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HARNESSING INTELLIGENCE: THE ROLE OF AI AND MACHINE LEARNING MODELS IN HUMAN SERVICES

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Abstract

Artificial Intelligence (AI) and Machine Learning (ML) are the future of business in the public or private sector. The private sector is taking advantage of these emerging technologies faster than the public sector, especially the local governments. This paper aims to provide a comprehensive understanding of AI and ML, the AI models, how they can be trained, and the applications of AI models in human services.

Keywords—Artificial Intelligence (AI), Machine Learning (ML), AI Models, Deep Neural Network, Decision Tree, Supervised, unsupervised, and semi-supervised learning

I. INTRODUCTION

Artificial intelligence (AI) is the computing science of building machines that can think and act like humans. AI aims to augment human efforts toward the community's growth and humankind in general.

AI should not be seen as replacing human effort but as accelerating human attempts at an incredible speed to achieve goals faster, efficiently, and effectively. AI is primarily used in the Healthcare, Manufacturing, Marketing, Entertainment, and Finance industries. The advantages of AI are so vast that more industries are attempting to use AI. The human services industry makes some attempts to leverage AI, but there are more opportunities within this sector where AI can be used, which has yet to be explored or implemented.

This paper covers AI and ML and how AI models can be leveraged in human services.

II. DECODING AI AND MACHINE LEARNING MODELS

Machine Learning is a subfield of AI. Where AI is the science of building machines that act like humans, Machine Learning (ML) is its branch, which develops computer systems that can learn and adapt without explicitly being programmed. ML uses algorithms and statistical models to analyze and draw inferences from the data.

There are various AI Models, but the most popular ones are Deep Neural Network, Decision Tree, linear regression, Logistic regression, and Random Forest.

A. Deep Neural Network

Deep Neural Network is also known as deep learning. The function of this model is to process the data in the computer system in a way inspired by the human brain. It uses interconnected nodes in a layered structure. It helps the computer to learn from its mistakes and improve.

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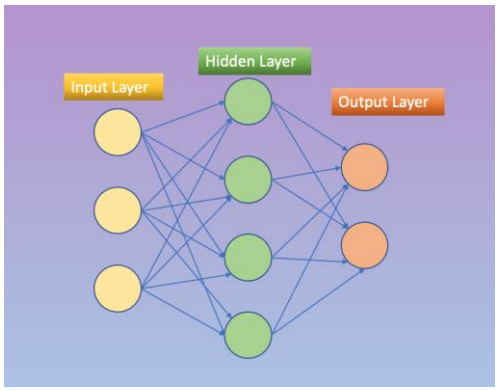

Fig 1: Neural Network Architect

Deep Neural Networks have three layers at a high level:
Input layer – This layer receives the raw data process, analyzes and categorizes it, and sends it to the next layer.
Hidden layer—A neural network can have many hidden layers. This layer further processes and analyzes the data received from the input or other hidden layers and passes it on to the next hidden layer or output layer, depending on the data's stage.
Output layer – This layer gives the outcome of the data processing. It can have single or multiple nodes.

B. Linear Regression

Linear regression in machine learning helps to find a linear relationship between input and output variables. A linear relationship indicates that changes in one variable are directly proportional to another. The linear regression model is used to solve regression problems, i.e., to predict the continuous output variable based on independent variables, for instance, predicting future home prices based on population or predicting temperature based on historical weather data.

Risk analysis is one of the applications of the linear regression model; for instance, it can help the financial institution identify the risk factors that can cause payment defaults by analyzing factors like debt-to-equity ratio, cash flow, profitability, etc.

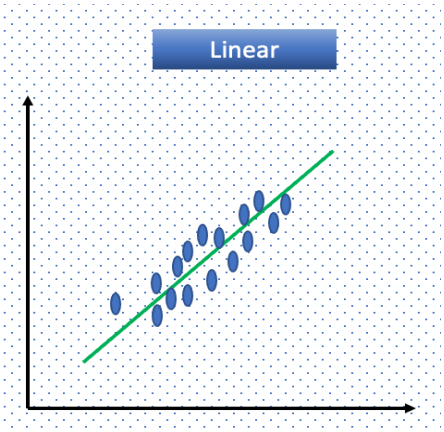

Fig 2: Linear Regression

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C. Logistic Regression

Logistic regression is a machine-learning technique for estimating the probability of an event to occur. It is also used to solve classification-based problems. The logistic regression model uses the logistic function in mathematics for equations between variables. The outcome of logistic regression will always be 0 or 1. Anything in between is rounded off. For instance, it can help determine if home prices will increase by 50% in 3 years.

In healthcare, one of the applications of the Logistic regression model is to analyze the probability of disease by comparing the impact of genes on disease.

Linear regression and Logistic regression are closely related. The key difference is that linear regression predicts the value of the continuous dependent variable. In contrast, logistic regression cannot predict the actual values but can predict the probability of a specific event.

D. Decision Tree

The decision tree is a flow chart that algorithmically categorizesthe data based on answers to the previous questions. The decision tree model is very close to the neural network model; daily, humans use the decision tree model in decision-making. For instance, what to wear, how much to spend this month on entertainment, etc.

The decision tree is a series of if-else statements that help segment the data and assist in decision-making.

The decision tree structure has components like the root node, which is the primary question to be answered. Decision nodes are internal nodes that further classify the root nodes. The leaf is the decision outcome.

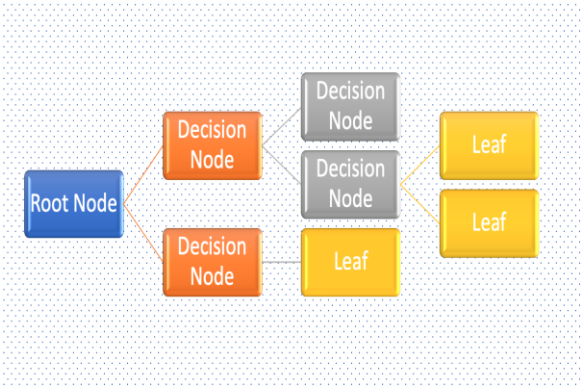

Fig 3: Decision Tree Structure

E. Random Forest

The random Forest model is a cluster of decision tree. Each random forest tree will learn from sample data, and each node can be split based on a random set of features.

The random forest model outperforms the decision tree when data is more complex. It is used to handle dataset complex with many features and non-linear relationships.

It is used in agriculture to predict crop yield and assess soil quality, as well as in Environmental Science for Species classification and climate modelling.

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III. TRAINING PROCESS BEHIND AI MODELS

A. Supervised Learning

Supervised learning is machine learning, where a model is trained on a labeled dataset. In this approach, the algorithm learns to map input features to the corresponding output labels. The training dataset consists of input-output pairs, it helps learning the relationship between the inputs and the outputs.

Supervised learning is commonly used in training models like linear regression, decision trees, and neural networks.

Supervised learning is applied in various fields, including finance (credit scoring), healthcare (disease prediction), and marketing (customer segmentation). Supervised learning increases interpretability and predicts more accurately.

B. Unsupervised Learning

Unsupervised learning deals with datasets that do not have labelled outputs. Instead of learning from explicit input-output pairs, the model explores the underlying structure of the data. The main objective is to identify patterns, groupings, or relationships within the data.

Unsupervised Learning receives a dataset consisting solely of input features (e.g., numerical values, text data, and images) and discovers relationships between variables. The algorithm analyzes the data to find patterns or structures without any prior labels.

It helps understand the data structure and identify patterns that may need to be made apparent. It can be applied when data labelling is difficult, expensive, or time-consuming.

C. Semi-Supervised Learning

Semi-supervised learning leverages the strengths of both supervised and unsupervised learning.

It is a machine learning type that combines labeled and unlabeled data during training. It is beneficial when obtaining a fully labeled dataset is expensive or time-consuming, allowing the model to leverage the information from a small amount of labeled data alongside a larger pool of unlabeled data.

Semi-supervised learning allows using a small labeled dataset with a larger unlabeled dataset, reducing labeling costs. Utilizing unlabeled data can enhance model performance.

IV. EXPLORING THE APPLICATION OF AI MODELS

A. Case worker Assistant

A deep neural network can be used to implement Caseworker assistant AI. This personal assistant can help the caseworker by guiding them on how to perform specific functions according to the caseworker's profile and alerting them to areas where the probability of procedural error is higher.

Case assistant AI can be trained using supervised or semi-supervised learning. AI can learn from Training guides and pre-defined steps to process complex cases.

B. Client Assistant

Like caseworker assistant, AI models like Decision Tree and Neural Network can be leveraged to implement online client assistant or call center client assistant.

This assistant can help clients answer any inquiry on the application status and guide them in online application submission.

C. Fraud detection

A decision tree model can be used to make an informed decision regarding fraud risk by analyzing patterns of client interactions with the system, such as the number of times a benefits card is issued, the number of cases the client is active on, etc.

D. Predicting workload

The linear regression model can help predict the workload using historical workload data. It will help the program managers and section chiefs track the work movement and alert them if an unexpected workload is expected. The model can use the historical workload data as one of the parameters to predict the workload and assist in workload management.

E. Quality assurance

A decision tree or random forest model can be used for quality assurance. Based on different parameters during the case processing, these models can predict if a case will fail the auditor's review. And accordingly, alert the caseworker to process the case proactively and accurately.

V. CONCLUSION

In conclusion, the public sector should invest in AI and ML technologies. Starting small and expanding slowly to realize the latest opportunities in machine learning. AI models like neural networks, decision tree linear regression, etc., can help implement AI solutions, which can be trained in a controlled manner to minimize bias.

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