HW2 Q1

February 4, 2024

In this notebook we explore the performance of thee different classifiers: (DecisionTree, Bagging-Classifier, and RandomForestClassifiers) on financial data, and compare their performance after finding the optimal hyperparameters (using Optuna) and the optimal feature sets (using Shap).

The objective for optimisations will be profit (defined traditionally), and we backl test the performance of the models over the period 2010 - 2018, and finally compute the Sharpe Ratios, Information Ratios and alpha for the three classifier strategies and the buy-and-hold strategy for SPY.

```python
[1]: import pandas as pd
     import numpy as np
     import matplotlib.pyplot as plt
     %matplotlib inline
     from sklearn.metrics import accuracy_score, confusion_matrix
     from sklearn.tree import DecisionTreeClassifier
     from sklearn.ensemble import BaggingClassifier
     from sklearn.ensemble import RandomForestClassifier
     import sklearn
     from sklearn.preprocessing import StandardScaler

     pd.set_option('use_inf_as_na', True)
     from collections import Counter

     from tqdm import tqdm # to measure progress of for loops
```

/var/folders/sp/wlr6xm2979l8vx6kjh2z1dk00000gn/T/ipykernel_2415/524871555.py:12:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  pd.set_option('use_inf_as_na', True)

```python
[2]: # load dataset
     raw_data = pd.read_pickle('dataset.pkl')
     data = raw_data.drop([x  for x in raw_data.columns if 'fqtr' in x],axis=1)
     # restrict companies to market cap > 1 billion
     data = raw_data[raw_data['market_cap'] > 1000.0]
     data = data.copy()
     # fill in missing values
     data.fillna(0.0,inplace=True)
```

0.0.1 Insert a column in dataset based on stock performance

Inserting a column in the dataset where entries are:
- 1 if the stock return is more than 5% higher than the SPY return
- 0 if it is between -10% and +5% relative to the SPY return
- -1 if it is less then -10% relative to the SPY return

```python
[3]: # function to return appropriate values based on performance as detailed above
     def f(x):
         if x > 0.05:
             return 1
         elif x < -0.1:
             return -1
         else:
             return 0
```

```python
[4]: # add the new column
     data['rel_performance'] = data['pred_rel_return'].apply(f)
     # make the date the index
     data.reset_index(inplace=True)
     data.set_index('date',inplace=True)
```

```python
[5]: data[['pred_rel_return', 'rel_performance']][100:110]
```

```
[5]:             pred_rel_return  rel_performance
     date
     2000-04-03         0.261336                1
     2000-04-05        -0.337466               -1
     2000-04-06         0.272372                1
     2000-04-07        -0.645219               -1
     2000-04-07         0.192161                1
     2000-04-11         0.153474                1
     2000-04-11         0.317203                1
     2000-04-11        -0.051039                0
     2000-04-11         0.028730                0
     2000-04-11         0.095712                1
```

```python
[6]: print(data.index)
```

```
DatetimeIndex(['2000-02-09', '2000-02-09', '2000-02-10', '2000-02-11',
               '2000-02-15', '2000-02-16', '2000-02-16', '2000-02-16',
               '2000-02-16', '2000-02-16',
               ...
               '2018-12-21', '2018-12-21', '2018-12-21', '2018-12-21',
               '2018-12-21', '2018-12-21', '2018-12-21', '2018-12-21',
               '2018-12-21', '2018-12-24'],
              dtype='datetime64[ns]', name='date', length=111468, freq=None)
```

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0.0.2 Split the data into training, validation, and test

- Data for training period is from 2007 to 2009 (inclusive, i.e. 3 years)
- Data for validation period is 1 quarter after end of training period
- Data for test period is immediately proceeding the training period

```
[7]: df_1 = data.loc['2007-01-01':'2010-01-01']
     df_valid = data.loc['2010-04-01':'2010-07-01']
     df_test = data.loc['2010-07-01':'2010-10-01']
```

```
[8]: train_1 = df_1.reset_index().drop(['ticker','date',
                                         'next_period_return',
                                         'spy_next_period_return',
                                         'rel_performance','pred_rel_return',
                                         'return', 'cum_ret', 'spy_cum_ret'],axis=1)

     valid = df_valid.reset_index().drop(['ticker','date',
                                          'next_period_return',
                                          'spy_next_period_return',
                                          'rel_performance','pred_rel_return',
                                          'return', 'cum_ret', 'spy_cum_ret'],axis=1)

     test = df_test.reset_index().drop(['ticker','date',
                                        'next_period_return',
                                        'spy_next_period_return',
                                        'rel_performance','pred_rel_return',
                                        'return', 'cum_ret', 'spy_cum_ret'],axis=1)
```

```
[9]: # Obtain the y values for each data split
     train_1_stock_returns = df_1['next_period_return']
     valid_stock_returns = df_valid['next_period_return']
     test_stock_returns = df_test['next_period_return']

     y_1 = df_1['rel_performance']
     y_valid = df_valid['rel_performance']
     y_test = df_test['rel_performance']

     y_1 = y_1.values
     y_valid = y_valid.values
     y_test = y_test.values
```

0.0.3 Import Optuna to find the optimal hyperparameters for the classifiers

```
[10]: import optuna
      from optuna.trial import Trial
      # optuna.logging.set_verbosity(optuna.logging.FATAL)
      import warnings
      warnings.filterwarnings("ignore")
```

0.1 Defining the Optuna objective function for our 3 classifiers:

- DecisionTree classifier
- Bagging classifier
- RandomForest classifier

Note that in each case we are optimizing for the profit rather than the accuracy

```python
def objective_tree(trial:
 Trial,train=None,labels=None,val=None,val_labels=None,val_rets=None):

    t_min_samples_leaf = trial.suggest_int('min_samples_leaf',100,1200,step=200)
    t_max_depth = trial.suggest_int('max_depth',5,25,step=5)

    tree_clf = DecisionTreeClassifier(min_samples_leaf =
 t_min_samples_leaf,max_depth=t_max_depth,random_state=123)
    tree_clf.fit(train,labels)

    preds = tree_clf.predict(val)
    profit = (preds * val_rets).sum()

    return profit
```

```python
def objective_bagging(trial:
 Trial,train=None,labels=None,val=None,val_labels=None,val_rets=None):

    t_min_samples_leaf = trial.suggest_int('min_samples_leaf',100,1200,step=200)
    t_max_depth = trial.suggest_int('max_depth',5,25,step=5)
    t_n_estimators = trial.suggest_int('n_estimators',5,50,step=5)

    t_clf = DecisionTreeClassifier(min_samples_leaf =
 t_min_samples_leaf,max_depth=t_max_depth,random_state=123)
    bg_clf =
 BaggingClassifier(t_clf,n_estimators=t_n_estimators,random_state=123,n_jobs=1)
    bg_clf.fit(train,labels)

    preds = bg_clf.predict(val)
    profit = (preds * val_rets).sum()

    return profit
```

```python
def objective_rf(trial:
 Trial,train=None,labels=None,val=None,val_labels=None,val_rets=None):

    rf_n_estimators = trial.suggest_int('n_estimators', 10,40,step=5)
    rf_max_features = trial.suggest_categorical('max_features',['sqrt','log2'])
    rf_min_samples_leaf = trial.
 suggest_int('min_samples_leaf',800,2400,step=800)
```

```python
    rf_max_depth = trial.suggest_int('max_depth',4,15)

    rf_clf = RandomForestClassifier(n_estimators=rf_n_estimators,
                                    max_depth=rf_max_depth,
                                    min_samples_leaf=rf_min_samples_leaf,
↳max_features=rf_max_features,random_state=123)
    rf_clf.fit(train,labels)

    preds = rf_clf.predict(val)
    profit = (preds * val_rets).sum()

    return profit
```

```python
[14]: study_tree = optuna.create_study(direction="maximize")
      study_bagging = optuna.create_study(direction="maximize")
      study_rf = optuna.create_study(direction="maximize")
```

```
[I 2024-02-04 20:38:13,061] A new study created in memory with name: no-
name-9c8e0ef4-6fad-4938-b3df-43bc4decf7d1
[I 2024-02-04 20:38:13,061] A new study created in memory with name: no-
name-32573266-7473-4929-8fd1-9ea6b5732dfe
[I 2024-02-04 20:38:13,061] A new study created in memory with name: no-name-
dabe04c2-f647-4709-824c-d3b1f871bb0e
```

0.1.1 Run optimizations to find optimal parameters

```python
[15]: from functools import partial
```

```python
[16]: %%time
      study_tree.
      ↳optimize(partial(objective_tree,train=train_1,labels=y_1,val=valid,val_labels=y_valid,val_r
      ↳n_trials=200,n_jobs=-1)
```

```
[I 2024-02-04 20:38:14,225] Trial 8 finished with value: -42.11555900000003 and
parameters: {'min_samples_leaf': 1100, 'max_depth': 15}. Best is trial 8 with
value: -42.11555900000003.
[I 2024-02-04 20:38:14,260] Trial 6 finished with value: -20.87378900000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 5}. Best is trial 6 with
value: -20.87378900000001.
[I 2024-02-04 20:38:14,283] Trial 3 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 15}. Best is trial 6 with
value: -20.87378900000001.
[I 2024-02-04 20:38:14,289] Trial 1 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 6 with
value: -20.87378900000001.
[I 2024-02-04 20:38:14,361] Trial 2 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 15}. Best is trial 6 with
```

value: -20.87378900000001.
[I 2024-02-04 20:38:14,408] Trial 4 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:14,476] Trial 5 finished with value: -24.667206000000032 and
parameters: {'min_samples_leaf': 500, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:14,615] Trial 0 finished with value: -29.37272300000003 and
parameters: {'min_samples_leaf': 300, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:14,630] Trial 9 finished with value: -24.667206000000032 and
parameters: {'min_samples_leaf': 500, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:15,337] Trial 11 finished with value: -25.39247900000003 and
parameters: {'min_samples_leaf': 500, 'max_depth': 5}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:15,375] Trial 13 finished with value: -42.11555900000003 and
parameters: {'min_samples_leaf': 1100, 'max_depth': 5}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:15,511] Trial 16 finished with value: -20.87378900000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 5}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:15,650] Trial 7 finished with value: -23.811000000000046 and
parameters: {'min_samples_leaf': 100, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:15,688] Trial 17 finished with value: -42.11555900000003 and
parameters: {'min_samples_leaf': 1100, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:15,806] Trial 15 finished with value: -29.37272300000003 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:16,045] Trial 14 finished with value: -29.37272300000003 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:16,224] Trial 10 finished with value: -23.811000000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:16,526] Trial 18 finished with value: -23.811000000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:16,652] Trial 12 finished with value: -23.811000000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:16,979] Trial 24 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,021] Trial 23 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:17,039] Trial 22 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,380] Trial 26 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,407] Trial 19 finished with value: -23.811000000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,480] Trial 21 finished with value: -23.811000000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,503] Trial 25 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,659] Trial 27 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,807] Trial 20 finished with value: -23.811000000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:17,969] Trial 28 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,104] Trial 29 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,415] Trial 32 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,417] Trial 33 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,431] Trial 30 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,457] Trial 31 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,611] Trial 35 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,644] Trial 34 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:18,712] Trial 36 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:18,850] Trial 37 finished with value: -33.88995700000003 and parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:19,017] Trial 38 finished with value: -33.88995700000003 and parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:19,225] Trial 39 finished with value: -33.88995700000003 and parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:19,727] Trial 41 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:19,740] Trial 40 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:19,908] Trial 44 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,006] Trial 43 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,037] Trial 45 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,042] Trial 46 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,061] Trial 47 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,216] Trial 48 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,234] Trial 42 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 25}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:20,443] Trial 49 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,130] Trial 51 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,166] Trial 50 finished with value: -24.667206000000032 and parameters: {'min_samples_leaf': 500, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,200] Trial 53 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:21,222] Trial 55 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,232] Trial 52 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,272] Trial 54 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,335] Trial 56 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,426] Trial 57 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,637] Trial 59 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:21,975] Trial 58 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,293] Trial 61 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,388] Trial 62 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,416] Trial 64 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,423] Trial 60 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,442] Trial 65 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,476] Trial 63 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,548] Trial 66 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,612] Trial 67 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with value: -20.46544500000001.
[I 2024-02-04 20:38:22,810] Trial 68 finished with value: -20.46544500000001 and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:23,453] Trial 70 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,482] Trial 69 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,539] Trial 74 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,595] Trial 73 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,633] Trial 75 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,633] Trial 76 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,692] Trial 72 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,725] Trial 77 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,805] Trial 71 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:23,843] Trial 78 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:24,524] Trial 79 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:24,604] Trial 81 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:24,801] Trial 82 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:24,831] Trial 80 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:24,861] Trial 85 finished with value: -33.88995700000003 and
parameters: {'min_samples_leaf': 900, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:24,934] Trial 83 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:24,977] Trial 86 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:25,127] Trial 84 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:25,242] Trial 88 finished with value: -29.37272300000003 and
parameters: {'min_samples_leaf': 300, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:25,257] Trial 87 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:25,825] Trial 90 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,021] Trial 91 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,071] Trial 89 finished with value: -29.37272300000003 and
parameters: {'min_samples_leaf': 300, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,083] Trial 93 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,130] Trial 94 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,210] Trial 92 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,312] Trial 95 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,426] Trial 96 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,506] Trial 97 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:26,594] Trial 98 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,116] Trial 99 finished with value: -20.46544500000001 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,209] Trial 101 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:27,215] Trial 102 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,322] Trial 103 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,351] Trial 100 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,537] Trial 105 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,797] Trial 108 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,809] Trial 106 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,862] Trial 104 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:27,885] Trial 107 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,476] Trial 111 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,477] Trial 112 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,517] Trial 113 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,536] Trial 110 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,605] Trial 109 finished with value: -24.667206000000032
and parameters: {'min_samples_leaf': 500, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,680] Trial 114 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:28,959] Trial 116 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,037] Trial 118 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:29,086] Trial 115 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,511] Trial 117 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,655] Trial 120 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,712] Trial 119 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,754] Trial 121 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,835] Trial 123 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,852] Trial 124 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:29,918] Trial 122 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 10}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:30,116] Trial 125 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:30,268] Trial 127 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:30,329] Trial 126 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:30,793] Trial 129 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:30,870] Trial 130 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:30,999] Trial 132 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:31,014] Trial 128 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:31,062] Trial 133 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:31,080] Trial 131 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:31,151] Trial 134 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:31,287] Trial 136 finished with value: -42.11555900000003
and parameters: {'min_samples_leaf': 1100, 'max_depth': 15}. Best is trial 4
with value: -20.46544500000001.
[I 2024-02-04 20:38:31,346] Trial 135 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:31,556] Trial 137 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:31,699] Trial 138 finished with value: -42.11555900000003
and parameters: {'min_samples_leaf': 1100, 'max_depth': 15}. Best is trial 4
with value: -20.46544500000001.
[I 2024-02-04 20:38:31,993] Trial 139 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,240] Trial 143 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,279] Trial 142 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,387] Trial 140 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,409] Trial 144 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,507] Trial 145 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,538] Trial 146 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,690] Trial 141 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,823] Trial 147 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:32,860] Trial 148 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:33,116] Trial 149 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,431] Trial 150 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,531] Trial 151 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,574] Trial 153 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,644] Trial 152 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,813] Trial 154 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,852] Trial 155 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:33,984] Trial 157 finished with value: -20.87378900000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 5}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,036] Trial 156 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,051] Trial 158 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,273] Trial 159 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,650] Trial 160 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,796] Trial 161 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,847] Trial 163 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,879] Trial 162 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:34,944] Trial 165 finished with value: -20.87378900000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 5}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:34,989] Trial 164 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:35,165] Trial 166 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:35,230] Trial 167 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:35,311] Trial 168 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:35,568] Trial 169 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:35,861] Trial 170 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,008] Trial 171 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,138] Trial 172 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,268] Trial 175 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,279] Trial 174 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,315] Trial 173 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,371] Trial 176 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,501] Trial 177 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,597] Trial 178 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:36,967] Trial 179 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,121] Trial 180 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:37,169] Trial 181 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,374] Trial 182 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,564] Trial 186 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,593] Trial 185 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,633] Trial 184 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,635] Trial 183 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,682] Trial 187 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:37,854] Trial 188 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,213] Trial 189 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,334] Trial 190 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,351] Trial 191 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,540] Trial 192 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,731] Trial 193 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 15}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,747] Trial 195 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,816] Trial 194 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,830] Trial 197 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with

value: -20.46544500000001.
[I 2024-02-04 20:38:38,875] Trial 196 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 25}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:38,933] Trial 198 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.
[I 2024-02-04 20:38:39,249] Trial 199 finished with value: -20.46544500000001
and parameters: {'min_samples_leaf': 700, 'max_depth': 20}. Best is trial 4 with
value: -20.46544500000001.

CPU times: user 3min 48s, sys: 2.72 s, total: 3min 51s
Wall time: 26.2 s

```
[17]: %%time
      study_bagging.
      ↪optimize(partial(objective_bagging,train=train_1,labels=y_1,val=valid,val_labels=y_valid,va
      ↪n_trials=200,n_jobs=-1)
```

[I 2024-02-04 20:38:43,087] Trial 9 finished with value: -33.29038000000004 and
parameters: {'min_samples_leaf': 300, 'max_depth': 5, 'n_estimators': 5}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:38:44,820] Trial 0 finished with value: -37.487501000000044 and
parameters: {'min_samples_leaf': 900, 'max_depth': 10, 'n_estimators': 10}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:38:48,573] Trial 3 finished with value: -34.22570200000003 and
parameters: {'min_samples_leaf': 700, 'max_depth': 5, 'n_estimators': 15}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:38:50,427] Trial 1 finished with value: -38.103020000000036 and
parameters: {'min_samples_leaf': 900, 'max_depth': 5, 'n_estimators': 20}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:38:51,806] Trial 6 finished with value: -34.67733300000003 and
parameters: {'min_samples_leaf': 700, 'max_depth': 15, 'n_estimators': 20}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:38:56,828] Trial 4 finished with value: -39.066652000000026 and
parameters: {'min_samples_leaf': 1100, 'max_depth': 20, 'n_estimators': 35}.
Best is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:38:58,185] Trial 8 finished with value: -35.50093700000003 and
parameters: {'min_samples_leaf': 700, 'max_depth': 20, 'n_estimators': 30}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:39:02,119] Trial 12 finished with value: -38.14073200000004 and
parameters: {'min_samples_leaf': 900, 'max_depth': 15, 'n_estimators': 25}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:39:03,578] Trial 5 finished with value: -38.74424600000003 and
parameters: {'min_samples_leaf': 500, 'max_depth': 5, 'n_estimators': 35}. Best
is trial 9 with value: -33.29038000000004.
[I 2024-02-04 20:39:08,115] Trial 10 finished with value: -28.781955000000053
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 20}.
Best is trial 10 with value: -28.781955000000053.

[I 2024-02-04 20:39:08,269] Trial 16 finished with value: -38.52192300000003 and parameters: {'min_samples_leaf': 1100, 'max_depth': 20, 'n_estimators': 20}. Best is trial 10 with value: -28.781955000000053.
[I 2024-02-04 20:39:12,484] Trial 7 finished with value: -38.11762600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 15, 'n_estimators': 45}. Best is trial 10 with value: -28.781955000000053.
[I 2024-02-04 20:39:14,639] Trial 17 finished with value: -39.032059000000025 and parameters: {'min_samples_leaf': 1100, 'max_depth': 15, 'n_estimators': 25}. Best is trial 10 with value: -28.781955000000053.
[I 2024-02-04 20:39:15,766] Trial 2 finished with value: -37.868225000000024 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 50}. Best is trial 10 with value: -28.781955000000053.
[I 2024-02-04 20:39:18,471] Trial 13 finished with value: -37.343960000000024 and parameters: {'min_samples_leaf': 700, 'max_depth': 20, 'n_estimators': 45}. Best is trial 10 with value: -28.781955000000053.
[I 2024-02-04 20:39:18,589] Trial 21 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:20,305] Trial 18 finished with value: -38.65281800000003 and parameters: {'min_samples_leaf': 900, 'max_depth': 25, 'n_estimators': 30}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:20,905] Trial 22 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:21,899] Trial 23 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:24,699] Trial 24 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:24,823] Trial 25 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:26,515] Trial 26 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:27,065] Trial 27 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:27,289] Trial 11 finished with value: -30.705330000000068 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:30,699] Trial 28 finished with value: -32.36191500000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:33,660] Trial 30 finished with value: -32.36191500000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.

[I 2024-02-04 20:39:34,031] Trial 29 finished with value: -32.36191500000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:34,850] Trial 32 finished with value: -33.74813800000003 and parameters: {'min_samples_leaf': 300, 'max_depth': 5, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:35,360] Trial 33 finished with value: -33.74813800000003 and parameters: {'min_samples_leaf': 300, 'max_depth': 5, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:35,916] Trial 31 finished with value: -32.36191500000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:38,163] Trial 15 finished with value: -36.52820600000003 and parameters: {'min_samples_leaf': 300, 'max_depth': 25, 'n_estimators': 45}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:38,452] Trial 34 finished with value: -33.74813800000003 and parameters: {'min_samples_leaf': 300, 'max_depth': 5, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:45,099] Trial 35 finished with value: -35.95071500000003 and parameters: {'min_samples_leaf': 300, 'max_depth': 5, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:45,472] Trial 36 finished with value: -35.95071500000003 and parameters: {'min_samples_leaf': 300, 'max_depth': 5, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:48,027] Trial 14 finished with value: -30.60352800000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 45}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:48,219] Trial 37 finished with value: -34.64956300000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 15, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:51,669] Trial 43 finished with value: -27.16182000000004 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:53,839] Trial 38 finished with value: -29.85468000000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:54,064] Trial 44 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:54,350] Trial 39 finished with value: -29.85468000000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:54,394] Trial 45 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:56,505] Trial 40 finished with value: -29.85468000000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.

[I 2024-02-04 20:39:56,692] Trial 41 finished with value: -29.85468000000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:57,465] Trial 47 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:57,865] Trial 48 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:57,886] Trial 46 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:58,009] Trial 50 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:39:58,116] Trial 49 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:00,165] Trial 51 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:00,381] Trial 52 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:01,098] Trial 53 finished with value: -35.64506600000003 and parameters: {'min_samples_leaf': 500, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:03,696] Trial 42 finished with value: -29.85468000000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 15}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:03,915] Trial 54 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:04,170] Trial 55 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:06,656] Trial 56 finished with value: -30.487178000000036 and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:06,887] Trial 57 finished with value: -30.487178000000036 and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:08,000] Trial 20 finished with value: -30.42339100000006 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 50}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:08,864] Trial 58 finished with value: -30.487178000000036 and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.

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[I 2024-02-04 20:40:09,689] Trial 60 finished with value: -30.487178000000036
and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:10,728] Trial 19 finished with value: -30.991596000000058
and parameters: {'min_samples_leaf': 100, 'max_depth': 25, 'n_estimators': 50}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:11,923] Trial 61 finished with value: -30.487178000000036
and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:12,592] Trial 62 finished with value: -30.487178000000036
and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:12,749] Trial 63 finished with value: -30.487178000000036
and parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:18,030] Trial 72 finished with value: -33.63191400000004 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 5}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:18,456] Trial 70 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:19,012] Trial 71 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:22,473] Trial 68 finished with value: -29.53389800000005 and
parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:29,075] Trial 69 finished with value: -34.92127500000005 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 20}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:41,749] Trial 64 finished with value: -34.96292600000004 and
parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 40}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:45,026] Trial 59 finished with value: -34.82065200000004 and
parameters: {'min_samples_leaf': 100, 'max_depth': 5, 'n_estimators': 50}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:46,647] Trial 78 finished with value: -33.63191400000004 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 5}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:47,686] Trial 75 finished with value: -37.84667800000004 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 30}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:48,300] Trial 79 finished with value: -37.62985300000004 and
parameters: {'min_samples_leaf': 700, 'max_depth': 10, 'n_estimators': 5}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:49,805] Trial 80 finished with value: -37.62985300000004 and
parameters: {'min_samples_leaf': 700, 'max_depth': 10, 'n_estimators': 5}. Best
is trial 21 with value: -26.708862000000046.
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[I 2024-02-04 20:40:54,175] Trial 81 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:54,773] Trial 82 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:56,010] Trial 77 finished with value: -37.89145300000003 and
parameters: {'min_samples_leaf': 700, 'max_depth': 10, 'n_estimators': 40}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:56,373] Trial 83 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:56,456] Trial 74 finished with value: -30.670912000000058
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 30}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:57,463] Trial 65 finished with value: -30.417995000000058
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 40}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:58,681] Trial 67 finished with value: -30.417995000000058
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 40}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:59,025] Trial 76 finished with value: -35.67529200000003 and
parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 40}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:40:59,324] Trial 66 finished with value: -30.417995000000058
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 40}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:00,304] Trial 84 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:06,084] Trial 92 finished with value: -27.16182000000004 and
parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 5}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:09,207] Trial 73 finished with value: -30.417995000000058
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 40}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:09,901] Trial 88 finished with value: -28.08505900000005 and
parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:10,021] Trial 87 finished with value: -28.08505900000005 and
parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:11,243] Trial 89 finished with value: -28.08505900000005 and
parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best
is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:12,175] Trial 90 finished with value: -28.08505900000005 and
parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best
is trial 21 with value: -26.708862000000046.

[I 2024-02-04 20:41:12,684] Trial 91 finished with value: -28.08505900000005 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:12,735] Trial 97 finished with value: -38.27588400000003 and parameters: {'min_samples_leaf': 1100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:13,921] Trial 93 finished with value: -28.08505900000005 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:15,174] Trial 95 finished with value: -37.487501000000044 and parameters: {'min_samples_leaf': 900, 'max_depth': 15, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:15,943] Trial 98 finished with value: -33.63191400000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:16,883] Trial 99 finished with value: -33.63191400000004 and parameters: {'min_samples_leaf': 300, 'max_depth': 20, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:18,999] Trial 100 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:19,458] Trial 101 finished with value: -27.16182000000004 and parameters: {'min_samples_leaf': 100, 'max_depth': 20, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:19,518] Trial 94 finished with value: -28.08505900000005 and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:20,278] Trial 102 finished with value: -27.16182000000004 and parameters: {'min_samples_leaf': 100, 'max_depth': 20, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:21,905] Trial 103 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:22,715] Trial 104 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:22,806] Trial 96 finished with value: -29.53389800000005 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:23,586] Trial 105 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:25,443] Trial 106 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:25,752] Trial 107 finished with value: -26.708862000000046 and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}. Best is trial 21 with value: -26.708862000000046.

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[I 2024-02-04 20:41:26,087] Trial 108 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:28,256] Trial 86 finished with value: -29.802219000000047
and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 25}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:28,509] Trial 110 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:28,985] Trial 85 finished with value: -29.802219000000047
and parameters: {'min_samples_leaf': 100, 'max_depth': 15, 'n_estimators': 25}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:29,041] Trial 112 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:29,091] Trial 111 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:30,248] Trial 113 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:31,693] Trial 114 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:32,149] Trial 115 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:32,302] Trial 116 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:34,522] Trial 117 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:34,749] Trial 118 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:35,146] Trial 120 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:35,201] Trial 121 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:35,361] Trial 119 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:36,350] Trial 122 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
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[I 2024-02-04 20:41:37,865] Trial 123 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:38,459] Trial 125 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:38,536] Trial 124 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:39,089] Trial 126 finished with value: -33.63191400000004
and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:43,799] Trial 127 finished with value: -32.36191500000004
and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:48,795] Trial 128 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:49,842] Trial 131 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:50,785] Trial 132 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:51,167] Trial 133 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:51,672] Trial 109 finished with value: -30.073145000000054
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 25}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:51,762] Trial 134 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:51,889] Trial 135 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:53,533] Trial 129 finished with value: -34.92127500000005
and parameters: {'min_samples_leaf': 300, 'max_depth': 10, 'n_estimators': 20}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:56,084] Trial 138 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:56,768] Trial 136 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:57,442] Trial 139 finished with value: -27.16182000000004
and parameters: {'min_samples_leaf': 100, 'max_depth': 25, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
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[I 2024-02-04 20:41:57,701] Trial 140 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:58,608] Trial 142 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:58,787] Trial 143 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:41:59,198] Trial 141 finished with value: -27.16182000000004
and parameters: {'min_samples_leaf': 100, 'max_depth': 25, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:00,807] Trial 144 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:01,557] Trial 148 finished with value: -38.44684100000005
and parameters: {'min_samples_leaf': 900, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:02,522] Trial 150 finished with value: -38.44684100000005
and parameters: {'min_samples_leaf': 900, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:03,815] Trial 145 finished with value: -27.16182000000004
and parameters: {'min_samples_leaf': 100, 'max_depth': 25, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:04,267] Trial 152 finished with value: -38.44684100000005
and parameters: {'min_samples_leaf': 900, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:04,670] Trial 146 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:05,180] Trial 147 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:06,554] Trial 151 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:07,194] Trial 149 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:09,123] Trial 153 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:11,489] Trial 155 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:12,010] Trial 156 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.

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[I 2024-02-04 20:42:12,773] Trial 158 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:14,528] Trial 160 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:18,677] Trial 162 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:18,857] Trial 163 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:19,492] Trial 164 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:21,659] Trial 165 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:23,064] Trial 130 finished with value: -30.705330000000068
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:26,218] Trial 167 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:26,415] Trial 166 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:26,732] Trial 168 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:28,627] Trial 169 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:30,419] Trial 170 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:32,879] Trial 171 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:33,019] Trial 172 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:33,680] Trial 173 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:35,229] Trial 174 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
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[I 2024-02-04 20:42:36,725] Trial 175 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:36,826] Trial 137 finished with value: -30.705330000000068
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:39,074] Trial 176 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:39,140] Trial 177 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:39,790] Trial 178 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:41,575] Trial 179 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:42,796] Trial 180 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:43,070] Trial 181 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:45,315] Trial 182 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:45,419] Trial 183 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:45,999] Trial 184 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:48,163] Trial 185 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:49,100] Trial 154 finished with value: -30.705330000000068
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:49,171] Trial 187 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:49,772] Trial 186 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:51,550] Trial 157 finished with value: -30.705330000000068
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}.
Best is trial 21 with value: -26.708862000000046.
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[I 2024-02-04 20:42:52,010] Trial 159 finished with value: -30.705330000000068
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:52,226] Trial 190 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:54,294] Trial 191 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:54,494] Trial 161 finished with value: -30.705330000000068
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 35}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:55,467] Trial 193 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:55,532] Trial 192 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:56,268] Trial 194 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:57,417] Trial 195 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:57,446] Trial 188 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:57,718] Trial 189 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:42:57,868] Trial 196 finished with value: -26.708862000000046
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 5}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:43:02,906] Trial 197 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:43:04,754] Trial 198 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.
[I 2024-02-04 20:43:05,056] Trial 199 finished with value: -29.53389800000005
and parameters: {'min_samples_leaf': 100, 'max_depth': 10, 'n_estimators': 10}.
Best is trial 21 with value: -26.708862000000046.

CPU times: user 38min 43s, sys: 15 s, total: 38min 58s
Wall time: 4min 25s
```

[18]:
```
%%time
```

```
study_rf.
 ↪optimize(partial(objective_rf,train=train_1,labels=y_1,val=valid,val_labels=y_valid,val_ret
 ↪n_trials=200,n_jobs=-1)
```

[I 2024-02-04 20:43:05,336] Trial 4 finished with value: -40.74410800000003 and
parameters: {'n_estimators': 15, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 11}. Best is trial 4 with value: -40.74410800000003.
[I 2024-02-04 20:43:05,346] Trial 6 finished with value: -39.25296700000003 and
parameters: {'n_estimators': 10, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 6}. Best is trial 6 with value: -39.25296700000003.
[I 2024-02-04 20:43:05,413] Trial 8 finished with value: -40.00959700000004 and
parameters: {'n_estimators': 10, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 15}. Best is trial 6 with value: -39.25296700000003.
[I 2024-02-04 20:43:05,451] Trial 9 finished with value: -37.859784000000026 and
parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 15}. Best is trial 9 with value: -37.859784000000026.
[I 2024-02-04 20:43:05,464] Trial 7 finished with value: -38.53366700000004 and
parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf':
2400, 'max_depth': 11}. Best is trial 9 with value: -37.859784000000026.
[I 2024-02-04 20:43:05,491] Trial 3 finished with value: -40.77534300000005 and
parameters: {'n_estimators': 25, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 14}. Best is trial 9 with value: -37.859784000000026.
[I 2024-02-04 20:43:05,586] Trial 1 finished with value: -40.466121000000044 and
parameters: {'n_estimators': 35, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 9 with value: -37.859784000000026.
[I 2024-02-04 20:43:05,638] Trial 13 finished with value: -40.13517700000003 and
parameters: {'n_estimators': 10, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 13}. Best is trial 9 with value: -37.859784000000026.
[I 2024-02-04 20:43:05,676] Trial 0 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:05,729] Trial 5 finished with value: -41.546579000000044 and
parameters: {'n_estimators': 40, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 12}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:05,739] Trial 2 finished with value: -41.546579000000044 and
parameters: {'n_estimators': 40, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 10}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:05,774] Trial 12 finished with value: -40.00959700000004 and
parameters: {'n_estimators': 10, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 10}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:05,951] Trial 10 finished with value: -37.08585400000004 and
parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 7}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:05,966] Trial 14 finished with value: -40.466121000000044
and parameters: {'n_estimators': 35, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 14}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,059] Trial 11 finished with value: -40.38669600000003 and
parameters: {'n_estimators': 40, 'max_features': 'sqrt', 'min_samples_leaf':

2400, 'max_depth': 9}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,109] Trial 20 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 7}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,154] Trial 21 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 7}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,262] Trial 16 finished with value: -39.79917200000003 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 8}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,287] Trial 17 finished with value: -41.546579000000044
and parameters: {'n_estimators': 40, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 12}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,346] Trial 19 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 0 with value: -35.91543100000004.
[I 2024-02-04 20:43:06,406] Trial 15 finished with value: -35.43491800000005 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 15}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,450] Trial 23 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,558] Trial 22 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,577] Trial 24 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,680] Trial 25 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,771] Trial 26 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,849] Trial 28 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,878] Trial 27 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,892] Trial 18 finished with value: -36.93486700000005 and
parameters: {'n_estimators': 40, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 12}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,969] Trial 30 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:06,973] Trial 29 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,058] Trial 31 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,100] Trial 34 finished with value: -38.34989700000003 and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,190] Trial 35 finished with value: -38.34989700000003 and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,245] Trial 33 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,276] Trial 36 finished with value: -38.34989700000003 and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,323] Trial 32 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,353] Trial 37 finished with value: -38.34989700000003 and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,374] Trial 38 finished with value: -38.34989700000003 and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,668] Trial 39 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,717] Trial 40 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,770] Trial 41 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,829] Trial 46 finished with value: -40.419880000000035 and parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf': 800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,832] Trial 42 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,889] Trial 48 finished with value: -40.419880000000035 and parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf': 800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,910] Trial 47 finished with value: -40.419880000000035 and parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf': 800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:07,915] Trial 43 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,009] Trial 44 finished with value: -36.93703500000004 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,109] Trial 49 finished with value: -41.43783800000004 and
parameters: {'n_estimators': 20, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,118] Trial 50 finished with value: -41.43783800000004 and
parameters: {'n_estimators': 20, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,213] Trial 51 finished with value: -41.43783800000004 and
parameters: {'n_estimators': 20, 'max_features': 'log2', 'min_samples_leaf':
800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,239] Trial 45 finished with value: -35.43491800000005 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,316] Trial 54 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,319] Trial 56 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,361] Trial 55 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,443] Trial 57 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,518] Trial 53 finished with value: -37.08585400000004 and
parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,533] Trial 52 finished with value: -37.08585400000004 and
parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,556] Trial 58 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,591] Trial 59 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 11}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:08,677] Trial 60 finished with value: -37.859784000000026
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
2400, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,238] Trial 61 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,321] Trial 63 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':

800, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,350] Trial 62 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 11}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,388] Trial 64 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,427] Trial 70 finished with value: -38.40820800000004 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,469] Trial 65 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 11}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,507] Trial 67 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 11}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,536] Trial 66 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 11}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,571] Trial 68 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 11}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,632] Trial 69 finished with value: -36.00826400000005 and
parameters: {'n_estimators': 35, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 14}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,832] Trial 71 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,905] Trial 72 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,971] Trial 74 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 13}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:09,975] Trial 73 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,057] Trial 76 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 14}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,106] Trial 75 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 15}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,132] Trial 77 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 15}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,176] Trial 79 finished with value: -35.91543100000004 and
parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,207] Trial 78 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 14}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,237] Trial 80 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,449] Trial 81 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,538] Trial 82 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 15}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,602] Trial 84 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,658] Trial 83 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,681] Trial 85 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,733] Trial 86 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,772] Trial 87 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,800] Trial 88 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,849] Trial 90 finished with value: -35.91543100000004 and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:10,943] Trial 89 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,159] Trial 91 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,218] Trial 97 finished with value: -38.08497900000005 and parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,263] Trial 99 finished with value: -38.08497900000005 and parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf': 1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,277] Trial 92 finished with value: -36.93703500000004 and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,295] Trial 98 finished with value: -38.08497900000005 and
parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,378] Trial 93 finished with value: -36.93703500000004 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,425] Trial 94 finished with value: -36.93703500000004 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 6}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,468] Trial 95 finished with value: -36.93703500000004 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,512] Trial 96 finished with value: -36.93703500000004 and
parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,629] Trial 101 finished with value: -38.08497900000005
and parameters: {'n_estimators': 30, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,658] Trial 100 finished with value: -36.93703500000004
and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,725] Trial 103 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,731] Trial 105 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,752] Trial 104 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,813] Trial 106 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,855] Trial 107 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,926] Trial 108 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:11,959] Trial 109 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,035] Trial 102 finished with value: -36.93703500000004
and parameters: {'n_estimators': 30, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 5}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,060] Trial 110 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,102] Trial 111 finished with value: -38.34989700000003
and parameters: {'n_estimators': 15, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,238] Trial 113 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,282] Trial 112 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,299] Trial 114 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,339] Trial 115 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,414] Trial 116 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,466] Trial 118 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,537] Trial 119 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,575] Trial 117 finished with value: -35.91543100000004
and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,687] Trial 121 finished with value: -35.91543100000004
and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,717] Trial 120 finished with value: -35.91543100000004
and parameters: {'n_estimators': 25, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,796] Trial 123 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,810] Trial 122 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,815] Trial 124 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,899] Trial 125 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,932] Trial 126 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:12,995] Trial 127 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,023] Trial 128 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,168] Trial 129 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,228] Trial 130 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,264] Trial 131 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,330] Trial 132 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,337] Trial 134 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,381] Trial 133 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,419] Trial 135 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,460] Trial 136 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,544] Trial 138 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,560] Trial 137 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 13}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,821] Trial 139 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,852] Trial 140 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,921] Trial 141 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:13,968] Trial 142 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,033] Trial 143 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,045] Trial 144 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,078] Trial 145 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,100] Trial 146 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,232] Trial 147 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,294] Trial 148 finished with value: -37.08585400000004
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,365] Trial 150 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,457] Trial 151 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,495] Trial 149 finished with value: -37.08585400000004
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 10}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,498] Trial 152 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,585] Trial 153 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,690] Trial 154 finished with value: -37.08585400000004
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,733] Trial 155 finished with value: -37.08585400000004
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,767] Trial 156 finished with value: -37.08585400000004
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,793] Trial 158 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 8}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,878] Trial 159 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,913] Trial 157 finished with value: -37.08585400000004
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
800, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:14,962] Trial 160 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,014] Trial 162 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,038] Trial 161 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,107] Trial 163 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,224] Trial 164 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,262] Trial 165 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,311] Trial 167 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,333] Trial 166 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,418] Trial 168 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,454] Trial 169 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,501] Trial 170 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,538] Trial 171 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,569] Trial 172 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,657] Trial 173 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,773] Trial 174 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,805] Trial 178 finished with value: -38.31717400000004
and parameters: {'n_estimators': 20, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,805] Trial 180 finished with value: -39.25296700000003
and parameters: {'n_estimators': 10, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,820] Trial 175 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,894] Trial 176 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:15,936] Trial 177 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,025] Trial 179 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,039] Trial 183 finished with value: -38.31717400000004
and parameters: {'n_estimators': 20, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,119] Trial 181 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,165] Trial 182 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,380] Trial 185 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,381] Trial 186 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,394] Trial 187 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 4}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,410] Trial 184 finished with value: -42.63119100000003
and parameters: {'n_estimators': 40, 'max_features': 'log2', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,460] Trial 188 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 12}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,485] Trial 189 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,584] Trial 191 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':

1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,591] Trial 190 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,660] Trial 193 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,852] Trial 195 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,879] Trial 197 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,888] Trial 198 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,907] Trial 199 finished with value: -35.548178000000036
and parameters: {'n_estimators': 20, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 9}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:16,924] Trial 192 finished with value: -37.329935000000035
and parameters: {'n_estimators': 40, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 7}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:17,140] Trial 196 finished with value: -37.329935000000035
and parameters: {'n_estimators': 40, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 12}. Best is trial 15 with value: -35.43491800000005.
[I 2024-02-04 20:43:17,141] Trial 194 finished with value: -37.329935000000035
and parameters: {'n_estimators': 40, 'max_features': 'sqrt', 'min_samples_leaf':
1600, 'max_depth': 12}. Best is trial 15 with value: -35.43491800000005.

CPU times: user 1min 14s, sys: 5 s, total: 1min 19s
Wall time: 12.1 s

0.1.2 Instantiate the classifiers with the best parameters

```
[19]: print("Best parameters for decision tree: ", study_tree.best_params)
      print("Best parameters for bagging: ", study_bagging.best_params)
      print("Best parameters for random forest: ", study_rf.best_params)
```

Best parameters for decision tree: {'min_samples_leaf': 700, 'max_depth': 25}
Best parameters for bagging: {'min_samples_leaf': 100, 'max_depth': 10,
'n_estimators': 5}
Best parameters for random forest: {'n_estimators': 30, 'max_features': 'sqrt',
'min_samples_leaf': 800, 'max_depth': 15}

```
[20]: t_clf = DecisionTreeClassifier(**study_tree.best_params,random_state=123)
```

```
[21]: tree_cfl = DecisionTreeClassifier(**{'min_samples_leaf': study_bagging.
      ↪best_params['min_samples_leaf'],
```

```
                                 'max_depth': study_bagging.
  ↪best_params['max_depth']})
bg_clf = BaggingClassifier(tree_cfl,n_estimators=study_bagging.
  ↪best_params['n_estimators'],random_state=123 ,n_jobs=-1)
```

[22]:
```
rf_clf = RandomForestClassifier(**study_rf.best_params)
```

0.1.3 Train each of the classifiers

[23]:
```
t_clf.fit(train_1,y_1)
```

[23]:
```
DecisionTreeClassifier(max_depth=25, min_samples_leaf=700, random_state=123)
```

[24]:
```
bg_clf.fit(train_1,y_1)
```

[24]:
```
BaggingClassifier(estimator=DecisionTreeClassifier(max_depth=10,
                                                   min_samples_leaf=100),
                  n_estimators=5, n_jobs=-1, random_state=123)
```

[25]:
```
rf_clf.fit(train_1,y_1)
```

[25]:
```
RandomForestClassifier(max_depth=15, min_samples_leaf=800, n_estimators=30)
```

0.1.4 Back test the performance of the models over the period 2010 - 2018

[26]:
```
start_dates = [pd.to_datetime('2010-01-01') + pd.DateOffset(months = 3*i) for i␣
  ↪in range(21)]
end_dates = [d + pd.DateOffset(months = 36) for d in start_dates]
# So the first period is [2010 Jan 1 - 2013 Jan 1], and the last period is␣
  ↪[2015 Jan 1 - 2018 Jan 1]
```

[27]:
```
training_frames = [data.loc[d:d+pd.DateOffset(months = 36)] for d in␣
  ↪start_dates]
valid_frames = [data.loc[d + pd.DateOffset(months=3):d+pd.DateOffset(months =␣
  ↪6)] for d in end_dates]
test_frames = [data.loc[d + pd.DateOffset(months=6):d+pd.DateOffset(months =␣
  ↪9)] for d in end_dates]

training_labels = [d['rel_performance'].values for d in training_frames]

training_stock_returns = [d['next_period_return'].values for d in␣
  ↪training_frames]
test_stock_returns = [d['next_period_return'] for d in test_frames]
```

[28]:
```
training_data = [df.reset_index().drop(['ticker','date',
                                        'next_period_return',
                                        'spy_next_period_return',
```

```
                                  'rel_performance', 'pred_rel_return',
                                  'return', 'cum_ret', 'spy_cum_ret'],axis=1)␣
 ↪for df in training_frames]
valid_data = [df.reset_index().drop(['ticker','date',
                                  'next_period_return',
                                  'spy_next_period_return',
                                  'rel_performance','pred_rel_return',
                                  'return', 'cum_ret', 'spy_cum_ret'],axis=1)␣
 ↪for df in valid_frames]
test_data = [df.reset_index().drop(['ticker','date',
                                  'next_period_return',
                                  'spy_next_period_return',
                                  'rel_performance','pred_rel_return',
                                  'return', 'cum_ret', 'spy_cum_ret'],axis=1)␣
 ↪for df in test_frames]
```

```
[29]: # dictionary to store performance and returns
      xs = {'t':[1], 'bg':[1], 'rf':[1]}
      rets = {'t':[], 'bg':[], 'rf':[]}
      models = {'t':t_clf, 'bg':bg_clf, 'rf':rf_clf}

      for i in tqdm(range(len(start_dates)-1)):
          for key, model in models.items():
              model.fit(training_data[i],training_labels[i])

              preds = model.predict(test_data[i])
              profit_i = (preds*test_stock_returns[i]).sum()

              rets[key].append(profit_i)
              num_names = len(test_data[i])
              xs[key].append(xs[key][i] + (xs[key][i]/num_names)*profit_i)
```

```
100%|                              | 20/20 [01:28<00:00,  4.41s/it]
```

```
[30]: for key, x_list in xs.items():
          plt.plot(x_list, label = key);
      plt.legend()
```
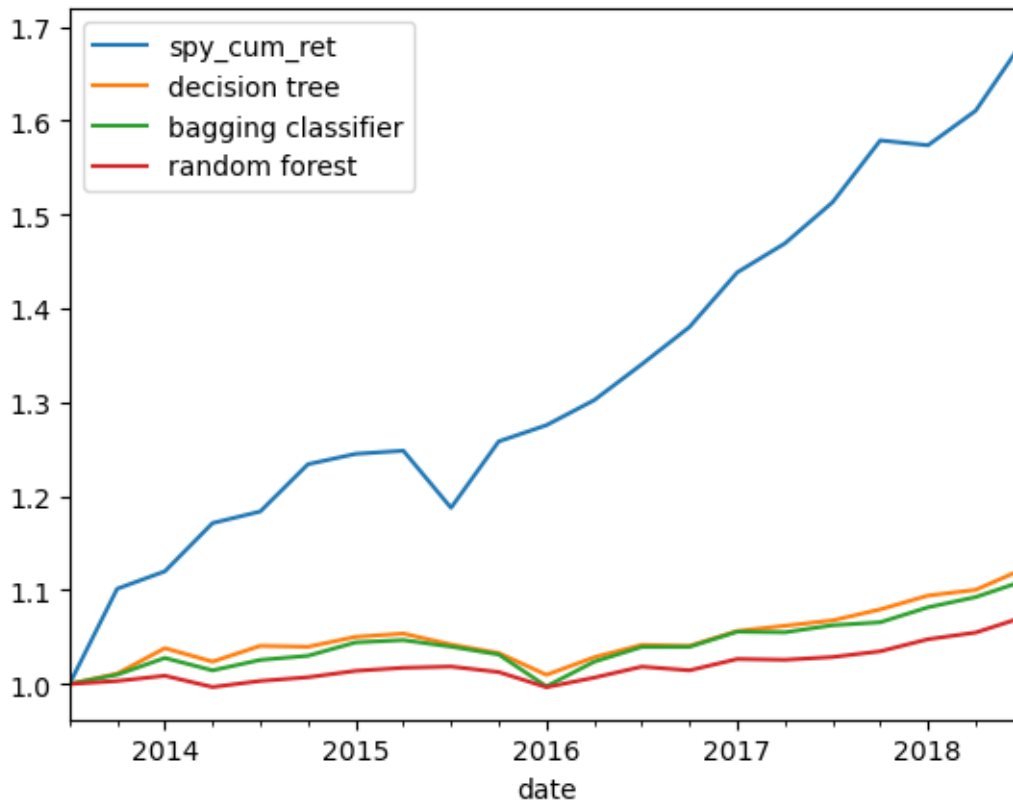
[30]: <matplotlib.legend.Legend at 0x2c5f0f490>
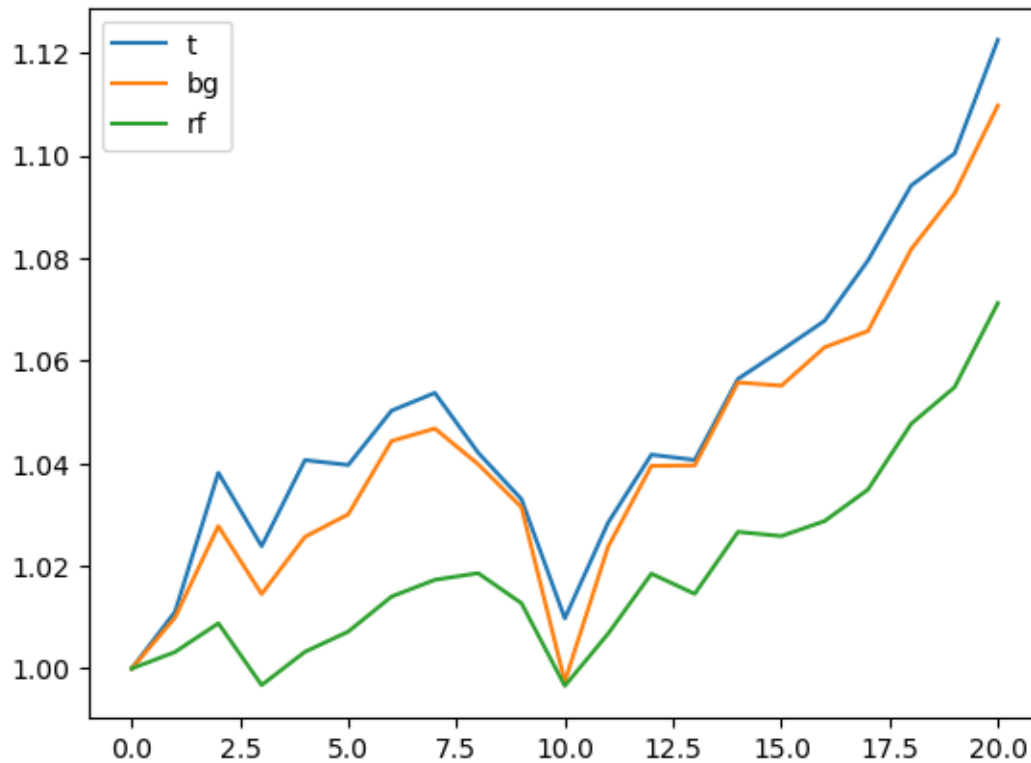
```
[31]:   # Compare to buy and hold of SPY
        SPY = pd.read_pickle(r'SPY_cum_ret.pkl')
        SPY = SPY.loc['2013-07-01':'2018-09-30']
        SPY = SPY.resample('Q').ffill()
        SPY['spy_cum_ret'] = (SPY['spy_cum_ret'] - SPY['spy_cum_ret'][0]+1)
        SPY['decision tree'] = xs['t']
        SPY['bagging classifier'] = xs['bg']
        SPY['random forest'] = xs['rf']
        SPY.plot();
```

0.1.5 Now we can compute the Shapley values for these models and see how the performance changes

0.1.6 Finding the features with non zero Shapley values

```python
[32]: # Retrain the models using the original training set (i.e. before backtesting)
      t_clf.fit(train_1,y_1)
      bg_clf.fit(train_1,y_1)
      rf_clf.fit(train_1,y_1)
```

```
[32]: RandomForestClassifier(max_depth=15, min_samples_leaf=800, n_estimators=30)
```

```python
[33]: # Obtain the feature importances
      def tree_feat_importance(m, df):
          return pd.DataFrame({'cols':df.columns, 'feat_imp':m.feature_importances_}
                              ).sort_values('feat_imp', ascending=False)

      def bagging_feat_importance(m, df):
          feature_importances = []
          for est in m.estimators_:
              fi = est.feature_importances_
```

```
        feature_importances.append(fi)
    feature_importances = np.array(feature_importances)

    return pd.DataFrame({'cols':train_1.columns, 'feat_imp':np.
  ↪mean(feature_importances,axis=0)}
                        ).sort_values('feat_imp', ascending=False)

def randomforest_feat_importances(m, df):

    return pd.DataFrame({'cols':df.columns, 'feat_imp': m.feature_importances_}
                        ).sort_values('feat_imp', ascending=False)

def plot_fi(fi): return fi.plot('cols', 'feat_imp', 'barh', figsize=(12,7),␣
  ↪legend=False)
```

```
[34]: t_fi = tree_feat_importance(t_clf,train_1)
      bg_fi = bagging_feat_importance(bg_clf,train_1)
      rf_fi = randomforest_feat_importances(rf_clf,train_1)
```

```
[35]: # Only use features that have positive feature importance
      t_features = t_fi[(t_fi['feat_imp'] > 0.00)]
      bg_features = bg_fi[(bg_fi['feat_imp'] > 0.00)]
      rf_features = rf_fi[(rf_fi['feat_imp'] > 0.00)]
```

```
[36]: train_t = train_1[t_features['cols'].values]
      valid_t = valid[t_features['cols'].values]
      valid_t['returns'] = valid_stock_returns.values

      train_bg = train_1[bg_features['cols'].values]
      valid_bg = valid[bg_features['cols'].values]
      valid_bg['returns'] = valid_stock_returns.values

      train_rf = train_1[rf_features['cols'].values]
      valid_rf = valid[rf_features['cols'].values]
      valid_rf['returns'] = valid_stock_returns.values
```

```
[37]: print(f"Number of features used for decision tree classifier reduced from:␣
        ↪{train_1.shape[1]} to {train_t.shape[1]}")
      print(f"Number of features used for bagging classifier reduced from      :␣
        ↪{train_1.shape[1]} to {train_bg.shape[1]}")
      print(f"Number of features used for random forest classifier reduced from:␣
        ↪{train_1.shape[1]} to {train_rf.shape[1]}")
```

```
Number of features used for decision tree classifier reduced from: 725 to 16
Number of features used for bagging classifier reduced from      : 725 to 133
Number of features used for random forest classifier reduced from: 725 to 121
```

```
[38]:  # Retrain the classifiers using the new feature set
       t_clf.fit(train_t,y_1)
       bg_clf.fit(train_bg,y_1)
       rf_clf.fit(train_rf,y_1)
```

[38]: RandomForestClassifier(max_depth=15, min_samples_leaf=800, n_estimators=30)

```
[39]:  import shap

       def model_t(features):
           tree_features = features[features.columns[:-1].values]
           pred = t_clf.predict(tree_features)
           ret = pred * features[features.columns[-1]]
           return ret

       def model_bg(features):
           bagging_features = features[features.columns[:-1].values]
           pred = bg_clf.predict(bagging_features)
           ret = pred * features[features.columns[-1]]
           return ret

       def model_rf(features):
           rf_features = features[features.columns[:-1].values]
           pred = rf_clf.predict(rf_features)
           ret = pred * features[features.columns[-1]]
           return ret
```
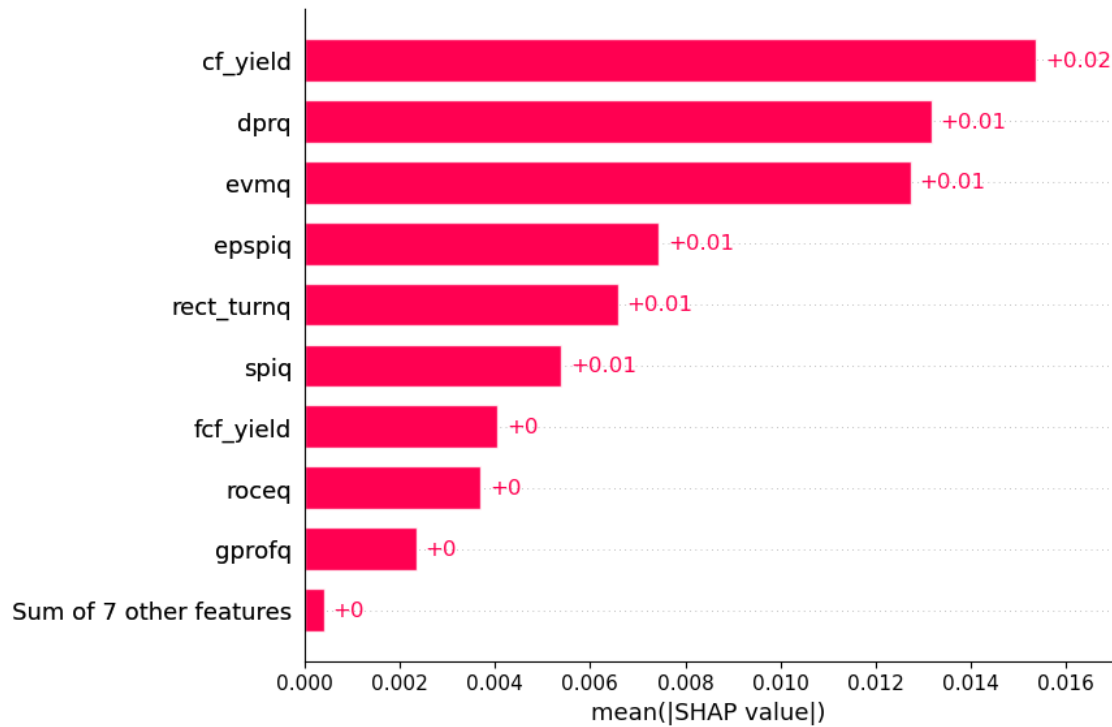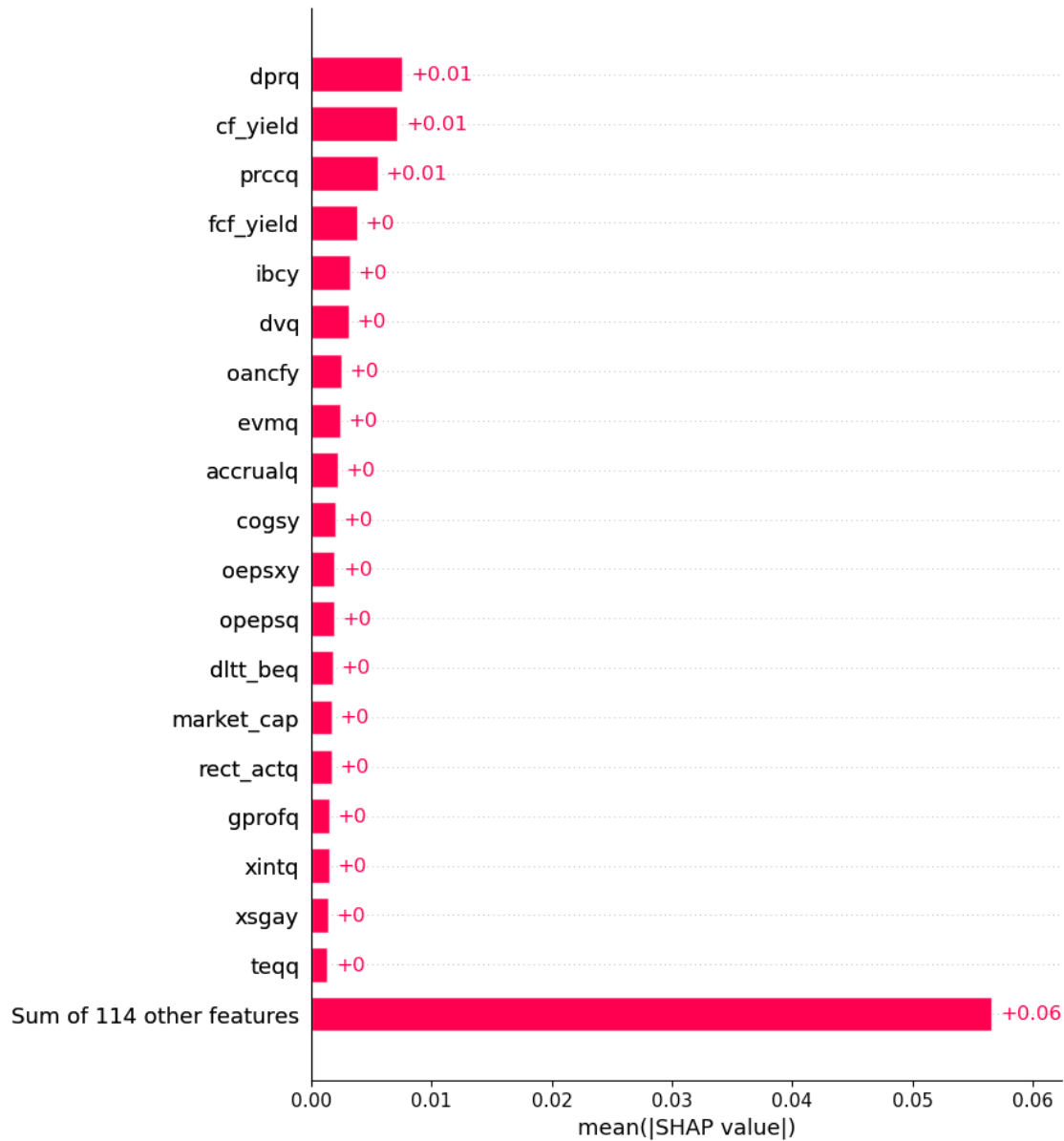
```
[40]:  # Shapley for tree classifier
       model_t(valid_t)
       t_explainer = shap.explainers.Permutation(model_t,valid_t)
       t_shap_values = t_explainer(valid_t,max_evals=2000)
       shap.plots.bar(t_shap_values[:,:-1],max_display=10)
```

PermutationExplainer explainer: 1442it [00:54, 21.85it/s]

```
[41]:  # Shapley for bagging classifier
       model_bg(valid_bg)
       bg_explainer = shap.explainers.Permutation(model_bg,valid_bg)
       bg_shap_values = bg_explainer(valid_bg,max_evals=2000)
       shap.plots.bar(bg_shap_values[:,:-1],max_display=20)
```

PermutationExplainer explainer: 1442it [35:30, 1.48s/it]

```
[42]:  # Shapley for random forest classifier
       model_rf(valid_rf)
       rf_explainer = shap.explainers.Permutation(model_rf,valid_rf)
       rf_shap_values = rf_explainer(valid_rf,max_evals=2000)
       shap.plots.bar(rf_shap_values[:,:-1],max_display=20)
```

PermutationExplainer explainer: 1442it [05:45, 4.06it/s]
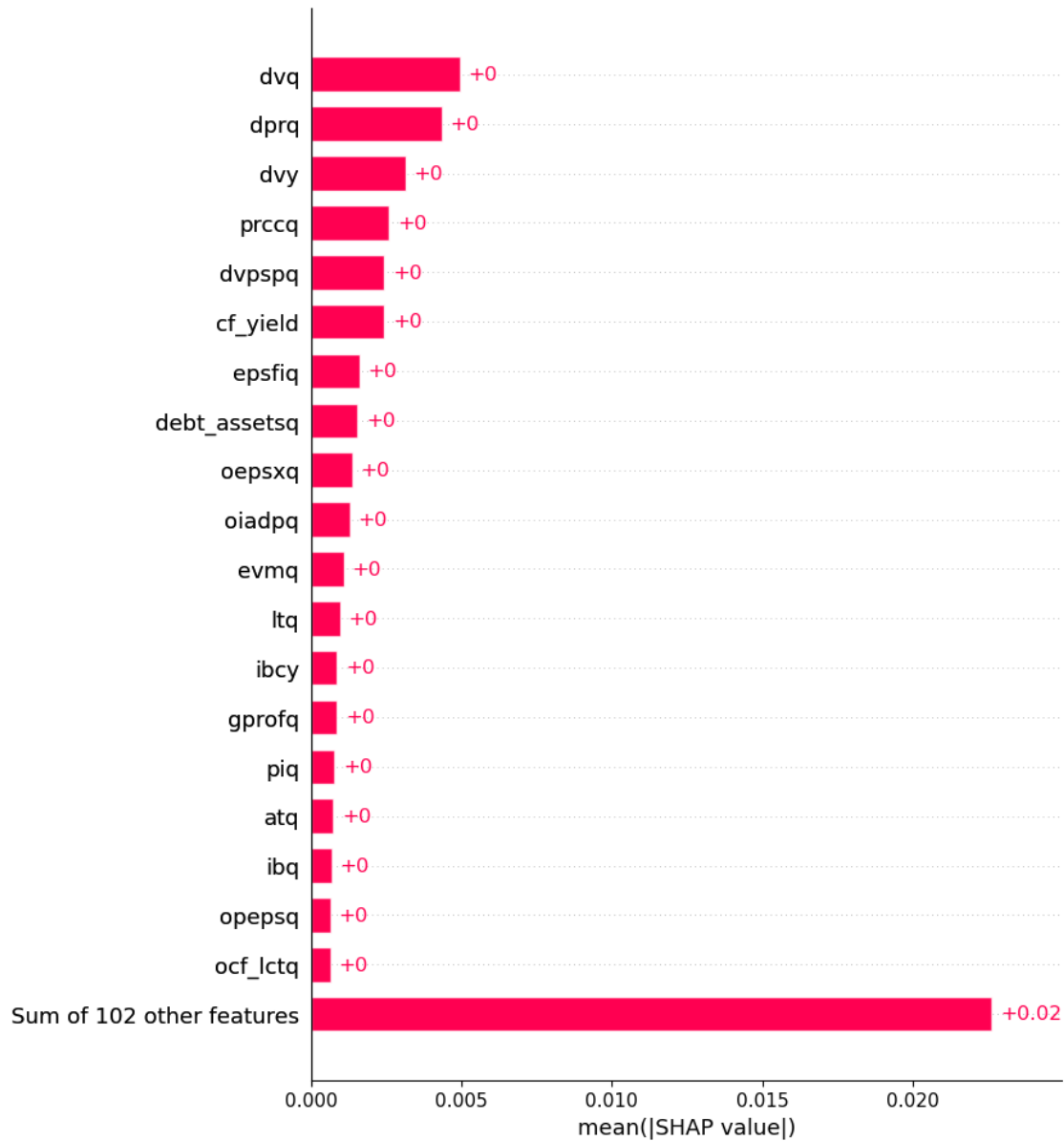
0.1.7 Retrain the models with the features that have non-zero Shapley values

```
[43]: t_cols = t_features['cols'].values
      t_shap_cols = t_cols[np.abs(t_shap_values[:,:-1].values).mean(axis=0)>0.000]

      bg_cols = bg_features['cols'].values
      bg_shap_cols = bg_cols[np.abs(bg_shap_values[:,:-1].values).mean(axis=0)>0.000]

      rf_cols = rf_features['cols'].values
      rf_shap_cols = rf_cols[np.abs(rf_shap_values[:,:-1].values).mean(axis=0)>0.000]
```

```
[44]:  # Retrain the classifiers using the new feature set
       t_clf.fit(train_t[t_shap_cols],y_1)
       bg_clf.fit(train_bg[bg_shap_cols],y_1)
       rf_clf.fit(train_rf[rf_shap_cols],y_1)
```

[44]: RandomForestClassifier(max_depth=15, min_samples_leaf=800, n_estimators=30)

0.1.8 Back test over the period 2010 - 2018

```
[45]:  scalers = [StandardScaler() for _ in range(len(training_data))]

       def get_opt_data(shap_cols):
           opt_training_data = [pd.DataFrame(scalers[i].
        ↪fit_transform(training_frames[i][shap_cols].values),columns=shap_cols) for i
        ↪in range(len(training_data))]
           opt_valid_data = [pd.DataFrame(scalers[i].
        ↪transform(valid_frames[i][shap_cols].values),columns=shap_cols) for i in
        ↪range(len(valid_data))]
           opt_test_data = [pd.DataFrame(scalers[i].
        ↪transform(test_frames[i][shap_cols].values),columns=shap_cols) for i in
        ↪range(len(test_data))]
           return opt_training_data, opt_valid_data, opt_test_data

       t_opt_training_data, t_opt_valid_data, t_opt_test_data =
        ↪get_opt_data(t_shap_cols)
       bg_opt_training_data, bg_opt_valid_data, bg_opt_test_data =
        ↪get_opt_data(bg_shap_cols)
       rf_opt_training_data, rf_opt_valid_data, rf_opt_test_data =
        ↪get_opt_data(rf_shap_cols)
```

```
[46]:  # dictionary to store performance and returns
       opt_xs = {'t':[1], 'bg':[1], 'rf':[1]}
       opt_rets = {'t':[], 'bg':[], 'rf':[]}
       models = {'t':t_clf, 'bg':bg_clf, 'rf':rf_clf}

       # dictionary of training and test data for each classifier model
       opt_training_data = {'t':t_opt_training_data, 'bg':bg_opt_training_data, 'rf':
        ↪rf_opt_training_data}
       opt_test_data = {'t':t_opt_test_data, 'bg':bg_opt_test_data, 'rf':
        ↪rf_opt_test_data}

       for i in tqdm(range(len(start_dates)-1)):
           for key, model in models.items():
               model.fit(opt_training_data[key][i],training_labels[i])

               preds = model.predict(opt_test_data[key][i])
               profit_i = (preds*test_stock_returns[i]).sum()
```

```
        opt_rets[key].append(profit_i)
        num_names = len(opt_test_data[key][i])
        opt_xs[key].append(opt_xs[key][i] + (opt_xs[key][i]/num_names)*profit_i)
```
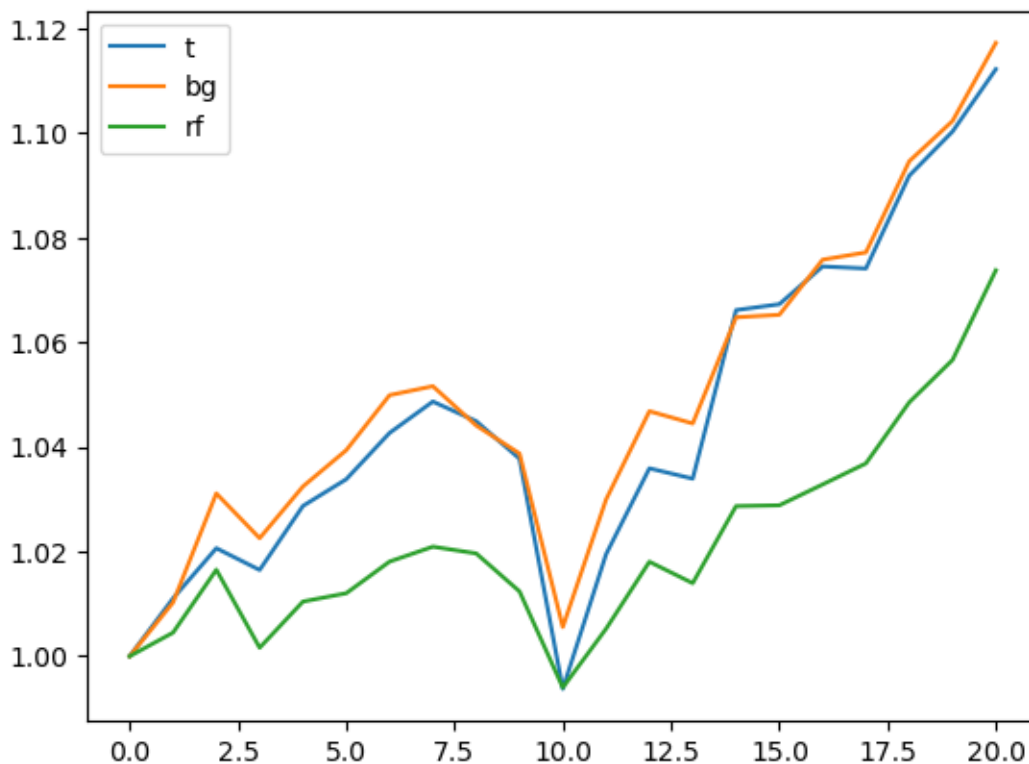
100%|███████████████████████| 20/20 [00:52<00:00, 2.65s/it]

```
[47]: for key, x_list in opt_xs.items():
          plt.plot(x_list, label = key);
      plt.legend()
```

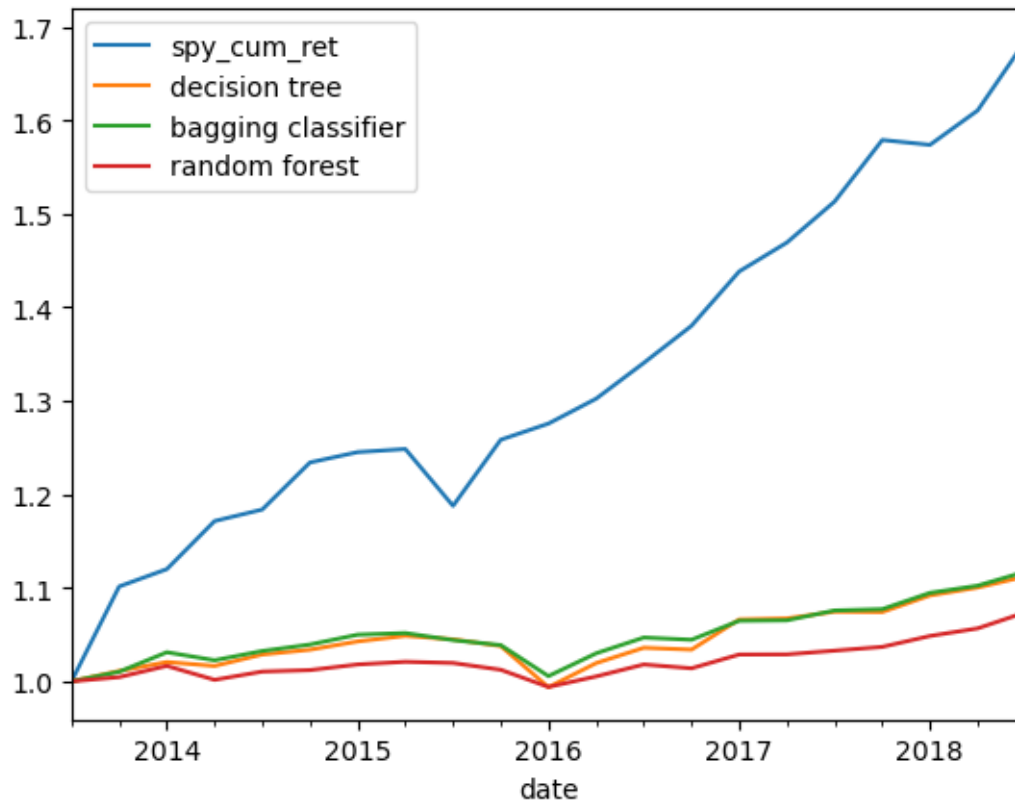[47]: <matplotlib.legend.Legend at 0x2f5b61550>


```
[48]: # Compare to buy and hold of SPY
      SPY = pd.read_pickle(r'SPY_cum_ret.pkl')
      SPY = SPY.loc['2013-07-01':'2018-09-30']
      SPY = SPY.resample('Q').ffill()
      SPY['spy_cum_ret'] = (SPY['spy_cum_ret'] - SPY['spy_cum_ret'][0]+1)
      SPY['decision tree'] = opt_xs['t']
      SPY['bagging classifier'] = opt_xs['bg']
      SPY['random forest'] = opt_xs['rf']
      SPY.plot();
```

0.1.9 Compute the Sharpe Ratio, Information Ratio, and alpha for the strategies and for the buy-and-hold strategy for SPY

```
[49]: strategies = {'decision tree' :      "Decision Tree Strategy      ",
                    'bagging classifier': "Bagging Classifier Strategy",
                    'random forest' :     "Random Forest Strategy      ",
                    'spy_cum_ret':        "SPY Buy-and-hold Strategy   "}
```

```
[50]: # Sharpe Ratio
      for key, strat in strategies.items():
          strategy_mean_ret = (SPY[key] - 1).diff().mean()
          strategy_std = (SPY[key] - 1).diff().std()
          strategy_sr = strategy_mean_ret/strategy_std
          print(strat, ' Sharpe Ratio:', strategy_sr)
```

```
Decision Tree Strategy       Sharpe Ratio: 0.36664541127858863
Bagging Classifier Strategy  Sharpe Ratio: 0.44052597772678764
Random Forest Strategy       Sharpe Ratio: 0.39177764778019614
SPY Buy-and-hold Strategy    Sharpe Ratio: 0.9869583355280026
```

```
[51]: # Information Ratio
      spy_ret = (SPY['spy_cum_ret'] - 1).diff().values[1:]

      for key, strat in list(strategies.items())[:-1]:
          strategy_ret = (SPY[key] - 1).diff().values[1:]
          beta = (np.cov(spy_ret,strategy_ret)/np.var(spy_ret))[1,0]
          residual_ret = strategy_ret - beta * spy_ret
          IR = np.mean(residual_ret)/np.std(residual_ret)
          print(strat, ' Information Ratio:', IR)
```

```
Decision Tree Strategy       Information Ratio: 0.24407902834503367
Bagging Classifier Strategy  Information Ratio: 0.2944040595301684
Random Forest Strategy       Information Ratio: 0.3438453383357505
```

```
[52]: # Alpha
      for key, strat in list(strategies.items())[:-1]:
          strategy_ret = (SPY[key] - 1).diff().values[1:]
          beta = (np.cov(spy_ret,strategy_ret)/np.var(spy_ret))[1,0]
          residual_ret = strategy_ret - beta * spy_ret
          alpha = np.mean(residual_ret)
          print(strat, ' alpha:', alpha)
```

```
Decision Tree Strategy       alpha: 0.003612123226636429
Bagging Classifier Strategy  alpha: 0.003775197633395072
Random Forest Strategy       alpha: 0.003151106466031975
```