perception, as theolder we get, the more we perceive the speed of time.

From the result of experiment, the researchersconcluded that human perception has 3 stages (18 to24, 25 to 35 and 36 to 62). They also showed thatexperimental and environmental factors can influencehuman perception. The endeavor of the research cancontribute in our ability to cope, life style and workproductivity. Another research analyzed human NonRapid

Researchconducted by A.-A. Samadani and Z. Moussavi [11] alsoperformed experiment which shows that the cognitiveabilities develop and change during all life cycle of ahuman being. The results show that children (7 to12 years) and old men where they are 65+ alwaysperformed similar during cognitive tasks.

There is a general perception that cognitiveabilities are affected inevitably due to aging andnothing can halt this decline. Some researchershowever do not agree with this claim completely. Theyargue that although certain abilities do show a declinewith increase, especially in later age, however someother skills remain stable [12] and this decline canbe slow down by some intervention.

Similarly event that have been stored over many years inpast as remote memory is mostly preserved with increasein age while new memory and tendency to remembercurrent things decrease with age specially with doingsimultaneously.

Although vocabulary and verbal abilitiesremain same in elder age but choice of proper words andnames in conversion get effected with age factors. Besideage other factors also affect these cognitive abilities, bothin positive and negative manner. Health conditions [13],moods and other emotions also contribute in the level ofthese skills.
Our research study not limited to age and emotionsbut also study the relationship between gender andcognitive skills. Y. Jing, S. Jing, C. Huajian, S.Chuangang, and L. Yan [14] conducted experiment ofcognitive processing and tested ninety oneparticipants which contain 53 female and 38 maleduring fine background sound conditions (countrymusic, jazz music, rock music, traffic noise, andsilence). The research shows that rock music havenegative impact over speed of the cognitive processing male participants while traffic noise havenegative effect over accuracy of male individuals.

This shows that men and women have differentweakness of distraction which further pays the way forthe statement that men can more easily influencedby irrelevant stimulus.

D. Algorithms to Analyze Dataset
In the proposed experiments, a dataset will be 165prepared to analyze the values of cognitive regardingemotions and age in both genders. This shows that wewill need classification algorithms which cansuccessfully analyze the dataset for future machinelearning algorithm. The future machine learning algorithm can be used to analyze and then predict themental abilities of a person in advance. According to A.Falahiazar[15] the top three classifier of offline scenarioare given bellow.
• SVM
• AdaBoost and Bagging
• AdaBoost Stacking and Bagging
The result of the experiments shows that for somesubject, if you want to obtain 70% results then youhave train the classifier on a test data. Some subjectsbecome failed to obtain the goal they cannot concentrateboth on the training data and online classification.

Association rule mining has two parts. One is saidto be antecedent and the other is consequent. When weselect any item set from the data set then it is said to beantecedent and then any related item set with theprevious one is consequent. The main function andpurpose of the association rule mining is to find thecorrelation between the item set sold frequently and itis helpful to reveal and implement marketingtechniques . The proposed research is to identifythe association among Emotions, age and gender thatinfluence human Cognitive Skills. In [16] According S. Nasehi Optimal EEG-based

Algorithm can be used to recognize the human emotionby using Gabor feature. In Sz. L. T6thl, D. Sztah61and K. Vicsi 1 tried to do research over emotionrecognition algorithm which can predict eight differenttypes of emotions as happy, sad, angry, surprised,disgusted, afraid, excited and neutrality. Duringresearch these emotions was reduced to four basicemotions as sad, surprise, disgust and excited.

III. PROPOSED WORK

A. Data preparation
Student related data were collected from the Students performance dataset from UCI machine learning repository.

B. Data selection and transformation
In this step only those fields were selected which wererequired for the training process. The student dataset for Math course and Portuguese language course are taken into consideration. The attribute selection is shown in thetable1.

Table 1: Student Performance Variable

Attribute	Description	Possible Value
age	student's age	numeric: from 15 to 22
famsize	family size	binary: "LE3" - less or equal to 3 or "GT3" - greater than 3
traveltime	home to school travel time	numeric: 1 - <15 min., 2 - 15 to 30 min., 3 - 30 min. to 1 hour, or 4 - >1 hour
studytime	weekly study time	numeric: 1 - <2 hours, 2 - 2 to 5 hours, 3 - 5 to 10 hours, or 4 - >10 hours
schoolsup	extra educational support	binary: yes or no
Famsup	family educational support	binary: yes or no
Famrel	quality of family relationships	numeric: from 1 - very bad to 5 – excellent
freetime	free time after school	numeric: from 1 - very low to 5 - very high
Dalc	workday alcohol consumption	numeric: from 1 - very low to 5 - very high
Walc	weekend alcohol consumption	numeric: from 1 - very low to 5 - very high
health	current health status	numeric: from 1 - very bad to 5 - very good

Step 1: Collect data from student performance data set in UCI repository.
Step 2: Calculate the probability of each attribute value.
Step 3: Apply the formulae

$$P(C \mid A) = \frac{P(A \mid C)P(C)}{P(A)}$$

The more general version of Bayes rule deals with the case where C is a class value, and the attributes are $A_1, A_2 ... A_n$.

$$P(C|A_1, A_2 ... A_n) = \frac{(\prod_{i=1}^{n} P(A_i \mid C))\, P(C)}{P(A_1, A_2 ... A_n)}$$

Step 4: Use the product rule to obtain a joint conditional probability for the attributes

Step 5: Use Bayes rule to derive conditional probabilities for the class variable. Once this has been done for all class values, output the class with the highest probability.

IV. EXPERIMENTAL RESULTS

The performance of the classifiers is assessed using the standard measures of accuracy, recall, precision and F1.

Accuracy - Accuracy is simply a ratio of correctly predicted observation to the total observations. For our model, we have got 0.983 which means our model is approx. 98% accurate.

$$Accuracy = \frac{\sum_{i=1}^{4}(TP_i)}{\sum_{i=1}^{4}(TP_i + FP_i + TN_i + FN_i)}$$

Precision - Precision is the ratio of correctly predicted positive observations to the total predicted positive observations. We have got 0.967 precision which is pretty good.

$$Precision = \frac{(TP_i)}{TP_i + \sum_{i=1}^{3}(FP_i)}$$

Recall (Sensitivity) - Recall is the ratio of correctly predicted positive observations to the all observations in actual class. We have got recall of 0.953 which is good for this model.

$$Recall = \frac{(TP_i)}{TP_i + \sum_{i=1}^{3}(FN_i)}$$

F1 score - F1 Score is the weighted average of Precision and Recall. In our case, F1 score is 0.945.

V. CONCLUSION AND FUTURE WORK

$$F1 = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$

In the current study, we presented a method to measure cognitive skills of student. A proposed model predicts the students' performance in an academic organization. A machine learning algorithm Naïve Bayes is used for prediction. Further, the importance of different cognitive factor is considered, in order to determine which of these are correlated with student performance. The results show that the proposed machine learning algorithm Naive Bayes method achieved 98% accuracy. In future, different machine leaning technique can be applied to find more accuracy.

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