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Career Recommendation using ANN

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Abstract: ***There is a pattern among understudies to, for the most part, settle on professional ways in light of their colleagues' choices or, on the other hand, the most significant compensation-paying jobs. They neglect to know their assets and pick their careers randomly, leading to frustration and demoralization. Moreover, while recruiting thecandidates, recruiters need to assess them in all different aspects. Consequently, there is a requirement for a framework that helps students decide on a job role best suited for them based on/her skillset and other evaluation metrics, which is now possible due to advancements in deep learning. This project proposes an automated system using an Artificial Neural Network, which considers the individual's personality traits and personal interests, and academics to predict which computer science job role would be best suited for them.***

Keywords: Deep learning, artificial neural networks, multiclass classification, backpropagation algorithm, career recommendation, computer science.

I. INTRODUCTION

Artificial Neural Network [1] is an handling framework comprising an enormous number of straightforward, exceptionally interconnected handling components in engineering roused by the construction of the cerebral cortex piece of the cerebrum. Subsequently, brain networks arefrequently fit for doing things that people orcreatures get along nicely, yet conventional computers often do poorly. Various parameters (mentioned in section II. proposed system, subsection B. model) are considered for career recommendation; this is difficult to predict withtraditional recommender models. Recommender systems [2] have become widely used in various commercial platforms in recent years to guide users. Every field has multiple work jobs, making itdifficult for any undergrad understudy and enrollment specialist to settle on an appropriate occupation for understudies. Any understudy after graduation requirements to determine what work job is the most ideal for him as per his profile. This is significant for a drawn-out professional plan. Essentially, for an enrollment specialist, it isexceptionally pivotal to enlist a competitor in the wake of surveying them from a different angle. A vocation recommender framework will helpcollege understudies and selection representatives find the right job based on their personality, academics, interests, etc. This was a valuabletechnique for offering the best career choice for the student. Furthermore, Arafatetal. (2018) research anticipated understudies' assessed professions, including understudies' assets and shortcomings. This paper proposes a professional suggestion framework utilizing brain networks because of the significant number of boundaries for characterization. These boundaries remember understudy execution for different subjects present in the undergrad educational program of software engineering and understudy interests, relational abilities, gifts, and so on[3,4]. This project aims to implement the concept using an Artificial NeuralNetwork (ANN) model. The model is trained and tested on 15,000 and 3,000 dataset entries. Themodel performs multiclass classification and canpredict one of the six domains (i.e., DatabaseAdministrator, Project Manager, Softwaredeveloper)

II. PROPOSED SYSTEM

A. *Architecture of Neural Network*

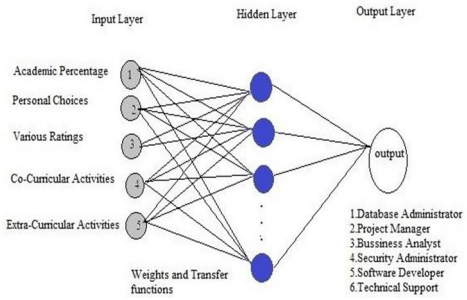

Fig 1:ANN Architecture

The Neural Network architecture is made of individual units called neurons that mimic the biological behavior of the brain. Neural network is a method in artificial intelligence that teaches computers to process data in a way that is inspired by the human brain [5].ANN is made of three layers namely input layer, output layer, and hiddenlayer/s. There must be a connection from the nodesin the input layer with the nodes in the hidden layer and from each hidden layer node with the nodes of the output layer.Layers of connected input units and output units called neurons.A single layer neural network is called a perceptron. Multiple hidden layers may also be present in an artificial neural network.

The proposed ANN consists of input layer, 10 hidden layers and output layer.The output layer uses sequential model. 15 input features like academic percentages,co- circular activities.hackatons attended,olympiads and personal choices were given to the input layer.20 nodes in total take the input and gives output to the next layer using activation function.Rectified linear unit is used as activation function.Relu is used instead of sigmoid and tanh because it was less expensive operation than other two and it gives better accuracy. Relu is a piecewise linear function that will output the input directly if it is positive, otherwise, it will output zero.The main advantage of using the ReLU function over other activation functions is that it does not activate all the neurons at the same time.

Layer 2 also consists of 20 nodes which take input from the previous layer i.e.,first layer.Just like the first layer ReLu function is used as activation function.

Next 9 layers are same as 2^{nd} layer whoseoperation resembles the 2^{nd} layer.The last layer i.e., output layer consists of 6 outputs because themodel predicts one of the six domains for which the model uses multiclass classification (the problem of classifying instances into one of three or more classes).For multiclass classificationsoftmax activation functin was used which fairly gave good results,The model used categeorical class entrophy to select a particular domain.Categorical crossentropy is a loss function that is used in multi-class classification tasks.

The model sets the probability to each class and selects the one with highest probability.

Flow of the model is shown in fig 2.

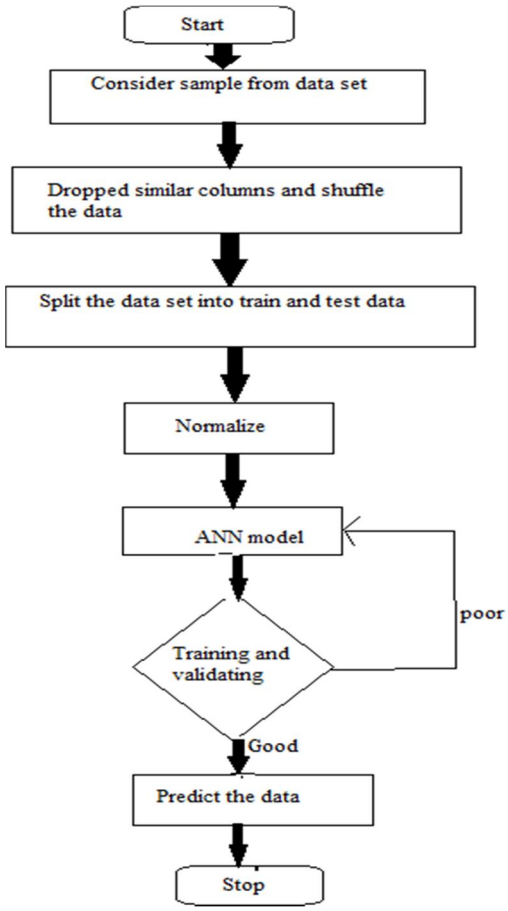

Fig 2:ANN Flowchart

B. Model

Our model consists of 30,000 entries from students with their marks,personal interets, hackathons attended and job role they were suited for etc..we considered 15 parameters.

Table I Input Parameters

NO	NAME	TYPE
1	Percentage 1.Operating Systems. 2.Algorithms 3.Programming Concepts 4.Software Engineering 5.Communication Networks. 6.Communication Skills 7.Mathematics .	Academics
2.	Hackathons	Co-Curricular
3.	Interests: 1. Analyst 2. Management 3. Programming 4. Cloud Computing 5. Data Engineer 6. Software Engineering 7. System Developer 8. Hacking 9. Networks 10. Security 11. Web Development	Co-Curricular
4.	Certifications 1. App Developmet 2. Full Stack Development 3. Hadoop 4. Information Security 5. Machine Learning 6. Python 7. Shell Programming	Co-Curricular
5.	Team- Spirit(Sports)	Extra-Curricular
6.	Leadership Ability	Personality
7.	Introvert/Extrovert	Personality
8.	Self Learning Capability	Personality
9.	Management/Technical	Personality

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Preprocessing: Data was cleaned by removing thecolumns like salary range expected,talenttests,Type of books they are interested in,Type ofcompany they want to settle in?.since they were repetative and not useful in predicting .Suggestedjob role was categorical so one hat encoding wasused to convert it into binary form.This type ofencoding creates a new binary feature for eachpossible category and assigns a value of 1 to thefeature of each sample that corresponds to itsoriginal category. The data set consists ofparameters with different ranges ,so to normalizethe data standard scalar python library was used.

Algorithm: A feed forward algorithm was used to find theweight and the bias,along with this backpropagation algorithm was also used for thepurpose of updating corresponding weights according to respective layer.

Intially ,input vector $\boldsymbol{X}$ and weight matrix $\boldsymbol{\theta^1}$ need to be multiplied for the first layer $\boldsymbol{(X*\theta^1)}$ and then activation function $\boldsymbol{g}$ is applied, for first layer we get

$$a_{1(2)} = g(\Theta_{10}(1)x_0 + \Theta_{11}(1)x_1 + \ldots + \Theta_{115}(1)x_{15} + b_1)$$
$$a_{1(3)} = g(\Theta_{10}(2)x_0 + \Theta_{11}(2)x_1 + \ldots + \Theta_{115}(2)x_{15} + b_1)$$
$$a_{1(15)} = g(\Theta_{10}(14)x_0 + \Theta_{11}(14)x_1 + \ldots + \Theta_{115}(14)x_{15} + b_{15})$$

…..*(1)*

Correspondingly,for subsequent layers we getsimilar activation function.

For second layer $(\boldsymbol{A*\theta})$,by multiplying hidden layer vector with weight matrix $\boldsymbol{\theta}$ we get output forthe hypothesis function:

$$y\Theta(x) = a_{1(15)} = g(\Theta_{10}(2)a_{0(2)} + \Theta_{11}(2)a_{1(2)} + \ldots + \Theta_{115}(2)a_{14(2)})$$

……(2)

Rectified linear unit is used as activation function.Relu is used instead of sigmoid and tanh because it was less expensive operation than othertwo and it gives better accuracy.Relu function is given as:

$$g(z) = \max(0,z)$$

Graphical Representation of Relu Function isshown in Fig 3:

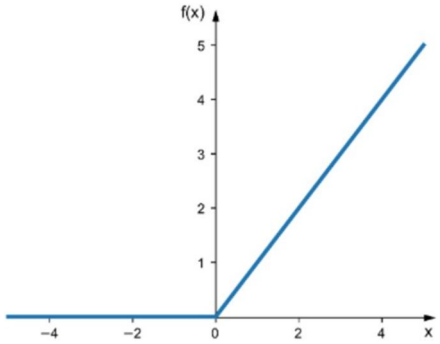

Fig 3.ReLu Function graph

Second ,using categorical cross entrophy function the model calculates loss.The loss is calculated by taking the cross product of the actual output (y) andthe log of the predicted value ($y\Theta$).

$$L(y,y\Theta) = -\Sigma Mj{=}0\Sigma Ni = 0(yij * log(y\Theta ij))$$

…..…..*(4)*

Using (4 as the cross-entropy loss function, the gradients of the weights(dθ(x)) and biases(db(x)) are calculated as follows :

$$J(y,a) = 1m\Sigma mj{=}1L(y,y\Theta)\ J(y,a) = 1m\Sigma mj{=}1L(y,y\Theta)\ldots\ldots(5)$$

$$d\theta(x) = d(x)^*\ J(y,a)\ db(x) = ddb(x)^*\ J(y,a)\ \ldots.(6)$$

Further for updating weights and biases the model uses Adam optimization technique. For this calculation of variance($V\theta(x)$) and standard deviation($S\theta(x)$) of the weight matrix is calculated by a moment-wise update and RMS propagation- wise update respectively.

Initializing,

$V(x) = 0, S\theta(x) = 0, Vdb(x) = 0, Sdb(x) = 0$ …(7)

$V(x) = \beta1 * Vd\theta(x) + (1-\beta1) * d\theta(x)$ …(8)

$V(x) = \beta1 * Vdb(x) + (1-\beta1) * db(x)$ ….(9)

$S(x) = \beta2 * Sd\theta(x) + (1-\beta2) * d\theta(x)$ ….(10)

$S(x) = \beta2 * Sdb(x) + (1-\beta2) * db(x)$ (11)

Updating weights and biases as follows,

$\theta(x) = \theta(x) - \alpha * V(x) / \sqrt{Sd\theta(x)} + \epsilon$ …..(12)

$b(x) = b(x) - \alpha * Vd(x) \sqrt{Sdb(x)} + \epsilon$ …..(13)

TABLE II
TRAINING PARAMETERS

Parameter	Symbol	Value
Learning Rate	α	0.0001
Exponential decay rate for moment	$\beta1$ $\beta2$	0.9 0.999
Epsilon	ϵ	10-8
Epochs	-	1000
Minibatch Size	-	512

III. RESULT

The proposed Recommender System is being trained on 21,000 datasets having 15 parameters which gives an accuracy of 86% whereas testing on 9,000 datasets with same parameters gave an accuracy of 86%.In comparison with Roy, K. [6] etal. (2018) model who used traditional machine learning algorithms like XG Boost and Decision our model proved to give better accuracy than theirs. The cost function shows exponential decrease as:

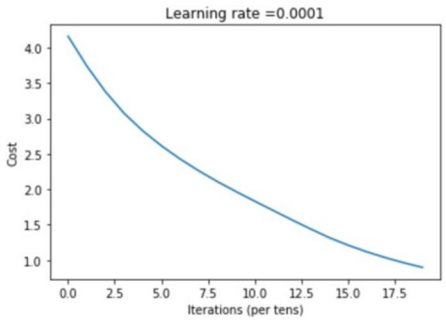

Fig 4:Cost Function

The result for output model is is Shown in figure 5:

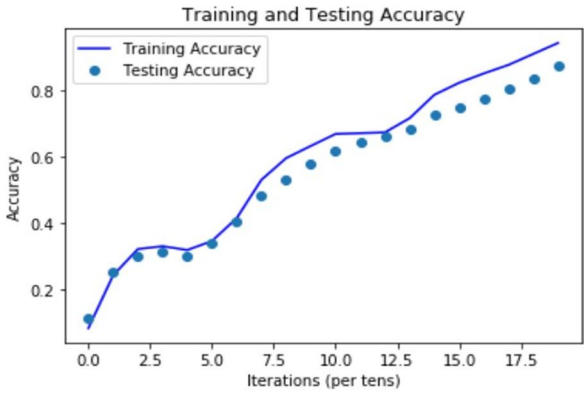

Fig 5:Training and Testing Accuracy

IV. CONCLUSION

The goal of this research is to develop an effective ANN model for predicting a suitable professional role for a Computer Engineering student. For aperson with qualifying knowledge and abilities, theproposed model is suitable for examining a wide range of objective criteria. This recommenderframework can be used by any IT-based enrollment professional to find a competitor who isa good fit for the job. Furthermore, a Computer Engineering fresher can determine the space theyare qualified for based on their profile and theopinions of individuals who are unfamiliar withtheir field. The proposed model used15characteristics to accurately predict one of thesix labour jobs with a 86 % accuracy.

As a result, the ANN model produces more exactresults than traditional AI models.

V. FUTUREWORK

1) *Sub Domains* - The model can also be scaled to understand the specialization within that particular space. If the suggested position is in the realm of security, for example, there may be sub domains such as System Security Administrator, Network Engineer, Network Administrator, Information Security Analyst, and so on.
2) *Adaptability* - The dataset was created using only computer design fields. The approach can be scaledto work in several sevtors of educaton such asCommerce,Arts and so on…

VI. ACKNOWLEDGEMENT

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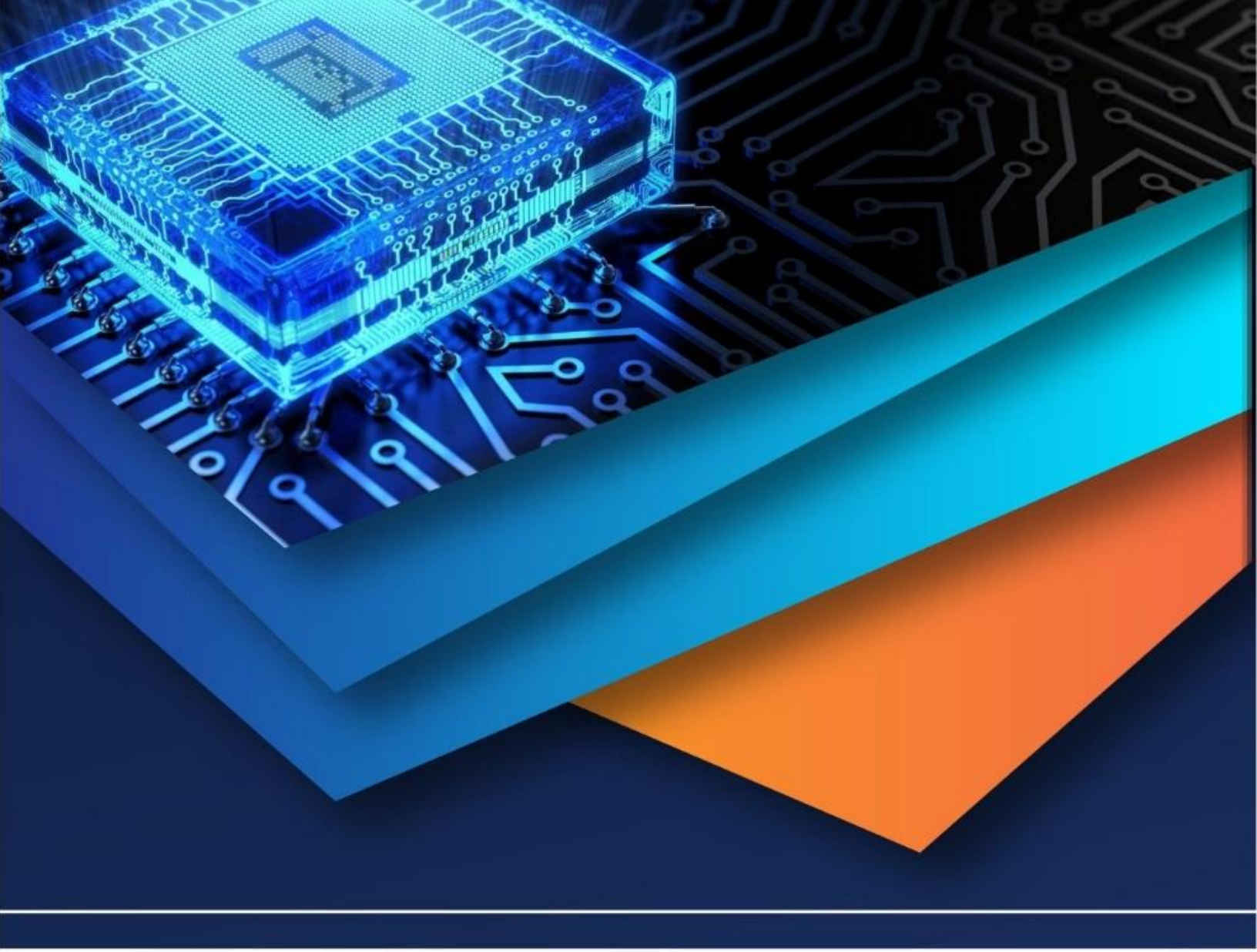

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