International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 9
September 2017

Indexing Student Performance with Fuzzy Logics Evaluation in Engineering Education

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Abstract:

Indian engineering education sector is bounded with a typical competitive environment. Some of the reasons for this competition are emerging technologies & open sources, Increase in business requirements, Economic growth of the country, social & environmental impacts on living standards, etc. In this situation, Industry & society is expecting engineering graduates with good vision, problem solving skills, personality development, ethical behaviour, etc. Hence, the responsibility of the higher education institutions has increased to meet the day-to-day challenges in this competitive environment. This paper focused on the performance analysis of emerging engineers during the course by using Fuzzy Logics evaluation methods. A Fuzzy Logics Inference System(FLIS) is developed with the selected attributes of student performance by using MATLAB software. The results of the model are indexed with simulation process to use as continuous evaluation method in student progression. The indexing process is applicable with any other selected attributes for any institution to adopt and implement.

Key words: Engineering Education, Competition, Student Evaluation, Fuzzy Logics, MATLAB

1. Introduction:

Rapid and drastic changes in economic growth are creating higher demands for technical educations especially in engineering educations. Engineering education faces significant challenges as it seeks to meet the demands on engineering profession in the 21st century as unemployment, research work and social aspects. Engineering is an art of specifying application of scientific, economic, social, practical knowledge in order to invent, design, build, maintain, research and improve structures, devices, machines, material and processes. According to Duderstadt, James J.(2007), the changing technologies needs of a global knowledge economy which challenges the nature of the engineering practices, demanding for broadcast skills than simply the mastery of scientific and disciplines[1]. As a result, curricula are often obsolete; the skills taught are usually not matched with the demand or local needs[2]. The students are naturally drawn in the learning process related to the aspect of personality development over & above technical skills[3]. The requirements of 21st century engineering is considerable & continuously revolving around engineering students. Being an engineering student, it is often observed that, engineering education is perceived as a job or business opportunity rather than the strongest interest among research, technology and its study. However, to fulfil these requirements, an engineering student must be technically competent, globally sophisticated, culturally aware, innovative & entrepreneurial.

2. Management Approaches in Engineering Institutions:

From Management perspective, institutions have to view the engineering profession as a service to humanity and their role is to help students to become responsible & effective members of society[4]. The nature of knowledge creation is changing, not only in India but Internationality[5]. Education in India is seen as one of the

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ISSN 2394 – 3386
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ways to upward social mobility. Good education is seen as a stepping stone to a high-flying career. There has in fact been considerable improvement in the higher education scenario of India in both quantitative and qualitative terms. In this regards the institutions who are striving for excellence are observing the minute differences between course structure and graduate quality with outcome based education system and practices. In line with outcome based education with well defined course/program objectives are evaluating with outcomes with qualitative and quantitative techniques. Technology become high supporter in assessing the student performance. The scenario has been changing from point evaluation to arc evaluation methodology. Now CGPA system is widely using to assess and rank the student instead of percentage(%) system. The reason for this change is to reduce pressure among students on ranking criteria with a particular quantity of measurements. And institutions are considering many other aspects along with subject knowledge through exams which are brainstorming students' capabilities. Self-learning activities, reading & writing sills, communication and soft skills, Project analysis and development skills interests on extra-curricular & co-curricular activities, etc. are becoming important qualitative measures to evaluate the graduates at UG level. In this scenario Institutions are adapting suitable management approaches like Policy & Strategies approaches, ERP systems, Total Quality Management(TQM) measures on Operations, etc. to make graduates with overall personality development with skills and responsible.

3. Role of Fuzzy Logics in evaluating Students Performance:

Fuzzy logic theory was introduced by L.A. Zadeh in 1965 (Zadeh, 1965). Fuzzy logic comes in when conventional logic fails. It is a computational paradigm which is based on human thinking. An important concept in fuzzy logic is the application of linguistic variables i.e. variables whose values are words or sentences in natural language (Zadeh, 1975). One of the famous applications of fuzzy logic and fuzzy set theory is Fuzzy inference system (FIS) (Guillaume, 2001). FIS are knowledge-based or rule-based systems that contain descriptive if-then rules created from human knowledge and experience (Kharola and Gupta, 2014). (Wang et al. 2014) developed an adaptive item selection strategy mechanism to choose the student's current estimated ability. Their mechanism shows how student and teachers uses some useful information to assist in their future teaching and guidance. The proposed system applies fuzzification, fuzzy inference and defuzzification while considering the difficulty, importance and complexity of question as shown in below fiture:1.

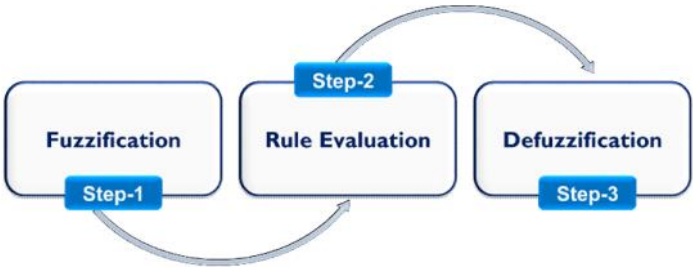

Figure:1 Fuzzification Evaluation levels

In this paper, a new methodological approach using fuzzy logic reasoning has been proposed for performance evaluation of students. This study considers academic as well as personality traits of students for better evaluation of their performances. The attributes considered for overall Performance evaluation of students were attendance, Self-learning ability, exam performance, Lab performance, Project skills, Innovation abilities to reach Academic Excellence. Communication & presentation skills, entrepreneurship ability, Attitude, ECA/CCA, Social responsibility to reach personality development. Finally, academic excellence and personality development leads to All-round performance of the student. The relationship between the selected attributes shown in the below table:

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The membership functions (MF's) considered for the analysis were of triangular shape (Nakamura and Kehtarnavaz, 1995). A view of input Membership Functions for input attributes attendance and Exam percentage are shown in figure 1.3 and figure 1.4 respectively.

Sl. No.	Input	Level:1 Output	Level:2 Output	Final Output
1	Attendance	Knowledge	**Academic Performance**	**Overall Performance**
2	Self-learning			
3	Exam Performance	Intelligence		
4	Lab Performance			
5	Project Skills	Entrepreneurial ability	**Personality Development**	
6	Presentation skills			
7	ECA/CCA	Social Responsibility		
8	Behavioural attitude			
Input Membership Functions		***Poor***	***Average***	***Good***
Output Membership Functions		***Low***	***Medium***	***High***

Table:1- Selection of Input-output variables and membership functions

4. Process of Fuzzy Evaluation with the selected attrubutes:

A Mamdani type FIS has been used for building the proposed model (Kaur and Kaur, 2012). A view of FIS for knowledge controller is shown in figure 1.2. In this study each of the input and output attribute is fuzzified with three linguistic variables Poor, Average, Good and given a universe of discourse of 0-10. The process is being followed the below step-by-step process to evaluate and index the performance.

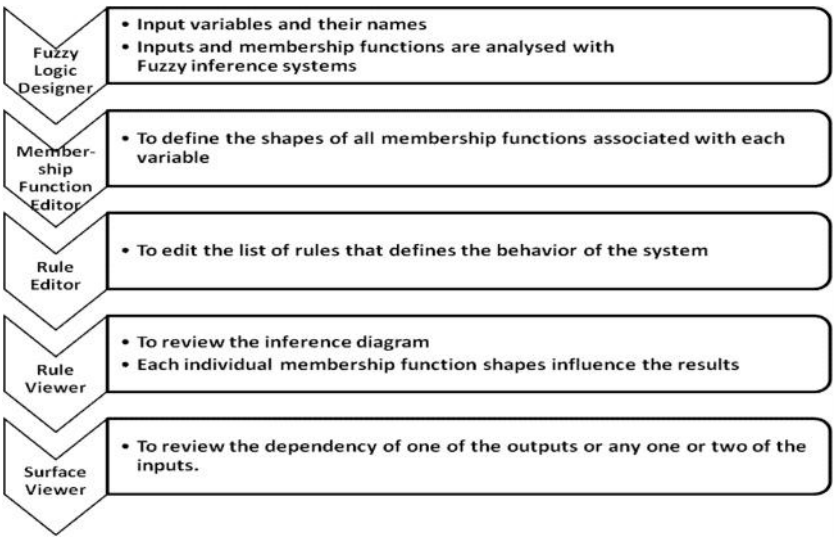

Figure:2 Fuzzy Logics process evaluation steps

The following Example diagrams are of Fuzzy Inference System(FIS) editor with one set of input and output functions on 0-10 scale created in MATLAB.

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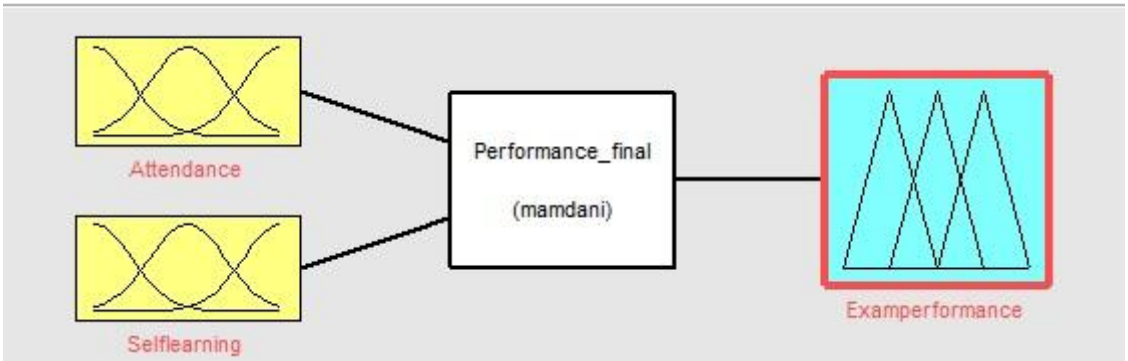

Figure-3: Selection of Input-Output parameters from FIS Editor MATLAB

According to the above figure:3, one set of attributes are created i.e. Attendance and Self-learning are inserted as inputs and Exam performance selected as output.

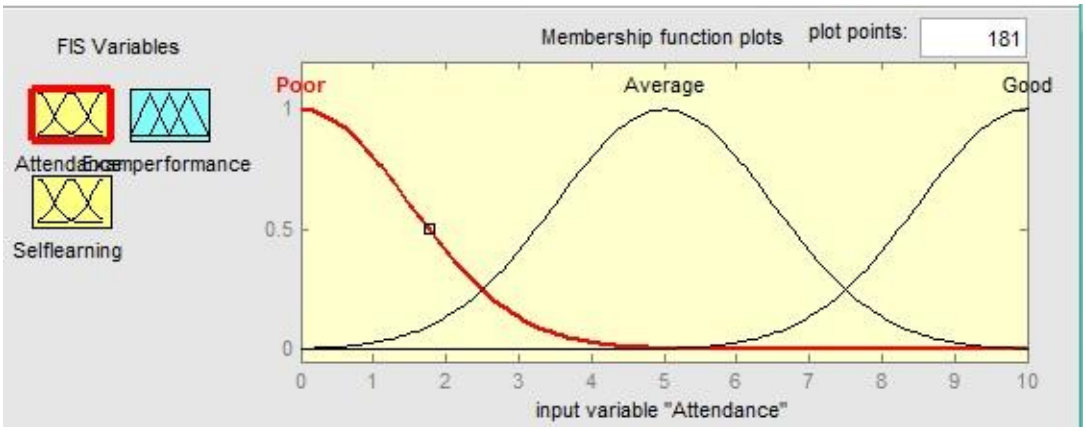

Figure 4: Membership functions for Inputs on 0-10 scaling

Here, to measure each input 0-10 scaling has given to the inputs in range column and selected three ***'gaussmf'*** type of membership curves named as '***Poor', 'Average'*** and ***'Good'*** with the parameters of ***'1.5:0', '1.5:1'*** and ***'1.5:10'*** respectively. In result, three non-linear curves formed and fit into the scale of 0-10 with the probability of 0-1 as shown in the figure.4 in MATLAB FIS editor.

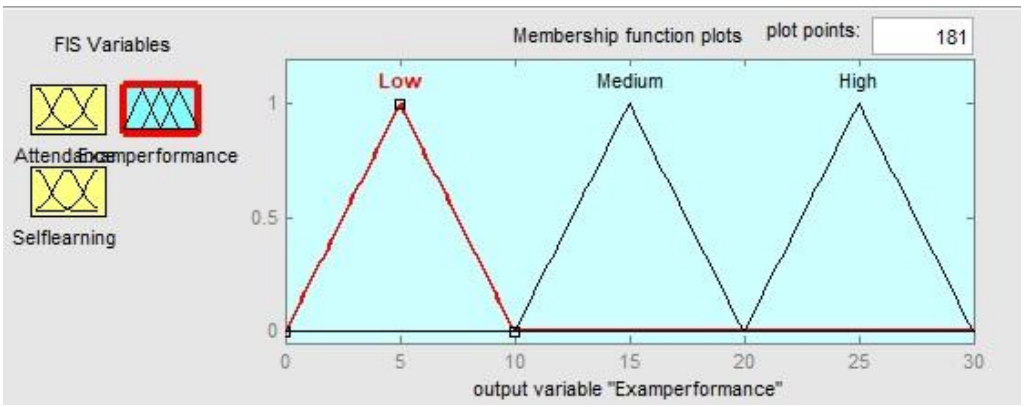

Figure 5: Membership functions for Output on 0-30 scaling

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ISSN 2394 – 3386
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Similarly, the membership functions have given to the ***output*** in 0-30 scaling in range column and selected three ***'trimf'*** type of membership curves named as ***'Low', 'Medium'*** and ***'High'*** with the parameters of ***'0:5:10', '10:15:20',*** and ***'20:25:30'*** respectively. In result, three linear curves formed and fit into the scale of 0-30 with the probability of 0-1 as shown in the figure:5 in MATLAB FIS editor.

Rules framing: To check the level of performance with input-output parameters, the 3x3 rules set has framed in order to create rules as shown in figure:7.

		INPUT-1		
		Poor	Average	Good
INPUT-2	Poor	**Low**	**Low**	**Average**
	Average	**Low**	**Average**	**High**
	Good	**Average**	**High**	**High**
		OUTPUT		

Figure:7 Rules set with 3x3 matrix

The FIS editor provides the selection of rules set from the given data in connection box with 'OR' & 'AND' syntaxes. The two input windows and one output window provides along with membership functions to select the rules. The rules set shown in the figure:8 have framed as 9 rules accordingly.

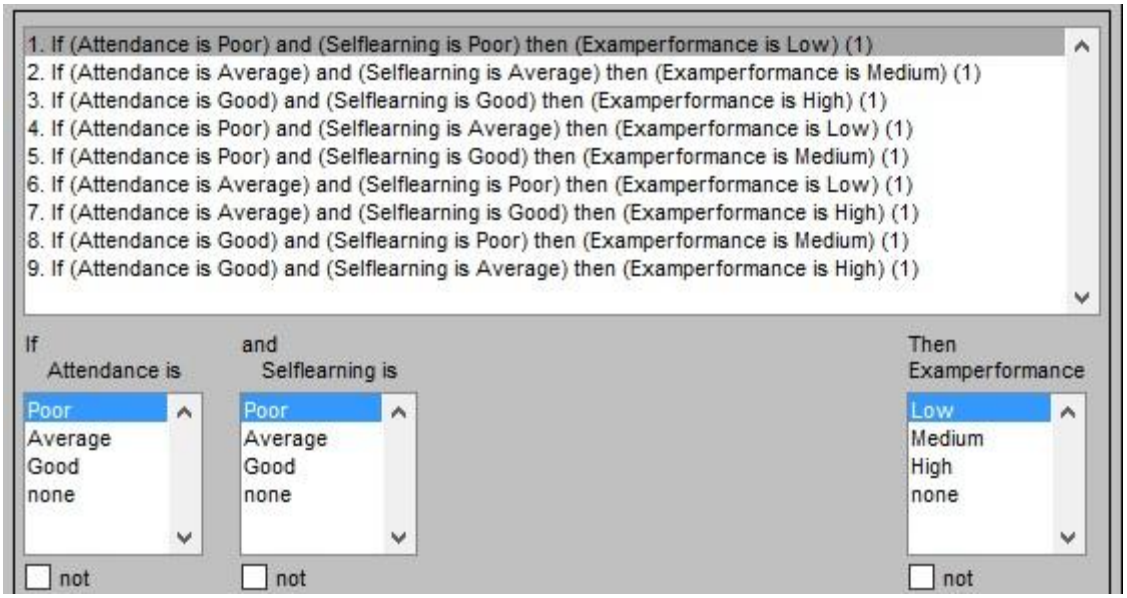

Figure 8: Rules for fuzzification as per 3x3 rule for indexing

Rule viewer with mapping: The results can be test in 'Rule viewer form' and 'Surface viewer form' as shown in the figure:9&10. The different dimension of 3D surface diagram is shown in the figure:10.

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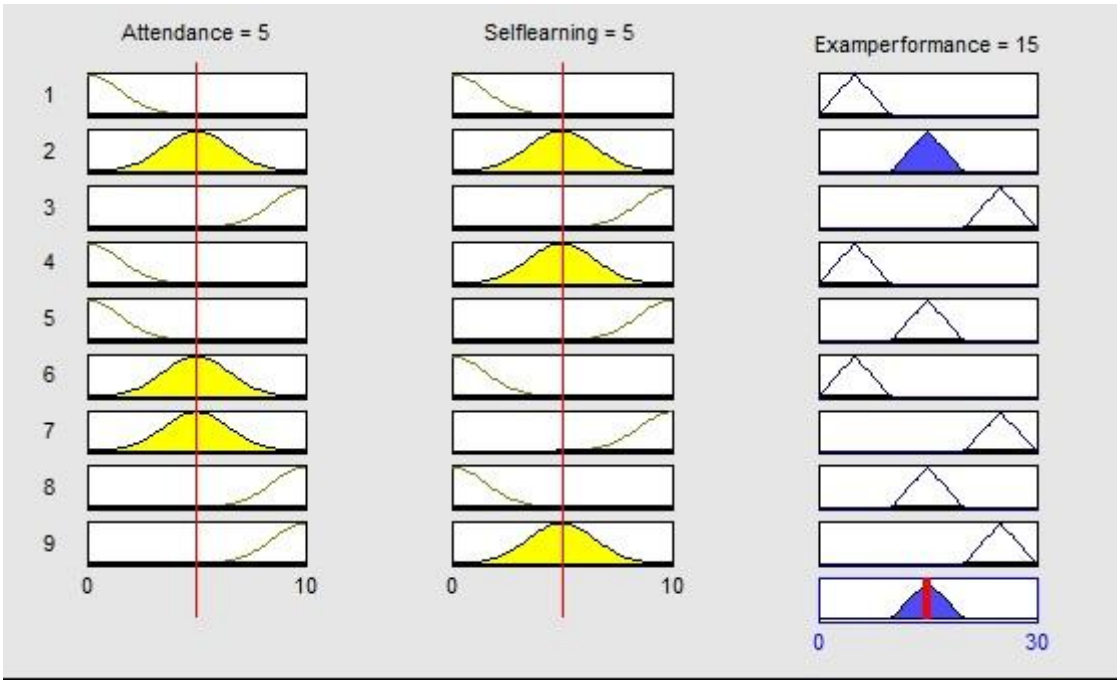

Figure 4.9: Rule viewer with scaling combinations

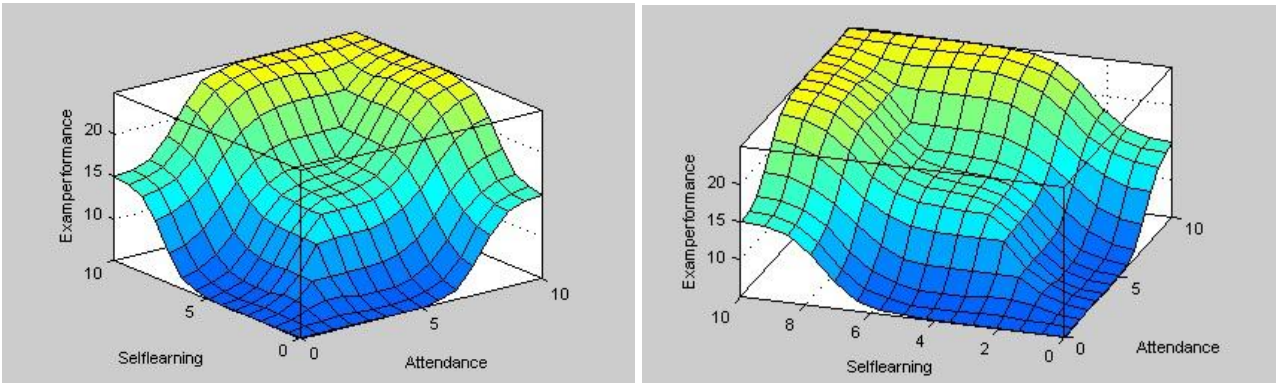

Figure 4.10: Surface diagram multidimensional 3D view

5. Simulation and results:

With the of Rule Viewer and Surface Viewer, Simulation process has done to check the fuzzy values of ultimate output i.e. overall performance. Simulink developed by MathWorks, as a graphical programming environment for modeling, simulating and analyzing multi-domain dynamic systems. Vega Group PLC. retrieved Simulink® on 01-11-2011 which is a block diagram environment for multi-domain simulation and Model-Based Design. The following figure shows the building of relationship with simulinks and values after mapping in the figure.11 followed by table:2

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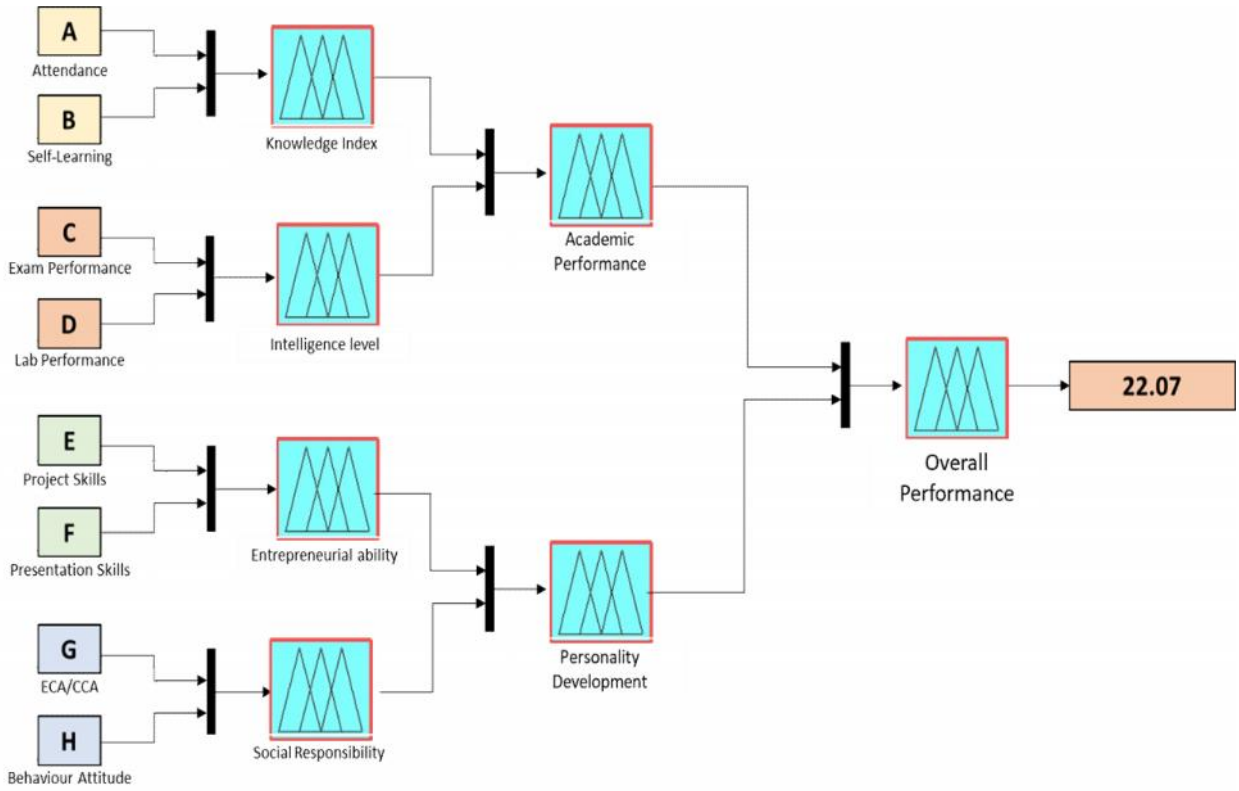

Figure-11: Simulink Block diagram with input-output links

The alphabetic symbol was allocated to each input parameter as mentioned in the above block diagram is mentioned in table:2. The rating of each attribute was done out of 30

S. No.	Input Parameter	Symbol
1	Attendance	A
2	Self-Learning	B
3	Exam Performance	C
4	Lab performance	D
5	Project skills	E
6	Presentation Skills	F
7	ECA/CCA	G
8	Behavioural attitude	H

The simulation results of fuzzy inference system compared with a traditional average method and the results shown in the table:3. To conducts the experiment the 20 students were selected from fourth year engineering course of seven branches, i.e. civil engineering, electrical engineering, mechanical engineering, electronics and communication engineering, computer science, information technology, & automobile engineering from VNR Vignana Jyothi Institute of Engineering & Technology, Hyderabad. A total of 20 sample experiments were conducted considered different value of output parameters.

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Students	Output Parameters				Avg. Value in %	Fuzzy Value
	KI*	IL*	EA*	SR*		
1	12	28	29	29	25	29.01
2	28	23	27	26	26	25.62
3	24	22	26	28	25	22.86
4	29	27	28	24	27	28.21
5	28	28	28	28	28	25.64
6	28	25	26	25	26	24.12
7	15	27	28	26	24	23.26
8	19	18	15	20	18	16.45
9	24	27	27	26	26	25.22
10	28	11	28	29	24	21.25
11	10	24	20	22	19	16.93
12	29	28	27	28	28	26.65
13	28	26	26	24	26	25.11
14	16	27	27	26	24	20.05
15	29	29	10	12	20	16.95
16	24	27	26	27	26	24.86
17	18	12	29	29	22	19.87
18	14	25	19	22	20	17.64
19	25	18	27	26	24	22.93
20	24	18	19	27	22	20.25
*KI=Knowledge Index; IL=Intelligence level; EA=Entrepreneurial abilities; SR=Social Responsibility						

Table-2: Sample evaluation with simulation results and average method

6. Conclusion:

The results clearly shown the advantage of weightage allocation of fuzzy values and observed that the results of fuzzy approach were close to the results obtained by average method for all samples but the accuracy is considered. The simulation result clearly shows the advantage of fuzzy controller over traditional average approach, means if a student scores less points in exam performances i.e. 12 still his overall rating is higher using average method i.e.29.01 but using fuzzy approach the overall rating is reduced to 25 points. The research objectives of obtaining a fuzzy reasoning based MATLAB-Simulink model for performance evaluation of students has been achieved. The fuzzy reasoning approach provides an additional advantage of allocating different weightage to each attribute according to needs and requirements of the institute. Thus, fuzzy model closely mimics the behaviour of traditional average method used for student performance evaluation. Further refinement of fuzzy rules can be done to optimise the result of fuzzy controllers. The proposed model can be further modified and used for performance evaluation of employees, faculty etc.

References:

[1] Duderstadt, James J. "Engineering for a Changing Road, A Roadmap to the Future of Engineering Practice, Research, and Education." (2007).
[2] Mills, Julie E., and David F. Treagust. "Engineering education-Is problem-based or project-based learning the answer?." *Australasian Journal of Engineering Education* 3 (2003): 2-16.
[3] Saeki, Hiroshi; Imaizumi, Saori. 2013. International comparative study: engineering education in India. South Asia Human Development Sector report no. 57. Washington DC; World Bank.
[4] Mohan. V. Buke, et.al.(2015), "Engineering education in India: Ethics and Stakeholders Perspective", American Journal of Educational Research, Vol.3, No.2, pp.137-141.
[5] Dr. K. Lokeswari(2014), "Research for Excellence in Higher Education", Indian Journal of Research, Vol.3, Issue.5, pp.38-39
[6] A. Ashwani Kharola, et.al.(2015), *"Students Performance Evaluation: A fuzzy logic reasoning approach"*, PM World Journal, Vol.4, Issue.9.
[7] Osman Taylan & Bahattin Karagözog Lu(2009), "An adaptive neuro-fuzzy model for prediction of student's academic performance" Elsevier Journal of Computers & Industrial Engineering, Vol. 57, pp.732-741
[8] Gokhan Gokmen, et.al. (2010), "Evaluation of student performance in laboratory applications using fuzzy logic", Elsevier Journal of Procedia Social and Behavioural Sciences, Vol.2, pp.902-909.
[9] Charles Elkan(1993), "The Paradoxical Success of Fuzzy Logic", IEEE Conference, Aug.1994 on "Artificial Intelligence", Washington D.C, MIT Press, pp.698-703.
[10] Konstantina Chrysafiadi & Maria Virvou (2012), "Evaluating the integration of fuzzy logic into the student model of a web-based learning environment" Elsevier Journal of Expert Systems with Applications, Vol.39, pp.13127-13134.
[11] Mamatha Guruprasad, et.al.(2016), "Fuzzy logic as a tool for evaluation of performance appraisal of faculty in higher education institutions", SHS Web of Conferences by EDP Sciences.
[12] Ibrahim A Hameed & Seong-in Kim (2009), "A fuzzy system for evaluating students' learning achievement", Elsevier Journal of Expert Systems with Applications, Vol.36, pp6236-6243.
[13] Arora N, Saini JKR (2013); A fuzzy Probabilistic Neural network for students Academic Performance evaluation;*International Journal of Innovative Research in Science* 2(9): 4425-4432, ISSN: 2319-8753.
[14] Guillaume S (2001) Designing Fuzzy inference systems from data: An Interpretability oriented review. *IEEE Transactions on fuzzy systems* 9(3): 426-443, doi: 10.1109/91.928739.
[15] Ingoley SN, Bakal JW (2012); Students performance evaluation using fuzzy logic; In Proc. of IEEE Nirma University International Conference on Engineering (NUICONE), 6-8 Dec 2012, Ahmadabad, pp. 1-6. doi: 10.1109/NUICONE.2012.6493179.
[16] Jamsandekar SS, Mudholkar RR (2013); Performance evaluation by fuzzy inference technique;*International Journal of Soft-computing and Engineering* (IJSCE) 3(2): 158-164, ISSN: 2231-2307.
[17] Jyothi G, Parvathi C, Srinivas P, Rahaman SA (2014); Fuzzy expert model for evaluation of faculty performance in Technical educational Institutions;*International Journal of Engineering Research and Applications;* 4(5): 41-50, ISSN: 2248-9622.
[18] Kaur A, Kaur A (2012); Comparison of Mamdani-type and Sugeno type fuzzy inference system for air conditioning systems;*International Journal of Soft computing and Engineering* (IJSCE), 2(2): 323-325, ISSN: 2231-2307.
[19] Kharola A, Gupta P (2014); Stabilization of Inverted Pendulum using hybrid adaptive neuro fuzzy controller;*Engineering Science Letters*, 3: 1-20, ISSN: 2052-5257.
[20] Nakamura, E. and Kehtarnavaz, N. (1995); Optimization of fuzzy membership function parameters; In. Proc. IEEE International Conference on Systems, Man and Cybernetics, 22-25 Oct 1995, Vancouver, pp 1 - 6 vol.1,doi 10.1109/ICSMC.1995.537723