Employee Attrition Prediction using Artificial Neural Network (ANN)

Author: Elavarasi Chinnadurai

1. Executive Summary

This project focuses on predicting employee attrition using an Artificial Neural Network (ANN). Attrition prediction helps organizations identify employees at risk of leaving, enabling proactive retention strategies. The model is trained on the IBM HR Analytics Employee Attrition Dataset from Kaggle, and it uses advanced deep learning techniques to capture complex relationships between employee characteristics and attrition behavior.

2. Dataset Overview

The dataset, sourced from Kaggle, contains employee demographic, job satisfaction, performance, and compensation details. Each record represents an employee, with the target variable 'Attrition' indicating whether they left the company. Data preprocessing included handling missing values, encoding categorical features using LabelEncoder, and scaling numerical features using StandardScaler.

3. Artificial Neural Network Architecture

The Artificial Neural Network (ANN) is a feedforward model implemented using Keras. It consists of multiple dense layers: an input layer, two hidden layers, and an output layer. The ReLU (Rectified Linear Unit) activation function is applied to the hidden layers to introduce non-linearity, and a sigmoid activation function is used in the output layer for binary classification.

Model Structure:
• Input Layer: Receives normalized employee data.
• Hidden Layer 1: 16 neurons, activation = ReLU.
• Hidden Layer 2: 8 neurons, activation = ReLU.
• Output Layer: 1 neuron, activation = Sigmoid.

4. Mathematical Explanation

Activation Function (ReLU):
$ReLU(x) = max(0, x)$
It introduces non-linearity by keeping positive values unchanged and converting negatives to zero.

Sigmoid Function:
$\sigma(x) = 1 / (1 + e^{-x})$
This squashes the output between 0 and 1, representing probability of attrition.

Loss Function (Binary Crossentropy):
$L = - (1/N) \Sigma [y * \log(p) + (1 - y) * \log(1 - p)]$
Where y is the actual label and p is the predicted probability. This measures the error between predicted and actual outcomes.

Optimizer (Adam):
Adam optimizer combines momentum and adaptive learning rate to efficiently update weights during backpropagation.

5. Model Training and Evaluation

The dataset is divided into training and testing subsets using an 80-20 split. The ANN is trained over 50 epochs with a batch size of 32. The model's performance is evaluated using accuracy and loss metrics. Additionally, confusion matrix and classification report are generated to analyze precision, recall, and F1-score.

6. Results and Visualization

The ANN model achieved high accuracy in predicting employee attrition. Visualization plots display training accuracy and loss trends across epochs. The model successfully identifies potential attrition cases, enabling HR departments to make data-driven decisions. Actual vs Predicted results validate the reliability of the model.

7. Conclusion and Future Scope

The project demonstrates the effectiveness of Artificial Neural Networks for human resource analytics. By analyzing employee-related factors, the model aids in understanding attrition behavior. Future work could involve hyperparameter tuning, integration of additional features such as performance trends, or experimenting with ensemble deep learning models to enhance prediction accuracy.

8. Dataset Reference

Dataset: IBM HR Analytics Employee Attrition Dataset
Kaggle Link: https://www.kaggle.com/datasets/pavansubhasht/ibm-hr-analytics-attrition-dataset

9. Author

Prepared by **Elavarasi Chinnadurai**