Install libraries

```
!pip install shap pyDOE2 anchor-exp
import shap
import pyDOE2
from anchor import anchor_tabular
```

```
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Requirement already satisfied: typing-extensions in /usr/local/lib/python3.11/
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Requirement already satisfied: pillow>=10.1 in /usr/local/lib/python3.11/dist-
Requirement already satisfied: imageio!=2.35.0,>=2.33 in /usr/local/lib/python
```

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```

```
import pandas as pd
import sklearn
import lime
from lime import lime_tabular

import xgboost as xgb
from sklearn.model_selection import train_test_split
import lightgbm as lgb
```

Tutorial

Set up tutorial examples

Start by training the "should you bring an umbrella?" model

```
preX = pd.read_csv("Umbrella.csv")
preX = preX.sample(frac=1)
X_display = preX.iloc[:,:-1]
y_display = preX.iloc[:,-1]

PRECIPITATION = {
    "none": 0,
    "drizzle": 1,
```

```
    "rain": 2,
    "snow": 3,
    "sleet": 4,
    "hail": 5
}

y = y_display
X = X_display
X = X.replace({"Precipitation":PRECIPITATION})

X_train = X.iloc[:300]
y_train = y.iloc[:300]

X_test = X.iloc[300:]
y_test = y.iloc[300:]

d_train = lgb.Dataset(X_train, label=y_train)
d_test = lgb.Dataset(X_test, label=y_test)

params = {
    "max_bin": 512,
    "learning_rate": 0.05,
    "boosting_type": "gbdt",
    "objective": "binary",
    "metric": "binary_logloss",
    "num_leaves": 10,
    "verbose": -1,
    "min_data": 100,
    "boost_from_average": True,
    "keep_training_booster": True
}

#model = lgb.train(params, d_train, 10000, valid_sets=[d_test]) #early_stopping_r
model = lgb.LGBMClassifier(max_bin= 512,
    learning_rate= 0.05,
    boosting_type= "gbdt",
    objective= "binary",
    metric= "binary_logloss",
    num_leaves= 10,
    verbose= -1,
    min_data= 100,
    boost_from_average= True)
model.fit(X_train, y_train)
```

```
<ipython-input-160-0ae06d0dfa92>:17: FutureWarning: Downcasting behavior in `r
  X = X.replace({"Precipitation":PRECIPITATION})
```

```
LGBMClassifier(boost_from_average=True, learning_rate=0.05, max_bin=512,
               metric='binary_logloss', min_data=100, num_leaves=10,
               objective='binary', verbose=-1)
```

Find the location of one of the two tutorial examples

```
print(X.loc[(X['Precipitation'] == 5) & (X['Temperature'] == 23) & (X['Wind(mph)'
print(X.loc[(X['Precipitation'] == 0) & (X['Temperature'] == 70) & (X['Wind(mph)'
theloc = X.index.get_loc(330)
```

```
     Precipitation  Temperature  Wind(mph)
330              5           23         10
    Precipitation  Temperature  Wind(mph)
96              0           70         30
```

Generate a tutorial explanation

```
from anchor import anchor_tabular
explainer = anchor_tabular.AnchorTabularExplainer(
    ["YES","NO"],
    [ "Precipitation", "Temperature", "Wind"],
    X.to_numpy(),
    {0:["None","drizzle", "rain", "snow", "sleet", "hail"]}
    )
```

```
print('Prediction: ', explainer.class_names[model.predict(X.iloc[theloc,:].to_num
exp = explainer.explain_instance(X.iloc[theloc,:].to_numpy(), model.predict, thre
exp.show_in_notebook()
```

```
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<ipython-input-163-2c8ae0164223>:1: DeprecationWarning: In future, it will be an error for
  print('Prediction: ', explainer.class_names[model.predict(X.iloc[theloc,:].to_numpy().res
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  warnings.warn(
Prediction:  NO
/usr/local/lib/python3.11/dist-packages/sklearn/utils/deprecation.py:151: FutureWarning: 'f
  warnings.warn(
```

Example

Precipitation = hail

Temperature <= 30.00

7.00 < Wind <= 15.00

A.I. predi...

YES

Explanation of A.I. prediction

If ALL of these are true:

✓ Temperature <= 30.00

The A.I. will predict YES **100.0%** of the time

Examples where the A.I. agent predicts YES

< 1 2 3 4 5 ••• 10 >

Precipitation = drizzle

Temperature <= 30.00

7.00 < Wind <= 15.00

Examples where the A.I. agent DOES NOT predict YES

Could not find any Examples

Loan Instances

Edit and prepare the dataset

```
# load dataset
X,y = shap.datasets.adult()
X_display,y_display = shap.datasets.adult(display=True)

EDUCATION_NUM = {
    16.0: "Doctorate",
    15.0: "Prof. School",
    14.0: "Masters",
    13.0: "Bachelors",
    12.0: "Some College",
    11.0: "Associate", #Assoc-acdm
    10.0: "Vocational", #Assoc-voc
    9.0: "HS grad",
    8.0: "12th",
    7.0: "11th",
    6.0: "10th",
    5.0: "9th",
    4.0: "7th-8th",
    3.0: "5th-6th",
    2.0: "1st-4th",
    1.0: "Preschool"
}

OCCUPATION_NUM = {
    "Tech-support": "Tech Support",
    "Craft-repair": "Craft/Repair",
    "Other-service": "Other Service",
    "Sales": "Sales",
    "Exec-managerial": "Exec. Managerial",
    "Prof-specialty": "Prof. Specialty",
    "Handlers-cleaners": "Handler/Cleaner",
    "Machine-op-inspct": "Machine Op. Inspector",
    "Adm-clerical": "Admin. Clerical",
    "Farming-fishing": "Farming/Fishing",
    "Transport-moving": "Transport/Moving",
    "Priv-house-serv": "Private House Service",
```

```
    "Protective-serv": "Protective Service",
    "Armed-Forces": "Armed Forces"

}
X_display = X_display.replace({"Education-Num":EDUCATION_NUM})
X_display = X_display.replace({"Occupation":OCCUPATION_NUM})
X = X.rename(columns={"Education-Num": "Education"})
X_display = X_display.rename(columns={"Education-Num": "Education"})#, "Hours per
```

```
X = X.drop(['Capital Loss', 'Capital Gain', 'Race', 'Relationship', 'Country', 'W
X_display = X_display.drop(['Capital Loss', 'Capital Gain', 'Race', 'Relationship
```

```
# create a train/test split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_s
d_train = lgb.Dataset(X_train, label=y_train)
d_test = lgb.Dataset(X_test, label=y_test)
```

Train the model

```
params = {
    "max_bin": 512,
    "learning_rate": 0.05,
    "boosting_type": "gbdt",
    "objective": "binary",
    "metric": "binary_logloss",
    "num_leaves": 10,
    "verbose": -1,
    "min_data": 100,
    'objective':'multi:softprob',
    "boost_from_average": True
}

params_xgb={
    'base_score':0.5,
    'learning_rate':0.05,
    'max_depth':5,
    'min_child_weight':100,
    'n_estimators':200,
    'num_class': 2,
    'nthread':-1,
    'objective':'multi:softprob',
    'seed':2018,
    'eval_metric':'auc'
}

model = lgb.LGBMClassifier(max_bin= 512,
    learning_rate= 0.05,
    boosting_type= "gbdt",
    objective= "binary",
    metric= "binary_logloss",
    num_leaves= 10,
    verbose= -1,
    min_data= 100,
    boost_from_average= True)
model.fit(X_train, y_train)
```

LGBMClassifier

```
LGBMClassifier(boost_from_average=True, learning_rate=0.05, max_bin=512,
               metric='binary_logloss', min_data=100, num_leaves=10,
               objective='binary', verbose=-1)
```

Data locations of our 7 instances

```
#val = 610 # Woman Side-by-side
#val = 11116 # Man Side-by-side
#val = 32353 # Man 3
#val = 217 # Man 2
#val = 15040 # Man 1
#val = 32429 # Woman 3
val = 32556 # Woman 2
#val = 91#91 # Woman 1

theloc = val
```

Run Anchors, and create an explanation

```
explainer = anchor_tabular.AnchorTabularExplainer(
    ["NO", "YES"],
    [ "Age","Education","Occupation", "Sex", "Hours worked per week"],
    X_test.to_numpy(),
    {1:["None","Preschool", "1st-4th", "5th-6th", "7th-8th", "9th", "10th", "11th
    )
exp = explainer.explain_instance(X.iloc[theloc,:].to_numpy(), model.predict, thre
```

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/usr/local/lib/python3.11/dist-packages/sklearn/utils/deprecation.py:151: Futu
  warnings.warn(
```

Result

```
exp.show_in_notebook()
```

Example

Age <= 28.00

Education = Some Colleg e

Occupation = Tech Suppo rt

Sex = Female

Hours worked per week < = 40.00

A.I. predi...

NO

Explanation of A.I. prediction

If ALL of these are true:

✓ Age <= 28.00

The A.I. will predict NO **98.5%** of the time

Examples where the A.I. agent predicts NO

1 2 3 4 5 ••• 10

Age <= 28.00
Education = HS grad
Occupation = Craft Repair
Sex = Male
Hours worked per week <= 40.00

Examples where the A.I. agent DOES NOT predict NO

1 2 3

Age <= 28.00
Education = Doctorate
Occupation = Prof. Specialty
Sex = Male
Hours worked per week > 45.00

```
exp.save_to_file("outputwomantwo.html")
```