**Model Optimization and Tuning Phase Template**

| Date | July 2024 |
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| Team ID | 739708 |
| Project Title | EcoForecast: AI-powered prediction of carbon monoxide levels |
| Maximum Marks | 10 Marks |

**Model Optimization and Tuning Phase**

The Model Optimization and Tuning Phase involves refining neural network models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

### Hyperparameter Tuning Documentation (8 Marks):

| **Model** | **Tuned Hyperparameters** |
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| Linear Regression | **-** |
| Random Forest Regressor | **-** |
| Decision Tree Regressor | **-** |
| KNN | **-** |
| Logistic Regression | #importing the library for grid search  from sklearn.model\_selection import GridSearchCV  The ‘lr\_param\_grid’ specifies different values for regularization strength (C), solvers (solver), and penalty types (penalty). GridSearchCV (lr\_cv) is employed with 5-fold cross-validation (cv=5), evaluating model performance based on accuracy (scoring="accuracy"). The process uses all available CPU cores (n\_jobs=-1) for parallel processing and provides verbose output (verbose=True) to track progress. |
| Random Forest | The parameter grid (rfc\_param\_grid) for hyperparameter tuning. It specifies different values for the number of trees (n\_estimators), splitting criterion (criterion), maximum depth of trees (max\_depth), and maximum number of features considered for splitting (max\_features). GridSearchCV (rfc\_cv) is employed with 3-fold cross-validation (cv=3), evaluating model performance based on accuracy (scoring="accuracy"). |
| Decision Tree | The parameters (params) define a grid for hyperparameter tuning of the Decision Tree Classifier (DecisionTreeClassifier), including max\_depth, min\_samples\_leaf, and criterion ('gini' or 'entropy'). GridSearchCV (dec\_cv) is used with 5-fold cross-validation (cv=5), evaluating model performance based on accuracy (scoring="accuracy") |
| K- Nearest Neighbors | The parameters (params) define a grid for hyperparameter tuning of the K-Nearest Neighbors Classifier (KNeighborsClassifier), including n\_neighbors, weights ('uniform' or 'distance'), and metric ('minkowski', 'euclidean', or 'manhattan'). GridSearchCV (knn\_cv) is used with 5-fold cross-validation (cv=5), evaluating model performance based on accuracy (scoring="accuracy") |

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### Final Model Selection Justification (2 Marks):

| **Final Model** | **Reasoning** |
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| **KNN**  **(k-nearest neighbor)** | KNN model is chosen for its robustness in handling complex datasets and its ability to mitigate overfitting while providing high predictive accuracy. |