Critical thinking enhancing predictive parameters in acquiring best results in academics for Higher Education Institutions (HEIs) in India: an computerized analytical modeling using WEKA

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Abstract— Critical thinking is the mentally thought procedure of effectively and skillfully conceptualizing, applying, dissecting, incorporating, and additionally assessing data assembled from, or produced by, perception, encounter, reflection, thinking, or correspondence, as a manual for conviction and activity. It doesn't involve aggregating data. This is a method of thinking - about any subject, substance, or issue - in which the mastermind enhances the nature of his or her thinking by skillfully assuming responsibility of the structures innate in thinking and forcing scholarly benchmarks upon them. An individual with a decent memory and who knows a great deal of realities isn't really great at it. A critical mastermind can derive results from what he/she knows, and he/she realizes how to make utilization of data to take care of issues, and to look for pertinent wellsprings of data to illuminate himself/herself. This might not be mistaken for being pugnacious or being critical of other individuals. Albeit critical thinking aptitudes can be utilized in uncovering deceptions and awful thinking, it can likewise assume an imperative job in helpful thinking and useful undertakings. Critical thinking can enable us to procure learning, enhance our speculations, and fortify contentions. It is independently directed, self-trained thinking which endeavors to reason at the most elevated amount of value in a honest manner. In this process the study undertake academic data for all years students ranging from 10th class to UG with a sample size of 200 students tested on 21 parameters. The WEKA is proposed to test the inputs on parameters namely naïve bayes, multilayer Perceptron, decision stump, LMT etc. The study infers that WEKA is a systematic modeling tool facilitating and enhancing the thought process for higher education institutes in India to acquire acquiring best results in academics and increase sustainability of institutions for a prolonged period.

Keywords- Critical Thinking, WEKA, Predictive Model, naïve bayes, multilayer Perceptron, decision stump, LMT

I. INTRODUCTION

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. Critical thinking can be seen as having two components:

1) A set of information and belief generating and processing skills, and
2) The habit, based on intellectual commitment, of using those skills to guide behavior.

Someone with critical thinking skills is able to do the following:
- understand the logical connections between ideas
- identify, construct and evaluate arguments
- detect inconsistencies and common mistakes in reasoning
- solve problems systematically
- identify the relevance and importance of ideas
- reflect on the justification of one's own beliefs and values.

Critical thinking can enable us to obtain learning, enhance our speculations, and reinforce contentions. Critical thinking of any sort is never all inclusive in any individual; everybody is liable to scenes of disorderly or unreasonable idea. Its quality is accordingly regularly a matter of degree and reliant on, in addition to other things, the quality and profundity of involvement in a given area of thinking or as for a specific class of inquiries [1]. Individuals who think critically reliably endeavor to live objectively, sensibly, empathically. They are distinctly mindful of the naturally imperfect nature of human thinking when left unchecked. They utilize the scholarly apparatuses that critical thinking offers – ideas and rules that empower them to break down, evaluate, and enhance thinking. They work industriously to build up the scholarly temperance of scholarly respectability, scholarly quietude, scholarly thoughtfulness, scholarly compassion, scholarly feeling of equity and trust in reason. They understand that regardless of how gifted they are as masterminds, they can generally enhance their thinking capacities and they will now and again fall prey to botches in thinking, human mindlessness, preferences, predispositions, mutilations, uncritically acknowledged social guidelines and taboos, personal circumstance, and personal stake. They endeavor to enhance the world in the manners in which they can and add to a progressively objective, socialized society [2]. In the meantime, they perceive the complexities regularly innate in doing as such. They abstain from thinking straightforwardly about confused issues and endeavor to fittingly think about the rights and needs of applicable others. They perceive the complexities in creating as scholars, and subscribe to long lasting practice toward personal development. A very much developed critical scholar:

- Brings up crucial issues and issues, planning them obviously and definitely;
- Gathers and surveys applicable data, utilizing unique plans to translate it viably arrives at all around contemplated Conclusions and arrangements, testing them against significant criteria and guidelines;

- Thinks liberally inside elective frameworks of thought, perceiving and evaluating, as need be, their suspicions, suggestions, and down to earth results;
- Communicates successfully with others in making sense of answers for complex issues.

Critical thinking is, to put it plainly, self-guided, self-taught, self-checked, and self-restorative thinking. It surmises consent to thorough benchmarks of brilliance and careful order of their utilization. It involves powerful correspondence and critical thinking capacities and a pledge to conquer our local egocentrism and sociocentrism. We can utilize critical thinking to upgrade work forms and enhance social foundations[31].

The accreditation body, endorsed by the MHRD and propelled by Honorable Minister of Human Resource Development traces a procedure to rank establishments the nation over. The approach draws from the general suggestions expansive comprehension touched base at by a Core Committee set up by MHRD, to recognize the wide parameters for positioning different colleges and organizations to acquire the best results in academic.

The higher education system in today's scenario is faced with many challenges like competitiveness, management, financing and reorientation of program by laying equal emphasis on quality of higher education, ethics and values together with the assessment of educational institutions and their accreditation. Higher education should be viewed as a long-term social investment for the promotion of social cohesion, cultural development, economic growth, equity and justice. Indian higher education system can address itself to the global challenges through maintaining the right balance between the need and the demand and channelizing teaching, research and extension activities[15]. It is thus required to bring quality of highest standards in every sphere of work. The needs and expectations of the society are changing at a fast pace and hence the quality of higher education needs to be enhanced at a commensurate level. Quality would depend on the quality of all the parameters and stakeholders, be it the students, faculty, staff, infrastructure etc.

Critical thinking can help us acquire knowledge, improve our theories, and strengthen arguments. Critical thinking of any kind is never universal in any individual; everyone is subject to episodes of undisciplined or irrational thought. Its quality is therefore typically a matter of degree and dependent on, among other things, the quality and depth of experience in a given domain of thinking or with respect to a particular class of questions. The development of critical thinking skills and dispositions is a life-long endeavor. So, critical thinking used to analyze convergent thinking skills in higher education and to enhance academic excellence through analysis of intellectual skills[14].

It is reliably estimated that educational institutions need to undergo innovations and up gradation in their existing working and infrastructural development. Educational institutions play a pivotal role in shaping a better tomorrow. Hence they should undergo quality assurance in imparting knowledge and developing a better tomorrow[16]. The above research indicates the ways and methods by which these educational institutions can make themselves competent to cater the demand of dynamic market.

The paper will focus on twenty one parameters at which the competency of institutions will be checked and evaluated in order to acquire the best results in academic by providing a cutting edge to the existing educational system in the HEIs[17].

Critical Thinking Ability shapes a vital piece of our fitness. There are numerous abilities that are required for an understudy to form into a productive person. For some focused tests, these aptitudes are utilized to discover the best competitors. These assume imperative job in anchoring seats in different government tests for employments and for getting seats in schools by selection tests[25]. These tests typically check the inclination of the candidate. Here is referenced goal:

To propose a few changes in advanced education segment in India through logical procedure of critical thinking.

II.   THE IMPORTANCE OF CRITICAL THINKING

Critical Thinking is a meta-thinking ability. It requires cautious reflection on the great standards of thinking, endeavoring to disguise them and applying them in every day life[26].

1.   Critical thinking is a space general thinking expertise: The capacity to think unmistakably and soundly is imperative whatever we do. On the off chance that work in training, inquire about, back, the executives or the legitimate calling, critical thinking is clearly essential. However, critical thinking abilities are not limited to a specific branch of knowledge. Having the capacity to think well and take care of issues deliberately is a benefit for any vocation.

2.   Critical thinking is imperative in the new learning economy: The worldwide information economy is driven by data and innovation. One must have the capacity to manage changes rapidly and successfully[30]. The new economy places expanding requests on adaptable scholarly aptitudes, and the capacity to dissect data and incorporate various wellsprings of learning in taking care of issues. Great critical thinking advances such thinking abilities, and is vital in the quick evolving working environment.

3.   Critical thinking upgrades dialect and introduction aptitudes: Thinking obviously and efficiently can enhance the manner in which we express our thoughts [3]. In figuring out how to break down the intelligent structure of writings, critical thinking likewise enhances appreciation capacities.

4.   Critical thinking advances inventiveness: To concoct an imaginative answer for an issue includes not simply having new thoughts. It should likewise be the situation that the new thoughts being created are helpful and important to the job needing to be done. Critical thinking assumes a significant job in assessing new thoughts, choosing the best ones and adjusting them if important

5.   Critical thinking is vital for self-reflection: In request to carry on with an important life and to structure our lives as needs be, we have to legitimize and consider our qualities and choices. Critical thinking gives the devices to this procedure of self-assessment[27].

6.   Good critical thinking is the establishment of science and popular government: Science requires the critical utilization of reason in experimentation and hypothesis affirmation. The best possible working of a liberal vote based system requires natives who can ponder social issues to advise their decisions about appropriate administration and to defeat inclinations and bias.

This prime scholarly and reasonable expertise is by all accounts something that dominant part of understudies coming into advanced education and the workforce are inadequate in application, as well as in idea. Frequently, Critical Thinking has been neglected at the basic, center, and secondary school levels where the essential spotlight is on repetition learning of ideas as opposed to able utilization of thoughts. At the point when these understudies make it to the dimension of advanced education or the corporate workforce, the instructors/coaches are constrained to start by showing the nuts and bolts of Critical Thinking rather than sharing complex data that require investigation [4]. Learning requires exertion, however Critical Thinking requires most extreme effort of scholarly limit. Subsequently, a significant part of the Critical Thinking idea remains not exclusively to be instructed however; in particular, to be relevantly used in our everyday lives. There are a couple of motivations to present Critical Thinking in Higher Education-Campus Curriculum[22]:

i.   Logical Thinking and Problem Solving is a benefit crosswise over vocations: Critical Thinking is an area skeptic expertise. Regardless of whether one works in the field of instruction, examine, fund, the executives or a legitimate calling, Critical Thinking is basic. Critical Thinking isn't disengaged however an original objective, the center point around which all other instructive fields merge. As understudies figure out how to think all the more critically, they turn out to be progressively capable at verifiable, logical, and scientific thinking. They create aptitudes, capacities and qualities critical for achievement in regular daily existence[12].

ii.   It is what is required in the present occasions – Today in the web time, access to perusing material isn't a benefit of those few enlisted in select establishments. Subsequently it is the manner to enquiry and capacity to think critically that is the genuine prerequisite of the present occasions.

iii.   CT upgrades dialect and introduction abilities: Thinking in an organized way can enhance the manner by which we express our thoughts. In figuring out how to investigate the intelligent structure of writings, Critical Thinking enhances cognizance capacities. It is the spirit of compelling correspondence[23].

iv.   Critical Thinking additionally advances imagination: Creative critical thinking commands the age of possible and applicable thoughts [5]. Critical Thinking assumes an essential job in assessing new thoughts, choosing the best ones and ad- libbing on them, as required. Innovativeness and Critical thinking go connected at the hip.

It's not 'what' to think rather 'how' to think. It incorporates the capacity to take part in free, intelligent thinking. A critical scholar ought to have the capacity to do the accompanying easily:

a.   Identify the significance and significance of thoughts
b.   Understand the sensible associations and set up linkages between thoughts
c.   Identify, develop and assess contentions
d.   Detect irregularities and basic oversights (paradoxes) in thinking
e.   Solve issues methodically
f.   Reflect on the exactness of one's own convictions and qualities

A Critical Thinker isn't neither a data hoarder who realizes how to use data astutely to tackle issues nor Critical of others. Albeit Critical Thinking abilities can be utilized in uncovering false notions/awful thinking, it encourages agreeable and helpful thinking[24].

III. METHODOLOGY

Here we have taken some significant parameters dependent on which the dataset has been made. Regions are NIRF positioning, Academic territory, Library, Infrastructure, Faculty, Graduate understudies, Placements, Examination. Here it has been referenced that Grade has been taken as class qualities[18].
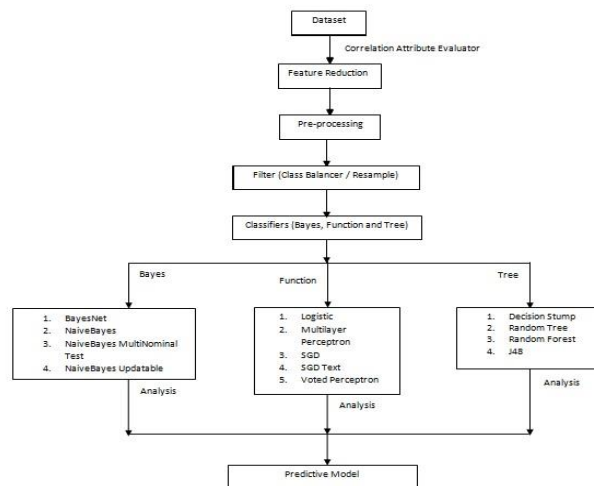
Fig1: Process flow of analysis

Class-Balancer: It re-loads cases in datasets with the goal that each class has a similar aggregate weight whose summation over all occasions will be kept up. Just the loads in the primary information clump gotten by this channel are changed, so it might be utilized with the Filtered Classifier. On the off chance that the class is numeric, it is defamed utilizing meet width discretization to build up pseudo classes for weighting [7].

Naïve Bayes classifier: This calculation is a probabilistic classifier. It depends on likelihood models that join solid autonomy suspicions. A Naive Bayes display comprises of a vast 3D square that incorporates the accompanying measurements:

a)   Input field name
b)   Input field an incentive for discrete fields, or information field esteem go for consistent fields. Persistent fields are isolated into discrete receptacles by the Naive Bayes calculation

c)   Target field esteem

This implies a Naive Bayes demonstrate records how frequently an objective field esteem seems together with an estimation of an information field[13].
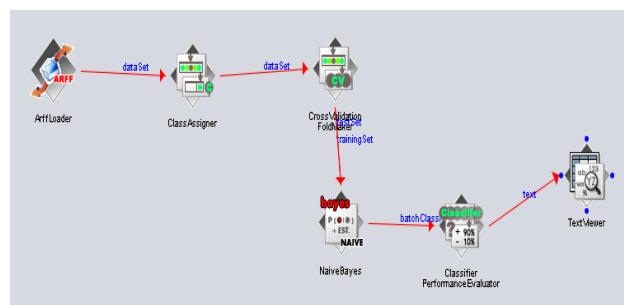

Fig 2 : Knowledge Flow for Bayes classifier

Function Classifier: Perceptron comprises of loads (counting inclination), the summation processor and actuation function. A perceptron takes a weighted total of sources of info and yields:

1 if the entirety > some customizable edge esteem (θ)
0 generally

$W_1X_1+W_2 X_2+...+W_nX_n> θ$ output will be 1
$W_1X_1+W_2 X_2+...+W_nX_n≤ θ$ output will be 0

The data sources and association loads are ordinarily genuine qualities. The information esteems are exhibited to the perceptron and if the anticipated yield is equivalent to the ideal yield, the execution is viewed as palatable and no progressions to the loads are made. In any case, on the off chance that the yield does not coordinate the ideal yield, the loads should be changed to lessen the blunders[19].

A multilayer perceptron has an equivalent structure of a solitary layer perceptron with at least one concealed layer.
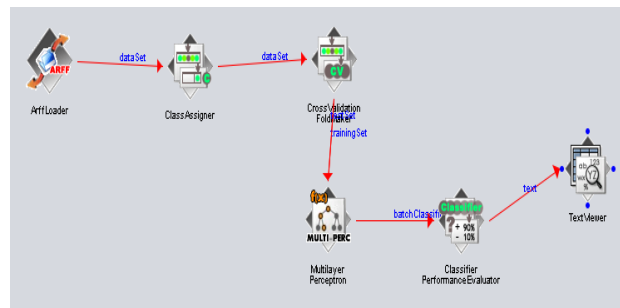

Fig 3: Knowledge Flow for Multilayer Perceptron

Tree Classifier: A decision stump is a machine learning model comprising of a one-level choice tree. That is, it is a choice tree with one inner hub (the root) which is promptly associated with the terminal hubs (its leaves). A choice stump makes an expectation dependent on the estimation of only a solitary information include[10]. Now and again they are likewise called 1-rules. For ostensible highlights, one may assemble a stump which contains a leaf for every conceivable component esteem or a stump with the two abandons, one of which relates to some picked class, and the other leaf to the various classifications [8]. For paired highlights these two plans are indistinguishable. A missing quality might be treated as a one more class. For constant highlights, normally, some limit include esteem is chosen, and the stump contains two leaves — for qualities beneath or more the edge. Be that as it may, once in a while, numerous limits might be picked and the stump consequently contains at least three leaves. Choice stumps are regularly utilized as parts (called "frail students" or "base students") in machine learning group systems, for example, stowing and boosting.
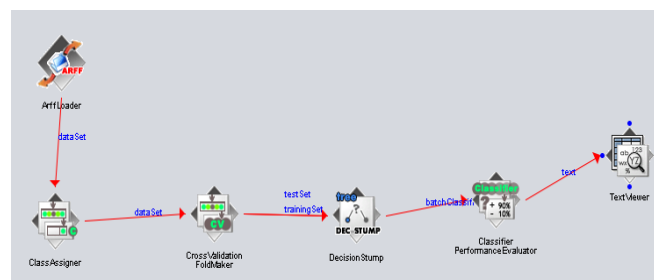

Fig 4: Knowledge Flow for Decision Stump

Resample:"Re-sampling" implies consolidating addition and destruction to change the rate of examining by a sound factor. It is generally done to interface two frameworks which have diverse testing rates. In the event that the proportion of two framework's rates happens to be a whole number, annihilation or introduction can be utilized to change the testing rate (contingent upon whether the rate is being diminished or expanded); something else, interjection and destruction must be utilized together to change the rate [9].

IV.   RESULTS AND ANALYSIS

Here, we have taken two outcomes: one is for class balancer and another is for re-test. At the point when class balancer is utilized around then, Bayesian, Function and Tree classifiers has been utilized appropriately. These are the outcomes for class balancer and resample dependent on academic data for all year students ranging from 10th class to UG datasets in like manner. Presently following table demonstrates the near examination of best precision given by the calculations in Bayes, Function and Tree classifiers[11].

Classifier	Accuracy (%)		Recall/sensitivity (%)		specificity (%)		Precision (%)	
	Class Balancer	Resample	Class Balancer	Resample	Class Balancer	Resample	Class Balancer	Resample
Naïve bayes	78.05	78.54	59.71	61.09	95.08	94.68	92.84	92.40
MULTILAYER PERCEPTRON	87.77	89.09	79.55	80.95	94.68	95.92	93.66	95.10
DECISION STUMP	93.18	94.49	94.17	94.99	90.88	92.68	90.85	92.51
LMT	90.78	92.75	89.57	93.45	90.68	90.74	90.33	90.68
Naïve bayes	60.45	75.01	86.28	84.95	31.92	64.06	55.57	70.23
MULTILAYER PERCEPTRON	77.91	77.36	87.55	71.01	83.00	83.00	81.32	81.20
DECISION STUMP	85.31	87.93	87.55	87.55	83.68	87.67	84.35	87.75
LMT	78.69	86.90	67.67	85.91	89.34	85.67	87.10	85.82
Naïve bayes	63.53	77.36	87.46	86.13	37.47	69.61	57.83	73.66
MULTILAYER PERCEPTRON	80.39	80.09	72.91	72.21	88.55	88.55	86.58	86.49
DECISION STUMP	89.69	91.06	88.73	88.73	89.23	93.22	88.95	92.68
LMT	81.36	89.36	68.87	87.09	94.89	91.22	93.40	90.65

Table1: Results against Classifiers for before UG

Classifier	Accuracy (%)		Recall/sensitivity (%)		specificity (%)		Precision (%)	
	Class Balancer	Resample	Class Balancer	Resample	Class Balancer	Resample	Class Balancer	Resample
Naïve bayes	69.78	79.59	91.30	90.02	43.56	63.37	63.92	72.99
MULTILAYER PERCEPTRON	85.05	92.03	84.00	91.00	90.10	97.03	89.46	96.81
DECISION STUMP	98.00	98.00	94.32	97.00	94.38	94.91	92.36	93.01
LMT	96.50	96.51	97.00	96.81	89.91	91.02	88.63	89.32
Naïve bayes	62.76	77.32	86.28	84.95	31.92	64.06	55.57	70.23
MULTILAYER PERCEPTRON	80.22	79.67	71.71	71.01	83.00	83.00	81.32	81.20
DECISION STUMP	87.62	90.24	87.55	87.55	83.68	87.67	84.35	87.75
LMT	81.00	89.21	67.67	85.91	89.34	85.67	87.10	85.82
Naïve bayes	65.50	79.33	87.46	86.13	37.47	69.61	57.83	73.66
MULTILAYER PERCEPTRON	82.36	82.06	72.91	72.21	88.55	88.55	86.58	86.49
DECISION STUMP	91.66	93.03	88.73	88.73	89.23	93.22	88.95	92.68
LMT	83.33	91.33	68.87	87.09	94.89	91.22	93.40	90.65

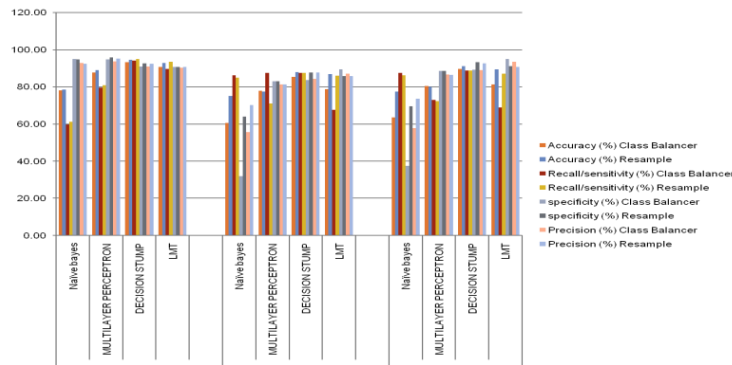Table2: Results against Classifiers for after UG

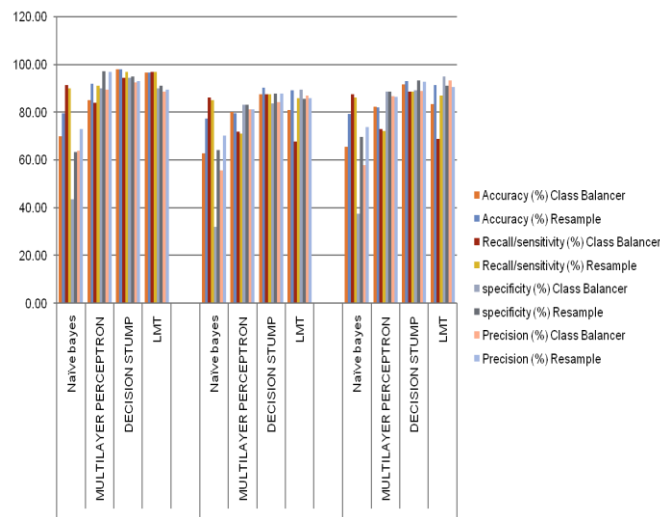Fig 5: Performance analysis based on Classifiers for before UG

Fig 6: Performance analysis based on Classifiers for after UG

V. CONCLUSION

At present there exist in excess of more students from various colleges in India. To render quality instruction, the colleges need to focus on enhancement their quality on standard premise to acquire best results in academics. For examination of this need of these organizations, the critical thinking process is required. The academic data for all years students ranging from 10th class to UG has been taken as a benchmark[20].

In light of classifiers, for example, Bayes, Function, Tree, a through scientific procedure of critical thinking was completed, for both administered occurrences channels like class-balancer and resample. Choice Stump order demonstrate was found to give better outcomes when contrasted with MultiLayer Perceptron and LMT[21]. Along these lines it is suggested that before applying for any accreditation/positioning, colleges may foresee their positioning/accreditation status utilizing this critical thinking based choice stump grouping expectation display.

The above near table infers that decision stump classifier gives preferred outcomes over others and every single credits conveys level with load to make the inner evaluation advantageous to gain better positioning in acquiring best results in academics for Organizations[28].

VI. LIMITATIONS OF WORK

In this work, to make a prescient model for evaluating nature of Higher Education Institutions (HEIs) in India through diagnostic procedure of critical thinking, add up to twenty one characteristics are utilized. Subsequent to applying connection quality choice calculation on given dataset, we get initial seven positioned characteristics. On those dataset of initial seven characteristics the two procedures have been connected and as result precision was diminishing. At that point we get initial ten positioned characteristics. On those dataset of initial ten characteristics the two systems have been connected and as result exactness was expanding than the consequence of initial seven diminished dataset yet diminishing from the aftereffect of unique dataset. Along these lines, the above said twenty one credits has rise to significance to make a prescient model for evaluating nature of Higher Education Institutions (HEIs) in India through diagnostic procedure of critical thinking.

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