```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.datasets import make_classification
from sklearn.linear_model import LogisticRegression, SGDClassifier
from mlxtend.plotting import plot_decision_regions
from sklearn.utils import shuffle
from sklearn.metrics import log_loss
```

```
!pip install --upgrade --no-cache-dir gdown
!gdown 1FS-JXMl-PFGzA2ogy1xdBKVI6VbVDQMF
```

```
Requirement already satisfied: gdown in /usr/local/lib/python3.10/dist-packages (4.7.3)
Collecting gdown
  Downloading gdown-5.0.1-py3-none-any.whl (16 kB)
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.10/dist-packages (from gdown) (4.11.2)
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from gdown) (3.13.1)
Requirement already satisfied: requests[socks] in /usr/local/lib/python3.10/dist-packages (from gdown) (2.31.0)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from gdown) (4.66.1)
Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.10/dist-packages (from beautifulsoup4->gdown) (2.5)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (2023.11.17)
Requirement already satisfied: PySocks!=1.5.7,>=1.5.6 in /usr/local/lib/python3.10/dist-packages (from requests[socks]->gdown) (1.7.1)
Installing collected packages: gdown
  Attempting uninstall: gdown
    Found existing installation: gdown 4.7.3
    Uninstalling gdown-4.7.3:
      Successfully uninstalled gdown-4.7.3
Successfully installed gdown-5.0.1
Downloading...
From: https://drive.google.com/uc?id=1FS-JXMl-PFGzA2ogy1xdBKVI6VbVDQMF
To: /content/heart_disease_health_indicators.csv
100% 11.8M/11.8M [00:00<00:00, 65.9MB/s]
```

```
df = pd.read_csv('/content/heart_disease_health_indicators.csv')
df
```

	HeartDiseaseorAttack	HighBP	HighChol	CholCheck	BMI	Smoker	Stroke	Diabetes	PhysActivity	Fruits	...	AnyHealthcare	NoDoc
0	0	1	1	1	40	1	0	0	0	0	...	1	
1	0	0	0	0	25	1	0	0	1	0	...	0	
2	0	1	1	1	28	0	0	0	0	1	...	1	
3	0	1	0	1	27	0	0	0	1	1	...	1	
4	0	1	1	1	24	0	0	0	1	1	...	1	
...	...	...	...	...	...	...	...	...	...	...	...	...	
253656	0	0	0	1	25	0	0	0	1	1	...	1	
253657	0	0	1	1	24	0	0	0	0	0	...	1	
253658	0	0	0	0	27	0	0	0	1	0	...	1	
253659	0	0	1	1	37	0	0	2	0	0	...	1	
253660	0	0	1	1	34	1	0	0	0	1	...	1	

253661 rows × 22 columns

```
df = df.rename(columns={'Income': 'HeartDiseaseorAttack', 'HeartDiseaseorAttack': 'Income'})
df
```

	Income	HighBP	HighChol	CholCheck	BMI	Smoker	Stroke	Diabetes	PhysActivity
0	0	1	1	1	40	1	0	0	0
1	0	0	0	0	25	1	0	0	1
2	0	1	1	1	28	0	0	0	0
3	0	1	0	1	27	0	0	0	1
4	0	1	1	1	24	0	0	0	1
...	...	...	...	...	...	...	...	...	...
253656	0	0	0	1	25	0	0	0	1
253657	0	0	1	1	24	0	0	0	0
253658	0	0	0	0	27	0	0	0	1
253659	0	0	1	1	37	0	0	2	0
253660	0	0	1	1	34	1	0	0	0

253661 rows × 22 columns

```
df['Income'], df['HeartDiseaseorAttack'] = df['HeartDiseaseorAttack'].copy(), df['Income'].copy()
df
```

	Income	HighBP	HighChol	CholCheck	BMI	Smoker	Stroke	Diabetes	PhysActivity
0	3	1	1	1	40	1	0	0	0
1	1	0	0	0	25	1	0	0	1
2	8	1	1	1	28	0	0	0	0
3	6	1	0	1	27	0	0	0	1
4	4	1	1	1	24	0	0	0	1
...	...	...	...	...	...	...	...	...	...
253656	8	0	0	1	25	0	0	0	1
253657	3	0	1	1	24	0	0	0	0
253658	5	0	0	0	27	0	0	0	1
253659	1	0	1	1	37	0	0	2	0
253660	3	0	1	1	34	1	0	0	0

253661 rows × 22 columns

```
# جدا کردن ویژگی‌ها و خروجی
features = df.iloc[:, :-1]  # ستونهای ۲ تا آخر به عنوان ویژگی‌ها
output = df.iloc[:, -1]    # ستون اول به عنوان خروجی

# ایجاد دیتافریم جدید برای هر کلاس
class_0_samples = df[output == 0].head(100)
class_1_samples = df[output == 1].head(100)

# ادغام داده‌های دو کلاس در یک دیتافریم جدید
new_df = pd.concat([class_0_samples, class_1_samples], ignore_index=True)
new_df
```

	Income	HighBP	HighChol	CholCheck	BMI	Smoker	Stroke	Diabetes	PhysActivity
0	3	1	1	1	40	1	0	0	0
1	1	0	0	0	25	1	0	0	1
2	8	1	1	1	28	0	0	0	0
3	6	1	0	1	27	0	0	0	1
4	4	1	1	1	24	0	0	0	1
...	...	...	...	...	...	...	...	...	...
195	5	1	1	1	25	1	0	2	1
196	6	0	1	1	29	0	0	0	0
197	5	1	0	1	31	0	0	2	0
198	3	1	1	1	30	0	0	0	1
199	7	1	1	1	32	0	0	2	1

200 rows × 22 columns

```
shuffled_data = shuffle(new_df)
shuffled_data.to_csv('created_data.csv', index=False)
print(shuffled_data)
```

```
     Income  HighBP  HighChol  CholCheck  BMI  Smoker  Stroke  Diabetes  \
34        3       0         0          1   26       1       0         0
11        7       0         0          1   26       1       0         0
199       7       1         1          1   32       0       0         2
149       1       1         1          1   25       0       1         2
79        7       1         1          1   29       1       0         2
..      ...     ...       ...        ...  ...     ...     ...       ...
108       3       1         1          1   23       1       1         2
9         8       0         0          1   25       1       0         2
164       8       0         0          1   22       1       0         0
128       7       1         1          1   26       1       0         2
144       3       1         1          1   29       1       0         0

     PhysActivity  Fruits  ...  AnyHealthcare  NoDocbcCost  GenHlth  MentHlth  \
34              1       1  ...              0            0        1         0
11              0       0  ...              1            0        3         0
199             1       0  ...              1            0        5        30
149             1       1  ...              1            1        4         5
79              1       1  ...              1            0        3         0
..            ...     ...  ...            ...          ...      ...       ...
108             0       1  ...              1            1        1         2
9               1       1  ...              1            0        3         0
164             1       1  ...              1            0        3         0
128             0       1  ...              1            0        4         0
144             1       1  ...              1            0        5        15

     PhysHlth  DiffWalk  Sex  Age  Education  HeartDiseaseorAttack
34          1         0    1    4          5                     0
11         15         0    0    7          5                     0
199        30         0    0    7          5                     1
149        15         1    0   11          3                     1
79          0         0    1   11          5                     0
..        ...       ...  ...  ...        ...                   ...
108         0         0    0    7          5                     1
9           0         0    1   13          6                     0
164         0         0    1    7          4                     1
128         0         0    0   10          6                     1
144         7         0    1   11          3                     1

[200 rows x 22 columns]
```

```
df1 = pd.read_csv('/content/created_data.csv')
df1
```

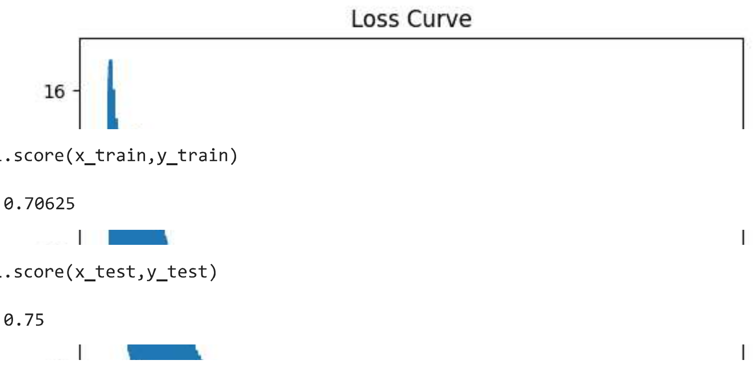
	Income	HighBP	HighChol	CholCheck	BMI	Smoker	Stroke	Diabetes	PhysActivity	Fr
0	3	0	0	1	26	1	0	0	1	
1	7	0	0	1	26	1	0	0	0	
2	7	1	1	1	32	0	0	2	1	
3	1	1	1	1	25	0	1	2	1	
4	7	1	1	1	29	1	0	2	1	
...	...	...	...	...	...	...	...	...	...	
195	3	1	1	1	23	1	1	2	0	
196	8	0	0	1	25	1	0	2	1	
197	8	0	0	1	22	1	0	0	1	
198	7	1	1	1	26	1	0	2	0	
199	3	1	1	1	29	1	0	0	1	

200 rows × 22 columns

```
X = new_df.iloc[:, :-1]
y = new_df.iloc[:, -1].values.reshape(-1,1)
X.shape,y.shape
```

```
((200, 21), (200, 1))
```

```
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=42)
model = SGDClassifier(loss='log_loss',max_iter=20000, random_state=27)
y_train = y_train.ravel()
y_test = y_test.ravel()
# آموزش مدل و دریافت مقدار تابع اتلاف در هر تکرار
loss_history = [];

for epoch in range(20000):
    # آموزش مدل
    model.partial_fit(x_train, y_train, classes=np.unique(y))

    # پیش‌بینی احتمالات
    y_prob = model.predict_proba(x_train);

    # محاسبه تابع اتلاف
    loss = log_loss(y_train, y_prob);

    loss_history.append(loss);


# نمایش نمودار تغییرات تابع اتلاف در هر تکرار
plt.plot(loss_history)
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title('Loss Curve')
plt.show()
```



```
model.score(x_train,y_train)
```

```
0.70625
```

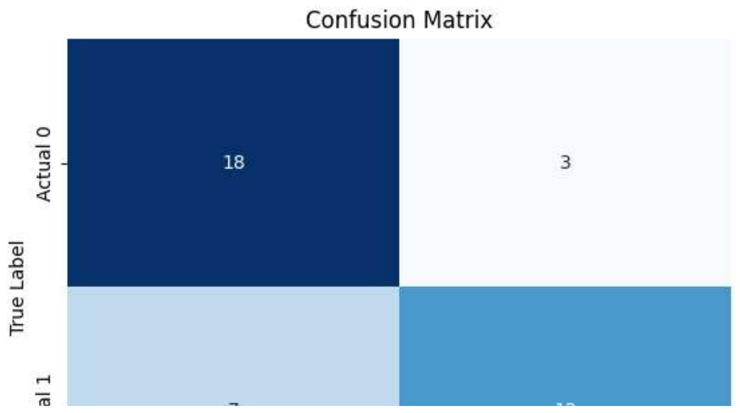
```
model.score(x_test,y_test)
```

```
0.75
```

```
y_pred=model.predict(x_test)
import seaborn as sns
from sklearn.metrics import confusion_matrix, precision_score, recall_score
conf_matrix = confusion_matrix(y_test, y_pred)
print("Confusion Matrix:")
print(conf_matrix)
# محاسبه recall برای کلاس 0
recall_class_0 = recall_score(y_test, y_pred, pos_label=0)
print(f"Recall for Class 0: {recall_class_0}")

# محاسبه precision برای کلاس 0
precision_class_0 = precision_score(y_test, y_pred, pos_label=0)
print(f"Precision for Class 0: {precision_class_0}")

# محاسبه recall برای کلاس 1
recall_class_1 = recall_score(y_test, y_pred, pos_label=1)
print(f"Recall for Class 1: {recall_class_1}")

# محاسبه precision برای کلاس 1
precision_class_1 = precision_score(y_test, y_pred, pos_label=1)
print(f"Precision for Class 1: {precision_class_1}")
```

```
Confusion Matrix:
[[18  3]
 [ 7 12]]
Recall for Class 0: 0.8571428571428571
Precision for Class 0: 0.72
Recall for Class 1: 0.631578947368421
Precision for Class 1: 0.8
```

```
conf_matrix = confusion_matrix(y_test, y_pred)

# رسم ماتریس درهم‌ریختگی با استفاده از سی‌بورن
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues', cbar=False,
            xticklabels=['Predicted 0', 'Predicted 1'], yticklabels=['Actual 0', 'Actual 1'])

plt.xlabel('Predicted Label')
plt.ylabel('True Label')
plt.title('Confusion Matrix')
plt.show()
```


Confusion Matrix
Actual 0
True Label