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+ Code + Markdown ···

Select Kernel

Hyperparameter Tuning / Model Optimization

DT HPT

```
dt.get_params().keys()
```

[178] Python

```
dict_keys(['ccp_alpha', 'class_weight', 'criterion', 'max_depth', 'max_features', 'max_leaf_nodes', 'min_impurity_decrease', 'min_impurity_split',
'min_samples_leaf', 'min_samples_split', 'min_weight_fraction_leaf', 'presort', 'random_state', 'splitter'])
```

```
#example of grid searching key hyperparametres for logistic regression
from sklearn.model_selection import RepeatedStratifiedKFold
from sklearn.model_selection import GridSearchCV

# define models and parameters
model = DecisionTreeClassifier()
criterion = ["gini", "entropy"]
splitter = ["best", "random"]
min_samples_split = [2,4,6,8,10]

# define grid search
grid = dict(splitter=splitter, criterion=criterion, min_samples_split=min_samples_split)
```

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```
# define grid search
grid = dict(splitter=splitter, criterion=criterion, min_samples_split=min_samples_split)
cv = RepeatedStratifiedKFold(n_splits=10, n_repeats=3, random_state=1)
grid_search_dt = GridSearchCV(estimator=model, param_grid=grid, n_jobs=-1, cv=cv,
                              scoring='accuracy',error_score=0, iid=True)
grid_search_dt.fit(X_train, Y_train)

# summarize results
print(f"Best: {grid_search_dt.best_score_:.3f} using {grid_search_dt.best_params_}")
means = grid_search_dt.cv_results_['mean_test_score']
stds = grid_search_dt.cv_results_['std_test_score']
params = grid_search_dt.cv_results_['params']

for mean, stdev, param in zip(means, stds, params):
    print(f"{mean:.3f} ({stdev:.3f}) with: {param}")

print("Training Score:",grid_search_dt.score(X_train, Y_train)*100)
print("Testing Score:", grid_search_dt.score(X_test, Y_test)*100)
```

[216] Python

```
Best: 0.590 using {'criterion': 'gini', 'min_samples_split': 10, 'splitter': 'best'}
0.584 (0.029) with: {'criterion': 'gini', 'min_samples_split': 2, 'splitter': 'best'}
0.569 (0.030) with: {'criterion': 'gini', 'min_samples_split': 2, 'splitter': 'random'}
0.584 (0.028) with: {'criterion': 'gini', 'min_samples_split': 4, 'splitter': 'best'}
0.571 (0.025) with: {'criterion': 'gini', 'min_samples_split': 4, 'splitter': 'random'}
0.588 (0.029) with: {'criterion': 'gini', 'min_samples_split': 6, 'splitter': 'best'}
0.584 (0.031) with: {'criterion': 'gini', 'min_samples_split': 6, 'splitter': 'random'}
```

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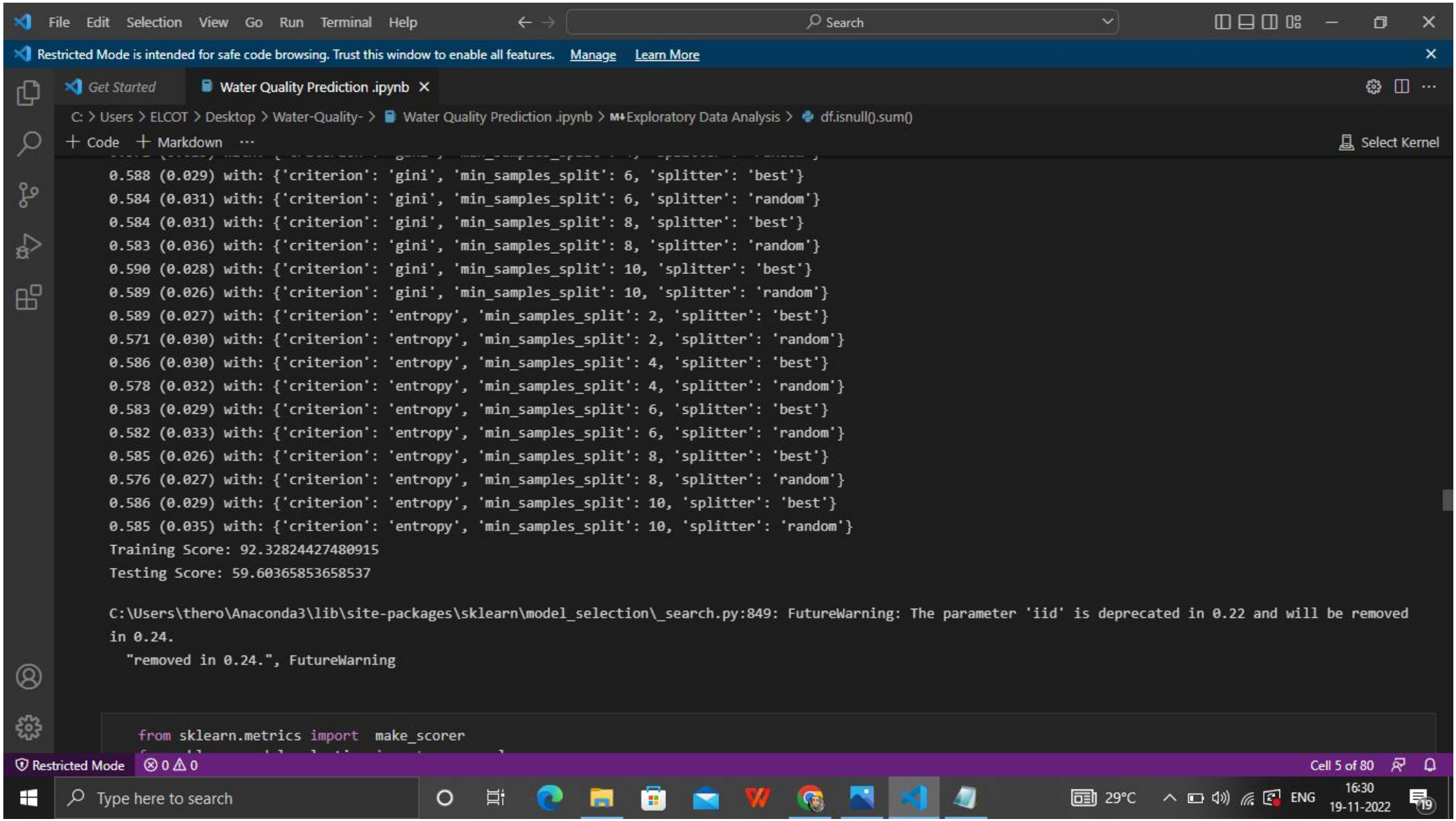
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0.588 (0.029) with: {'criterion': 'gini', 'min_samples_split': 6, 'splitter': 'best'}
0.584 (0.031) with: {'criterion': 'gini', 'min_samples_split': 6, 'splitter': 'random'}
0.584 (0.031) with: {'criterion': 'gini', 'min_samples_split': 8, 'splitter': 'best'}
0.583 (0.036) with: {'criterion': 'gini', 'min_samples_split': 8, 'splitter': 'random'}
0.590 (0.028) with: {'criterion': 'gini', 'min_samples_split': 10, 'splitter': 'best'}
0.589 (0.026) with: {'criterion': 'gini', 'min_samples_split': 10, 'splitter': 'random'}
0.589 (0.027) with: {'criterion': 'entropy', 'min_samples_split': 2, 'splitter': 'best'}
0.571 (0.030) with: {'criterion': 'entropy', 'min_samples_split': 2, 'splitter': 'random'}
0.586 (0.030) with: {'criterion': 'entropy', 'min_samples_split': 4, 'splitter': 'best'}
0.578 (0.032) with: {'criterion': 'entropy', 'min_samples_split': 4, 'splitter': 'random'}
0.583 (0.029) with: {'criterion': 'entropy', 'min_samples_split': 6, 'splitter': 'best'}
0.582 (0.033) with: {'criterion': 'entropy', 'min_samples_split': 6, 'splitter': 'random'}
0.585 (0.026) with: {'criterion': 'entropy', 'min_samples_split': 8, 'splitter': 'best'}
0.576 (0.027) with: {'criterion': 'entropy', 'min_samples_split': 8, 'splitter': 'random'}
0.586 (0.029) with: {'criterion': 'entropy', 'min_samples_split': 10, 'splitter': 'best'}
0.585 (0.035) with: {'criterion': 'entropy', 'min_samples_split': 10, 'splitter': 'random'}
Training Score: 92.32824427480915
Testing Score: 59.60365853658537
C:\Users\thero\Anaconda3\lib\site-packages\sklearn\model_selection_search.py:849: FutureWarning: The parameter 'iid' is deprecated in 0.22 and will be removed in 0.24.
"removed in 0.24.", FutureWarning
from sklearn.metrics import make_scorer
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Select Kernel

```
from sklearn.metrics import  make_scorer
from sklearn.model_selection import cross_val_score

def classification_report_with_accuracy_score(Y_test, y_pred2):
    print (classification_report(Y_test, y_pred2)) # print classification report
    return accuracy_score(Y_test, y_pred2) # return accuracy score


nested_score = cross_val_score(grid_search_dt, X=X_train, y=Y_train, cv=cv,
                               scoring=make_scorer(classification_report_with_accuracy_score))
print (nested_score)
```

[217] Python

```
C:\Users\thero\Anaconda3\lib\site-packages\sklearn\model_selection\_search.py:849: FutureWarning: The parameter 'iid' is deprecated in 0.22 and will be removed in 0.24.
  "removed in 0.24.", FutureWarning

              precision    recall  f1-score   support

           0       0.62      0.68      0.65       159
           1       0.42      0.36      0.39       103

    accuracy                           0.55       262
   macro avg       0.52      0.52      0.52       262
weighted avg       0.54      0.55      0.55       262
```

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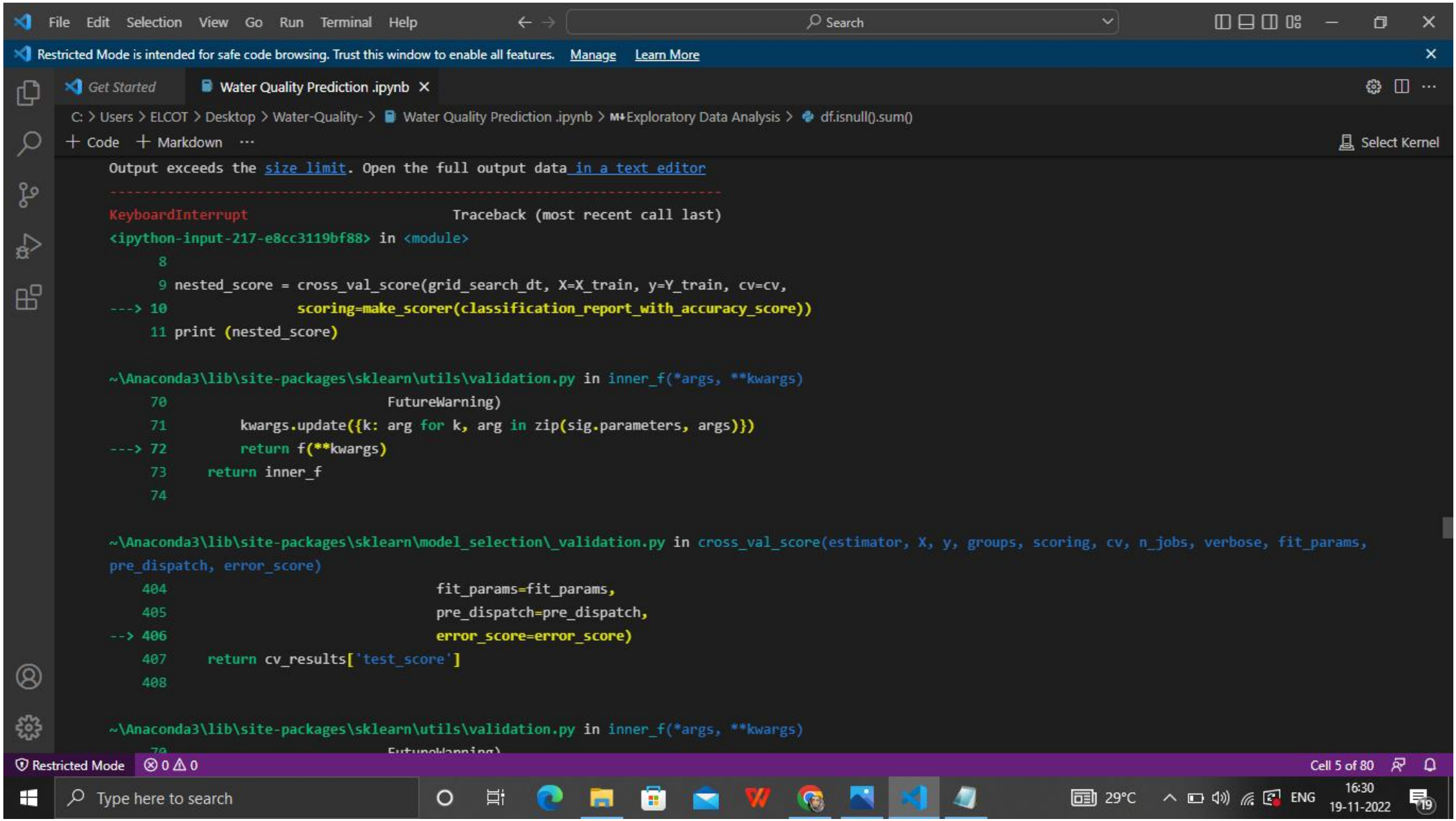
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Output exceeds the size limit. Open the full output data in a text editor
KeyboardInterrupt Traceback (most recent call last)
<ipython-input-217-e8cc3119bf88> in <module>
8
9 nested_score = cross_val_score(grid_search_dt, X=X_train, y=Y_train, cv=cv,
---> 10 scoring=make_scorer(classification_report_with_accuracy_score))
11 print (nested_score)
~\Anaconda3\lib\site-packages\sklearn\utils\validation.py in inner_f(*args, **kwargs)
70 FutureWarning)
71 kwargs.update({k: arg for k, arg in zip(sig.parameters, args)})
---> 72 return f(**kwargs)
73 return inner_f
74
~\Anaconda3\lib\site-packages\sklearn\model_selection_validation.py in cross_val_score(estimator, X, y, groups, scoring, cv, n_jobs, verbose, fit_params, pre_dispatch, error_score)
404 fit_params=fit_params,
405 pre_dispatch=pre_dispatch,
--> 406 error_score=error_score)
407 return cv_results['test_score']
408
~\Anaconda3\lib\site-packages\sklearn\utils\validation.py in inner_f(*args, **kwargs)
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```
~\Anaconda3\lib\site-packages\sklearn\utils\validation.py in inner_f(*args, **kwargs)
     70                          FutureWarning)
     71         kwargs.update({k: arg for k, arg in zip(sig.parameters, args)})
...
--> 296                 waiter.acquire()
    297                 gotit = True
    298             else:

KeyboardInterrupt:
```

```
dt_y_predicted = grid_search_dt.predict(X_test)
dt_y_predicted
```

[218] Python

```
Output exceeds the size limit. Open the full output data in a text editor
array([1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 1,
       1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0,
       0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1,
       0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1,
       0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0,
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       0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1,
       0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0,
```

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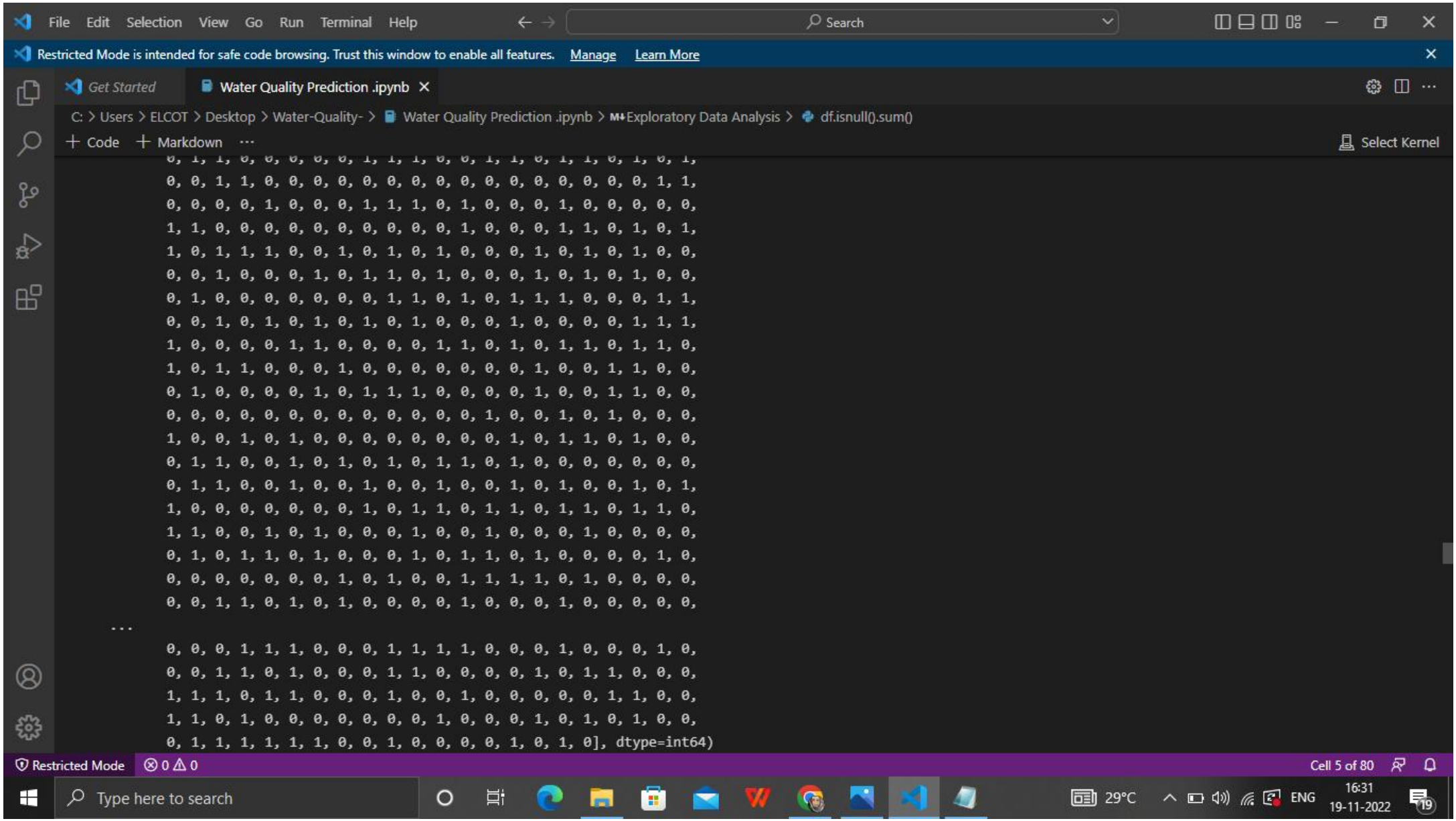
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0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1,
0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0,
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1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0,
0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0], dtype=int64)
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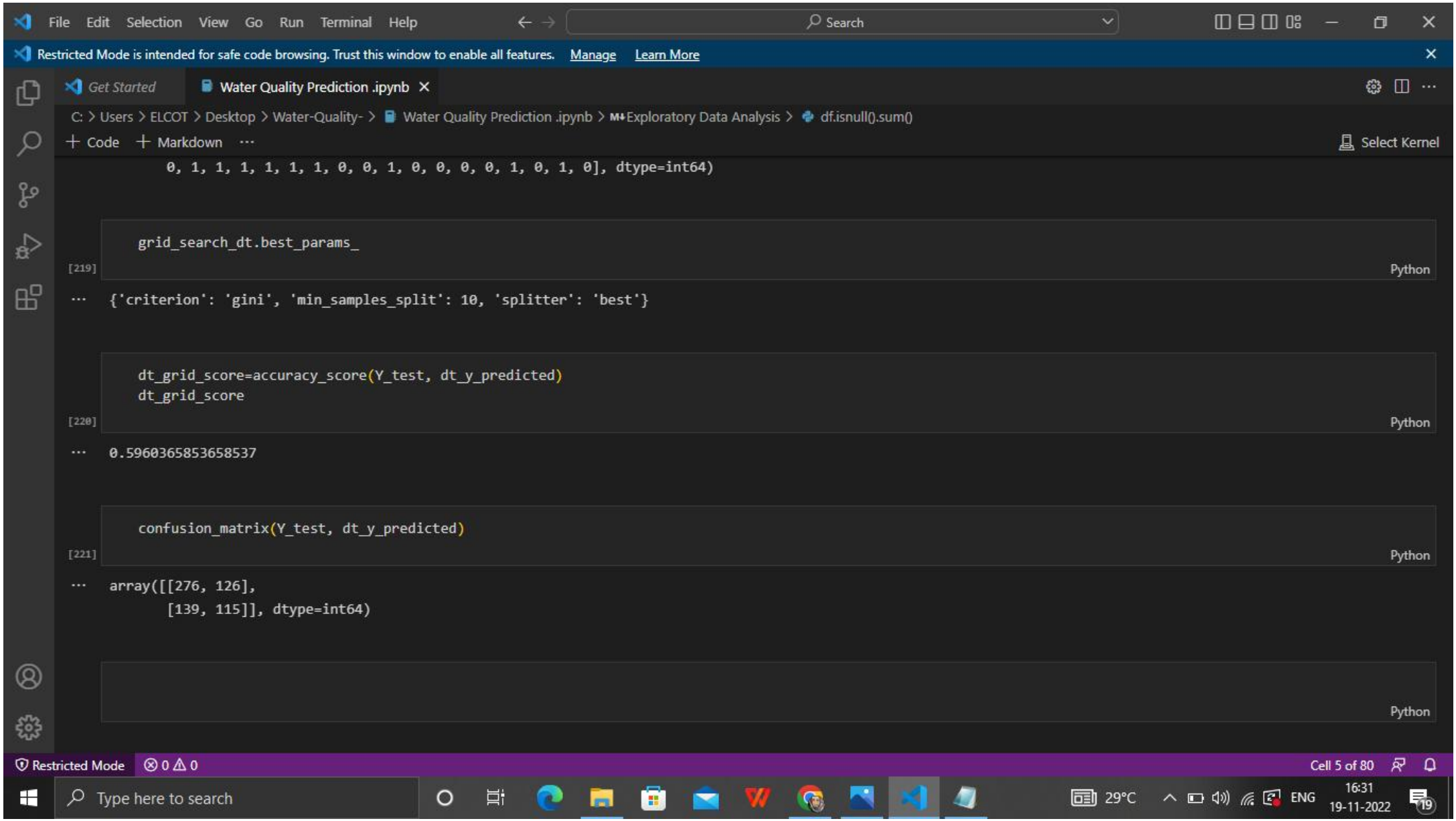
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0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0], dtype=int64)
grid_search_dt.best_params_
[219]
Python
{'criterion': 'gini', 'min_samples_split': 10, 'splitter': 'best'}
dt_grid_score=accuracy_score(Y_test, dt_y_predicted)
dt_grid_score
[220]
Python
0.5960365853658537
confusion_matrix(Y_test, dt_y_predicted)
[221]
Python
array([[276, 126],
[139, 115]], dtype=int64)
Python
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