Model Optimization and Tuning Phase Template

Date	July 2024
Team ID	739964
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
Linear Regression	-
Random Forest Regressor	-
Decision Tree Regressor	-
KNN	-

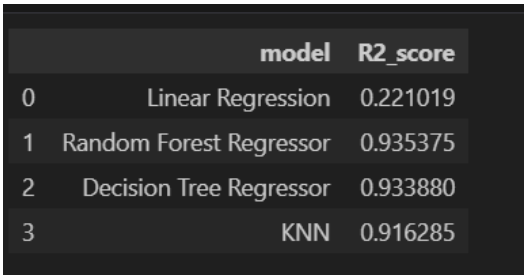
Logistic Regression	#importing the library for grid search
	from sklearn.model_selection import GridSearchCV
	
	The 'lr_param_grid' specifies different values for regularization strength (C), solvers (solver), and penalty types (penalty). GridSearchCV (lr_cv) is employed with 5-fold cross-validation (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.
	
	LOGISTIC REGRESSION HYPER PARAMETER TUNNING
	
	[54] #finding the grid search cv for logistic regression
	lr=LogisticRegression(n_jobs=-1,random_state=0)
	lr_param_grid={
	'C':[0.1,0.5,1,5,10],
	'solver':['liblinear','saga'],
	'penalty':['l1','l2']
	
	}
	lr_cv=GridSearchCV(lr,lr_param_grid,cv=5,scoring="accuracy",n_jobs=-1,verbose=T
	lr_cv.fit(x_train,y_train)
	
	Fitting 5 folds for each of 20 candidates, totalling 100 fits
	/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:1211:
	warnings.warn(
	GridSearchCV
	estimator: LogisticRegression
	LogisticRegression

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").
	
	RANDOM FOREST HYPER PARAMETER TUNNING
	
	[55] #finding the grid search cv for random forest classifier
	rfc=RandomForestClassifier()
	rfc_param_grid={
	'n_estimators':[100,200],
	'criterion':['entropy','gini'],
	'max_depth':[5,10],
	'max_features':['auto','sqrt']
	}
	rfc_cv=GridSearchCV(rfc,rfc_param_grid,cv=3,scoring="accuracy",n_jobs=-1,verbose=3)
	rfc_cv.fit(x_train,y_train)
	
	Fitting 3 folds for each of 16 candidates, totalling 48 fits
	/usr/local/lib/python3.10/dist-packages/sklearn/ensemble/_forest.py:424: FutureWarning:
	warn(
	GridSearchCV
	estimator: RandomForestClassifier
	RandomForestClassifier

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")
	
	DECISION TREE CLASSIFIER-HYPER PARAMETER TUNNING
	
	[68] #finding grid search cv for decision tree classifier
	dec=DecisionTreeClassifier(random_state=42)
	params={ 'max_depth': [2, 3, 5, 10, 20],
	'min_samples_leaf': [5, 10, 20, 50, 100],
	'criterion': ['gini', 'entropy']
	}
	dec_cv=GridSearchCV(dec,param_grid=params,cv=5,n_jobs=-1,scoring="accuracy",verbose=3)
	dec_cv.fit(x_train,y_train)
	
	Fitting 5 folds for each of 50 candidates, totalling 250 fits
	GridSearchCV
	estimator: DecisionTreeClassifier
	DecisionTreeClassifier

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")
	
	K-NEAREST NEIGHBORS-HYPER PARAMETER TUNNING
	
	[69] #finding the grid search cv for k-nearest neighbors
	knn=KNeighborsClassifier()
	params={
	'n_neighbors':[3,5,7,9,11],
	'weights':['uniform','distance'],
	'metric':['minkowski','eculidean','manhattan']
	}
	knn_cv = GridSearchCV(knn, param_grid=params,cv=5, n_jobs=-1, verbose=3)
	knn_cv.fit(x_train, y_train)
	
	GridSearchCV
	estimator: KNeighborsClassifier
	KNeighborsClassifier

Final Model Selection Justification (2 Marks):

Final Model	Reasoning
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. 

	model	R2_score
0	Linear Regression	0.221019
1	Random Forest Regressor	0.935375
2	Decision Tree Regressor	0.933880
3	KNN	0.916285