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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 the candidates, 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 are frequently fit for doing things that people or creatures 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 with traditional 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 it difficult 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 is exceptionally pivotal to enlist a competitor in the wake of surveying them from a different angle. A vocation recommender framework will help college understudies and selection representatives find the right job based on their personality, academics, interests, etc. This was a valuable technique for offering the best career choice for the student. Furthermore, Arafat et al. (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 Neural Network (ANN) model. The model is trained and tested on 15,000 and 3,000 dataset entries. The model performs multiclass classification and can predict one of the six domains (i.e., Database Administrator, Project Manager, Software Developer)

II. PROPOSED SYSTEM

A. Architecture of Neural Network

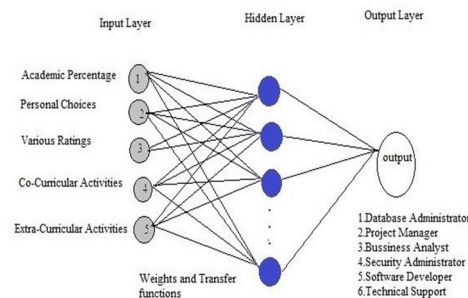


Fig 1:ANN Architecture

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 hidden layer/s. There must be a connection from the nodes in 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 give 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 2nd layer whose operation resembles the 2nd layer. The last layer i.e., output layer consists of 6 outputs because the model 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 classification softmax activation function was used which fairly gave good results. The model used categorical class entropy to select a particular domain. Categorical cross entropy 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.

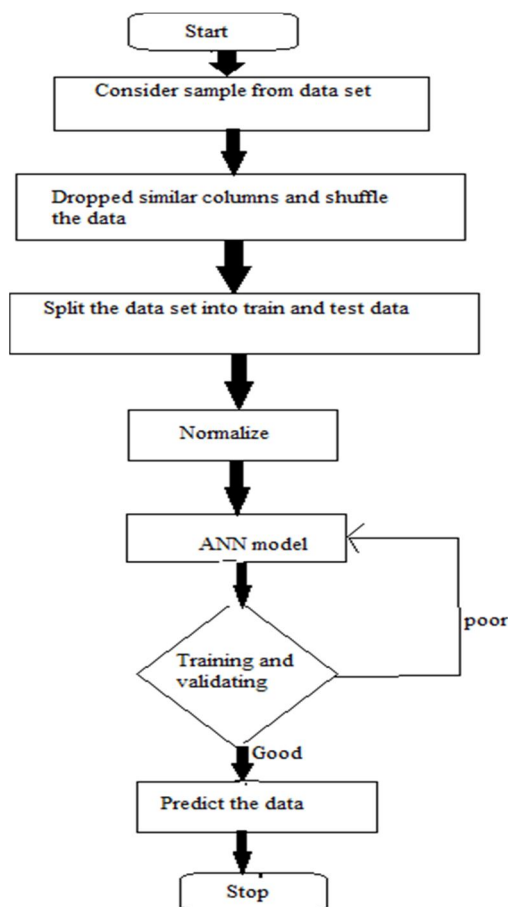


Fig 2: ANN Flowchart

B. Model

Our model consists of 30,000 entries from students with their marks, personal interests, 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 Development 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

Preprocessing: Data was cleaned by removing the columns like salary range expected, talent tests, Type of books they are interested in, Type of company they want to settle in?. Since they were repetitive and not useful in predicting. Suggested job role was categorical so one-hot encoding was used to convert it into binary form. This type of encoding creates a new binary feature for each possible category and assigns a value of 1 to the feature of each sample that corresponds to its original category. The data set consists of parameters with different ranges, so to normalize the data standard scalar python library was used.

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

Initially, input vector X and weight matrix θ^l need to be multiplied for the first layer ($X * \theta^l$) and then activation function g is applied, for first layer we get

$$\begin{aligned}
 a_{1(2)} &= g(\theta_{10}(1)x_0 + \theta_{11}(1)x_1 + \dots + \theta_{115}(1)x_{15} + b_1) \\
 a_{1(3)} &= g(\theta_{10}(2)x_0 + \theta_{11}(2)x_1 + \dots + \theta_{115}(2)x_{15} + b_1) \\
 a_{1(15)} &= g(\theta_{10}(14)x_0 + \theta_{11}(14)x_1 + \dots + \\
 &\quad \theta_{115}(14)x_{15} + b_{15})
 \end{aligned}
 \tag{1}$$

Correspondingly, for subsequent layers we get similar activation function.

For second layer ($A * \theta$), by multiplying hidden layer vector with weight matrix θ we get output for the hypothesis function:

$$y\theta(x) = a_{1(15)} = g(\theta_{10}(2)a_{0(2)} + \theta_{11}(2)a_{1(2)} + \dots + \theta_{115}(2)a_{14(2)})
 \tag{2}$$

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

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

Graphical Representation of ReLU Function is shown in Fig 3:

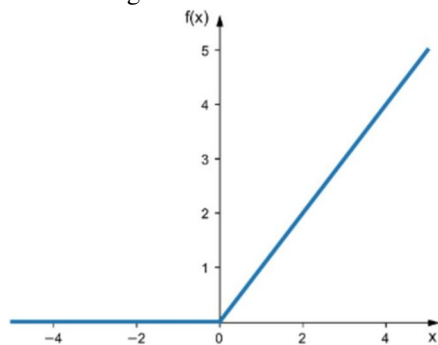


Fig 3. ReLU Function graph

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

$$L(y, y\theta) = - \sum_{j=0}^m \sum_{i=0}^n I_{ij} = 0(y_{ij} * \log(y\theta_{ij}))
 \tag{4}$$

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

$$J(y, a) = 1/m \sum_{j=1}^m L(y, y\theta) \quad J(y, a) = 1/m \sum_{j=1}^m L(y, y\theta) \dots \tag{5}$$

$$d\theta(x) = a(x) * J(y, a) \quad db(x) = db(x) * J(y, a) \dots \tag{6}$$

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,

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

$$V(x) = \beta_1 * Vd\theta(x) + (1-\beta_1)*d\theta(x) \quad \dots(8)$$

$$V(x) = \beta_1 * Vdb(x) + (1-\beta_1)*db(x) \quad \dots(9)$$

$$S(x) = \beta_2 * Sd\theta(x) + (1-\beta_2)*d\theta(x) \quad \dots(10)$$

$$S(x) = \beta_2 * Sdb(x) + (1-\beta_2)*db(x) \quad \dots(11)$$

Updating weights and biases as follows,

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

$$b(x) = b(x) - \alpha * Vd(x) / \sqrt{Sdb(x)} + \epsilon \quad \dots(13)$$

TABLE II
TRAINING PARAMETERS

Parameter	Symbol	Value
Learning Rate	α	0.0001
Exponential decay rate for moment	β_1 β_2	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] et al. (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:

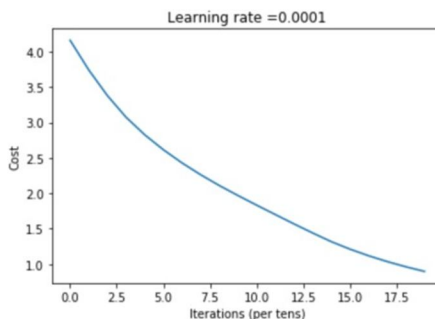


Fig 4: Cost Function

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

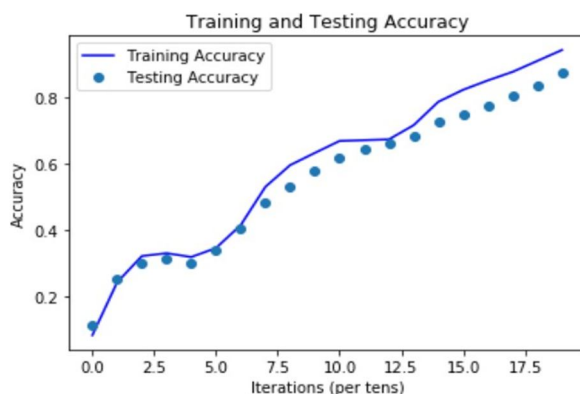


Fig 5: Training and Testing Accuracy

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 a person with qualifying knowledge and abilities, the proposed model is suitable for examining a wide range of objective criteria. This recommender framework can be used by any IT-based enrollment professional to find a competitor who is a good fit for the job. Furthermore, a Computer Engineering fresher can determine the space they are qualified for based on their profile and the opinions of individuals who are unfamiliar with their field. The proposed model used 15 characteristics to accurately predict one of these six labour jobs with a 86 % accuracy.

As a result, the ANN model produces more exact results 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 scaled to work in several sectors of education such as Commerce, Arts and so on...

VI. ACKNOWLEDGEMENT

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