Open in Colab

Group 16 - Assignment 2

Name	Email	Contributions
BALAKRISHNAN V S	2024aa05017@wilp.bits-pilani.ac.in	100%
JAISRI S	2024aa05138@wilp.bits-pilani.ac.in	100%
AKHILESH KUMAR SHRIVASTAVA	2024aa05860@wilp.bits-pilani.ac.in	100%

Credit Card Approval Prediction using MLP with LIME and SHAP Explanations

Task 1: Load the dataset and perform exploratory data analysis via appropriate visualization. Normalize the features as appropriate

In [ ]:
```
%pip install lime shap
```

```
Requirement already satisfied: lime in /usr/local/lib/python3.11/dist-packages (0.2.0.1)
Requirement already satisfied: shap in /usr/local/lib/python3.11/dist-packages (0.48.0)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.11/dist-packages (from lime) (3.10.0)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (from lime) (2.0.2)
Requirement already satisfied: scipy in /usr/local/lib/python3.11/dist-packages (from lime) (1.16.1)
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (from lime) (4.67.1)
Requirement already satisfied: scikit-learn>=0.18 in /usr/local/lib/python3.11/dist-packages (from lime) (1.6.1)
Requirement already satisfied: scikit-image>=0.12 in /usr/local/lib/python3.11/dist-packages (from lime) (0.25.2)
Requirement already satisfied: pandas in /usr/local/lib/python3.11/dist-packages (from shap) (2.2.2)
Requirement already satisfied: packaging>20.9 in /usr/local/lib/python3.11/dist-packages (from shap) (25.0)
Requirement already satisfied: slicer==0.0.8 in /usr/local/lib/python3.11/dist-packages (from shap) (0.0.8)
Requirement already satisfied: numba>=0.54 in /usr/local/lib/python3.11/dist-packages (from shap) (0.60.0)
Requirement already satisfied: cloudpickle in /usr/local/lib/python3.11/dist-packages (from shap) (3.1.1)
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.11/dist-packages (from shap) (4.14.1)
Requirement already satisfied: llvmlite<0.44,>=0.43.0dev0 in /usr/local/lib/python3.11/dist-packages (from numba>=0.
54->shap) (0.43.0)
Requirement already satisfied: networkx>=3.0 in /usr/local/lib/python3.11/dist-packages (from scikit-image>=0.12->li
me) (3.5)
Requirement already satisfied: pillow>=10.1 in /usr/local/lib/python3.11/dist-packages (from scikit-image>=0.12->lim
e) (11.3.0)
Requirement already satisfied: imageio!=2.35.0,>=2.33 in /usr/local/lib/python3.11/dist-packages (from scikit-image>
=0.12->lime) (2.37.0)
Requirement already satisfied: tifffile>=2022.8.12 in /usr/local/lib/python3.11/dist-packages (from scikit-image>=0.
12->lime) (2025.6.11)
Requirement already satisfied: lazy-loader>=0.4 in /usr/local/lib/python3.11/dist-packages (from scikit-image>=0.12-
>lime) (0.4)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn>=0.18->li
me) (1.5.1)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn>=
0.18->lime) (3.6.0)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib->lime)
(1.3.3)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib->lime) (0.1
2.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib->lime)
(4.59.0)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib->lime)
(1.4.9)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib->lime)
(3.2.3)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.11/dist-packages (from matplotlib->lim
```

```
e) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas->shap) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas->shap) (2025.
2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.7->matpl
otlib->lime) (1.17.0)
```

In [ ]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split, cross_val_score, KFold
from sklearn.neural_network import MLPClassifier
from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.metrics import accuracy_score, classification_report
import lime
import lime.lime_tabular
import shap
from sklearn.utils import resample
import random
from IPython.display import display
import IPython

# Set random seed for reproducibility
np.random.seed(42)
random.seed(42)
```

In [ ]:
```python
# Load the dataset
data = pd.read_csv('UniversalBank.csv')

# Display basic information
print("Dataset shape:", data.shape)
print("\nFirst 5 rows:")
display(data.head())
```

```
Dataset shape: (5000, 14)

First 5 rows:
```

	ID	Age	Experience	Income	ZIP Code	Family	CCAvg	Education	Mortgage	Personal Loan	Securities Account	CD Account	Online	CreditCard
0	1	25	1	49	91107	4	1.6	1	0	0	1	0	0	0
1	2	45	19	34	90089	3	1.5	1	0	0	1	0	0	0
2	3	39	15	11	94720	1	1.0	1	0	0	0	0	0	0
3	4	35	9	100	94112	1	2.7	2	0	0	0	0	0	0
4	5	35	8	45	91330	4	1.0	2	0	0	0	0	0	1

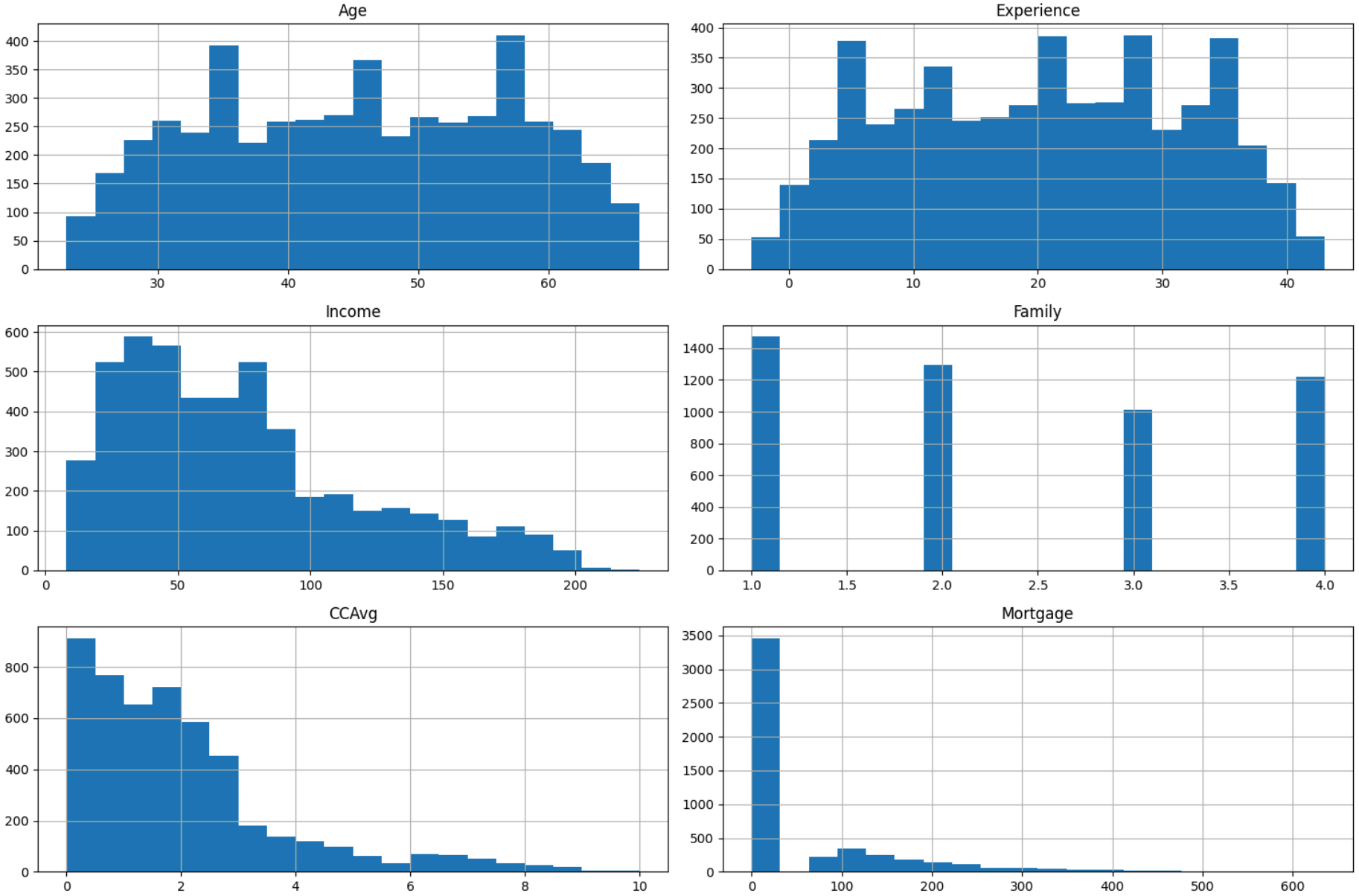
In [ ]:
```
# Basic statistics
print("\nDescriptive statistics:")
display(data.describe())

# Check for missing values
print("\nMissing values:")
print(data.isnull().sum())
```

```
Descriptive statistics:
```

	ID	Age	Experience	Income	ZIP Code	Family	CCAvg	Education	Mortgag
count	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5000.00000
mean	2500.500000	45.338400	20.104600	73.774200	93152.503000	2.396400	1.937938	1.881000	56.49880
std	1443.520003	11.463166	11.467954	46.033729	2121.852197	1.147663	1.747659	0.839869	101.71380
min	1.000000	23.000000	-3.000000	8.000000	9307.000000	1.000000	0.000000	1.000000	0.00000
25%	1250.750000	35.000000	10.000000	39.000000	91911.000000	1.000000	0.700000	1.000000	0.00000
50%	2500.500000	45.000000	20.000000	64.000000	93437.000000	2.000000	1.500000	2.000000	0.00000
75%	3750.250000	55.000000	30.000000	98.000000	94608.000000	3.000000	2.500000	3.000000	101.00000
max	5000.000000	67.000000	43.000000	224.000000	96651.000000	4.000000	10.000000	3.000000	635.00000

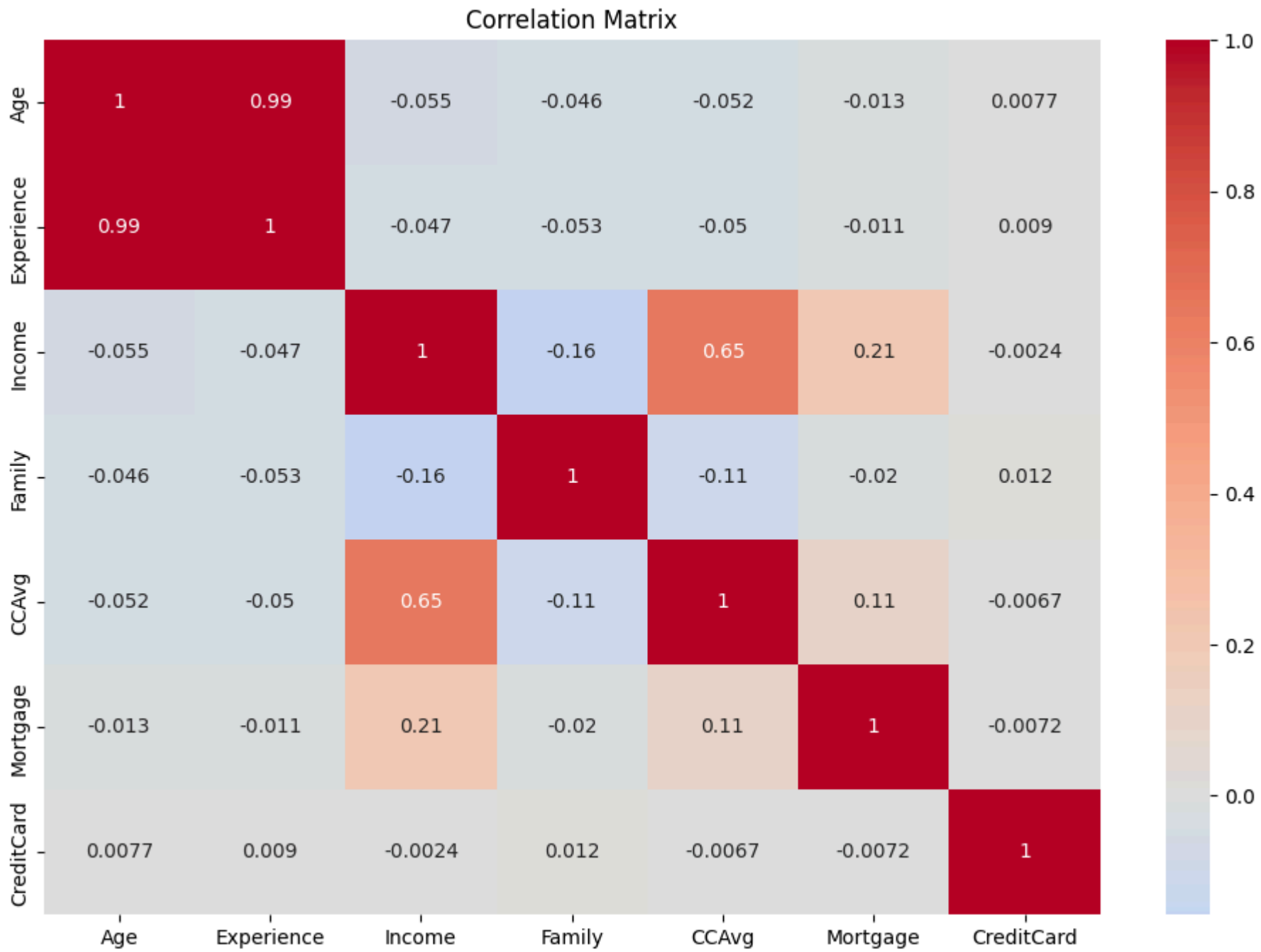
```
Missing values:
ID                    0
Age                   0
Experience            0
Income                0
ZIP Code              0
Family                0
CCAvg                 0
Education             0
Mortgage              0
Personal Loan         0
Securities Account    0
CD Account            0
Online                0
CreditCard            0
dtype: int64
```

In [ ]:
```
# Visualize the distribution of numerical features
numerical_cols = ['Age', 'Experience', 'Income', 'Family', 'CCAvg', 'Mortgage']
data[numerical_cols].hist(bins=20, figsize=(15, 10))
plt.tight_layout()
plt.show()
```



In [ ]:
```
# Correlation matrix
plt.figure(figsize=(12, 8))
corr_matrix = data[numerical_cols + ['CreditCard']].corr()
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', center=0)
```

```
plt.title('Correlation Matrix')
plt.show()
```


Correlation Matrix
Age
Experience
Income
Family
CCAvg
Mortgage
CreditCard
1 0.99 -0.055 -0.046 -0.052 -0.013 0.0077
0.99 1 -0.047 -0.053 -0.05 -0.011 0.009
-0.055 -0.047 1 -0.16 0.65 0.21 -0.0024
-0.046 -0.053 -0.16 1 -0.11 -0.02 0.012
-0.052 -0.05 0.65 -0.11 1 0.11 -0.0067
-0.013 -0.011 0.21 -0.02 0.11 1 -0.0072
0.0077 0.009 -0.0024 0.012 -0.0067 -0.0072 1
1.0
0.8
0.6
0.4
0.2
0.0

In [ ]:
```
# Prepare data for modeling
# Drop ID and ZIP Code as they are not useful for prediction
data = data.drop(['ID', 'ZIP Code'], axis=1)

# Split into features and target
X = data.drop('CreditCard', axis=1)
y = data['CreditCard']

# Normalize features
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)

# Split into train and test sets (we'll use the entire data for cross-validation)
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42)

print("Training set shape:", X_train.shape)
print("Test set shape:", X_test.shape)
```

```
Training set shape: (4000, 11)
Test set shape: (1000, 11)
```

Task 2: Using 5 fold cross-validation, implement a multilayer perceptron with no more than 2 hidden layers. Report the training error and cross-validation error.

In [ ]:
```
# Initialize MLP classifier
mlp = MLPClassifier(hidden_layer_sizes=(50, 30), max_iter=1000, random_state=42)

# Perform 5-fold cross-validation
kfold = KFold(n_splits=5, shuffle=True, random_state=42)
cv_scores = cross_val_score(mlp, X_scaled, y, cv=kfold, scoring='accuracy')

# Train the model on full training set
mlp.fit(X_train, y_train)

# Calculate training error
train_pred = mlp.predict(X_train)
train_error = 1 - accuracy_score(y_train, train_pred)
```

```
print("Cross-validation scores:", cv_scores)
print("Mean CV accuracy: {:.4f}".format(cv_scores.mean()))
print("Training error: {:.4f}".format(train_error))
```

```
Cross-validation scores: [0.681 0.682 0.709 0.678 0.689]
Mean CV accuracy: 0.6878
Training error: 0.2057
```

In [ ]:
```
# Initialize MLP classifier
mlp = MLPClassifier(hidden_layer_sizes=(80, 30), max_iter=1000, random_state=42)

# Perform 5-fold cross-validation
kfold = KFold(n_splits=5, shuffle=True, random_state=42)
cv_scores = cross_val_score(mlp, X_scaled, y, cv=kfold, scoring='accuracy')

# Train the model on full training set
mlp.fit(X_train, y_train)

# Calculate training error
train_pred = mlp.predict(X_train)
train_error = 1 - accuracy_score(y_train, train_pred)

print("Cross-validation scores:", cv_scores)
print("Mean CV accuracy: {:.4f}".format(cv_scores.mean()))
print("Training error: {:.4f}".format(train_error))
```

```
Cross-validation scores: [0.696 0.682 0.7   0.648 0.701]
Mean CV accuracy: 0.6854
Training error: 0.1913
```

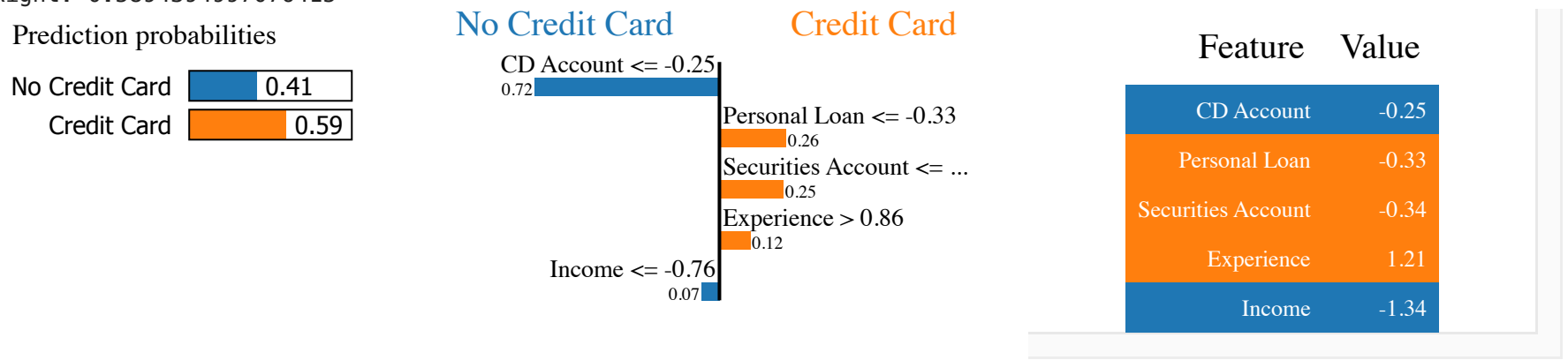
Task 3: Randomly select 5 data points. Apply LIME to explain the individual outcome predicted by the MLP. Then implement submodular pick and derive a LIME explanation for 10% of training data points with no more than 10 explanations. Using these explanations, predict whether credit card is approved or not using the entire training data and calculate the classification error.

In [ ]:
```
# Randomly select 5 data points
np.random.seed(42)
```

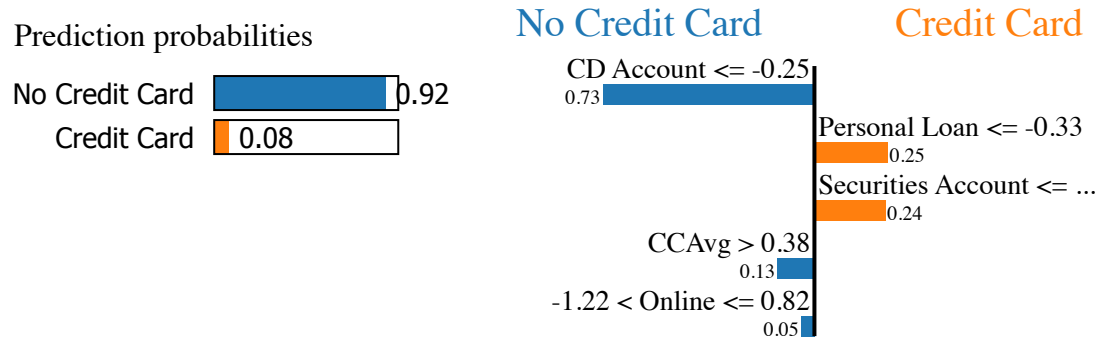
```
sample_indices = np.random.choice(X_train.shape[0], 5, replace=False)
samples = X_train[sample_indices]
sample_labels = y_train.iloc[sample_indices]

# Initialize LIME explainer
explainer = lime.lime_tabular.LimeTabularExplainer(
    X_train,
    feature_names=X.columns,
    class_names=['No Credit Card', 'Credit Card'],
    verbose=True,
    mode='classification'
)
```

In [ ]:
```
# Explain predictions for the 5 samples
for i, (sample, label) in enumerate(zip(samples, sample_labels)):
    print(f"\nExplanation for sample {i+1} (True label: {label})")
    exp = explainer.explain_instance(sample, mlp.predict_proba, num_features=5)
    exp.show_in_notebook(show_table=True)
```

```
Explanation for sample 1 (True label: 1)
Intercept 0.48741698365443037
Prediction_local [0.32920175]
Right: 0.5894394997076415
```

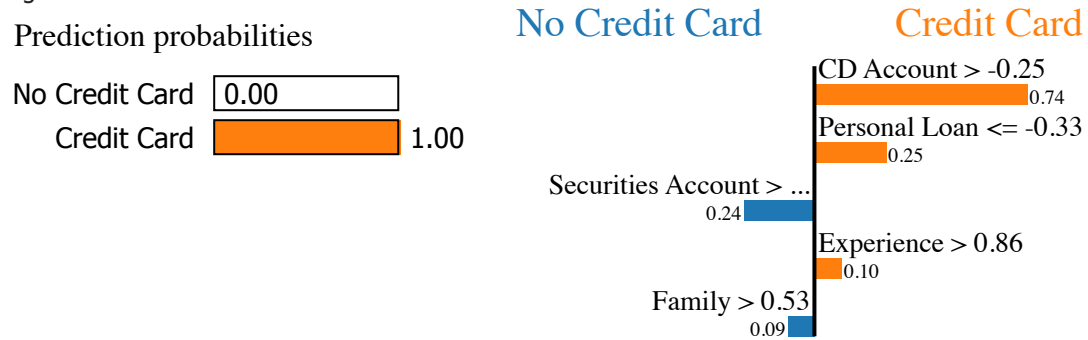



```
Explanation for sample 2 (True label: 0)
Intercept 0.5748080134493218
Prediction_local [0.16792684]
Right: 0.0801755747259019
```



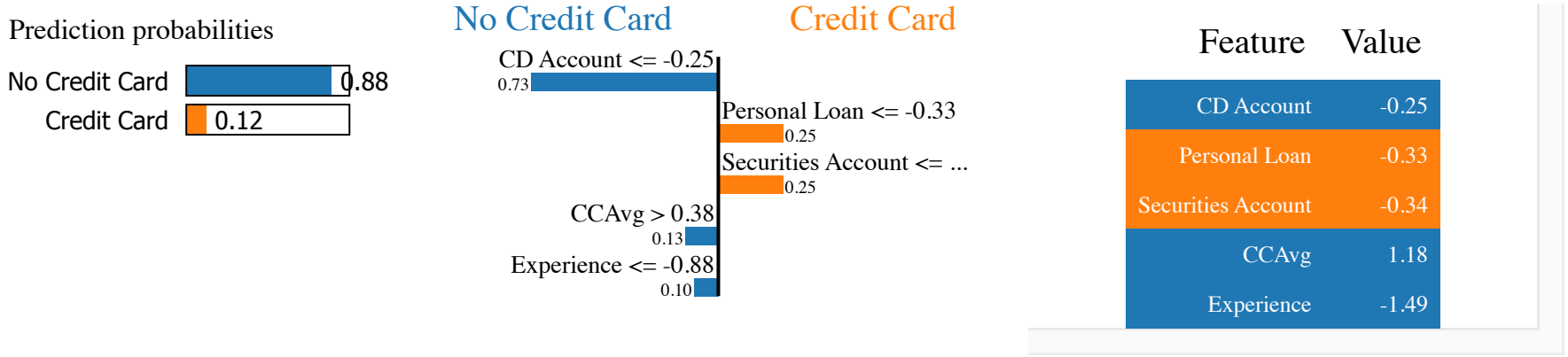
Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
CCAvg	0.49
Online	0.82

```
Explanation for sample 3 (True label: 1)
Intercept 0.030399993232458455
Prediction_local [0.7743904]
Right: 0.9999486349787456
```

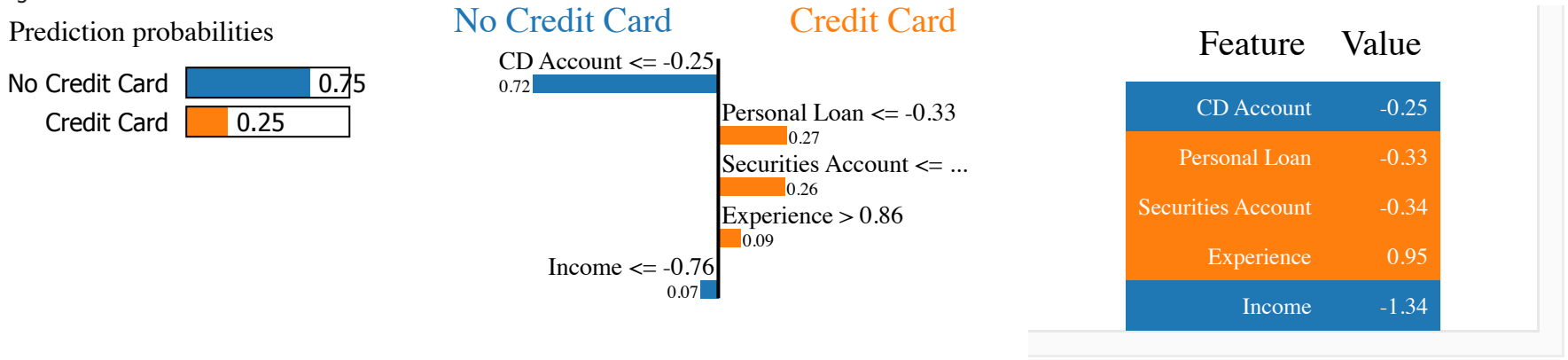


Feature	Value
CD Account	3.94
Personal Loan	-0.33
Securities Account	2.93
Experience	1.56
Family	1.40

```
Explanation for sample 4 (True label: 0)
Intercept 0.563290239855015
Prediction_local [0.11878935]
Right: 0.11957885569948559
```




```
Explanation for sample 5 (True label: 1)
Intercept 0.4811436763374918
Prediction_local [0.30391079]
Right: 0.25169674985323076
```



In [ ]:
```python
# Implement Submodular Pick for LIME explanations

def submodular_pick(X, explainer, model, num_explanations=10, num_samples=0.1):
    # Select 10% of data
    n_samples = int(X.shape[0] * num_samples)
    sample_indices = np.random.choice(X.shape[0], n_samples, replace=False)
    X_samples = X[sample_indices]

    # Get explanations for all samples
    explanations = []
    for sample in X_samples:
        exp = explainer.explain_instance(sample, model.predict_proba, num_features=5)
```

```
        explanations.append(exp)

    # For simplicity, we'll just pick the first 'num_explanations' explanations
    # In a real implementation, we would use submodular optimization to pick diverse explanations
    selected_explanations = explanations[:num_explanations]
    selected_indices = sample_indices[:num_explanations]

    return selected_explanations, selected_indices
```

In [ ]:
```
# Get submodular pick explanations
sp_explanations, sp_indices = submodular_pick(X_train, explainer, mlp)
```

```
Intercept 0.49308724320999897
Prediction_local [0.28565576]
Right: 0.21703748405316253
Intercept 0.5412624984408567
Prediction_local [0.23079908]
Right: 0.6627182713838982
Intercept 0.49633990478311835
Prediction_local [0.26991777]
Right: 0.4606676620019547
Intercept 0.516743502561598
Prediction_local [0.1641509]
Right: 0.1409977762596764
Intercept 0.4736609188059042
Prediction_local [0.30496494]
Right: 0.13174259243844508
Intercept 0.46237463328831097
Prediction_local [0.37444485]
Right: 0.06688669111710253
Intercept 0.4423934664893472
Prediction_local [0.39805445]
Right: 0.7742947732937621
Intercept 0.535586830184246
Prediction_local [0.18232491]
Right: 0.4690453526851437
Intercept 0.47840429018502
Prediction_local [0.30805087]
Right: 0.18581198593052498
Intercept 0.49573458818945915
Prediction_local [0.31455608]
Right: 0.3795306334780898
Intercept 0.4852372393256873
Prediction_local [0.28610123]
Right: 0.20870975964788693
Intercept 0.7704076900505988
Prediction_local [-0.0426393]
Right: 0.06394053846350395
Intercept 0.5119209992707148
Prediction_local [0.27354462]
Right: 0.25931353696833803
Intercept -0.17875786784821335
Prediction_local [0.87887342]
```

```
Right: 0.9999994397618931
Intercept 0.49316770567454327
Prediction_local [0.33963841]
Right: 0.23437045234355897
Intercept 0.49343611165033363
Prediction_local [0.27490786]
Right: 0.3441259772473614
Intercept 0.03437750132405204
Prediction_local [0.75616868]
Right: 0.28083025072605144
Intercept 0.545435568825264
Prediction_local [0.217182]
Right: 0.17463991221536082
Intercept 0.4331232059461694
Prediction_local [0.38578229]
Right: 0.23839627995125126
Intercept 0.7866742750944831
Prediction_local [-0.06911598]
Right: 3.208362155250929e-07
Intercept 0.49748131314929994
Prediction_local [0.286808]
Right: 0.7901342555473342
Intercept 0.5427742925956992
Prediction_local [0.15993522]
Right: 0.2738391520364248
Intercept 0.5522160093644802
Prediction_local [0.17149274]
Right: 0.15122499494840438
Intercept 0.4832949047759558
Prediction_local [0.31859596]
Right: 0.2355623673271266
Intercept 0.4923390098267605
Prediction_local [0.28495301]
Right: 0.7048970974588349
Intercept 0.4901558827091324
Prediction_local [0.29700155]
Right: 0.5490827143925748
Intercept 0.010644851032939773
Prediction_local [0.79546063]
Right: 0.9821972425116082
Intercept 0.5265381460369447
```

```
Prediction_local [0.27650061]
Right: 0.4709484986166547
Intercept 0.5063064840863167
Prediction_local [0.2905594]
Right: 0.22348011947803645
Intercept 0.4584213169319494
Prediction_local [0.28448096]
Right: 0.18367519992764897
Intercept 0.013507030610219628
Prediction_local [0.85906497]
Right: 0.999080841575664
Intercept 0.33393772967260743
Prediction_local [0.37586675]
Right: 5.537039765706517e-05
Intercept 0.5118444081087962
Prediction_local [0.27095834]
Right: 0.4582059194020542
Intercept -0.024943340118481594
Prediction_local [0.93223964]
Right: 0.8749728078520326
Intercept 0.5009966483061634
Prediction_local [0.29490334]
Right: 0.164717638049228
Intercept 0.5621609439256032
Prediction_local [0.17639346]
Right: 0.056320391632467916
Intercept 0.0850705849522819
Prediction_local [0.55078654]
Right: 0.9999262095750617
Intercept 0.501028425991043
Prediction_local [0.27492544]
Right: 0.35586576017112076
Intercept 0.5060642430833471
Prediction_local [0.1988483]
Right: 0.43258722797868154
Intercept 0.5143469145401729
Prediction_local [0.27551823]
Right: 0.6720046102678615
Intercept 0.5258531634707815
Prediction_local [0.24696691]
Right: 0.41173465548407695
```

```
Intercept 0.4860910370056192
Prediction_local [0.28160788]
Right: 0.07434057788865323
Intercept 0.5011674107380786
Prediction_local [0.28004547]
Right: 0.11897856297228623
Intercept 0.49771730181479545
Prediction_local [0.28599557]
Right: 0.3158188694906174
Intercept 0.48511301445070365
Prediction_local [0.28594182]
Right: 0.45711455435860443
Intercept 0.5398320925516905
Prediction_local [0.19482224]
Right: 0.5864544154604229
Intercept 0.49595530233436136
Prediction_local [0.28290142]
Right: 0.2847177597217093
Intercept 0.49760503278219026
Prediction_local [0.29831463]
Right: 0.07882820133015624
Intercept 0.4728658060020159
Prediction_local [0.28901366]
Right: 0.29759495497302263
Intercept 0.5298148104615346
Prediction_local [0.16596212]
Right: 0.08758679265259868
Intercept 0.4740575408602765
Prediction_local [0.28025227]
Right: 0.20516880252552708
Intercept 0.4986875781570917
Prediction_local [0.25612484]
Right: 0.14770662971219878
Intercept 0.5281968543927285
Prediction_local [0.18126318]
Right: 0.2750197091911813
Intercept 0.4941489040773972
Prediction_local [0.2854916]
Right: 0.31224087620792246
Intercept 0.4737539123566492
Prediction_local [0.37372383]
```

```
Right: 0.1461236303345805
Intercept 0.7532798505100818
Prediction_local [0.06136537]
Right: 0.07799763346979746
Intercept 0.008561485706532423
Prediction_local [0.78199209]
Right: 0.999706307419314
Intercept 0.7406902397768469
Prediction_local [0.09500884]
Right: 1.4302339137181426e-07
Intercept 0.474513447038701
Prediction_local [0.28614486]
Right: 0.36330042821358943
Intercept 0.4652854290628131
Prediction_local [0.40753456]
Right: 0.3852831527415579
Intercept 0.7608822318197246
Prediction_local [0.01896371]
Right: 0.060216697863244545
Intercept 0.49804379368023843
Prediction_local [0.27992708]
Right: 0.3919029144037455
Intercept 0.489158733691891
Prediction_local [0.26982766]
Right: 0.07805808537002965
Intercept 0.7630105468876965
Prediction_local [0.03644969]
Right: 4.305807628564569e-06
Intercept 0.4446234024488984
Prediction_local [0.35415566]
Right: 0.3917352551530277
Intercept 0.48982059120207877
Prediction_local [0.30562459]
Right: 0.1051650161729494
Intercept 0.4950716006095871
Prediction_local [0.35093798]
Right: 0.15761617025791688
Intercept 0.6791959258322271
Prediction_local [0.23404306]
Right: 0.0005834711988731187
Intercept 0.5419021765225993
```

```
Prediction_local [0.19121837]
Right: 0.5849735125038231
Intercept 0.49861915266961876
Prediction_local [0.20989278]
Right: 0.41036295680059676
Intercept 0.5469169907197347
Prediction_local [0.15624246]
Right: 0.1437445328132137
Intercept 0.5072773463936606
Prediction_local [0.28634563]
Right: 0.358426233860643
Intercept 0.7437981843050437
Prediction_local [0.07142026]
Right: 2.563307434190744e-05
Intercept 0.5037343718596157
Prediction_local [0.27966737]
Right: 0.28168863248262127
Intercept 0.496251000204371
Prediction_local [0.31601478]
Right: 0.6681963849371239
Intercept 0.48149263192032654
Prediction_local [0.3047734]
Right: 0.2914323672335651
Intercept 0.53370232315616
Prediction_local [0.28978559]
Right: 0.1569138193202226
Intercept -0.16236241391938938
Prediction_local [0.93595881]
Right: 0.9999975220339193
Intercept 0.5186628611236451
Prediction_local [0.24401367]
Right: 0.01925001908731053
Intercept 0.03174791763494761
Prediction_local [0.77744156]
Right: 0.7485289782899177
Intercept 0.5004400525382793
Prediction_local [0.31502202]
Right: 0.14313781331509084
Intercept 0.7749813877377507
Prediction_local [-0.08588119]
Right: 6.381697496090401e-07
```

```
Intercept 0.4758067617576414
Prediction_local [0.32019608]
Right: 0.3121898665142583
Intercept 0.4060827528312245
Prediction_local [0.49071676]
Right: 0.5029836773778776
Intercept 0.5430471413610283
Prediction_local [0.19635875]
Right: 0.34327349277954206
Intercept 0.5500300766695712
Prediction_local [0.20771194]
Right: 0.3553016047909115
Intercept 0.47741101860292684
Prediction_local [0.2851049]
Right: 0.8819559446491994
Intercept 0.5013050564473361
Prediction_local [0.30920008]
Right: 0.3009087804123412
Intercept 0.5224078467473574
Prediction_local [0.19704317]
Right: 0.17961385756699558
Intercept 0.4955311718931336
Prediction_local [0.29303313]
Right: 0.20633430540865255
Intercept 0.4866066946715587
Prediction_local [0.29655407]
Right: 0.5560670633785338
Intercept 0.38408162762238884
Prediction_local [0.50244468]
Right: 0.045679209115114305
Intercept 0.5582179798287561
Prediction_local [0.15607716]
Right: 0.20956644497967367
Intercept 0.5638280786259047
Prediction_local [0.19460261]
Right: 0.03368073247679197
Intercept 0.7369497167764419
Prediction_local [0.027216]
Right: 0.006635121074970262
Intercept 0.7616917985602393
Prediction_local [0.01709416]
```

```
Right: 1.173735638539799e-06
Intercept 0.48961917184467985
Prediction_local [0.31403332]
Right: 0.392304901209755
Intercept 0.7339936047386317
Prediction_local [0.02593144]
Right: 0.32244534488507315
Intercept 0.4681889606505277
Prediction_local [0.29753648]
Right: 0.604971457901315
Intercept 0.7679957985404009
Prediction_local [0.06489676]
Right: 0.955174642417321
Intercept 0.49790425416680517
Prediction_local [0.24659427]
Right: 0.04204014635732016
Intercept 0.47289869906555204
Prediction_local [0.29694965]
Right: 0.2068770300592745
Intercept -0.22623673925021698
Prediction_local [1.00876505]
Right: 0.9999999892163319
Intercept 0.478541738000116
Prediction_local [0.29606179]
Right: 0.4587516341188878
Intercept 0.48449031772719064
Prediction_local [0.28592541]
Right: 0.26051427768624863
Intercept 0.70050698048229
Prediction_local [0.22647238]
Right: 2.246919443990624e-06
Intercept 0.496450760477058
Prediction_local [0.30955162]
Right: 0.2065167660067746
Intercept 0.552582379555044
Prediction_local [0.110656]
Right: 0.11652714458056951
Intercept 0.49067645859167996
Prediction_local [0.28065345]
Right: 0.06952376146433747
Intercept 0.031980470897187974
```

```
Prediction_local [0.75304607]
Right: 0.9993391111358118
Intercept 0.506169737166141
Prediction_local [0.27602846]
Right: 0.5489099093671075
Intercept 0.5079279535284245
Prediction_local [0.26759676]
Right: 0.483445654501766
Intercept 0.038138043396702265
Prediction_local [0.74191111]
Right: 0.999317448095705
Intercept 0.5553280389069024
Prediction_local [0.19230137]
Right: 0.5937876414951028
Intercept 0.7194772233491731
Prediction_local [0.06144933]
Right: 0.008044445431832435
Intercept 0.8380516485515074
Prediction_local [-0.0855455]
Right: 1.7847422848642562e-05
Intercept 0.4910126952327332
Prediction_local [0.273425]
Right: 0.22604595804129335
Intercept 0.5310550653893406
Prediction_local [0.28237981]
Right: 0.3533122668880336
Intercept 0.4728368209830565
Prediction_local [0.31719013]
Right: 0.13631954213516323
Intercept 0.5330546023458493
Prediction_local [0.12029376]
Right: 0.1339005034351151
Intercept 0.465603895816469
Prediction_local [0.31274853]
Right: 0.36492906272751596
Intercept 0.5026791905940922
Prediction_local [0.28990913]
Right: 0.28349145129321107
Intercept 0.5145219420937944
Prediction_local [0.18071727]
Right: 0.20584753439011458
```

```
Intercept 0.4569495000484766
Prediction_local [0.27793664]
Right: 0.19570523807622223
Intercept 0.46528148088613996
Prediction_local [0.27644556]
Right: 0.041081413905792244
Intercept 0.5019090875150155
Prediction_local [0.25618325]
Right: 0.5233352618854975
Intercept 0.5032314748863806
Prediction_local [0.30123157]
Right: 0.21771922693105106
Intercept 0.5448850019788711
Prediction_local [0.17444822]
Right: 0.1046139958365679
Intercept 0.5216890114493686
Prediction_local [0.27306841]
Right: 0.4737520869042051
Intercept 0.48976206299885106
Prediction_local [0.30605903]
Right: 0.20388558085539324
Intercept 0.7655410989096014
Prediction_local [0.0271114]
Right: 0.11703450072762676
Intercept 0.49965632037097657
Prediction_local [0.27902045]
Right: 0.3408095817758115
Intercept 0.7966912998431861
Prediction_local [-0.07956515]
Right: 1.0227964629000484e-06
Intercept 0.4298050244741603
Prediction_local [0.36583551]
Right: 0.17631019173651769
Intercept 0.44933319913066994
Prediction_local [0.36262197]
Right: 0.10615969830831828
Intercept 0.7672699507758381
Prediction_local [0.04250313]
Right: 0.048963392703018055
Intercept 0.5457862167593006
Prediction_local [0.14228127]
```

```
Right: 0.4470566257280398
Intercept 0.4501983862081772
Prediction_local [0.41922271]
Right: 0.12142671594668138
Intercept 0.5443115529847775
Prediction_local [0.21484865]
Right: 0.4845777781567068
Intercept 0.7326995919325723
Prediction_local [0.02087923]
Right: 0.028380409283930753
Intercept 0.515595434776562
Prediction_local [0.20101694]
Right: 0.12662164777757853
Intercept 0.5203438091190717
Prediction_local [0.2823669]
Right: 0.29283001874524645
Intercept -0.22862484060436583
Prediction_local [0.99538527]
Right: 0.9999674985032418
Intercept 0.512232236081576
Prediction_local [0.20561718]
Right: 0.5577738100359207
Intercept 0.49721810545774847
Prediction_local [0.3206873]
Right: 0.08587252417958893
Intercept 0.49823061086460024
Prediction_local [0.26524141]
Right: 0.11479771612189864
Intercept 0.5246077713957618
Prediction_local [0.25210967]
Right: 0.1003848057342172
Intercept 0.4924132677583104
Prediction_local [0.2967821]
Right: 0.34867753047720546
Intercept 0.024085753316257785
Prediction_local [0.74137056]
Right: 0.7481917041550971
Intercept 0.5043656917184839
Prediction_local [0.28881573]
Right: 0.33782051507986166
Intercept 0.514965560863313
```

```
Prediction_local [0.24250376]
Right: 0.19139830012328418
Intercept 0.5590127881367357
Prediction_local [0.153689]
Right: 0.19431967927113603
Intercept 0.4695239677817423
Prediction_local [0.28927119]
Right: 0.4385244823321052
Intercept 0.7664977760852186
Prediction_local [0.06527895]
Right: 0.6485746030376252
Intercept 0.5726615881652777
Prediction_local [0.11655402]
Right: 0.005226151536579883
Intercept 0.6890418165896413
Prediction_local [0.24029876]
Right: 2.249879841292958e-06
Intercept 0.5824813039557607
Prediction_local [0.11851919]
Right: 0.09667425677286436
Intercept 0.5159842150136813
Prediction_local [0.26615832]
Right: 0.15219770055413023
Intercept 0.4835159122160569
Prediction_local [0.30736554]
Right: 0.5043055790758605
Intercept 0.4935615705226969
Prediction_local [0.29030125]
Right: 0.26758389279560835
Intercept 0.4653733308692516
Prediction_local [0.29657513]
Right: 0.12726680940366186
Intercept 0.5208392763884322
Prediction_local [0.26704257]
Right: 0.27602303441161175
Intercept 0.5132314032212263
Prediction_local [0.2041117]
Right: 0.5790945297482462
Intercept 0.7945984271602697
Prediction_local [-0.12136135]
Right: 0.0001171808643834374
```

```
Intercept 0.48882768562008877
Prediction_local [0.32227316]
Right: 0.4729826010640354
Intercept 0.40393238068859777
Prediction_local [0.48022098]
Right: 0.15078021058330715
Intercept 0.48797117758818415
Prediction_local [0.30188067]
Right: 0.07951962615999168
Intercept 0.49465358688968963
Prediction_local [0.29602912]
Right: 0.17842194726764116
Intercept 0.034213353945994784
Prediction_local [0.87075419]
Right: 0.9637475660646669
Intercept 0.5439252700354302
Prediction_local [0.18789203]
Right: 0.24397817591859208
Intercept 0.5049436688198373
Prediction_local [0.30992257]
Right: 0.22091869758706661
Intercept 0.4806788584219914
Prediction_local [0.32045946]
Right: 0.21358470545979685
Intercept 0.5260330086840156
Prediction_local [0.27493703]
Right: 0.3708396448478339
Intercept 0.7994259587744832
Prediction_local [-0.08998936]
Right: 0.2753289887940681
Intercept 0.512102769806419
Prediction_local [0.30713403]
Right: 0.43360432449235775
Intercept -0.02570396011683629
Prediction_local [0.90318169]
Right: 0.999943012086774
Intercept 0.014173026289585
Prediction_local [0.74659863]
Right: 0.9885210273596863
Intercept 0.4757885947786365
Prediction_local [0.31242488]
```

```
Right: 0.2781305924739409
Intercept 0.4555553665554465
Prediction_local [0.37356016]
Right: 0.16018365245064203
Intercept 0.49039708221002676
Prediction_local [0.26612123]
Right: 0.10380668404683417
Intercept 0.4747324027463914
Prediction_local [0.32557434]
Right: 0.2639458900947653
Intercept 0.2679381925332191
Prediction_local [0.52016704]
Right: 0.02122754119700713
Intercept 0.5419091093206563
Prediction_local [0.17302595]
Right: 0.14816933688300613
Intercept 0.4745859575812411
Prediction_local [0.29864928]
Right: 0.28020402982895987
Intercept 0.5297226123919854
Prediction_local [0.22487374]
Right: 0.306992791142008
Intercept 0.4894053636515222
Prediction_local [0.26917897]
Right: 0.4124075417514665
Intercept 0.44699514441112737
Prediction_local [0.39211175]
Right: 0.10046416534235228
Intercept 0.510896778702457
Prediction_local [0.17451738]
Right: 0.36393468899532694
Intercept 0.5507562590585395
Prediction_local [0.21212417]
Right: 0.07267976800120172
Intercept 0.41935608530396284
Prediction_local [0.4864902]
Right: 0.16735182088442088
Intercept 0.7647762592280327
Prediction_local [0.08547694]
Right: 1.677968768825116e-05
Intercept 0.4665644952138434
```

```
Prediction_local [0.28721536]
Right: 0.26657946898554963
Intercept 0.4990382710173932
Prediction_local [0.27645109]
Right: 0.12520040683393524
Intercept 0.7454807400668158
Prediction_local [0.00842558]
Right: 0.3630141327397499
Intercept 0.7450104765469663
Prediction_local [0.04367548]
Right: 0.13015817134154145
Intercept 0.5623649553798238
Prediction_local [0.15439202]
Right: 0.2004291815961433
Intercept 0.5368542561369734
Prediction_local [0.14071315]
Right: 0.13333820233825774
Intercept 0.4596356007198529
Prediction_local [0.31626157]
Right: 0.38553723070783735
Intercept 0.45087441970091147
Prediction_local [0.37848739]
Right: 0.36691587855587576
Intercept 0.7196135545725229
Prediction_local [0.0515827]
Right: 2.230093729014363e-07
Intercept 0.55797334010255
Prediction_local [0.14017849]
Right: 0.0029722583584120754
Intercept 0.48678787994993344
Prediction_local [0.27225609]
Right: 0.4438893452405069
Intercept 0.5070783805638038
Prediction_local [0.28648352]
Right: 0.043037115457054485
Intercept 0.4967302337384025
Prediction_local [0.30181167]
Right: 0.6818817995499832
Intercept 0.47142252419605446
Prediction_local [0.31555628]
Right: 0.8085395354281941
```

```
Intercept 0.5018539168732298
Prediction_local [0.3416621]
Right: 0.2970698445483241
Intercept 0.4765679595443339
Prediction_local [0.40812959]
Right: 0.21501112593412308
Intercept 0.47626279014654305
Prediction_local [0.38234608]
Right: 0.36003642904523486
Intercept 0.7531982245507154
Prediction_local [0.03954835]
Right: 1.6334807060470163e-06
Intercept 0.5077705967463079
Prediction_local [0.30533681]
Right: 0.5174326092036359
Intercept 0.7360572722660867
Prediction_local [0.05557299]
Right: 5.232421534902963e-06
Intercept 0.4293319864076758
Prediction_local [0.43047367]
Right: 0.43432400330631926
Intercept 0.48000948446816805
Prediction_local [0.3206899]
Right: 0.11923897478900236
Intercept 0.7950940175295242
Prediction_local [-0.07348402]
Right: 2.6464405993718205e-07
Intercept 0.49934060806651503
Prediction_local [0.3042411]
Right: 0.4005877578606603
Intercept 0.48808642060229235
Prediction_local [0.30142565]
Right: 0.47582800496182714
Intercept 0.4784129310162357
Prediction_local [0.31165315]
Right: 0.2942735187731146
Intercept 0.5171962306190913
Prediction_local [0.17608872]
Right: 0.03821433418891603
Intercept 0.49669230581117735
Prediction_local [0.31385473]
```

```
Right: 0.12189243640518777
Intercept 0.4159136020755127
Prediction_local [0.50597798]
Right: 0.016132240971285454
Intercept 0.5432661799861437
Prediction_local [0.17558714]
Right: 0.062139367929881596
Intercept 0.4951916340945437
Prediction_local [0.2956907]
Right: 0.5549558734426601
Intercept 0.5245384176801495
Prediction_local [0.23194632]
Right: 0.026587832865186026
Intercept 0.8337132487047272
Prediction_local [-0.1290075]
Right: 0.02484863576386282
Intercept 0.49717176350032316
Prediction_local [0.25540494]
Right: 0.27501146623276806
Intercept 0.563527181948601
Prediction_local [0.11124028]
Right: 0.21459325852894498
Intercept 0.47308342688720073
Prediction_local [0.27911149]
Right: 0.4626394896059243
Intercept 0.4737123074403129
Prediction_local [0.32186392]
Right: 0.0033405007030594797
Intercept 0.4934316677909878
Prediction_local [0.26815694]
Right: 0.6867469960542822
Intercept 0.4889456151198869
Prediction_local [0.32301947]
Right: 0.22542403267279237
Intercept 0.43660925676359996
Prediction_local [0.41850537]
Right: 0.5330549023861096
Intercept 0.5453499996175708
Prediction_local [0.18086706]
Right: 0.5401159795452636
Intercept 0.5179802632321315
```

```
Prediction_local [0.27968823]
Right: 0.41947351100044156
Intercept 0.49132641674762023
Prediction_local [0.29901361]
Right: 0.20618731726373693
Intercept 0.48743867767512716
Prediction_local [0.32069486]
Right: 0.1146912192718135
Intercept 0.4383279917674183
Prediction_local [0.39207089]
Right: 0.018718602483930275
Intercept 0.5203609737988648
Prediction_local [0.25581173]
Right: 0.2692806878282222
Intercept 0.5480880185097626
Prediction_local [0.1684961]
Right: 0.14348156150373534
Intercept 0.4721674762497722
Prediction_local [0.39038519]
Right: 0.47254036809086786
Intercept 0.49835936997936997
Prediction_local [0.26741612]
Right: 0.09046750389618927
Intercept 0.49210164365860987
Prediction_local [0.29713586]
Right: 0.1700495761582965
Intercept 0.45322429525827523
Prediction_local [0.39558362]
Right: 0.22937434487589317
Intercept 0.4868462884227486
Prediction_local [0.25398371]
Right: 0.3254917332993936
Intercept 0.4261886784668105
Prediction_local [0.46711025]
Right: 0.23733384113164013
Intercept 0.5247088889836067
Prediction_local [0.23911135]
Right: 0.12551228071562384
Intercept 0.6911018228983825
Prediction_local [0.20616983]
Right: 5.871317690405873e-10
```

```
Intercept 0.5271185108922362
Prediction_local [0.2574962]
Right: 0.22431635424474966
Intercept 0.49801963084100936
Prediction_local [0.29792716]
Right: 0.4835596662895015
Intercept 0.5605423995264591
Prediction_local [0.21285402]
Right: 0.1469207155200401
Intercept 0.5090900700106264
Prediction_local [0.15746496]
Right: 0.0893557921280419
Intercept 0.49753160833307675
Prediction_local [0.27903797]
Right: 0.16386432399294865
Intercept 0.4713416589481161
Prediction_local [0.3065339]
Right: 0.09030079717685707
Intercept 0.5143449138729524
Prediction_local [0.27591387]
Right: 0.051589809547193145
Intercept 0.49173006953973275
Prediction_local [0.28328995]
Right: 0.6357369764961729
Intercept 0.5350393606621002
Prediction_local [0.17098846]
Right: 0.163208062042027
Intercept 0.5372566688254505
Prediction_local [0.13799369]
Right: 0.18049556856014198
Intercept 0.026084635232738462
Prediction_local [0.80768732]
Right: 0.9998184099843234
Intercept 0.5064650696980054
Prediction_local [0.32826853]
Right: 0.49907487175567977
Intercept 0.4842834054919135
Prediction_local [0.35055285]
Right: 0.3462704646088412
Intercept 0.4844167440070808
Prediction_local [0.29434726]
```

```
Right: 0.2561428997698415
Intercept 0.5170049768235876
Prediction_local [0.34266271]
Right: 0.1151297623808747
Intercept 0.5583169331398365
Prediction_local [0.206478]
Right: 0.13331875060488782
Intercept 0.5019306529948149
Prediction_local [0.2503468]
Right: 0.1003848057342172
Intercept 0.5021617570994237
Prediction_local [0.29601305]
Right: 0.21360303190150357
Intercept 0.5128817792641057
Prediction_local [0.30082946]
Right: 0.18139643909089398
Intercept 0.5257498542631003
Prediction_local [0.20230561]
Right: 0.24868524933426725
Intercept 0.7564020342703561
Prediction_local [0.04039892]
Right: 0.8345416181824894
Intercept 0.5371586492746439
Prediction_local [0.16225008]
Right: 0.36237840318080256
Intercept 0.5114777361741477
Prediction_local [0.27062289]
Right: 0.02310340757709468
Intercept 0.7843409250922642
Prediction_local [0.05321456]
Right: 0.40540235724885637
Intercept 0.7228507997971272
Prediction_local [0.04783134]
Right: 1.8706839723652917e-06
Intercept 0.5465617877665687
Prediction_local [0.20986083]
Right: 0.46215537933824713
Intercept 0.4963579448998403
Prediction_local [0.29470253]
Right: 0.37496458823039563
Intercept 0.7833984088813315
```

```
Prediction_local [-0.03335153]
Right: 1.6403326934090088e-06
Intercept 0.013507979621679989
Prediction_local [0.76379977]
Right: 0.9999940459126013
Intercept 0.27870737542352925
Prediction_local [0.48951453]
Right: 0.0023420916451490667
Intercept 0.4477086072308597
Prediction_local [0.37914706]
Right: 0.3955562090685172
Intercept 0.8112050466040451
Prediction_local [-0.03710764]
Right: 0.00020995062420196129
Intercept 0.7633419244305824
Prediction_local [0.05524145]
Right: 0.5617929223923348
Intercept 0.49221258864143075
Prediction_local [0.26881459]
Right: 0.2441168138553621
Intercept 0.492004951953525
Prediction_local [0.28203392]
Right: 0.05560979251449409
Intercept 0.5191324413852568
Prediction_local [0.28549224]
Right: 0.26487907582274867
Intercept 0.4823273887354902
Prediction_local [0.28930293]
Right: 0.13761834796268335
Intercept 0.4736593056079498
Prediction_local [0.30116455]
Right: 0.23519502079054383
Intercept 0.5026867634654472
Prediction_local [0.26585196]
Right: 0.24217009425858402
Intercept 0.6783788989328589
Prediction_local [0.22492604]
Right: 0.23700874515424092
Intercept 0.4053918566686898
Prediction_local [0.50018218]
Right: 0.04960055680884135
```

```
Intercept 0.5006195761091442
Prediction_local [0.28615332]
Right: 0.21565689636321497
Intercept 0.4079966238988767
Prediction_local [0.48743273]
Right: 0.3831219383223579
Intercept 0.49400676492483153
Prediction_local [0.28506666]
Right: 0.09520378635175232
Intercept 0.5798577922862402
Prediction_local [0.15629328]
Right: 0.4733070117379418
Intercept 0.026513396399907407
Prediction_local [0.77340479]
Right: 0.9827773063763119
Intercept 0.7532908393165864
Prediction_local [0.05911624]
Right: 0.9237904932951908
Intercept 0.500303244564469
Prediction_local [0.2717639]
Right: 0.3122366802767785
Intercept 0.39055095722331645
Prediction_local [0.50259315]
Right: 0.20077978116790507
Intercept 0.6813726316123485
Prediction_local [0.19918983]
Right: 8.976347823603069e-07
Intercept 0.5460126226136771
Prediction_local [0.18405371]
Right: 0.47410294042315987
Intercept 0.7642224740893426
Prediction_local [0.03613975]
Right: 5.846945012585074e-07
Intercept 0.7252639561046321
Prediction_local [0.15316107]
Right: 0.005963493431154653
Intercept 0.033925455528966086
Prediction_local [0.77981765]
Right: 0.9748170169596674
Intercept 0.7381923689514314
Prediction_local [0.05090122]
```

```
Right: 0.11811111560981981
Intercept 0.4358267334435189
Prediction_local [0.43251964]
Right: 0.42655573782134815
Intercept 0.5682151616863923
Prediction_local [0.20147317]
Right: 0.351821068133829
Intercept 0.46439473575775375
Prediction_local [0.35445613]
Right: 0.24522546385803645
Intercept 0.5121301335281943
Prediction_local [0.21160253]
Right: 0.05655793288005606
Intercept 0.025290511317631437
Prediction_local [0.75755763]
Right: 0.9825797421221961
Intercept 0.5523050947986229
Prediction_local [0.21455969]
Right: 0.3637519748924829
Intercept 0.5376784971749355
Prediction_local [0.22477093]
Right: 0.2021656810082254
Intercept 0.7402374720425329
Prediction_local [0.05921099]
Right: 0.00031941515634096717
Intercept -0.3124055495308846
Prediction_local [1.1725174]
Right: 0.9999999062840331
Intercept 0.4685071443453621
Prediction_local [0.38244517]
Right: 0.15019712333886923
Intercept 0.47145791275226545
Prediction_local [0.29799606]
Right: 0.11650555570113401
Intercept 0.4283468403545855
Prediction_local [0.44927654]
Right: 0.05412627702972953
Intercept 0.5428082374991126
Prediction_local [0.15950659]
Right: 0.3936375238826852
Intercept 0.5005188460095424
```

```
Prediction_local [0.28123526]
Right: 0.5220372586859657
Intercept 0.7196671380293718
Prediction_local [0.06173772]
Right: 7.589061820030484e-07
Intercept 0.026241578665613385
Prediction_local [0.76090257]
Right: 0.9997214334498459
Intercept 0.7658049716359339
Prediction_local [0.03449497]
Right: 3.6832042697627923e-07
Intercept 0.4760983546414913
Prediction_local [0.27655271]
Right: 0.14865531276368563
Intercept 0.49675068255388255
Prediction_local [0.29310952]
Right: 0.2629111951886411
Intercept 0.4820863050239684
Prediction_local [0.30048911]
Right: 0.31342602346134135
Intercept 0.4007755441394904
Prediction_local [0.51634541]
Right: 0.3204835910957543
Intercept 0.50495538517939
Prediction_local [0.19073988]
Right: 0.5621803274064052
Intercept 0.4876903730663239
Prediction_local [0.30439095]
Right: 0.12363473082515808
Intercept -0.18793537406419858
Prediction_local [0.89765543]
Right: 0.999999986280492
Intercept 0.4752357096686466
Prediction_local [0.29984048]
Right: 0.07001345519888666
Intercept 0.7083146141446122
Prediction_local [0.13214317]
Right: 0.6143628970535714
Intercept 0.4063376696178578
Prediction_local [0.48985017]
Right: 0.046255469824131534
```

```
Intercept 0.5083398151580832
Prediction_local [0.28828081]
Right: 0.40328479786739807
Intercept 0.4927451697782472
Prediction_local [0.28509917]
Right: 0.12495065078178408
Intercept 0.5373903254039554
Prediction_local [0.22374052]
Right: 0.2413563099268522
Intercept 0.44569195034426456
Prediction_local [0.39401587]
Right: 0.4266166989880802
Intercept 0.4228515410707534
Prediction_local [0.39823224]
Right: 0.1864882130439075
Intercept 0.5349295170458404
Prediction_local [0.19468456]
Right: 0.30196662530282814
Intercept 0.7392745991363814
Prediction_local [0.01428213]
Right: 1.8690014144882303e-06
Intercept 0.7317186038884644
Prediction_local [0.05646888]
Right: 0.21412826898757484
Intercept 0.4302858639295948
Prediction_local [0.39091807]
Right: 0.023667824885161903
Intercept 0.4483797438984555
Prediction_local [0.39344839]
Right: 0.14627693272906003
Intercept 0.4355818246919611
Prediction_local [0.48865746]
Right: 0.43056084123166916
Intercept 0.5470311330634032
Prediction_local [0.17812801]
Right: 0.1963471076709516
Intercept 0.4949854077865998
Prediction_local [0.29856778]
Right: 0.40435480410166014
Intercept 0.41310964123310656
Prediction_local [0.45535956]
```

```
Right: 0.014181576215086956
Intercept 0.2765918375522357
Prediction_local [0.58268979]
Right: 0.2978036006157111
Intercept 0.46816328711221344
Prediction_local [0.32492758]
Right: 0.14167242502194305
Intercept 0.5044049581748558
Prediction_local [0.19746973]
Right: 0.4819023513152863
Intercept 0.7091850584637276
Prediction_local [0.1362213]
Right: 0.20639570581069555
Intercept 0.5020454916363235
Prediction_local [0.31138053]
Right: 0.39525872081576247
Intercept 0.5179589059467595
Prediction_local [0.29609385]
Right: 0.4577183492996648
Intercept 0.5075665318053548
Prediction_local [0.28579657]
Right: 0.1358028257100947
Intercept 0.4801170369073401
Prediction_local [0.30501457]
Right: 0.0485296777039603
Intercept 0.8206569949824325
Prediction_local [-0.13928715]
Right: 0.03145128356636698
Intercept 0.5635225156575892
Prediction_local [0.21427366]
Right: 0.16048244139561735
Intercept 0.4816726224186725
Prediction_local [0.34791522]
Right: 0.3590836648997414
Intercept 0.7522635131824691
Prediction_local [0.02829262]
Right: 5.720623554123094e-06
Intercept 0.5157711875265932
Prediction_local [0.18650034]
Right: 0.16818853912789417
Intercept 0.4769595215486093
```

```
Prediction_local [0.29343811]
Right: 0.2683286248090269
Intercept 0.7722111651152497
Prediction_local [0.04129039]
Right: 3.34247778490898e-06
Intercept 0.470091312559347
Prediction_local [0.34242494]
Right: 0.5292816284795957
Intercept 0.4835354866267204
Prediction_local [0.28050885]
Right: 0.14703208682704194
Intercept 0.03580473186913771
Prediction_local [0.75536873]
Right: 0.9928301750412062
Intercept 0.7505547795642374
Prediction_local [0.07435492]
Right: 0.00010915659238681898
Intercept 0.48071217335023875
Prediction_local [0.30552031]
Right: 0.044043227808070316
Intercept 0.44651133059007864
Prediction_local [0.32353701]
Right: 0.34582900424191215
Intercept 0.03473857323357504
Prediction_local [0.76238372]
Right: 0.9982597855153722
Intercept 0.48271632631244993
Prediction_local [0.32693686]
Right: 0.8524747081559183
Intercept 0.4755547374542565
Prediction_local [0.30923281]
Right: 0.3014781868048903
Intercept 0.029581435352898366
Prediction_local [0.75712342]
Right: 0.9992138512527332
Intercept 0.454412971079562
Prediction_local [0.30798203]
Right: 0.21807961968725803
Intercept 0.4164729820407305
Prediction_local [0.45369945]
Right: 0.0808573517978911
```

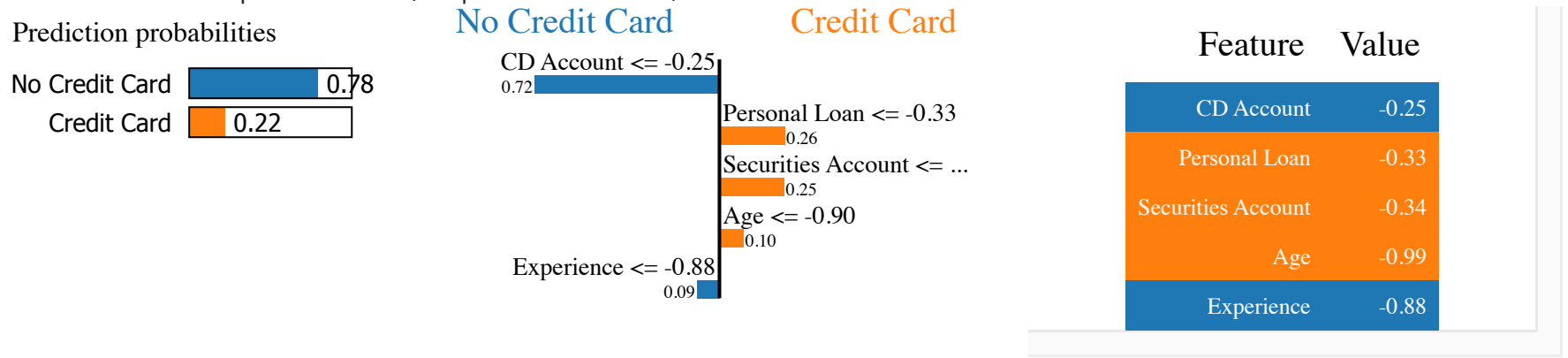
```
Intercept 0.4819652697902699
Prediction_local [0.28411091]
Right: 0.39790110534780343
Intercept 0.5009944502056404
Prediction_local [0.29537369]
Right: 0.846806653456075
Intercept 0.5072195872536781
Prediction_local [0.26863879]
Right: 0.24375874521892704
Intercept 0.4910166442432079
Prediction_local [0.29292138]
Right: 0.21104548481839033
Intercept 0.47097832453532773
Prediction_local [0.29959965]
Right: 0.5371326506590502
Intercept 0.4654742556426681
Prediction_local [0.28775717]
Right: 0.3424923846676156
Intercept 0.7193411343781297
Prediction_local [0.10220941]
Right: 0.23565307475755448
Intercept 0.49984383352741957
Prediction_local [0.28314263]
Right: 0.0412463584181111
Intercept 0.5279873632101717
Prediction_local [0.21296903]
Right: 0.019075315972603583
Intercept 0.7469034870285467
Prediction_local [-0.01170049]
Right: 0.2835379021266758
Intercept 0.7286926538053562
Prediction_local [0.05671181]
Right: 0.0003337856069630019
Intercept 0.49388818772667853
Prediction_local [0.30248233]
Right: 0.19563082688871836
Intercept 0.4910109413934589
Prediction_local [0.30986561]
Right: 0.15133974185695684
Intercept 0.46483450229267764
Prediction_local [0.37762477]
```

```
Right: 0.46626284663931533
Intercept -0.20272978233894223
Prediction_local [1.01470598]
Right: 0.9999999999775366
Intercept 0.019677942209979093
Prediction_local [0.80289854]
Right: 0.9994993207688792
Intercept 0.04046474364205366
Prediction_local [0.75767361]
Right: 0.9926127310595523
Intercept 0.524379920079904
Prediction_local [0.26591553]
Right: 0.09039280021317703
Intercept 0.463273643083163
Prediction_local [0.2770955]
Right: 0.19352046607642004
Intercept 0.748854357278036
Prediction_local [0.04317769]
Right: 0.6754804808560331
Intercept 0.7458220127801014
Prediction_local [0.05954827]
Right: 3.173179279406124e-07
Intercept 0.03792834888930474
Prediction_local [0.73555925]
Right: 0.8606576051804332
Intercept 0.48508613208643114
Prediction_local [0.29122502]
Right: 0.6105986798105792
Intercept 0.7469416000883982
Prediction_local [0.0006561]
Right: 0.020921983962884208
Intercept 0.42898134446588676
Prediction_local [0.4698003]
Right: 0.4522843896391205
Intercept 0.48959903986994474
Prediction_local [0.29291366]
Right: 0.4194048982110552
Intercept 0.5061776446401616
Prediction_local [0.27425945]
Right: 0.1073711632379113
Intercept 0.5162301486975667
```

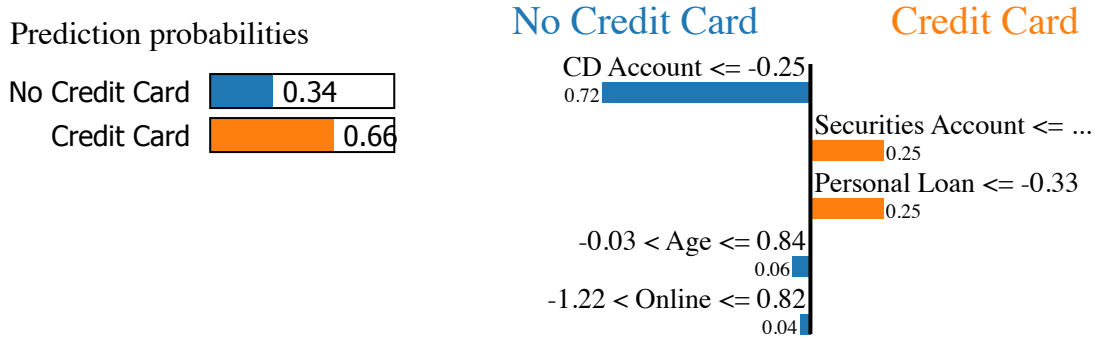
```
Prediction_local [0.27041715]
Right: 0.1924669313559401
Intercept 0.4759944630858878
Prediction_local [0.27130853]
Right: 0.12132314435239613
Intercept 0.4958874860799923
Prediction_local [0.28389574]
Right: 0.3194540205279071
Intercept 0.5210233900673328
Prediction_local [0.27220607]
Right: 0.4058886466407405
```

In [ ]:
```python
# Display the selected explanations
for i, exp in enumerate(sp_explanations):
    print(f"\nSubmodular Pick Explanation {i+1} (Sample index: {sp_indices[i]})")
    exp.show_in_notebook(show_table=True)
```

```
Submodular Pick Explanation 1 (Sample index: 3386)
```

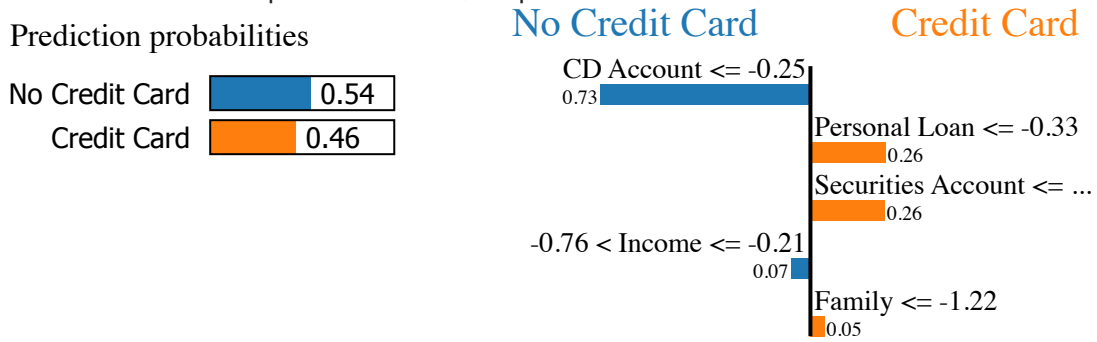



```
Submodular Pick Explanation 2 (Sample index: 3891)
```



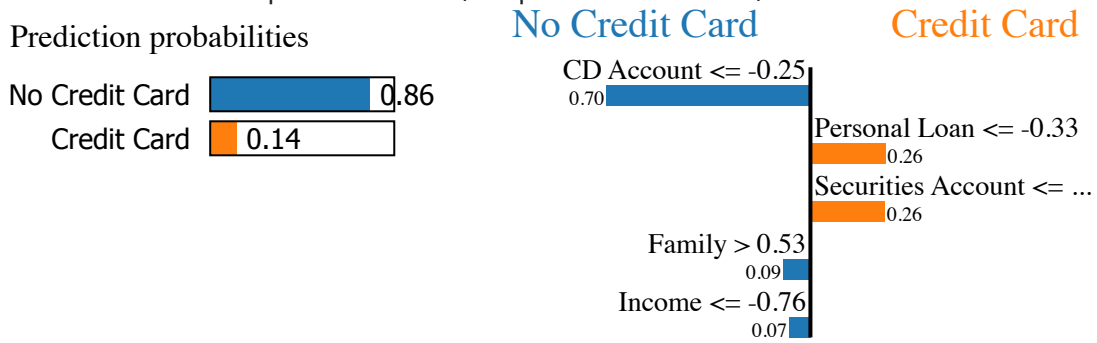
Feature	Value
CD Account	-0.25
Securities Account	-0.34
Personal Loan	-0.33
Age	0.58
Online	0.82

Submodular Pick Explanation 3 (Sample index: 1260)



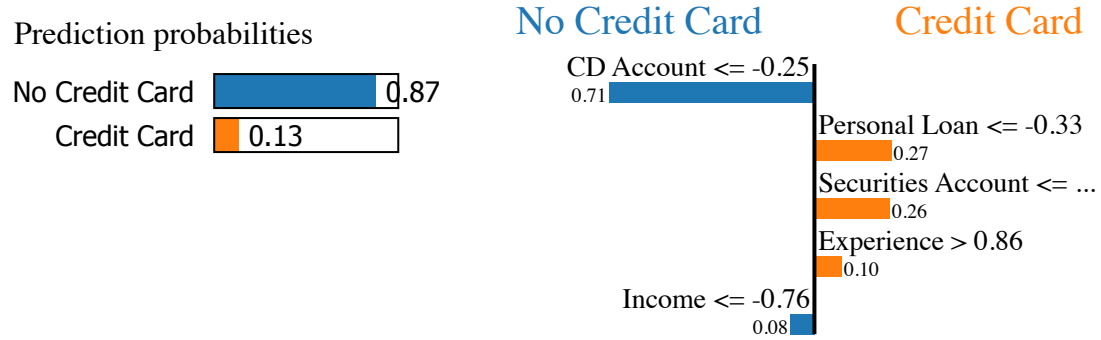
Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
Income	-0.69
Family	-1.22

Submodular Pick Explanation 4 (Sample index: 1608)



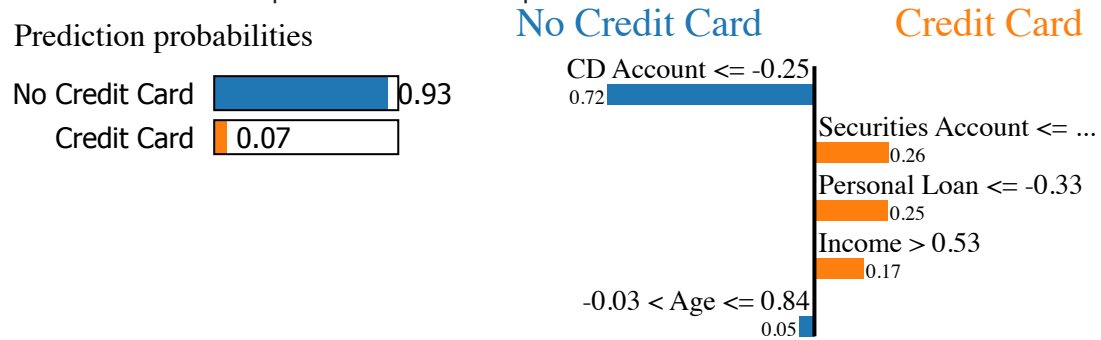
Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
Family	1.40
Income	-0.76

Submodular Pick Explanation 5 (Sample index: 1942)



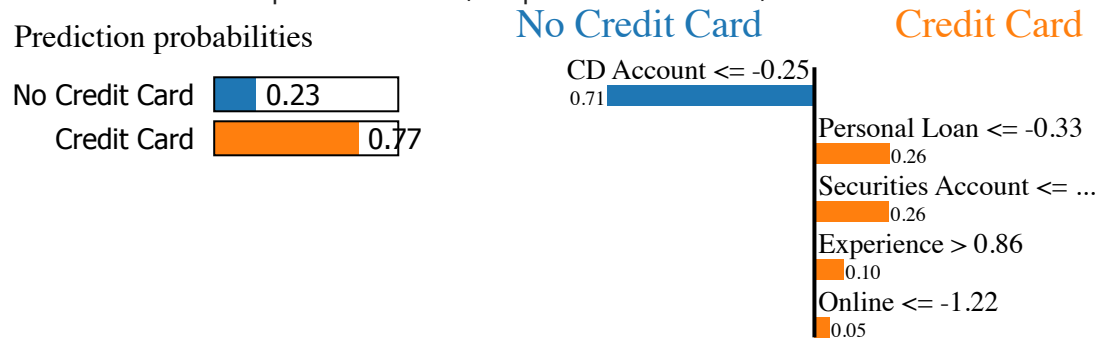
Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
Experience	1.30
Income	-1.10

Submodular Pick Explanation 6 (Sample index: 3432)



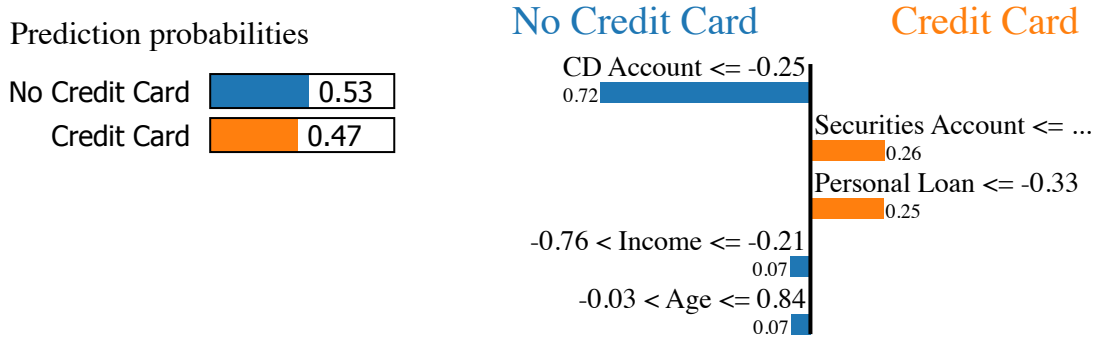
Feature	Value
CD Account	-0.25
Securities Account	-0.34
Personal Loan	-0.33
Income	1.29
Age	0.49

Submodular Pick Explanation 7 (Sample index: 3607)



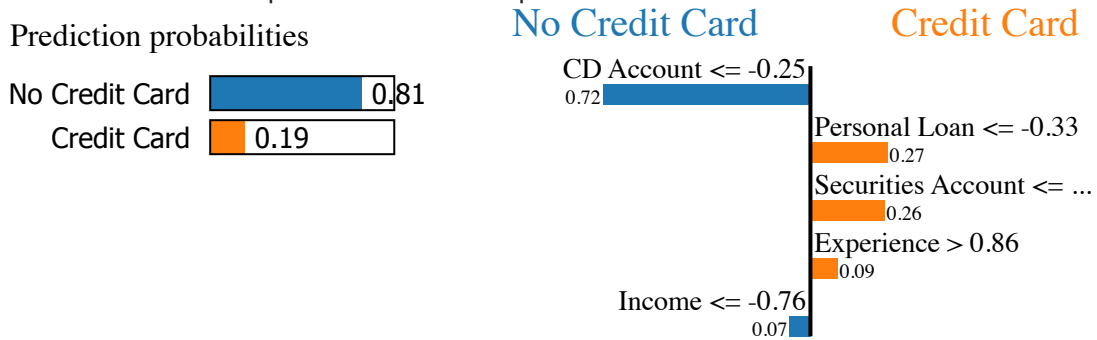
Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
Experience	1.47
Online	-1.22

Submodular Pick Explanation 8 (Sample index: 3553)



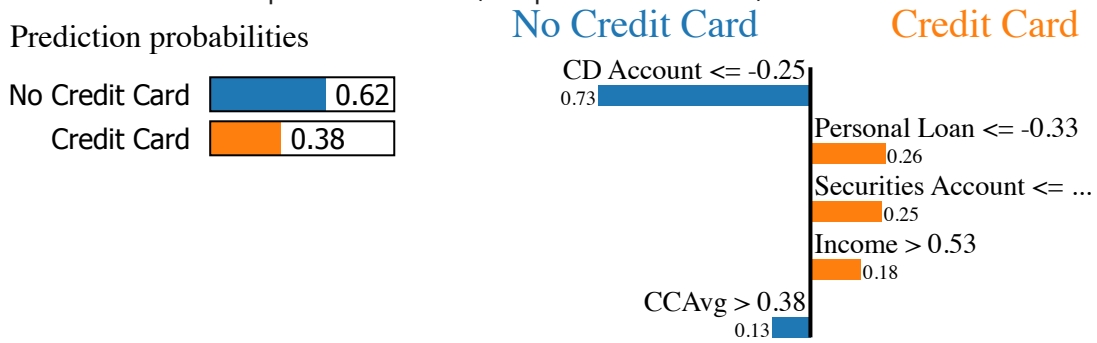
Feature	Value
CD Account	-0.25
Securities Account	-0.34
Personal Loan	-0.33
Income	-0.28
Age	0.23

Submodular Pick Explanation 9 (Sample index: 3758)



Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
Experience	1.30
Income	-1.12

Submodular Pick Explanation 10 (Sample index: 865)



Feature	Value
CD Account	-0.25
Personal Loan	-0.33
Securities Account	-0.34
Income	2.18
CCAvg	1.58