🚀 Stacking Algorithm:

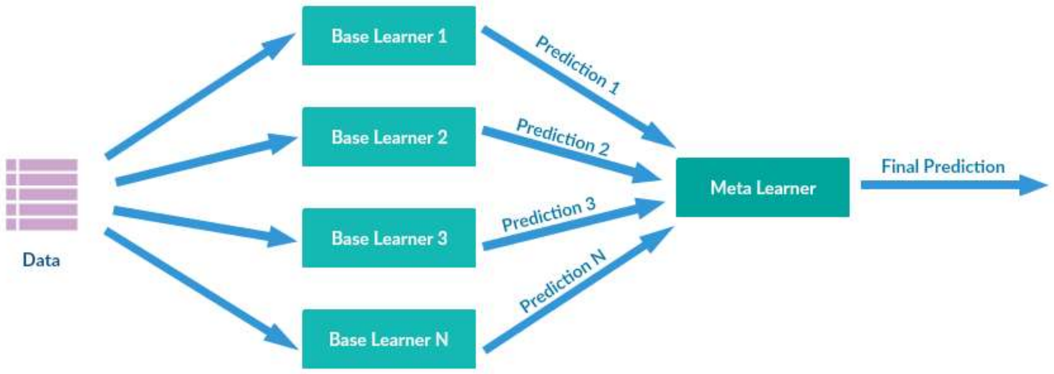
- Is an ensemble learning technique that combines the predictions of multiple base models to improve overall performance.
- In regression, stacking leverages a meta-learner to merge predictions from diverse models, yielding a more accurate and robust predictor.
- For classification, stacking similarly aggregates predictions from various classifiers, resulting in enhanced predictive power and adaptability to complex decision boundaries.
- By incorporating diverse models and effectively blending their outputs, stacking offers a powerful approach to tackle regression and classification tasks, ultimately enhancing predictive performance beyond what individual models can achieve.

🚀 How it works

In [590…

```python
from IPython.display import Image
image_path = "Stacking.png"
Image(filename=image_path)
```

Out[590]:



✨ Import Libraries

In [589…

```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.tree import DecisionTreeRegressor,DecisionTreeClassifier
from sklearn.linear_model import LinearRegression,LogisticRegression
from sklearn.svm import SVR,SVC
from sklearn.neighbors import KNeighborsRegressor,KNeighborsClassifier
from sklearn.ensemble import GradientBoostingRegressor,GradientBoostingClassifier,F
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score,mean_squared_error,classification_report
from sklearn.preprocessing import StandardScaler
import os
os.system("cls")
```

Out[589]:

```
0
```

✨ Implementation of Stacking Regressor,Classifier From Skratch

In [570…

```
class Stackig :
    def __init__ (self , base_models , meta_learner):    # user can choose base moc
        self.base_models = base_models
        self.meta_learner = meta_learner

    def fit (self , X ,y ) :
        base_prediction = []   # list to store the predictions of validation
        # X >> All data
        # split data into train and validation
        X_train , X_validation , y_train , y_validation = train_test_split(X,y ,tes
        # we will train base models
        for model in (self.base_models):
            model.fit(X_train , y_train)
            # use base models to predict validation
            base_prediction.append(model.predict(X_validation))

            # we can train meta learner >> input : base_prediction , output : y_val
        base_prediction = np.column_stack(base_prediction)     # to make list in 2
        self.meta_learner.fit(base_prediction,y_validation)
        # the model become able to take predection and get the final result (y) ins

    def predict ( self , X):
        base_prediction = np.column_stack([model.predict(X) for model in self.base_
        return self.meta_learner.predict(base_prediction)
```

✨ Loading Data For Regression

In [571…

```
data_regressor = pd.read_csv("data.csv")
data_regressor
```

Out[571]:

	X	y
0	0.093949	0.639861
1	0.101092	0.100920
2	0.195939	0.194688
3	0.301127	0.296597
4	0.355180	0.347759
...	...	...
75	4.818314	-0.043969
76	4.882297	-0.985600
77	4.883805	-0.985344
78	4.893092	-0.983718
79	4.941869	-0.973785

80 rows × 2 columns

✨ Split Data (X , y)

In [572…

```
X = data_regressor.drop("y", axis = 1).values
y =data_regressor["y"].values
```

✨ Use Model Which we built from Sktarch

In [573…

```
model = Stackig (base_models=[
   DecisionTreeRegressor(),
    SVR(),
    KNeighborsRegressor()
],meta_learner=LinearRegression())

model.fit(X,y)
```

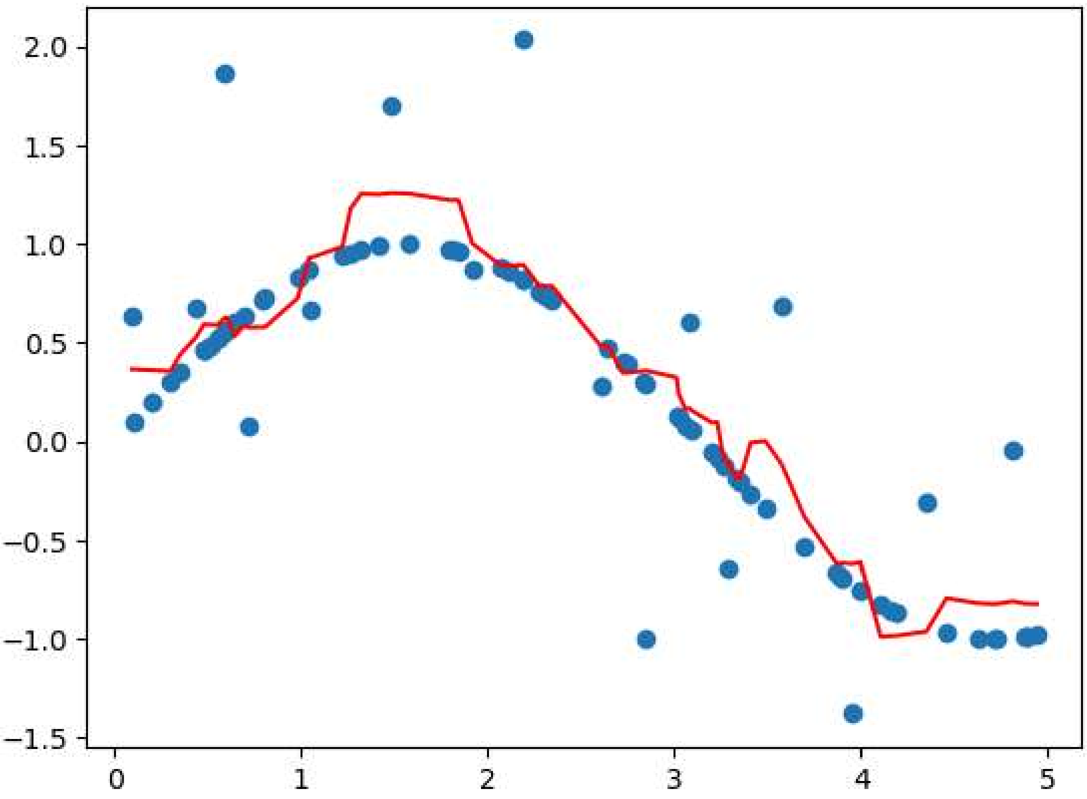
✨ Visualizaton

In [574…

```
y_pred = model.predict(X)
plt.scatter(X,y)
plt.plot(X,y_pred,c = "r")
```

Out[574]:

```
[<matplotlib.lines.Line2D at 0x223f2cb00d0>]
```



✨ Check Performance using Mean_squared_error

In [575…

```
y_pred = model.predict(X)
mse = mean_squared_error(y, y_pred)
print("Mean Squared Error:", mse)
```

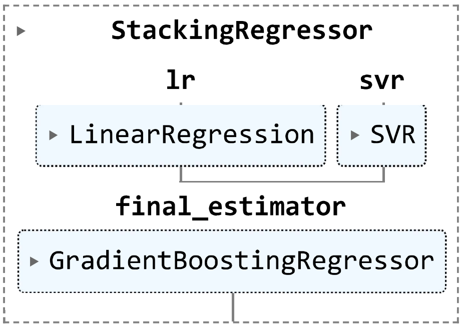
```
Mean Squared Error: 0.11773350281768429
```

✨ Use Built in Algorithm from Sklearn

In [576…

```
model = StackingRegressor(estimators=[
    ("lr", LinearRegression()),
    ("svr",SVR())
],final_estimator=GradientBoostingRegressor())
model.fit(X,y)
```

Out[576]:



▸ StackingRegressor

lr svr

▸ LinearRegression ▸ SVR

final_estimator

▸ GradientBoostingRegressor

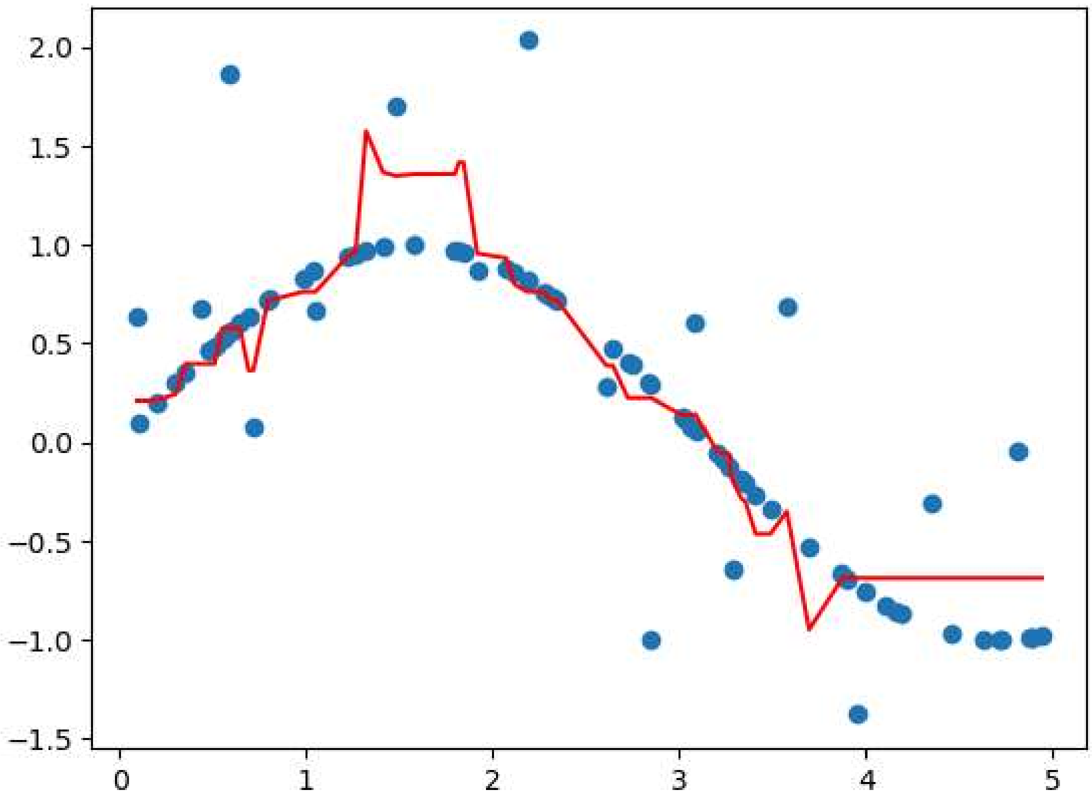
✨ Visualization

In [577…

```
y_pred = model.predict(X)
plt.scatter(X,y)
plt.plot(X,y_pred,c = "r")
```

Out[577]:

```
[<matplotlib.lines.Line2D at 0x223f1499990>]
```



✨ Check Performance using Mean_squared_error

In [578…

```
y_pred = model.predict(X)
mse = mean_squared_error(y, y_pred)
print("Mean Squared Error:", mse)
```

```
Mean Squared Error: 0.12807130902087438
```

✨ Loading Data for Classification

In [579…

```
data = pd.read_csv ("iris_data.csv")
data
```

Out[579]:

	feature1	feature2	target
0	5.1	3.5	0.0
1	4.9	3.0	0.0
2	4.7	3.2	0.0
3	4.6	3.1	0.0
4	5.0	3.6	0.0
...	...	...	...
145	6.7	3.0	1.0
146	6.3	2.5	1.0
147	6.5	3.0	1.0
148	6.2	3.4	1.0
149	5.9	3.0	1.0

150 rows × 3 columns

✨ Split Data (X , y)

In [580…

```
X = data.drop("target" ,axis=1).values
y = data["target"].values
print (X.shape , y.shape)
```

```
(150, 2) (150,)
```

✨ Use Model Which we built from Sktarch

In [581…

```
model = Stackig (base_models=[
   DecisionTreeClassifier(),
    SVR(),
    KNeighborsClassifier()
],meta_learner=LogisticRegression())

model.fit(X,y)
```

✨ Reshape y

In [582…

```
y_reshaped = y.reshape(-1, 1)
print("Shape of y_reshaped:", y_reshaped.shape)
```

```
Shape of y_reshaped: (150, 1)
```

In [583…

```
y_pred = model.predict(X)
```

✨ Visualization

In [584…

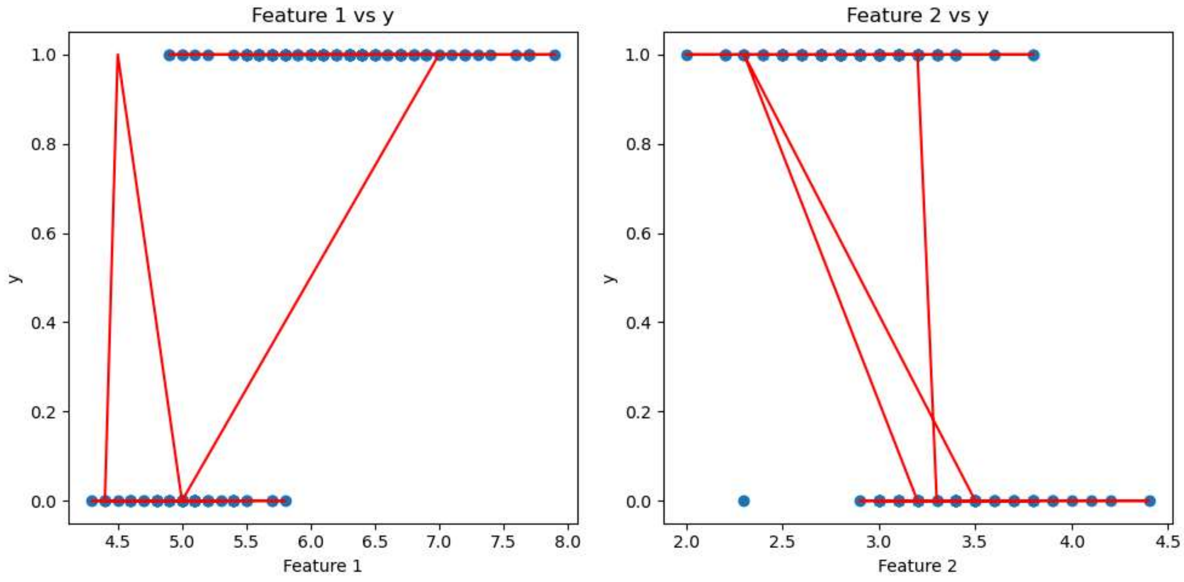
```
feature1 = X[:, 0]
feature2 = X[:, 1]

# Plot the scatter plot for each feature against y_pred
plt.figure(figsize=(10, 5))

plt.subplot(1, 2, 1)
plt.scatter(feature1, y_reshaped)
plt.plot(feature1, y_pred, c="r")
plt.xlabel('Feature 1')
plt.ylabel('y')
plt.title('Feature 1 vs y')

plt.subplot(1, 2, 2)
plt.scatter(feature2, y_reshaped)
plt.plot(feature2, y_pred, c="r")
plt.xlabel('Feature 2')
plt.ylabel('y')
plt.title('Feature 2 vs y')

plt.tight_layout()
plt.show()
```



✨ Check Performance using Accuracy_Score

In [585…

```
accuracy = accuracy_score(y, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 0.9933333333333333
```

🕵️ Note :

- from visualization and the value of accurecy_score we notice that the model is overfit the data
- we can solve this problem by reducing the number of base models or by using StandardScaler

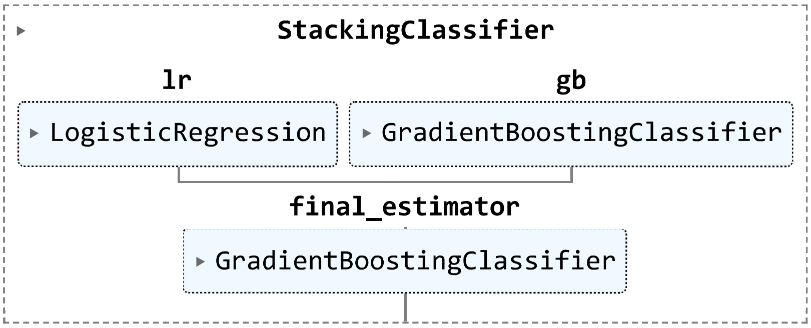
✨ Use Built in Algorithm from Sklearn

In [586…

```
# Define your base classifiers
model = Stackig (base_models=[
   DecisionTreeClassifier(),
    SVC(),
   KNeighborsClassifier()
],meta_learner=RandomForestClassifier())
# Define your final estimator
final_estimator = GradientBoostingClassifier()

# Create the stacking classifier model
model = StackingClassifier(estimators=base_classifiers, final_estimator=final_estim
# Train the model
model.fit(X, y)
```

Out[586]:



✨ Split data (train , test)

In [587…

```
X_train , X_test , y_train , y_test = train_test_split(X,y ,test_size=0.4 , random_
y_pred = model.predict(X_test)
```

✨ Check Performance using Accuracy_Score

In [588…

```
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 1.0
```

- Thanks 💖