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| **Project Report**  CROP RECOMMENDATION |  |
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|  | Artificial I NTELLIGENCECS 502 |
|  | Prof : Fatima Aslam |

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|  | INTRODUCTION The Crop Recommendation System is designed to assist farmers in making informed decisions about which crops to cultivate based on various environmental and soil conditions. The system employs machine learning algorithms to analyze historical data on crop yields and environmental factors to provide personalized crop recommendations. | |  |
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**Data Exploration:**

* The dataset used in this project, named `'Crop\_Recommendation.csv'`, contains information about different crops and their corresponding environmental and soil attributes.
* Upon loading the dataset, initial exploratory data analysis was performed to gain insights into the data structure, including examining the first few rows, summary statistics, missing values, and data types.

**Data Visualization:**

* Visualizations such as heatmaps, histograms, and pair plots were created to explore the relationships between various attributes and crop types.
* The correlation matrix heatmap provided insights into the relationships between different variables, helping identify potential patterns and dependencies.
* Histograms displayed the distributions of individual attributes, aiding in understanding their spread and variability.
* Pair plots visually represented the relationships between pairs of variables, with different crop types differentiated by color.

**Data Preprocessing:**

* The data was preprocessed to prepare it for machine learning tasks, including splitting into features (independent variables) and target (dependent variable) sets.
* Standardization was performed on the features using the `StandardScaler` to ensure uniform scaling and prevent any particular feature from dominating the model training process.

**Model Training and Evaluation:**

* Several machine learning algorithms were employed for crop recommendation:

**K-Nearest Neighbors (KNN)**: Utilized for classification based on similarity to neighboring data points.

**Linear Regression:** Employed for predicting crop yields based on environmental and soil attributes.

**Artificial Neural Network (ANN):** Implemented for complex pattern recognition and crop classification.

**K-Means Clustering:** Applied for grouping similar data points into clusters to identify potential crop types.

**Principal Component Analysis (PCA):** Utilized for dimensionality reduction to visualize data in lower dimensions.

* Models were trained using the training dataset and evaluated using appropriate metrics such as accuracy (for classification tasks) and mean squared error (for regression tasks).

**Results and Discussion:**

* The performance of each model was evaluated using metrics such as accuracy and mean squared error.
* The KNN classifier achieved an accuracy of X% in predicting crop types based on environmental attributes.
* Linear regression yielded a mean squared error of X, indicating the model's ability to predict crop yields based on given features.
* The ANN model achieved an accuracy of X% in classifying crop types, demonstrating its effectiveness in capturing complex relationships.
* K-Means clustering identified X clusters within the dataset, providing insights into potential groupings of similar crops.
* PCA visualization showcased the distribution of crops in reduced dimensions, aiding in understanding data patterns and clusters.

**Conclusion and Future Work:**

* The Crop Recommendation System successfully demonstrates the application of machine learning techniques in agriculture for assisting farmers in making informed decisions.
* Future enhancements could include incorporating real-time data, refining models for better accuracy, and integrating additional features such as weather forecasts for more precise recommendations.

**Acknowledgments:**

* We acknowledge the contributions of various open-source libraries such as pandas, scikit-learn, TensorFlow, seaborn, and matplotlib in the development of this project.

**Reference:**

[**Crop Recommendation**](https://storage.googleapis.com/kaggle-data-sets/4933767/8305330/bundle/archive.zip?X-Goog-Algorithm=GOOG4-RSA-SHA256&X-Goog-Credential=gcp-kaggle-com%40kaggle-161607.iam.gserviceaccount.com%2F20240520%2Fauto%2Fstorage%2Fgoog4_request&X-Goog-Date=20240520T143155Z&X-Goog-Expires=259200&X-Goog-SignedHeaders=host&X-Goog-Signature=)