International Journal of Future Generation Communication and Networking
Vol. 12, No. 2, (2019), pp. 31–37

ANN Approach to Predict Employment of Technical Undergraduate Students.

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Abstract

In this study, the various employment skill sets of undergraduate students were identified. Stakeholders of campus placement activity i.e. company HR, placed Alumni, senior T & P Officers and senior Trainers were authenticate the selected skill sets. Grouping of skill sets has done as per their characteristics into four groups i.e. Aptitude, Communication, Technical & Personality traits. Pen & paper test designed and conducted in Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur affiliated technical institutes to measure the skill sets. Nonlinear relationship was found between dependent variable Employment and independent variable skill sets. Due to nonlinearity, an Artificial Neural Network (ANN) approach used to develop model for predicting Employment. MAT Lab and SPSS version 20 tool used to carry out the research work. As per result of the research work, all skill sets have positive correlation with each other and also with the Employment. Technical institute needs to change their only traditional technical skill focus & make additional efforts to develop other skills that best foster Employment.

Key words: Employment, ANN, Skill sets, Technical Institute

Introduction

The globalization has resulted in a significant increase in demand for technocrats in India. To fulfill the increasing demand of technocrats the engineering institutes have also increased intake multifold in India. The increase in number of technical institutes has directly affected quality and employability of students [1]. To promote industrial and economic growth it is essential to train and develop the right kind of technical manpower. The institute and industry needs to work shoulder to shoulder to develop the technocrats through active interaction between them.

PurpleLeap study stated that only 7% engineering students are found employable when all skill factors like Technical Skills, Analytical Skills and Communication Skills are considered together. Study also reveals that more than 80% of the students do not meet the requirements on problem solving and analytical skills [2]. As per the study carried out by Federation of Indian Chambers of Commerce & Industry (FICCI) and the World Bank, 64% of employers are not satisfied with quality of skills of engineering graduates [3]. The companies invest lot of time and money on training engineering graduate recruited through campus placement to make them ready for work. The study has revealed that the employability of engineering graduate is very low. Aspiring Mind study shows that around 62 % of engineering undergraduates need training to make them employable in IT and IT enable services [4]. As per the feedback from employers, only 25% of hired technical graduates are employable after probationary training [5].

The most of the researchers suggests to upgrade the quality of technical institute by using Statistical Quality Control, Total Quality Management, Six Sigma, Quality Circle, Industry- Institute Partnership etc.[6][7][8]. The few of them have assessed influence of employability skills of engineering graduate on employability based on stakeholder's opinion. In this research employability skill is measured using questionnaire method which was validated by the stakeholders such as HR executives,

ISSN: 2233-7857 IJFGCN

Senior Training & Placement Officers (TPO) of various Engineering institutes, corporate trainers and Students/Alumni (selected through campus recruitment and working satisfactorily after successful completion of probation period).

Literature Review:

Tshilidzi Eric Nenzhelele et al., (2014) [9] has stated that Employability is of high importance not only for unemployed or laid off individuals, but also for those who are currently employed in today's turbulent work environment. It is a responsibility of high education institution to produce graduates with employability skills. There is a gap between skill requirements for entry-level graduate employment and those offered by high education institutions. Experiential learning has been suggested as a learning method to reduce the skills gap.

Savanee Sermsuk et al., (2014) [10] explored the importance of employability skills of secondary school graduates through employer's perspective. The data was collected through an interview and a survey with the employers / supervisors from many companies or from business owners in the Eastern Seaboard Industrial Estate (ESIE). The findings showed that the skills or abilities required for a high potential of employment were consisted of Personal management skills, Fundamental skills and Teamwork skills. Venkatesh B. R. et al., (2013) [11] has focused on the importance of Soft Skills and Positive Attitude as perceived by industry with specific reference to fresh engineers, right from the time of industrial revolution. As the times passed by, the needs of the community and society changed drastically, the demands rose with more specifics, technology grew by leaps and finally the products and services changed for the better.

Chithra R. et al., (2013) [12], studied the perception of employers as well as the employees towards employment skill sets required for entry level engineering graduates in multinational software companies. The study concluded that, the students with work experience have better awareness of the employability skills than the students with no work experience. Stuart Rosenberg et al., (2012) [13] has examined the basic employment skills needed for job performance, the reception of these skills in college, and the need for additional training in these skills after graduation. The research was based on a triangular design approach, in which the attitudes of three distinct groups – recent graduates, the faculty who taught them and human resource managers who recruit them – were studied. It is, therefore, imperative to strengthen the communication across these groups to ensure adequate preparation of graduates.

Gokuldas V. K. et al., (2011) [14] identified predictors of employment of undergraduate engineering students in campus recruitment drives of Indian software companies. It was observed that knowledge of engineering and proficiency in English language are important predictors of continuous employment of engineering graduates in campus interviews of software services companies.

Methodology:

The study was carried out in technical institutes affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur. The performance of final year engineering graduate students who have completed graduation in year 2013 was considered as population. The questionnaire method was used to collect primary data and measure students identified skill sets. Random and convenience sampling technique is used to collect samples. The secondary data i.e. students employment in IT companies were collected from the technical institutes.

Dependent variable:

The dependant variable of this study is "Employment" in campus placement. The employments of first 5 IT sector companies were considered for the study. The weightage is given base on attempt required for the selection i.e 1^{st} attempt – 100 %, 2^{nd} attempt - 80%, 3^{rd} attempt- 60 %, 4^{th} attempt- 40%, 5^{th} attempt – 20 % and remaining consider as 0 % for developing the model.

Independent variables:

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The independent variables i.e. skill sets are identified from literature review on employment of technical graduate students. Stakeholders of campus placement activity i.e. company HR, placed Alumni, senior T & P Officers and senior Trainers were authenticate the selected skill sets. Skill sets group into four major groups i.e. Aptitude, Communication, Technical & Personality traits. Pen & paper test designed and conducted in Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur affiliated Technical institutes to measure the skill sets. The opinion of the 45 stakeholders involved in campus placement selection process is taken into consideration to select 22 important skill sets and grouping into 4 major groups [15].

Sample Size Determination

The population of engineering students in technical institutes of Nagpur University, Nagpur with 60 % and above marks from SSC onwards in academics is considered. The population size is approximately 12000. Yamane (1967) formula is used to determine sample size with level of precision 5 % as shown below

Sample Size = Population size / (1+Population size * e^2)

Population size = 12000, e = 0.05 Precision error with 5%

Sample Size = 12000 / (1+12000*0.0025) = 333.33 (required)

Based on research constraints and data smoothening, the final sample available for developing model is 362 which are greater than required 333.33.

Data Analysis:

The analysis of collected data is carried out by using statistical tools i.e. Chi Square Test, T-Pair Test and SPSS-20. The adequacy and Sphericity of 362 samples is tested by using Kaiser Meyer Olkin (KMO) and Bartlett's Test [16] as shown in table 1.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.637
Bartlett's Test of Sphericity	Approx. Chi-Square	662.072
	df	10
	Sig.	.000

Table 1. Kaiser Meyer Olkin (KMO) & Bartlett's Test on 362 Samples

The adequacy of collected sample is 0.637 and moderate (Kaiser 1974, 0.7-0.8). The Sphericity of Sample data is confirmed by Bartlett's Test, which tested Chi Square 662.07 with degree of freedom 10 and it is found significant, P = 0.000 (P<0.05). The influence of Aptitude, Communication, Technical and Personality skill sets on Employment are tested and confirmed by Chi square test. The correlation between skill sets is checked by using T-pair test and it is found positively correlated with each other.

Development of Artificial Neural Network (ANN) Model

ANN model was developed to predict Employment with their skill sets in campus placement activity of engineering graduate students. Skill sets are Aptitude (A), Communication (C), Technical (T) & Personality (P) considered as independent variables and Performance of technical institute students in Campus Placement – Employment (Y) considered as dependent variable to formulate the model. It can be expressed as

Employment (Y) = function (A, C, T, P)

Generally, the engineering students desire to have employment in good multinational IT

ISSN: 2233-7857 IJFGCN

companies. It is observed that most of the reputed IT Company desire to have first slot in campus selection procedure and no one ready to visit college after 5th slot. An institute tries to achieve maximum placement within first 5 multinational companies. Therefore, an assumption was made that the students gets an offer letter within first five chances considered to be employed other participated but not selected considered as unemployed.

Introduction of ANN

The rapidly developing field of artificial neural networks (ANN) emphasizes biologically inspired approaches to solve real life problems. Inspired by the structure of the brain, a neural network consists of a set of highly interconnected entities, called Processing Elements (PE) or units. Each unit is designed to mimic its biological counterpart, the neuron. Each accepts a weighted set of inputs and responds with an output. Neural networks address problems that are often difficult for traditional computers to solve, such as speech and pattern recognition, weather forecasts, sales forecasts, scheduling of buses, power loading forecasts, early cancer detection, etc. [17][18][19].

Artificial neural networks process information differently from traditional computers. The computation occurs in parallel across large numbers of simple processing units rather than in the serial fashion of traditional computer architectures. Similarly, information is distributed across the entire network rather than being located in one specific place or address. For computer scientists and engineers, neural networks provide a paradigm for solving problems which is often very successful particularly in domains that are poorly understood or subjected to uncertainty. The complexity and flexibility of the relationship that can be created is thus tremendous. Artificial neural network model are referred to as adaptive systems. The similarity to the human brain enables the neural network to simulate a wide range of functional forms which are either linear or non-linear. A neural network is a more general method of regression analysis. Some of the advantages of the network over conventional regression includes a) there is no need to specify a function to which the data are to be fitted b) the network is able to capture almost arbitrarily nonlinear relationships.

Type of Network

There are feed-forward, back-propagation, and feedback types of networks depending on the manner of neuron connections. The first allows only neuron connections between two different layers. The second has not only feed- forward but also „error feedback‟ connections from each of the neurons above it. The last shares the same features as the first, but with feedback connections, that permit more training or learning iterations before results can be generated. Feed- forward type of network was used to design ANN model by using Matlab.

No of Hidden Layers

Generally a neural network consists of **n** layers of neurons of which two are input and output layers, respectively. The former is the first and the only layer which receives and transmits external signals while the latter is the last and the one that sends out the results of the computations. The two inner ones are called hidden layers which extract, in relays, relevant features or patterns from received signals. Those features considered important are then directed to the output layer. The ability of an ANN to handle complex problems depends on the number of the hidden layers. But in Matlab, Number hidden layers are fixed i.e. two.

Data Training Method

ANN learning can be either supervised or unsupervised. Supervised training was used to train the data. In supervised learning, the network is first trained using a set of actual data referred to as the training set. The

ISSN: 2233-7857 IJFGCN

actual outputs for each input signal are made available to the network during the training. Processing of the input and result comparison is then done by the network to get errors which are then back propagated, causing the system to adjust the weights which control the network.

Topology of the Network

After the data has been transformed and the method of training has been chosen, it is necessary to then determine the topology of the neural network. In order to arrive at an appropriate network topology, various topologies such as Multilayer Perceptron, recurrent network, and time-lagged recurrent network were considered. Due to the nature of our case study data, which is static and not sufficiently large to enable the use of complex topologies, the Multilayer Perceptron was selected.

Multilayer Perceptrons (MLPs) are layered feed forward networks typically trained with static back- propagation. The next step in building the neural network model is the determination of the number of processing elements. Selection of the number of processing elements is a delicate one because having few PE‟s reduces the discriminating power of the network. Since it is not possible to set the number of PE‟s analytically, the number of PE were varied from 5 to 20 nodes to arrive at the best performance network. The experiment was thus started with a small number of PE‟s, and observations made on the behavior of the learning curve. If the final training error is of a small and acceptable value, then the network has the right number of PEs. So the number of PE‟s should be increased & observe the performance of the network. It is observed that the network performance was best at 20 Processing Element (Neurons). The values of R^2 and Mean Square Error (MSE) is 0.9428 & 0.0294 respectively.

The Data Set Grouping

In supervised training, the data was divided into 3 categories; the training set, verification set and the testing set. The training set enables the system to observe relationships between input data and resulting outputs, so that it can develop relationship between inputs and the expected output. The sample of 362 students records were used for developing ANN model. About 70% of the total data (i.e. 254 candidates) were used as the training set, 15% (i.e. 54 candidates) as the testing set, and 15% (i.e. 54 candidates) used for cross validation. After the data classification, the neural network topology was built based on the Multilayer Perceptron with two hidden layers and 20 processing elements per layer.

Network Training and Validation Process

The network was trained by supervised training method with the number of runs set to three and the Epoch set to terminate at 1000. The training performance was evaluated by using the following performance measures:

The Mean Square Error (MSE):

$$MSE = \Sigma (dij - Yij)\ 2 / N\ P$$

Where: P = number of output of processing element.

N= no of exemplars in the data set.

Yij=network output for exemplars i at processing element j,

dij=desired output for exemplars i at processing element j,

In this research study, number of neurons varies from 5 to 20 and check performance of network after repetitive training done on data. It was observed that the ANN network performance best at overall R^2 is 0.9428 & Mean Square Error is 0.0294 at 20 neurons. The details of final ANN model by using MatLab software as shown in table 2 & figure 1.

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Overall R^2	0.9428
Training R^2	0.9583
Validation R^2	0.9075
Testing R^2	0.9200
Mean Square Error	0.0294
No of Hidden layers	2
No of neurons	20
Input variables	4 (A, C, T, P)
Output variable	1 (Y-Employment)

Table 1: Summer of ANN model

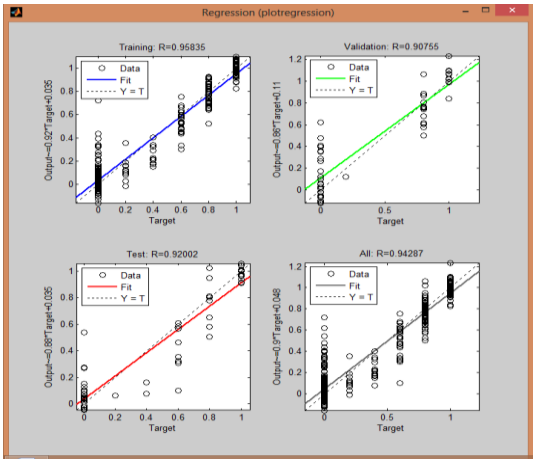

Figure 1: Regression Analysis of ANN model in MAT lab

CONCLUSIONS

As per result of the research work, all skill sets have positive correlation with each other and also with the Employment. The model achieved highest R^2 which shows the potential efficiency of Artificial Neural Network to develop model of nonlinear relationship between the variables. After various iterations, the best overall R^2 - 0.9428 & Mean Square Error is 0.0294 achieved at 2 Layers, 20 neurons. It means that all the technical institute needs to change their only traditional technical skill focus & make additional efforts to develop other skill sets that foster the best Employment.

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ISSN: 2233-7857 IJFGCN