```
# Standard imports
!pip install colorama
import os
import pandas as pd
import numpy as np
import plotly.express as px
import plotly.graph_objs as go
import matplotlib.pyplot as plt
import seaborn as sns
from tqdm import trange
from colorama import Fore
from glob import glob
import json
from pprint import pprint
import time
import cv2
from enum import Enum
from IPython.display import display
from sklearn.metrics import confusion_matrix
# For Data preparation
from sklearn.preprocessing import *
from sklearn.model_selection import *
from sklearn.metrics import *

```

Saved successfully!

```
Requirement already satisfied: colorama in /usr/local/lib/python3.7/dist-packages (0.4.4
```

```
from google.colab import drive
drive.mount('/content/drive')

```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mour
```

```
data_df = pd.read_csv("/content/drive/MyDrive/petfinder-pawpularity-score/train.csv")
test_df = pd.read_csv( "/content/drive/MyDrive/petfinder-pawpularity-score/test.csv")
sample_df = pd.read_csv(   "/content/drive/MyDrive/petfinder-pawpularity-score/sample_subm
```

```
data_df
```

	Id	Subject Focus	Eyes	Face	Near	Action	Accessory	Gr
0	0007de18844b0dbbb5e1f607da0606e0	0	1	1	1	0	0	
1	0009c66b9439883ba2750fb825e1d7db	0	1	1	0	0	0	
2	0013fd999caf9a3efe1352ca1b0d937e	0	1	1	1	0	0	
3	0018df346ac9c1d8413cfcc888ca8246	0	1	1	1	0	0	
4	001dc955e10590d3ca4673f034feeef2	0	0	0	1	0	0	
...	...	...	...	...	...	...	...	...
9907	ffbfa0383c34dc513c95560d6e1fdb57	0	0	0	1	0	0	
9908	ffcc8532d76436fc79e50eb2e5238e45	0	1	1	1	0	0	
9909	ffdf2e8673a1da6fb80342fa3b119a20	0	1	1	1	0	0	
9910	fff19e2ce11718548fa1c5d039a5192a	0	1	1	1	0	0	
9911	fff8e47c766799c9e12f3cb3d66ad228	0	1	1	1	0	0	

```
1 test_df
```

	Id	Subject Focus	Eyes	Face	Near	Action	Accessory	Grou
	fdb0c3	1	0	1	0	0	1	
1	43a2262d7738e3d420d453815151079e	0	1	0	0	0	0	
2	4e429cead1848a298432a0acad014c9d	0	0	0	1	0	1	
3	80bc3ccafcc51b66303c2c263aa38486	1	0	1	0	0	0	
4	8f49844c382931444e68dffbe20228f4	1	1	1	0	1	1	
5	b03f7041962238a7c9d6537e22f9b017	0	0	1	1	1	1	
6	c978013571258ed6d4637f6e8cc9d6a3	1	0	0	0	1	1	
7	e0de453c1bffc20c22b072b34b54e50f	1	0	1	0	0	0	

Saved successfully!

```
1 sample_df
```

	Id	Pawpularity
0	4128bae22183829d2b5fea10effdb0c3	67.75
1	43a2262d7738e3d420d453815151079e	59.15
2	4e429cead1848a298432a0acad014c9d	20.02

```
labels = data_df["Pawpularity"]
print(f"min value of Pawpularity is : {min(labels)}")
print(f"max value of Pawpularity is : {max(labels)}")
```

```
min value of Pawpularity is : 1
max value of Pawpularity is : 100
```

```
bins = None
dark = False
fig = px.histogram(data_df, x = 'Pawpularity', template = "plotly_dark" if dark else "ggpl
fig.update_layout(
        title_text = f"Distribution of {'Pawpularity'}",
        title_x = 0.5,
)
fig.show()

```

Saved successfully!

Distribution of Pawpularity

```
data_df["path"] = data_df["Id"].apply(lambda x : "/content/drive/MyDrive/petfinder-pawpula
test_df["path"] = test_df["Id"].apply(lambda x : "/content/drive/MyDrive/petfinder-pawpula
```

```
pp_100_df = data_df.loc[data_df.Pawpularity == 100]
pp_1_df = data_df.loc[data_df.Pawpularity == 1]

print(f"Num of images having 100 score : {len(pp_100_df)}")
print(f"Num of images having 1 score : {len(pp_1_df)}")
```

```
Num of images having 100 score : 288
Num of images having 1 score : 4
```

```
pp_100_df.head()
```

	Id	Subject Focus	Eyes	Face	Near	Action	Accessory	Gro
19	00768659c1c90409f81dcdecbd270513	0	1	1	0	0	0	
50	013f86ed0e765b189990d3d5ac28bd7d	0	0	0	1	0	0	
	45b2d1a	0	1	1	1	0	0	
182	04fef9f129bc6e4b90644d4290fde8c3	0	1	1	1	0	0	
227	063d79b149f4d163eae86f777a39a42f	0	0	1	1	0	0	

Saved successfully!

```
num_splits = 5
data=data_df
data["kfold"] = -1
data = data.sample(frac=1).reset_index(drop=True)

# Applying Sturg's rule to calculate the no. of bins for target
num_bins = int(1 + np.log2(len(data)))

data.loc[:, "bins"] = pd.cut(data['Pawpularity'], bins=num_bins, labels=False)

kf = StratifiedKFold(n_splits=num_splits)

for f, (t_, v_) in enumerate(kf.split(X=data, y=data.bins.values)):
```

```
    data.loc[v_, 'kfold'] = f

data = data.drop(["bins"], axis = 1)
data_df=data

data_df.kfold.value_counts()
```

```
1    1983
0    1983
4    1982
3    1982
2    1982
Name: kfold, dtype: int64
```

```
1
```

```
from sklearn.linear_model import LinearRegression, Ridge, ElasticNet

from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import ExtraTreesRegressor, RandomForestRegressor, VotingRegressor
from sklearn.ensemble import AdaBoostRegressor,GradientBoostingRegressor, StackingRegresso
from sklearn.neighbors import KNeighborsRegressor
!pip install catboost
from catboost import CatBoostRegressor
from xgboost import XGBRegressor
```

Saved successfully!

```
from sklearn.metrics import r2_score, mean_squared_error
from sklearn.model_selection import cross_validate
def rmse_score(y_label, y_preds):
    """
    Gives RMSE score
    """
    return np.sqrt(mean_squared_error(y_label, y_preds))


def trainRegModels(df : "data_file", features : list, label: str):
    """
    To automate the training of regression models. Considering
        > RMSE
        > R2 score

    """
    regModels = {
            "LinearRegression": LinearRegression(),
            "KNeighborsRegressor": KNeighborsRegressor(n_neighbors=2),
            "GradientBoostingRegressor": GradientBoostingRegressor(random_state=0),
            "DecisionTreeRegressor": DecisionTreeRegressor(),
            "RandomForestRegressor": RandomForestRegressor(n_jobs=-1),
        }
```

```
36
37      # Will return this as a data frame
38      summary = {
39          "Model" : [],
40          "Avg R2 Train Score" : [],
41          "Avg R2 Val Score" : [],
42          "Avg RSME Train Score" : [],
43          "Avg RSME Val Score" : []
44      }
45
46      # Training
47      for idx in trange(len(regModels.keys()), desc = "Models are training...", bar_format="
48          name = list(regModels.keys())[idx]
49          model = regModels[name]
50
51          # Initializing all the scores to 0
52          r2_train = 0; r2_val = 0
53          rmse_train = 0; rmse_val = 0
54
55          # Running K-fold Cross-validation on every model
56          for fold in range(5):
57              train_df = df.loc[df.kfold != fold].reset_index(drop = True)
58              val_df = df.loc[df.kfold == fold].reset_index(drop = True)
59
60              train_X = train_df[features]; train_Y = train_df[label]
61              val_X = val_df[features]; val_Y = val_df[label]
62
63
64              if name == 'CatBoostRegressor':
65                  cur_model.fit(train_X, train_Y,verbose=False)
66              else:
67                  cur_model.fit(train_X, train_Y)
68
69              Y_train_preds = model.predict(train_X)
70              Y_val_preds = model.predict(val_X)
71
72              # Collecting the scores
73              r2_train += r2_score(train_Y, Y_train_preds)
74              r2_val += r2_score(val_Y, Y_val_preds)
75
76              rmse_train += rmse_score(train_Y, Y_train_preds)
77              rmse_val += rmse_score(val_Y, Y_val_preds)
78
79          # Pushing the scores and the Model names
80          summary["Model"].append(name)
81          summary["Avg R2 Train Score"].append(r2_train/5)
82          summary["Avg R2 Val Score"].append(r2_val/5)
83          summary["Avg RSME Train Score"].append(rmse_train/5)
84          summary["Avg RSME Val Score"].append(rmse_val/5)
85
86      # Finally returning the summary dictionary as a dataframe
```

Saved successfully!

```
    summary_df = pd.DataFrame(summary)
    return summary_df

```

```
Requirement already satisfied: catboost in /usr/local/lib/python3.7/dist-packages (1.0.3
Requirement already satisfied: numpy>=1.16.0 in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: plotly in /usr/local/lib/python3.7/dist-packages (from ca
Requirement already satisfied: matplotlib in /usr/local/lib/python3.7/dist-packages (fro
Requirement already satisfied: pandas>=0.24.0 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: scipy in /usr/local/lib/python3.7/dist-packages (from cat
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from catbo
Requirement already satisfied: graphviz in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: python-dateutil>=2.7.3 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/li
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.7/dist-packag
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: retrying>=1.3.3 in /usr/local/lib/python3.7/dist-packages
```

```
req_cols = [
    'Subject Focus', 'Eyes', 'Face', 'Near', 'Action', 'Accessory',
       'Group', 'Collage', 'Human', 'Occlusion', 'Info', 'Blur'
]
training_summary = trainRegModels(data_df, req_cols, "Pawpularity")
training_summary
```

Saved successfully!

```
100%|██████████| 5/5 [00
```

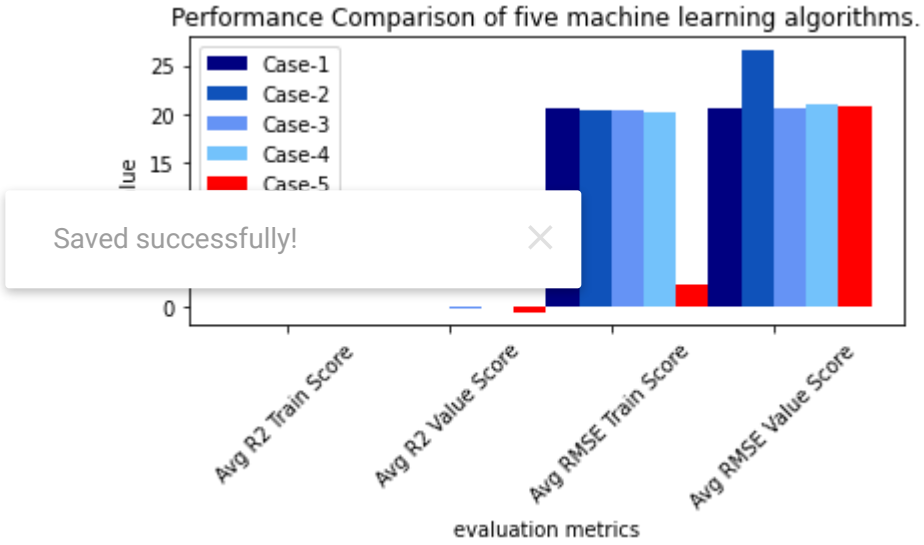
	Model	Avg R2 Train Score	Avg R2 Val Score	Avg RSME Train Score	Avg RSME Val Score
0	LinearRegression	0.002714	-0.000341	20.562978	20.594344
1	KNeighborsRegressor	-0.683220	-0.716607	26.317668	26.605666
2	GradientBoostingRegressor	0.014295	-0.000680	20.443236	20.597883
3	DecisionTreeRegressor	0.033930	-0.030120	20.238597	20.898306
4	RandomForestRegressor	0.032020	-0.018811	20.258595	20.783492

```
import numpy as np
import matplotlib.pyplot as plt


data = np.array([[ 0.00271445, 0.014272,  0.032205,  0.034189,  -0.0411631],
  [-0.000577, -0.001879, -0.20662, -0.033994,-0.468784],[20.56297787, 20.31766752, 20.44
  [20.59434407, 26.60566574, 20.59788302, 20.89830608, 20.78349217]])
length = len(data)
x_labels = ['Avg R2 Train Score', 'Avg R2 Value Score', 'Avg RMSE Train Score','Avg RMSE


# Set plot parameters
fig, ax = plt.subplots()
```

```
14  width = 0.2 # width of bar
15  x = np.arange(length)
16
17  ax.bar(x, data[:,0], width, color='#000080', label='Case-1')
18  ax.bar(x + width, data[:,1], width, color='#0F52BA', label='Case-2')
19  ax.bar(x + (2 * width), data[:,2], width, color='#6593F5', label='Case-3')
20  ax.bar(x + (3 * width), data[:,3], width, color='#73C2FB', label='Case-4')
21  ax.bar(x + (4 * width), data[:,4], width, color='r', label='Case-5')
22
23  ax.set_ylabel('Value')
24  ax.set_xticks(x + width + width/2)
25  ax.set_xticklabels(x_labels, rotation=45)
26  ax.set_xlabel('evaluation metrics')
27  ax.set_title('Performance Comparison of five machine learning algorithms.')
28  ax.legend()
29
30  fig.tight_layout()
31  plt.show()
32
```




```
1
2 actual= training_summary['Model'].values
3 actual
4
```

```
array(['LinearRegression', 'KNeighborsRegressor',
       'GradientBoostingRegressor', 'DecisionTreeRegressor',
       'RandomForestRegressor'], dtype=object)
```

```
1 training_summary.sort_values("Avg RSME Val Score", axis = 0, ascending = True)
```

	Model	Avg R2 Train Score	Avg R2 Val Score	Avg RSME Train Score	Avg RSME Va Scor
0	LinearRegression	0.002738	-0.000577	20.562730	20.59667
2	GradientBoostingRegressor	0.014272	-0.001879	20.443480	20.61022
4	RandomForestRegressor	0.032205	-0.020662	20.256667	20.80239

```
en = ElasticNet(random_state=0)
gbr = GradientBoostingRegressor(random_state=0)
VR_model = VotingRegressor([('en', en),('gbr', gbr)], n_jobs=-1)

r2_train = 0; r2_val = 0
rmse_train = 0; rmse_val = 0

model = VR_model
for fold in trange(5, desc = "Models are training...", bar_format="{l_bar}%s{bar:50}%s{r_b
    train_df = data_df.loc[data_df.kfold != fold].reset_index(drop = True)
    val_df = data_df.loc[data_df.kfold == fold].reset_index(drop = True)

    train_X = train_df[req_cols]; train_Y = train_df["Pawpularity"]
    val_X = val_df[req_cols]; val_Y = val_df["Pawpularity"]

    model.fit(train_X, train_Y)

    Y_train_preds = model.predict(train_X)
    Y_val_preds = model.predict(val_X)

    # Collecting the scores
    r2_train += r2_score(train_Y, Y_train_preds)
    r2_val += r2_score(val_Y, Y_val_preds)

    rmse_train += rmse_score(train_Y, Y_train_preds)
    rmse_val += rmse_score(val_Y, Y_val_preds)

print(f"Avg RSME Val Score : {rmse_val/5}")

```

Saved successfully!

```
Models are training...: 100%|██████████| 5/5 [0(
```

```
test_X = test_df[req_cols]

model_preds = model.predict(test_X)
test_df["Pawpularity"] = model_preds

submission = test_df[["Id", "Pawpularity"]]
submission.to_csv("submission.csv", index = False)
data_df.to_csv("data.csv", index = False)
```

```
 9 test_df.to_csv("test.csv", index = False)
10 submission
```

	Id	Pawpularity
0	4128bae22183829d2b5fea10effdb0c3	35.911807
1	43a2262d7738e3d420d453815151079e	37.221033
2	4e429cead1848a298432a0acad014c9d	48.224210
3	80bc3ccafcc51b66303c2c263aa38486	33.026713
4	8f49844c382931444e68dffbe20228f4	27.041284
5	b03f7041962238a7c9d6537e22f9b017	40.739421
6	c978013571258ed6d4637f6e8cc9d6a3	32.602862
7	e0de453c1bffc20c22b072b34b54e50f	35.663131

```
 1
 2 from sklearn import metrics
 3
 4 actual= sample_df['Pawpularity'].values
 5 predicted=submission['Pawpularity'].values
 6 actual
 7 predicted
```

Saved successfully!

```
11 test_df.std()
12
```

```
Subject Focus    0.517549
Eyes             0.462910
Face             0.517549
Near             0.462910
Action           0.517549
Accessory        0.517549
Group            0.534522
Collage          0.517549
Human            0.462910
Occlusion        0.534522
Info             0.517549
Blur             0.534522
Pawpularity      6.249649
dtype: float64
```

Saved successfully!