EFC3-Copy1

November 6, 2019

Centralizando com HTML

EFC 3

html inicio

EFC 3

Jimi Togni - RA: 226359 Rodrigo de Freitas Pereira - RA: 192063

fim html

0.1 Parte I - Devivação

Z = Camada intermediária da rede.

$outZ$ = Saída da camada Z (de acordo com a função de ativação).

$inpZ$ = Entrada da camada Z (amostras de entrada).

$\hat{y}$ = Ground true

De forma geral temos a seguinte derivação para a retropopagação do erro para qualquer v_n.

$\frac{\partial J}{\partial v_n} = \frac{\partial J}{\partial outZ}\frac{\partial outZ}{\partial inpZ}\frac{\partial inpZ}{\partial v_n}$

No caso específico para v_{12} temos:

$\frac{\partial J}{\partial v_{12}} = \frac{\partial J}{\partial outZ}\frac{\partial outZ}{\partial inpZ}\frac{\partial inpZ}{\partial v_{12}}$

Realizando as derivadas expostas acima:

$\frac{\partial J}{\partial outZ} = \sum_{n=1}^{N}(\hat{y} - y)w_n$

$\frac{\partial outZ}{\partial inpZ} = f(.)$

$\frac{\partial inpZ}{\partial v_n} = x_n$

Então para v_{12}:

$\frac{\partial J}{\partial outZ} = (\hat{y}_1 - y_1)w_{30} + (\hat{y}_2 - y_2)w_{31}$

$\frac{\partial outZ}{\partial inpZ} = f(.)$

$\frac{\partial inpZ}{\partial v_1 2} = x_1$

Finalmente:

$\frac{\partial J}{\partial v_{12}} = ((\hat{y}_1 - y_1)w_{30} + (\hat{y}_2 - y_2)w_{31}) \times f(.) \times x_1$

Inicio fonte 2 html

0.2 Parte II – Classificação binária com redes MLP e SVMs

Utilizando MLP, testou-se dois métodos de estimação: batch e online, dentre eles, pode-se observar que a melhor acurácia e também, convergiu mais rapidamente, em comparação ao batch, ocorreu quando usou-se o método de estimação batch, com as configurações:

Épocas = 200.

Camada oculta com 50 neurônios, com função de ativação ReLU.

Entropia cruzada para a função custo.

Os parâmetros foram calculadas utilizando o método Adam.

Onde observou-se que o melhor resultado foi 86% de acurácia nos testes, utilizando a validação cruzada nos testes de validação, foram testados os valores 5, 10, 15, 30, 50 para a camada oculta, a que apresentou o melhor resultado foi a rede com 50 neurônios, resultado esse, pouco melhor do que quando utilizado o valor de 30 neurônios para a camada oculta, o resultado pode ser visto na figura 1.

Figura 1: Curva de aprendizado.

Na figura 3, é possível analisar melhor as regiões de decisão e as classes de cada amostra, bastante parecida com a figura mostrada no enunciado utilizando o estimador MAP

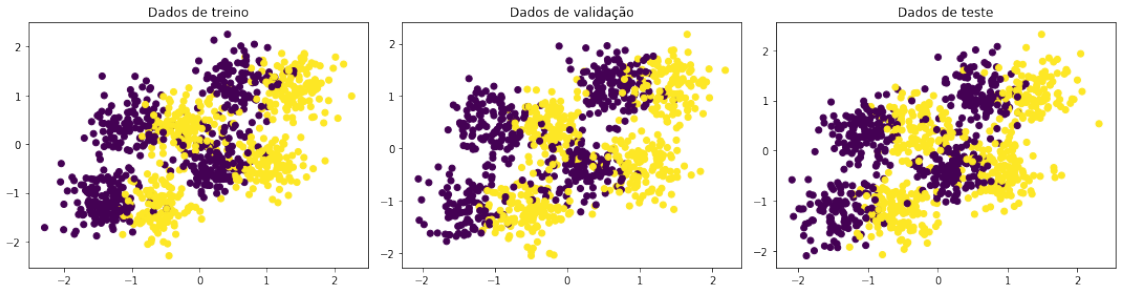
Figura 2: Regiões de decisão e classes

SVM - foi utilizada a biblioteca sklearn.svm para as máquinas de vetores de suporte, os hiper-parâmetros foram escolhidos com validação cruzada, igual feito no MLP.

O melhor resultado obtido com nos testes foi com o kernel RBF e taxa de penalidade do erro = 50, a melhor acurácia foi de 0.867, o gráfico plotado pode ser visto na figura 3

Figura 3: SVM com kernel rbf e penalização do erro =50

Para penalização (C) utilizou-se 1, 10, 50, 100 Os kernels testados foram ‘linear’, ‘poly’, ‘rbf’, ‘sigmoid’ No código, pode-se observar os resultados quando utilizado kernel linear, porém, o modelo não é capaz de classificar satisfatoriamente os dados



0.3 Aplicando a MLP

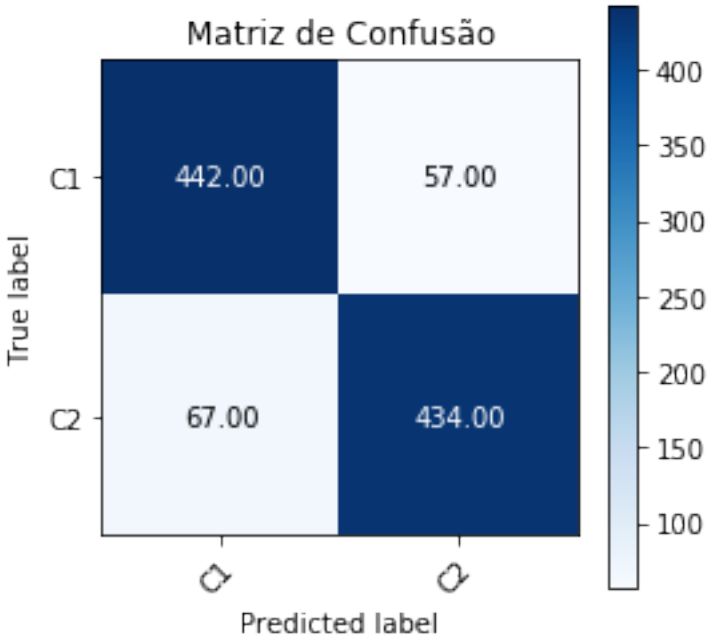
usando batch

Manual

[197]:
```
MLPClassifier(activation='relu', alpha=0.0001, batch_size=36, beta_1=0.9,
              beta_2=0.999, early_stopping=False, epsilon=1e-08,
              hidden_layer_sizes=(100,), learning_rate='constant',
              learning_rate_init=0.0001, max_iter=1000, momentum=0.9,
              n_iter_no_change=10, nesterovs_momentum=True, power_t=0.5,
              random_state=1, shuffle=True, solver='adam', tol=0.0001,
              validation_fraction=0.1, verbose=False, warm_start=False)
```

```
Acurácia:
87.6%

Classification report:
              precision    recall  f1-score   support

          C1       0.87      0.89      0.88       499
          C2       0.88      0.87      0.88       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.88      1000
weighted avg       0.88      0.88      0.88      1000
```

[198]:
```
(1.5, -0.5)
```



```
[200]: GridSearchCV(cv=3, error_score='raise-deprecating',
                    estimator=MLPClassifier(activation='relu', alpha=0.0001,
                                            batch_size='auto', beta_1=0.9,
                                            beta_2=0.999, early_stopping=False,
                                            epsilon=1e-08, hidden_layer_sizes=(100,),
                                            learning_rate='constant',
                                            learning_rate_init=0.001, max_iter=500,
                                            momentum=0.9, n_iter_no_change=10,
                                            nesterovs_momentum=True, power_t=0.5,
                                            random_sta…
                                            solver='adam', tol=0.0001,
                                            validation_fraction=0.1, verbose=False,
                                            warm_start=False),
                    iid='warn', n_jobs=-1,
                    param_grid={'activation': ['tanh', 'relu'],
                                'alpha': [0.0001, 0.05],
                                'hidden_layer_sizes': [(50, 50, 50), (50, 100, 50),
                                                       (100,)],
                                'learning_rate': ['constant', 'adaptive'],
                                'solver': ['sgd', 'adam']},
                    pre_dispatch='2*n_jobs', refit=True, return_train_score=False,
                    scoring=None, verbose=0)
```

0.3.1 Resultados usando

```
---------- Melhores parametros------------
Best parameters found:
 {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes': (50, 50, 50),
'learning_rate': 'constant', 'solver': 'adam'}
---------- Melhores parametros------------

0.663 (+/-0.036) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'constant', 'solver':
'sgd'}

0.878 (+/-0.044) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'constant', 'solver':
'adam'}

0.664 (+/-0.027) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'adaptive', 'solver':
'sgd'}

0.872 (+/-0.037) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'adaptive', 'solver':
```

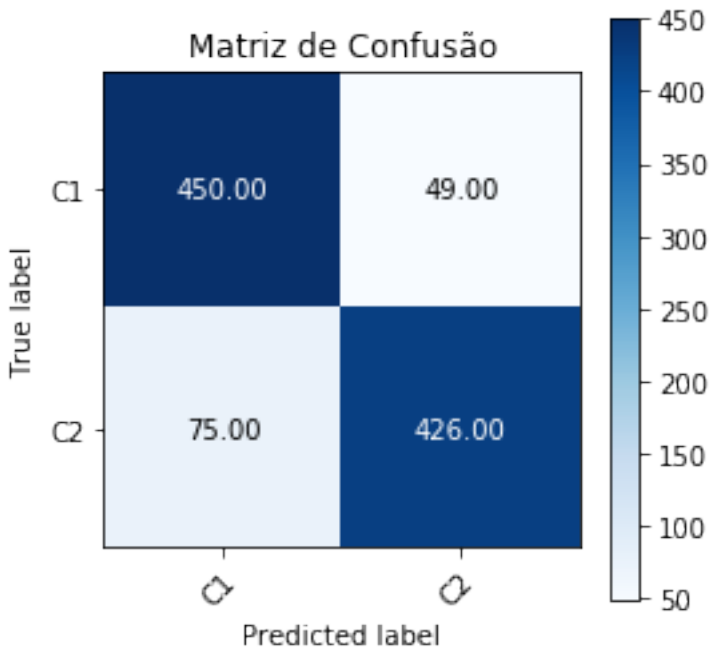
```
'adam'}

0.664 (+/-0.033) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'constant', 'solver':
'sgd'}

0.868 (+/-0.021) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'constant', 'solver':
'adam'}

0.661 (+/-0.026) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'adaptive', 'solver':
'sgd'}

0.874 (+/-0.038) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'adaptive', 'solver':
'adam'}

0.651 (+/-0.038) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'constant', 'solver': 'sgd'}

0.666 (+/-0.029) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'constant', 'solver': 'adam'}

0.650 (+/-0.036) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.666 (+/-0.029) for {'activation': 'tanh', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.668 (+/-0.024) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'constant', 'solver': 'sgd'}

0.870 (+/-0.044) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'constant', 'solver': 'adam'}

0.666 (+/-0.034) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.878 (+/-0.024) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.657 (+/-0.026) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'constant', 'solver': 'sgd'}

0.878 (+/-0.030) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'constant', 'solver': 'adam'}
```

```
0.668 (+/-0.034) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.867 (+/-0.020) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.651 (+/-0.029) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'constant', 'solver': 'sgd'}

0.657 (+/-0.014) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'constant', 'solver': 'adam'}

0.654 (+/-0.039) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.669 (+/-0.029) for {'activation': 'tanh', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.709 (+/-0.022) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'constant', 'solver':
'sgd'}

0.878 (+/-0.037) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'constant', 'solver':
'adam'}

0.719 (+/-0.041) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'adaptive', 'solver':
'sgd'}

0.874 (+/-0.035) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 50, 50), 'learning_rate': 'adaptive', 'solver':
'adam'}

0.754 (+/-0.085) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'constant', 'solver':
'sgd'}

0.875 (+/-0.050) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'constant', 'solver':
'adam'}

0.706 (+/-0.042) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'adaptive', 'solver':
'sgd'}

0.875 (+/-0.029) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (50, 100, 50), 'learning_rate': 'adaptive', 'solver':
```

```
'adam'}

0.671 (+/-0.028) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'constant', 'solver': 'sgd'}

0.872 (+/-0.049) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'constant', 'solver': 'adam'}

0.664 (+/-0.041) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.872 (+/-0.037) for {'activation': 'relu', 'alpha': 0.0001,
'hidden_layer_sizes': (100,), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.711 (+/-0.018) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'constant', 'solver': 'sgd'}

0.882 (+/-0.034) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'constant', 'solver': 'adam'}

0.712 (+/-0.031) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.879 (+/-0.034) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 50, 50), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.713 (+/-0.026) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'constant', 'solver': 'sgd'}

0.872 (+/-0.039) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'constant', 'solver': 'adam'}

0.719 (+/-0.036) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.880 (+/-0.039) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(50, 100, 50), 'learning_rate': 'adaptive', 'solver': 'adam'}

0.674 (+/-0.029) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'constant', 'solver': 'sgd'}

0.867 (+/-0.041) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'constant', 'solver': 'adam'}

0.670 (+/-0.036) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
(100,), 'learning_rate': 'adaptive', 'solver': 'sgd'}

0.871 (+/-0.040) for {'activation': 'relu', 'alpha': 0.05, 'hidden_layer_sizes':
```

```
(100,), 'learning_rate': 'adaptive', 'solver': 'adam'}

Results on the test set:
              precision    recall  f1-score   support

        -1.0       0.86      0.90      0.88       499
         1.0       0.90      0.85      0.87       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.88      1000
weighted avg       0.88      0.88      0.88      1000
```

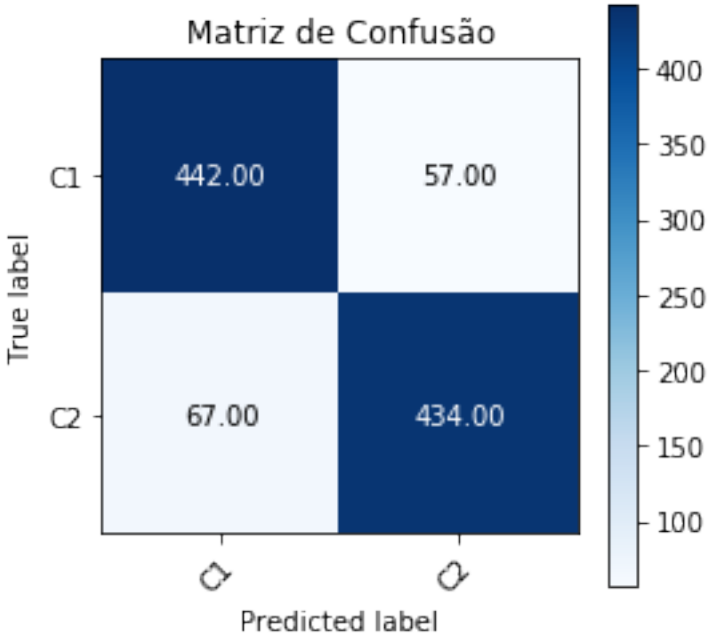
[203]: (1.5, -0.5)



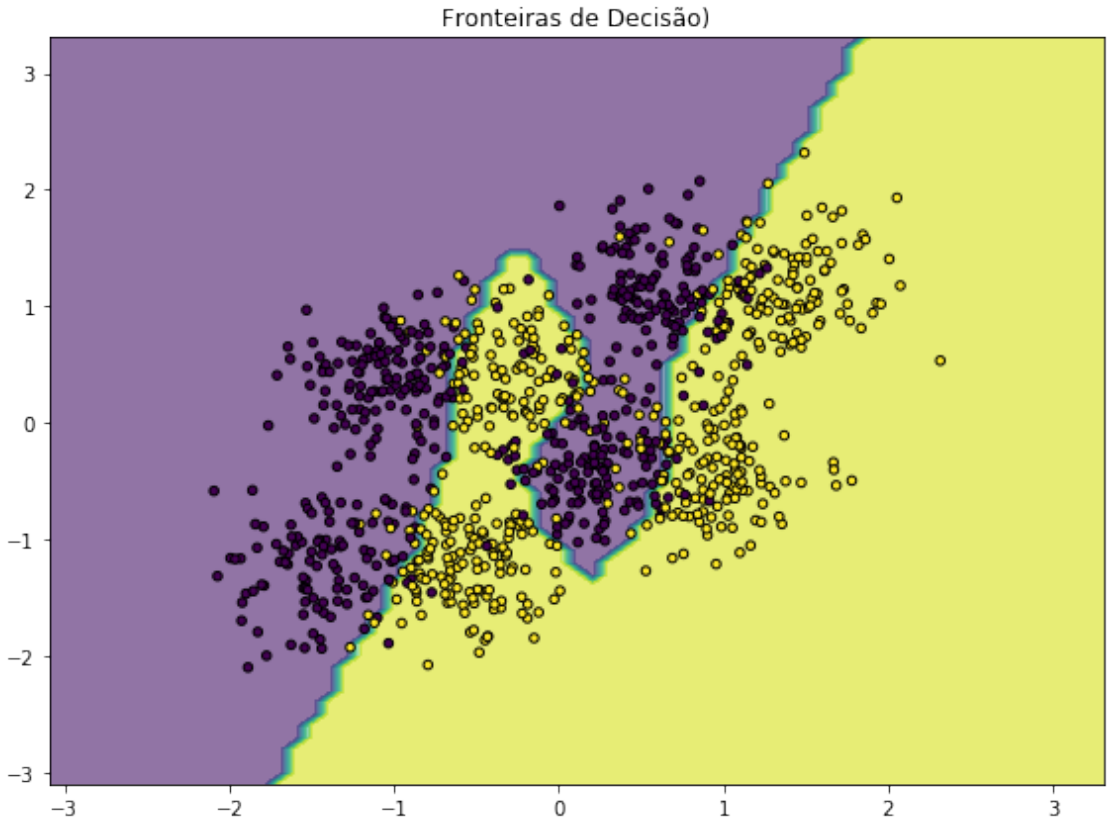

```
Acurácia:
87.6%

Classification report:
              precision    recall  f1-score   support

          C1       0.87      0.89      0.88       499
          C2       0.88      0.87      0.88       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.88      1000
```

```
weighted avg       0.88      0.88      0.88      1000
```

[204]: (1.5, -0.5)



0.3.2 Fronteiras de decição



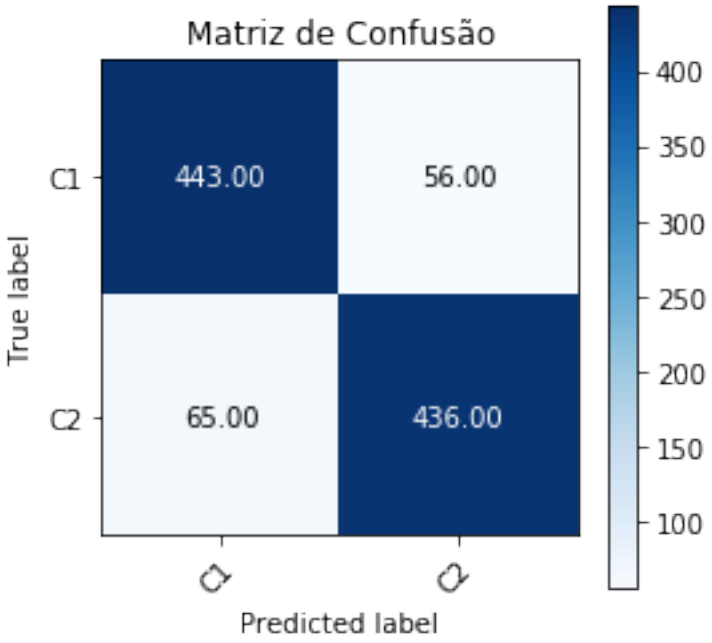

```
Model: "Multi Layer Perceptron"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
Input_Layer (Dense)          (None, 100)               300
_________________________________________________________________
Output_Layer (Dense)         (None, 2)                 202
=================================================================
Total params: 502
Trainable params: 502
Non-trainable params: 0
_________________________________________________________________
None


_________________________________________________________________
Optimizer:
- learning_rate: 0.001
- beta_1: 0.9
- beta_2: 0.999
- decay: 0.0
```

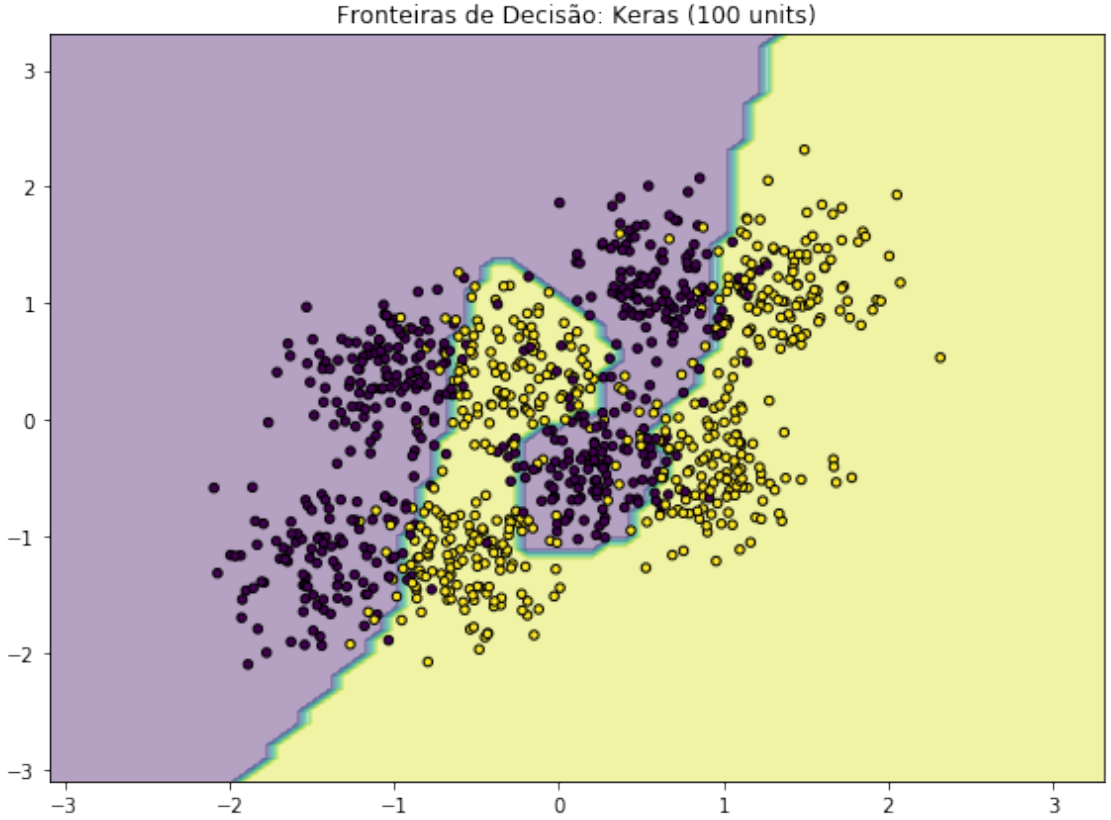
```
- epsilon: 0.0
- amsgrad: False
```

```
      ␣
↪---------------------------------------------------------------------------

       NameError                                 Traceback (most recent call␣
↪last)

       <ipython-input-10-684d061c2c1b> in <module>
   ----> 1 plt.figure(figsize=(13, 4))
         2 plt.subplot(1, 2, 1)
         3 plt.plot(history.history["loss"], label="Loss", color='red')
         4 plt.plot(history.history["accuracy"], label="Accuracy")
         5 plt.legend()


       NameError: name 'plt' is not defined
```

```
Acurácia:
87.9%

Classification report:
              precision    recall  f1-score   support

          C1       0.87      0.89      0.88       499
          C2       0.89      0.87      0.88       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.88      1000
weighted avg       0.88      0.88      0.88      1000
```

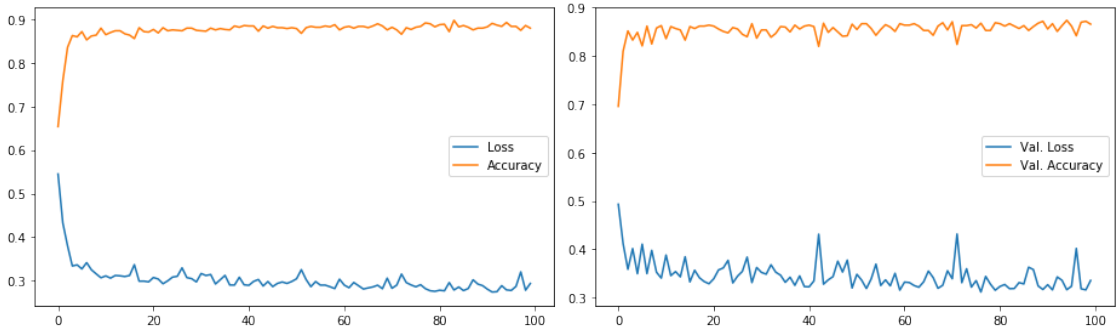
```
[217]: (1.5, -0.5)
```


Matriz de Confusão
443.00
56.00
65.00
436.00
C1
C2
True label
Predicted label
400
350
300
250
200
150
100


Fronteiras de Decisão: Keras (100 units)
3
2
1
0
−1
−2
−3
−3
−2
−1
0
1
2
3

com Keras, mais neuronios

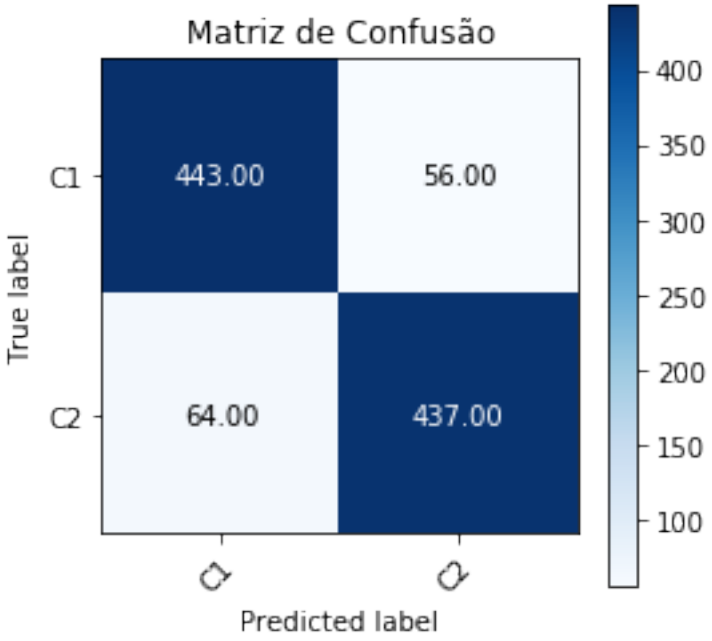
```
Model: "Multi Layer Perceptron"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
Input_Layer (Dense)          (None, 32768)             98304
_________________________________________________________________
Output_Layer (Dense)         (None, 2)                 65538
=================================================================
Total params: 163,842
Trainable params: 163,842
Non-trainable params: 0
_________________________________________________________________
None


_________________________________________________________________
Optimizer:
- learning_rate: 0.001
- beta_1: 0.9
- beta_2: 0.999
- decay: 0.0
- epsilon: 0.0
- amsgrad: True
```

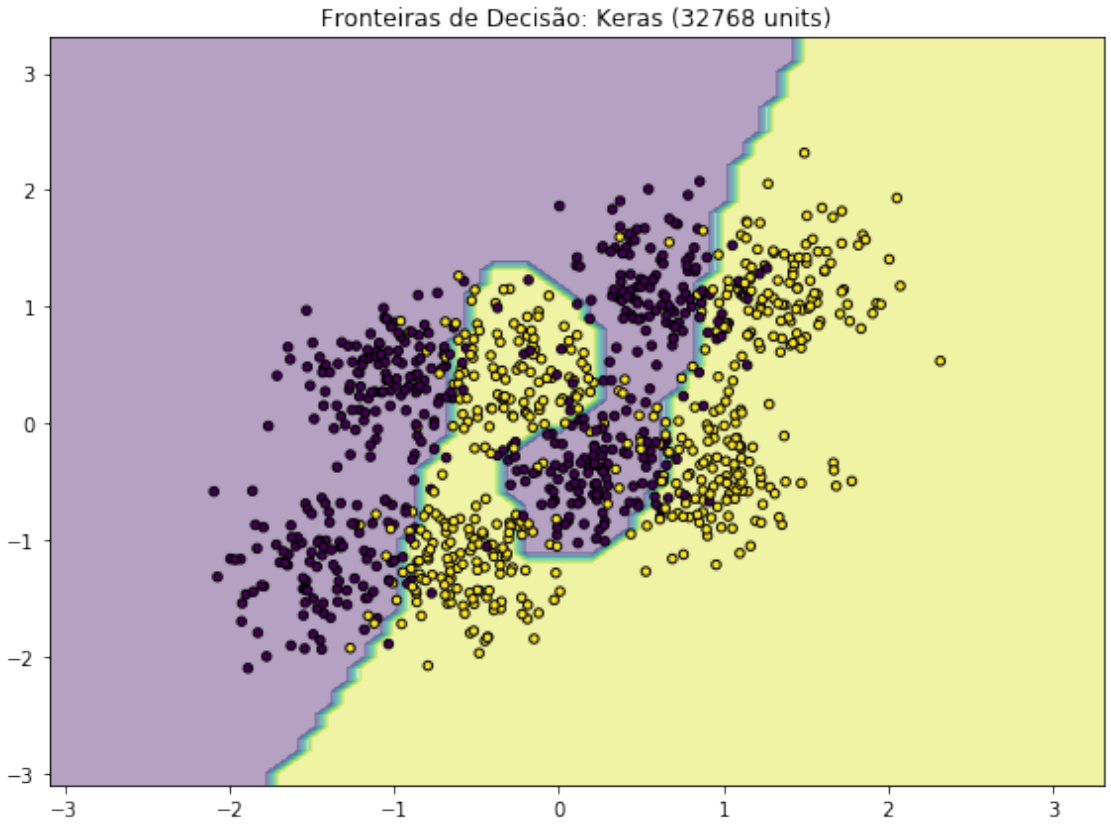



```
Acurácia:
88.0%

Classification report:
              precision    recall  f1-score   support

          C1       0.87      0.89      0.88       499
          C2       0.89      0.87      0.88       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.88      1000
```

```
weighted avg       0.88      0.88      0.88      1000
```

[222]: (1.5, -0.5)

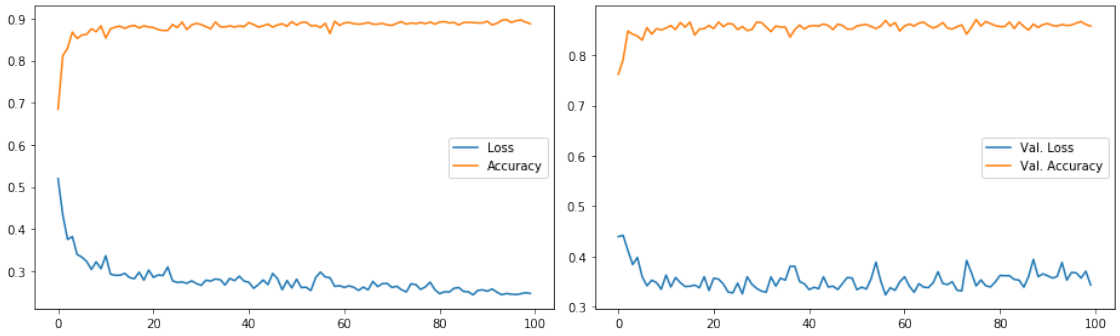




Mais camadas densas

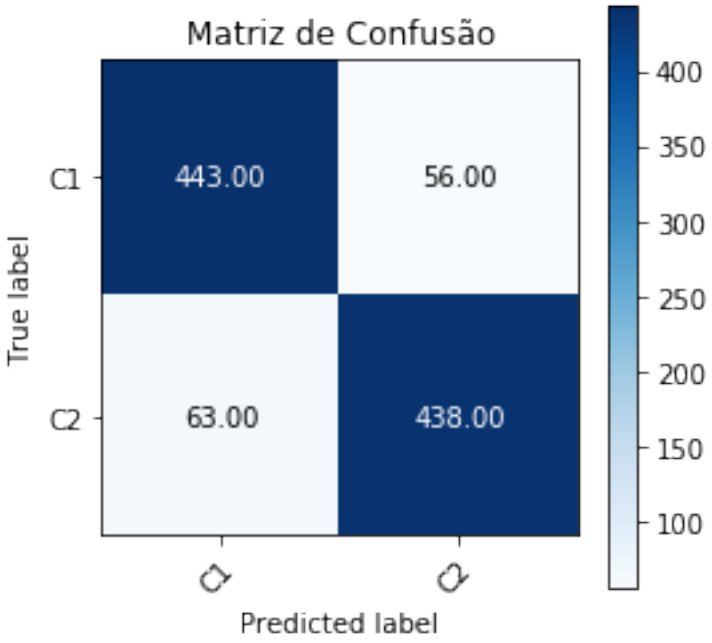
```
Model: "Multi Layer Perceptron"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
Input_Layer_1 (Dense)        (None, 1024)              3072
_________________________________________________________________
Input_Layer_2 (Dense)        (None, 1024)              1049600
_________________________________________________________________
Input_Layer_3 (Dense)        (None, 1024)              1049600
_________________________________________________________________
Input_Layer_4 (Dense)        (None, 1024)              1049600
_________________________________________________________________
Input_Layer_5 (Dense)        (None, 1024)              1049600
_________________________________________________________________
Input_Layer_6 (Dense)        (None, 1024)              1049600
_________________________________________________________________
Output_Layer (Dense)         (None, 2)                 2050
=================================================================
Total params: 5,253,122
Trainable params: 5,253,122
```

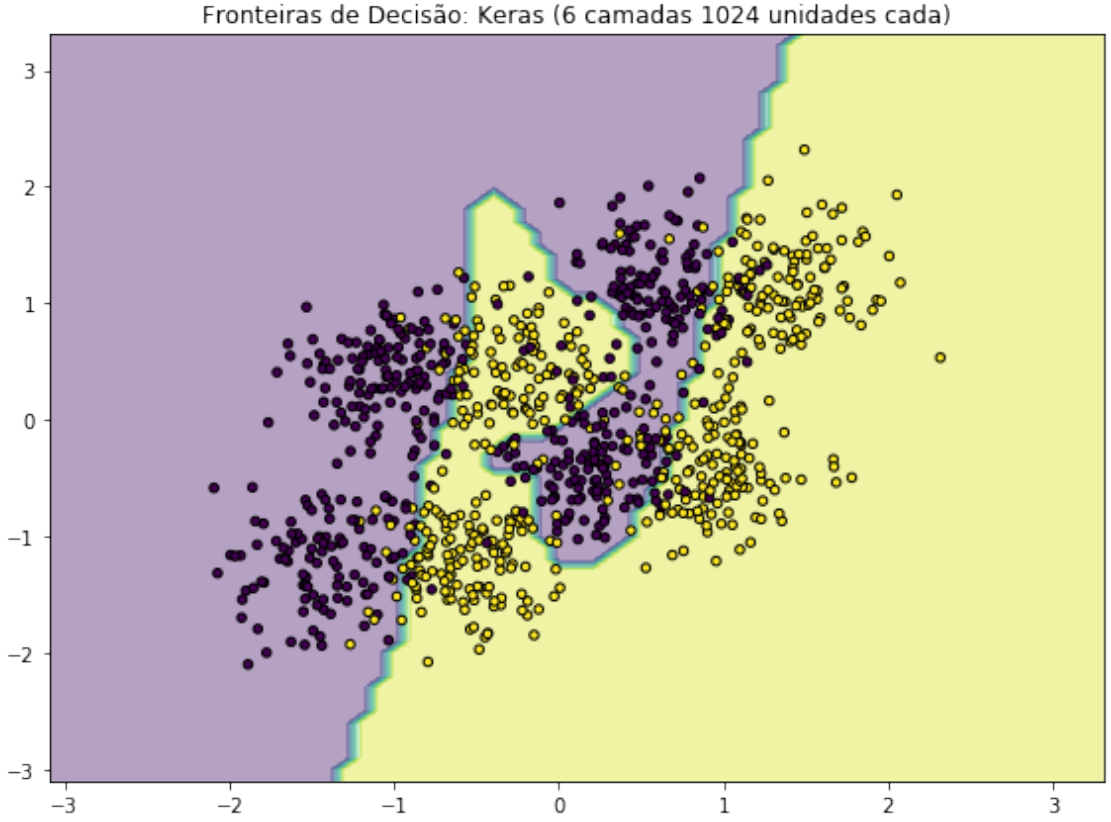
```
Non-trainable params: 0
_________________________________________________________________
None


_________________________________________________________________
Optimizer:
- learning_rate: 0.001
- beta_1: 0.9
- beta_2: 0.999
- decay: 0.0
- epsilon: 0.0
- amsgrad: True
```




```
Acurácia:
88.1%

Classification report:
              precision    recall  f1-score   support

          C1       0.88      0.89      0.88       499
          C2       0.89      0.87      0.88       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.88      1000
weighted avg       0.88      0.88      0.88      1000
```

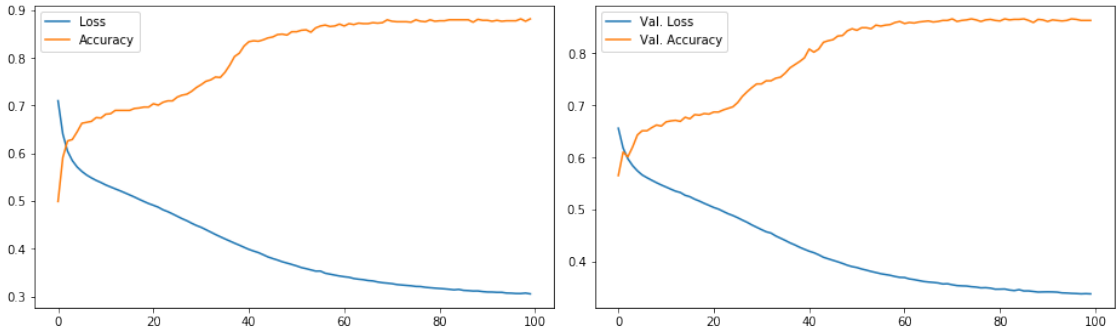
[227]: (1.5, -0.5)


Matriz de Confusão
443.00
56.00
63.00
438.00
C1
C2
True label
Predicted label
400
350
300
250
200
150
100


Fronteiras de Decisão: Keras (6 camadas 1024 unidades cada)
3
2
1
0
−1
−2
−3
−3
−2
−1
0
1
2
3

Minima quantidade de neuronios

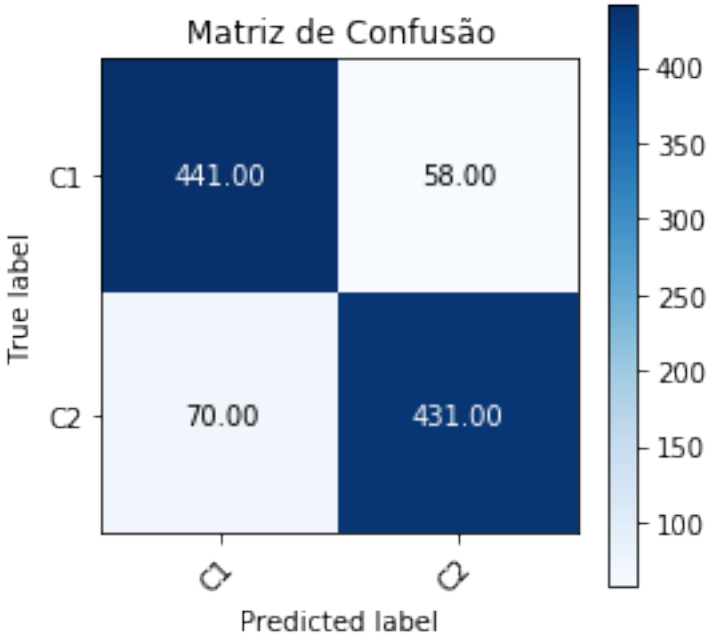
```
Model: "Multi Layer Perceptron"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
Input_Layer_1 (Dense)        (None, 30)                90
_________________________________________________________________
Output_Layer (Dense)         (None, 2)                 62
=================================================================
Total params: 152
Trainable params: 152
Non-trainable params: 0
_________________________________________________________________
None


_________________________________________________________________
Optimizer:
- learning_rate: 0.001
- beta_1: 0.9
- beta_2: 0.999
- decay: 0.0
- epsilon: 0.0
- amsgrad: True
```

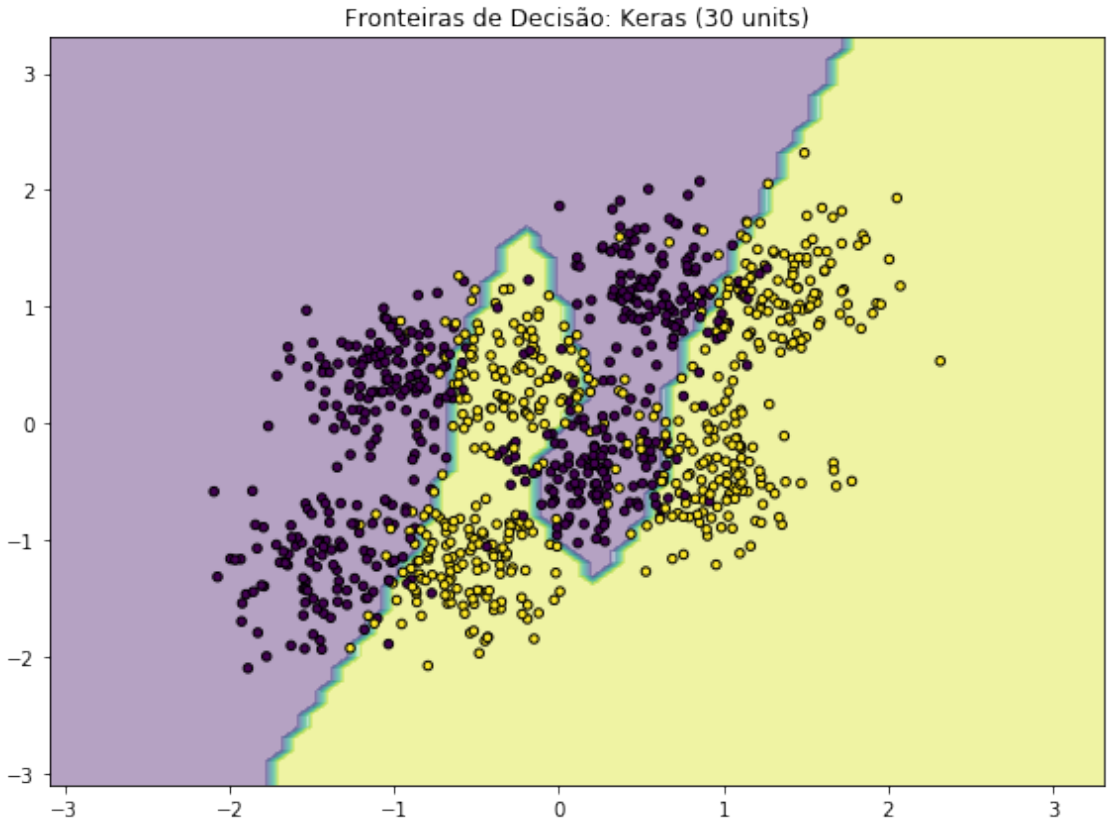



```
Acurácia:
87.2%

Classification report:
              precision    recall  f1-score   support

          C1       0.86      0.88      0.87       499
          C2       0.88      0.86      0.87       501

    accuracy                           0.87      1000
   macro avg       0.87      0.87      0.87      1000
```

```
       weighted avg       0.87      0.87      0.87      1000
```

[231]: (1.5, -0.5)

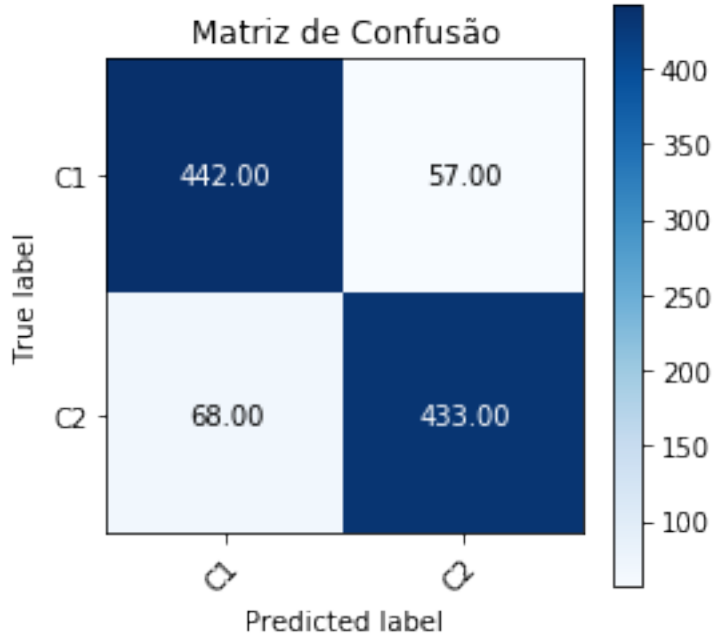


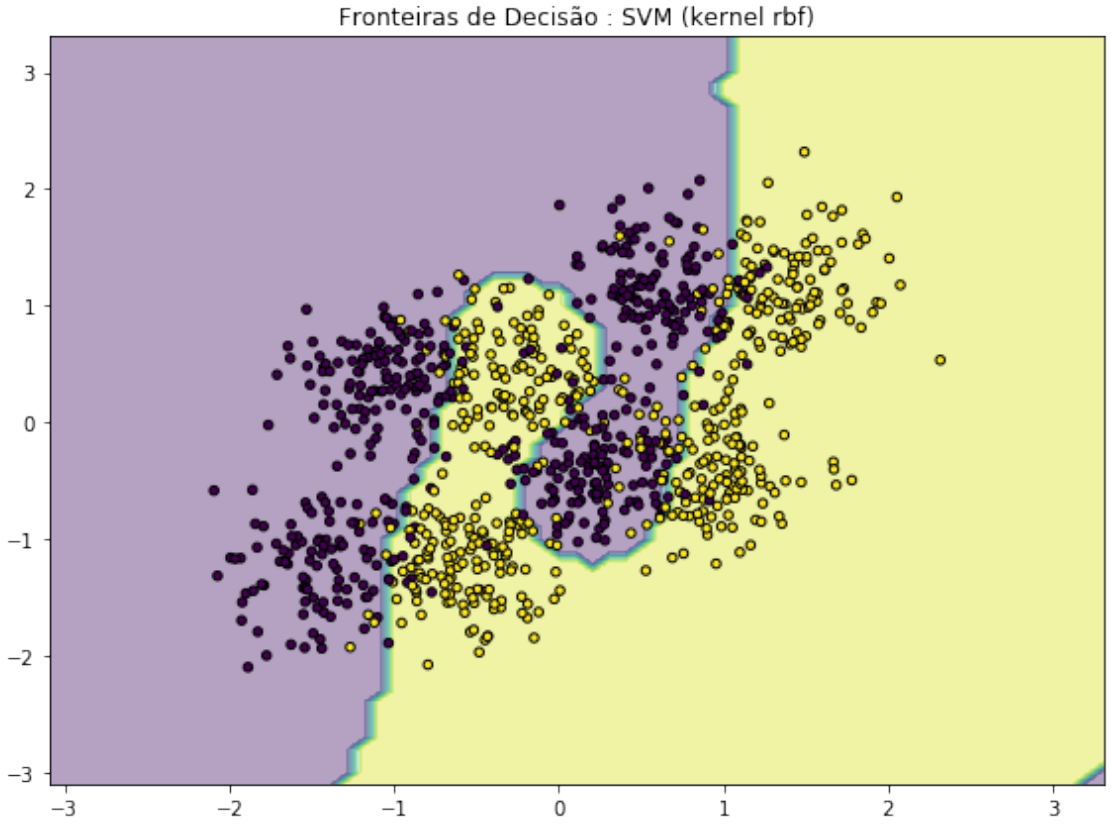


0.4 SVM

[233]:
```
SVC(C=5, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma='scale', kernel='rbf',
    max_iter=-1, probability=False, random_state=1, shrinking=True, tol=0.001,
    verbose=False)

Acurácia:
87.5%

Classification report:
              precision    recall  f1-score   support

          C1       0.87      0.89      0.88       499
          C2       0.88      0.86      0.87       501

    accuracy                           0.88      1000
   macro avg       0.88      0.88      0.87      1000
weighted avg       0.88      0.88      0.87      1000
```

[234]: (1.5, -0.5)


Matriz de Confusão
442.00
57.00
68.00
433.00
C1
C2
True label
Predicted label
400
350
300
250
200
150
100

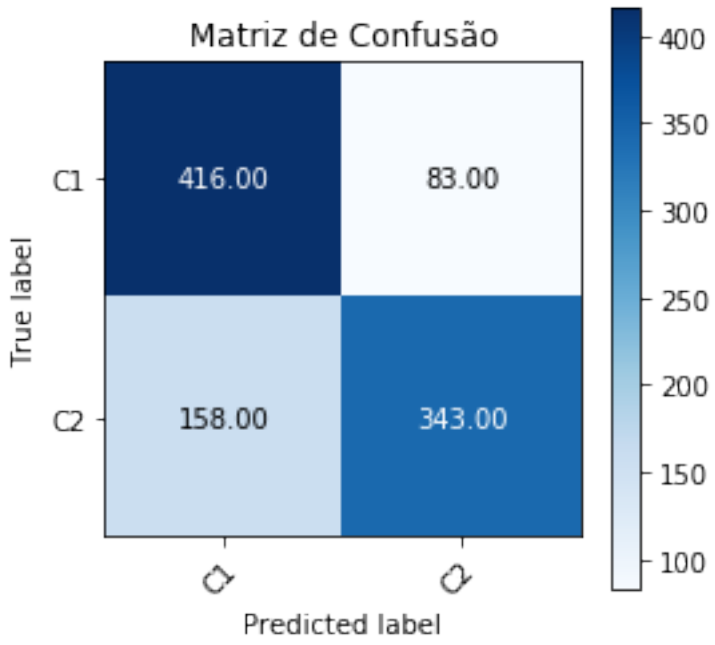

Fronteiras de Decisão : SVM (kernel rbf)
3
2
1
0
−1
−2
−3
−3
−2
−1
0
1
2
3

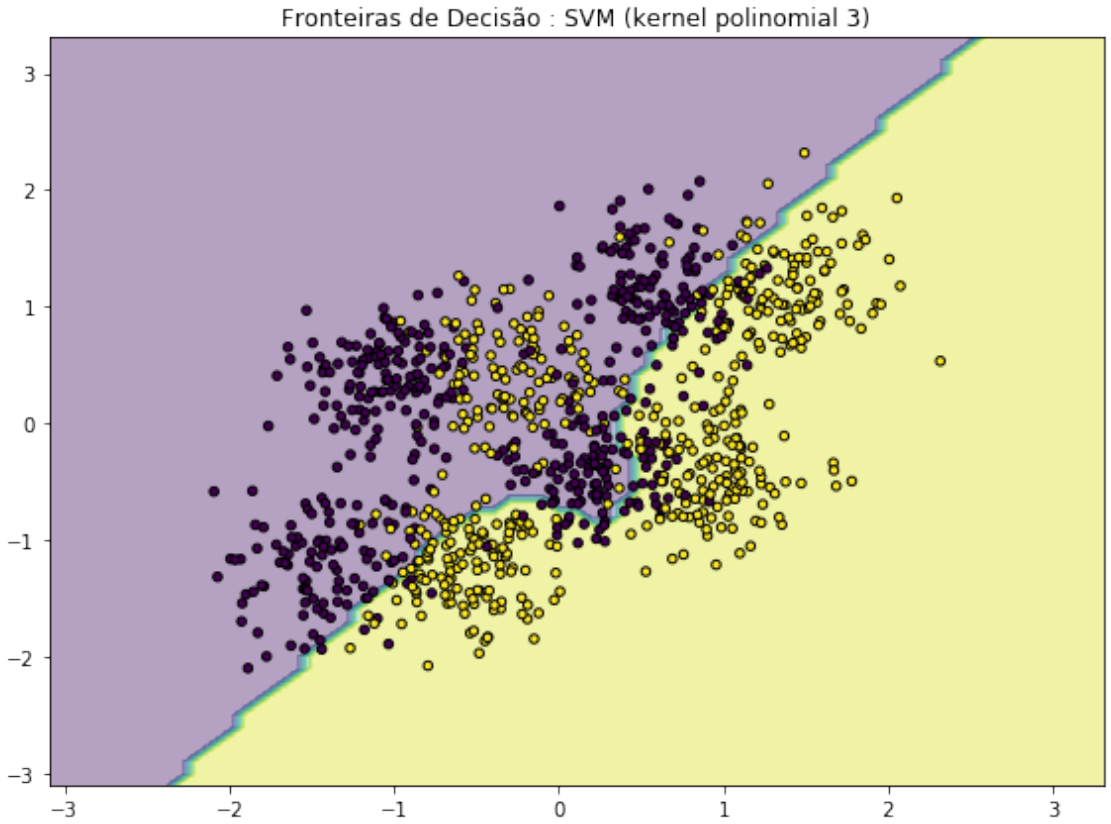
SVM diferente

[236]:
```
SVC(C=5, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma='scale', kernel='poly',
    max_iter=-1, probability=False, random_state=1, shrinking=True, tol=0.001,
    verbose=False)
```

```
Acurácia:
75.9%

Classification report:
              precision    recall  f1-score   support

          C1       0.72      0.83      0.78       499
          C2       0.81      0.68      0.74       501

    accuracy                           0.76      1000
   macro avg       0.76      0.76      0.76      1000
weighted avg       0.77      0.76      0.76      1000
```

[237]:
```
(1.5, -0.5)
```



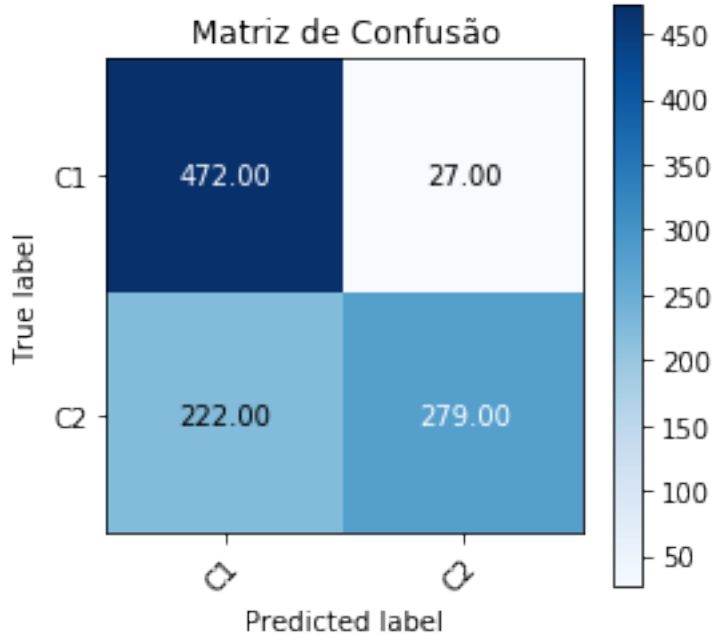


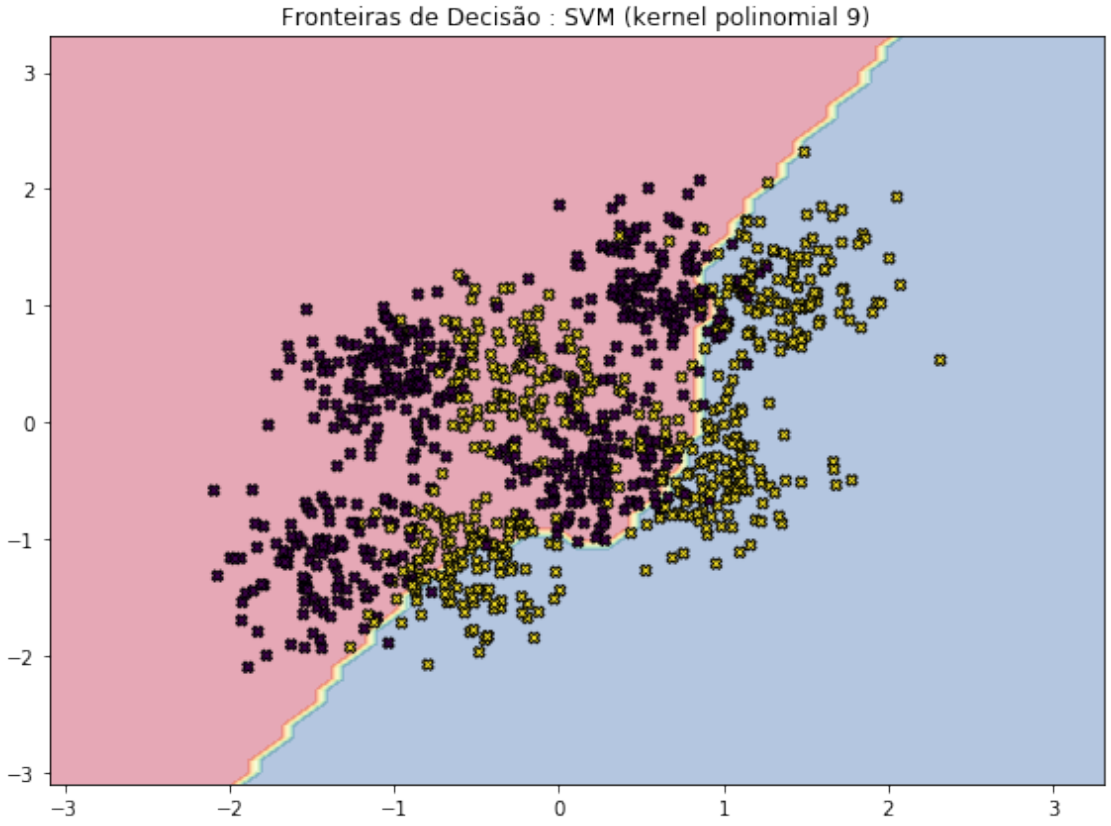
SVM 9

[239]:
```
SVC(C=5, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=9, gamma='scale', kernel='poly',
    max_iter=-1, probability=False, random_state=1, shrinking=True, tol=0.001,
    verbose=False)
```

```
Acurácia:
75.1%

Classification report:
              precision    recall  f1-score   support

          C1       0.68      0.95      0.79       499
          C2       0.91      0.56      0.69       501

    accuracy                           0.75      1000
   macro avg       0.80      0.75      0.74      1000
weighted avg       0.80      0.75      0.74      1000
```

[240]: (1.5, -0.5)


Matriz de Confusão
C1
C2
472.00
27.00
222.00
279.00
True label
Predicted label
450
400
350
300
250
200
150
100
50


Fronteiras de Decisão : SVM (kernel polinomial 9)
3
2
1
0
−1
−2
−3
−3
−2
−1
0
1
2
3

```
H =  5
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:17: UserWarning:
Using a target size (torch.Size([1000, 2])) that is different to the input size
(torch.Size([1000, 1])) is deprecated. Please ensure they have the same size.


      ␣
↪------------------------------------------------------------------------

       ValueError                                Traceback (most recent call␣
↪last)

       <ipython-input-74-823fb79200a5> in <module>
        15         otimizador.zero_grad()
        16         saida = modelo(X_treino_tmp)
   ---> 17         perda = F.binary_cross_entropy(saida, y_treino_tmp)
        18         perda.backward()
        19         otimizador.step()


       ~/.local/lib/python3.7/site-packages/torch/nn/functional.py in␣
↪binary_cross_entropy(input, target, weight, size_average, reduce, reduction)
      2056     if input.numel() != target.numel():
      2057         raise ValueError("Target and input must have the same number␣
↪of elements. target nelement ({}) "
   -> 2058                          "!= input nelement ({})".format(target.
↪numel(), input.numel()))
      2059
      2060     if weight is not None:


       ValueError: Target and input must have the same number of elements.␣
↪target nelement (2000) != input nelement (1000)
```

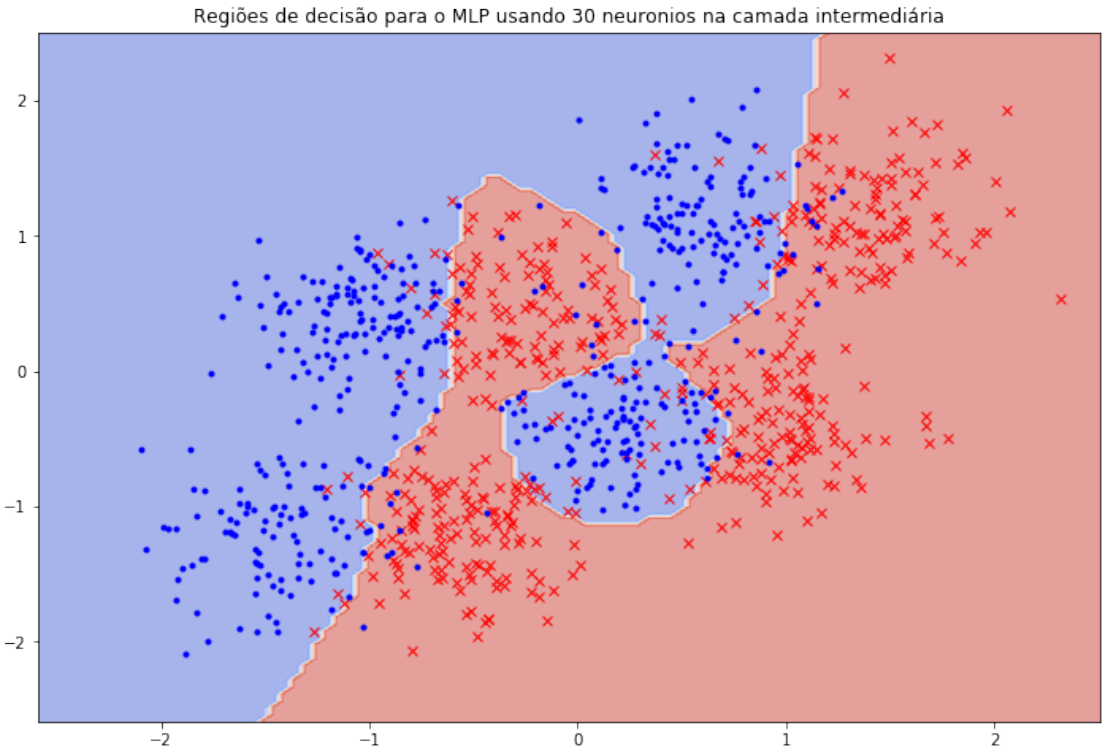
online (padrão-a-padrão)

```
H =  5
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:24: UserWarning:
Using a target size (torch.Size([2])) that is different to the input size
(torch.Size([1])) is deprecated. Please ensure they have the same size.


      ␣
↪------------------------------------------------------------------------
```

```
       ValueError                                Traceback (most recent call␣
↪last)

       <ipython-input-75-40a65456c008> in <module>
        22             otimizador.zero_grad()
        23             saida = modelo(data)
   ---> 24             perda = F.binary_cross_entropy(saida, target)
        25             perda.backward()
        26             otimizador.step()


       ~/.local/lib/python3.7/site-packages/torch/nn/functional.py in␣
↪binary_cross_entropy(input, target, weight, size_average, reduce, reduction)
      2056     if input.numel() != target.numel():
      2057         raise ValueError("Target and input must have the same number␣
↪of elements. target nelement ({}) "
   -> 2058                          "!= input nelement ({})".format(target.
↪numel(), input.numel()))
      2059
      2060     if weight is not None:


       ValueError: Target and input must have the same number of elements.␣
↪target nelement (2) != input nelement (1)
```

…
…
…
…

```
Dados de teste: Avg. loss: 0.3240, Accuracy: 881/1000 (88%)

/usr/local/lib/python3.7/dist-packages/torch/nn/_reduction.py:46: UserWarning:
size_average and reduce args will be deprecated, please use reduction='sum'
instead.
  warnings.warn(warning.format(ret))

Acurácia de teste 0.88
```

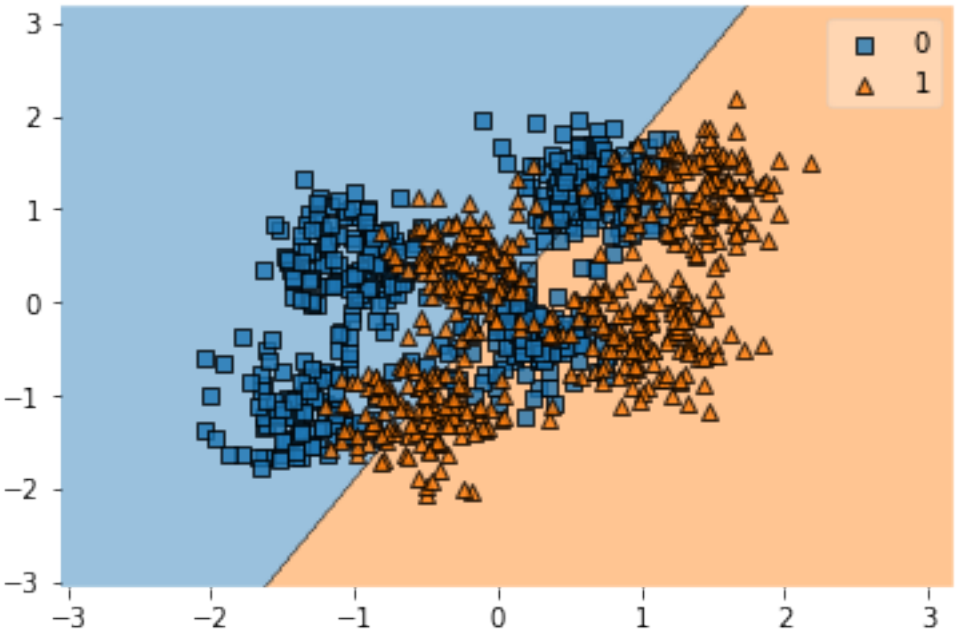


0.5 SVM

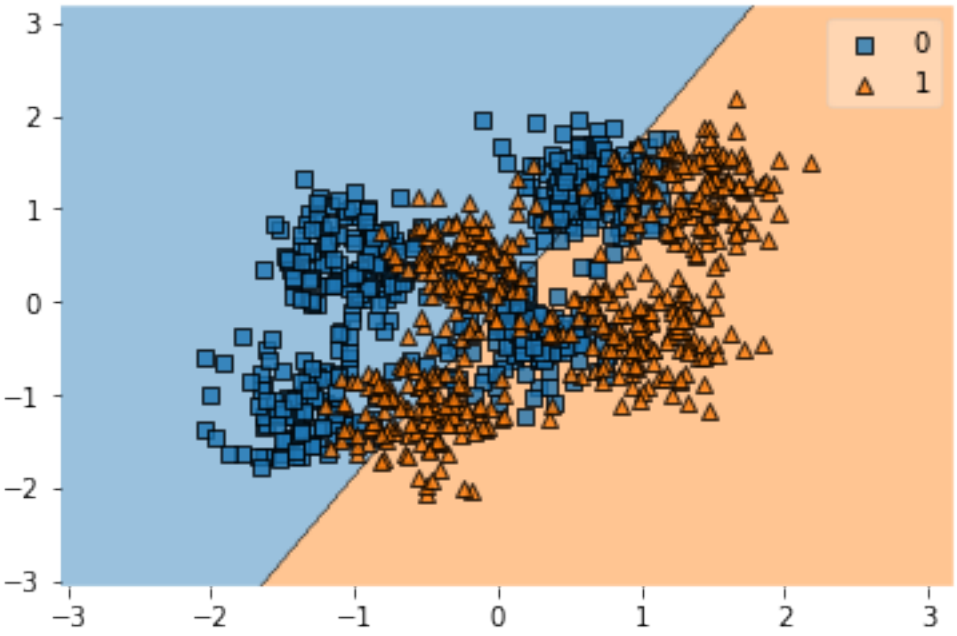
[61]:
```
SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
    decision_function_shape='ovr', degree=3, gamma='scale', kernel='rbf',
    max_iter=-1, probability=False, random_state=None, shrinking=True,
    tol=0.001, verbose=False)
```

[62]:
```
0.853
```

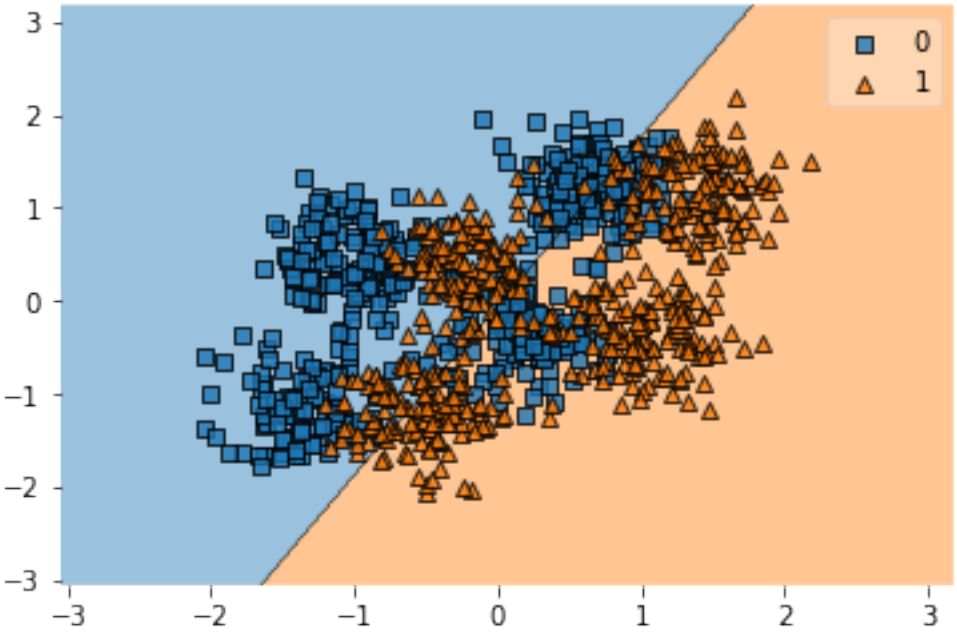
```
===
SVM com C = 1 e kernel = linear
Acurácia: 0.658, F1-score: 0.667, AUC: 0.658
```



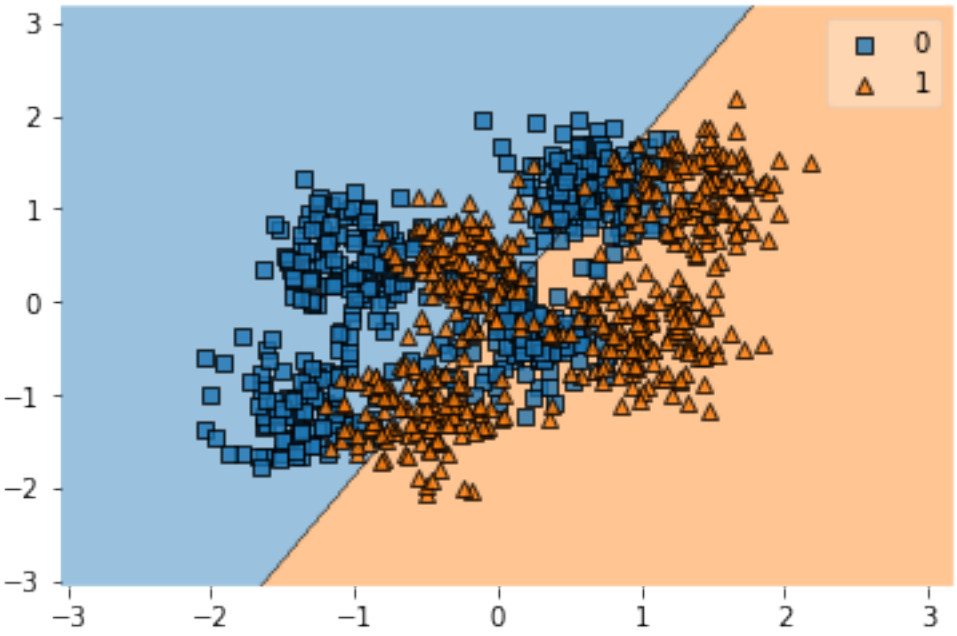
===
SVM com C = 10 e kernel = linear
Acurácia: 0.661, F1-score: 0.670, AUC: 0.661



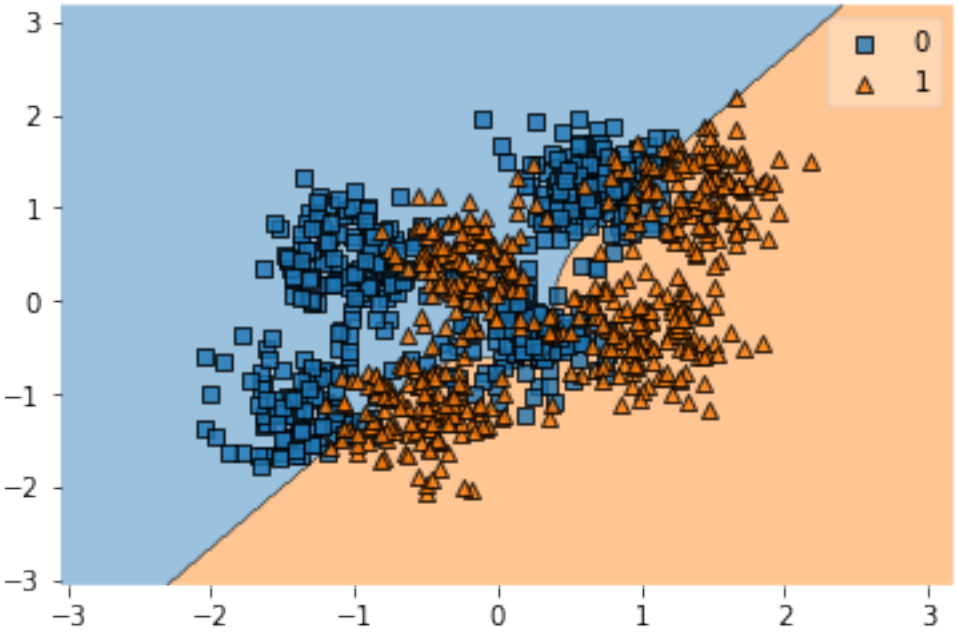
===
SVM com C = 50 e kernel = linear
Acurácia: 0.661, F1-score: 0.670, AUC: 0.661



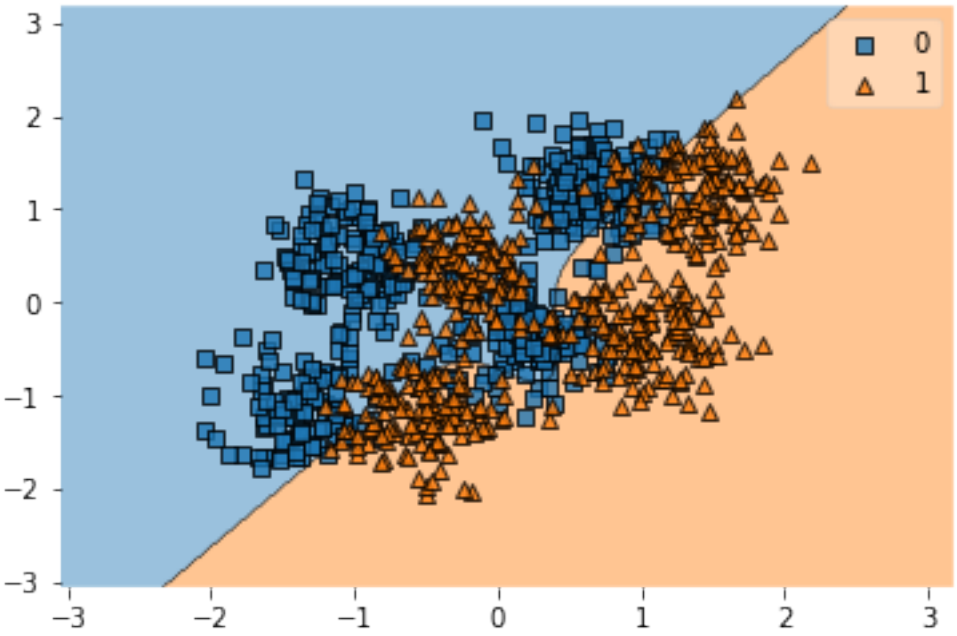
===
SVM com C = 100 e kernel = linear
Acurácia: 0.661, F1-score: 0.670, AUC: 0.661



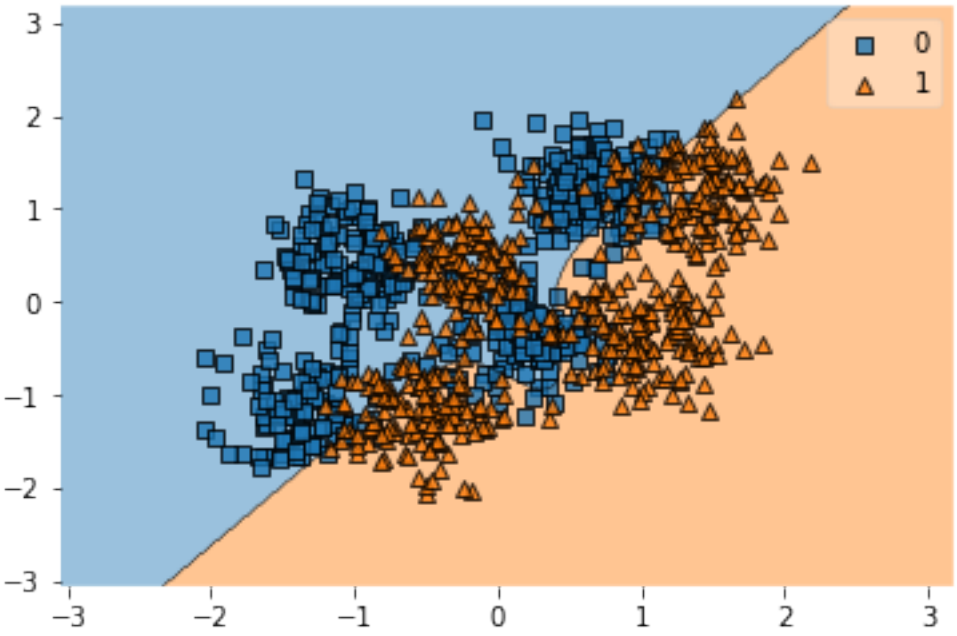
```
===
SVM com C = 1 e kernel = poly
Acurácia: 0.743, F1-score: 0.726, AUC: 0.746
```



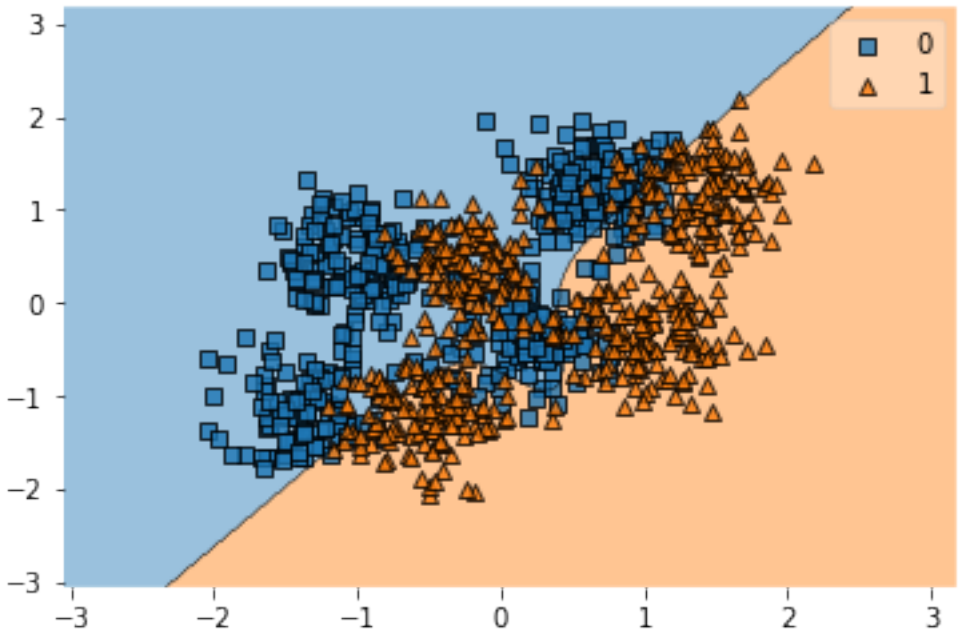

```
===
SVM com C = 10 e kernel = poly
Acurácia: 0.75, F1-score: 0.731, AUC: 0.754
```



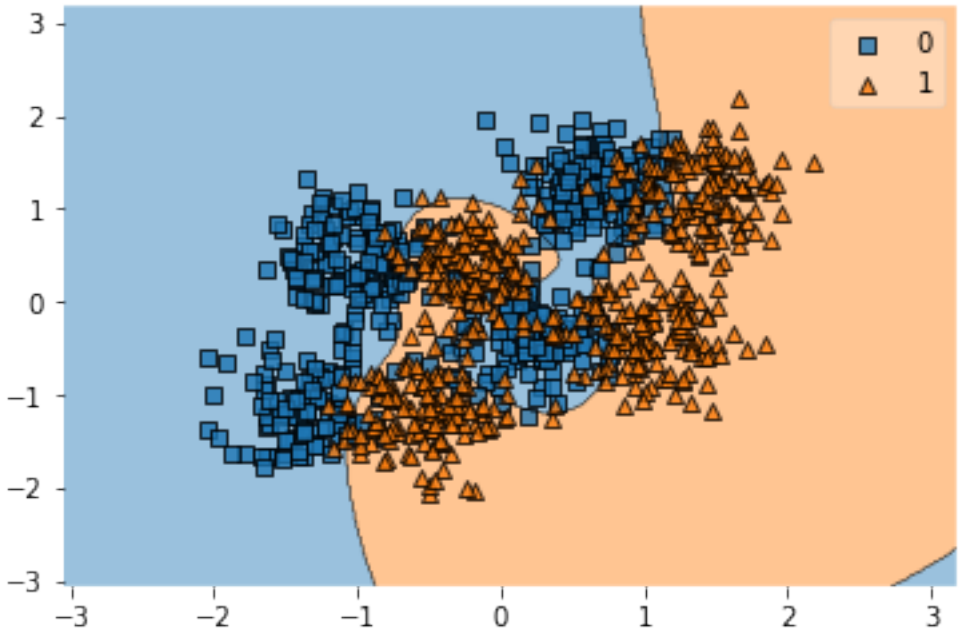
===
SVM com C = 50 e kernel = poly
Acurácia: 0.752, F1-score: 0.732, AUC: 0.756



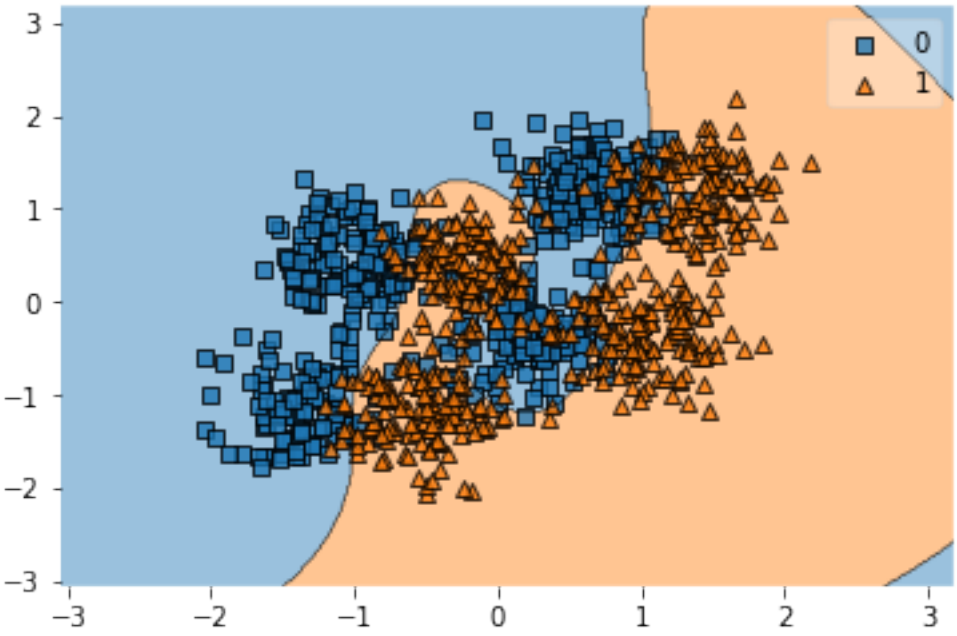
```
===
SVM com C = 100 e kernel = poly
Acurácia: 0.752, F1-score: 0.732, AUC: 0.756
```



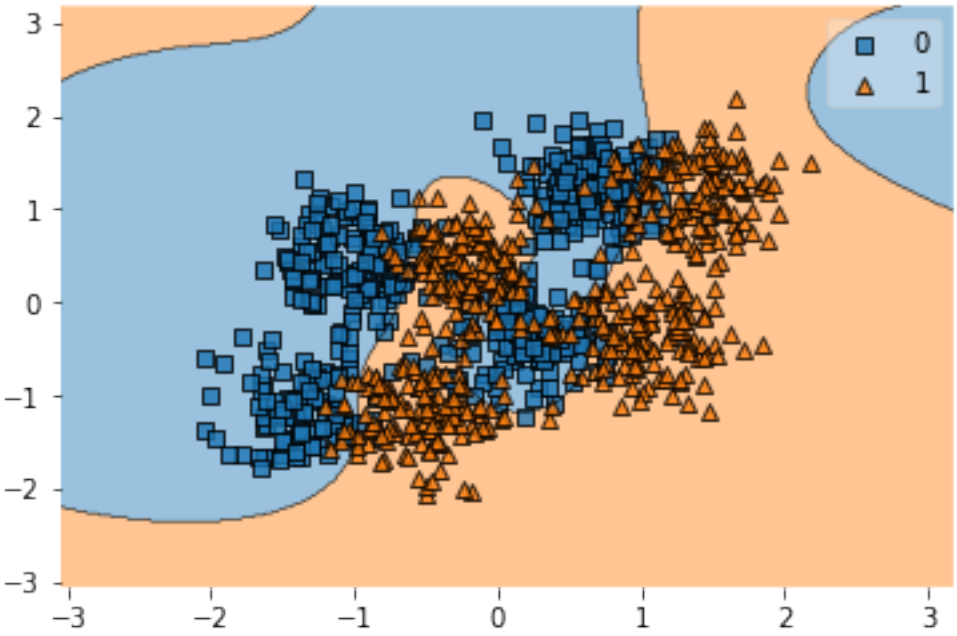

```
===
SVM com C = 1 e kernel = rbf
Acurácia: 0.853, F1-score: 0.858, AUC: 0.853
```



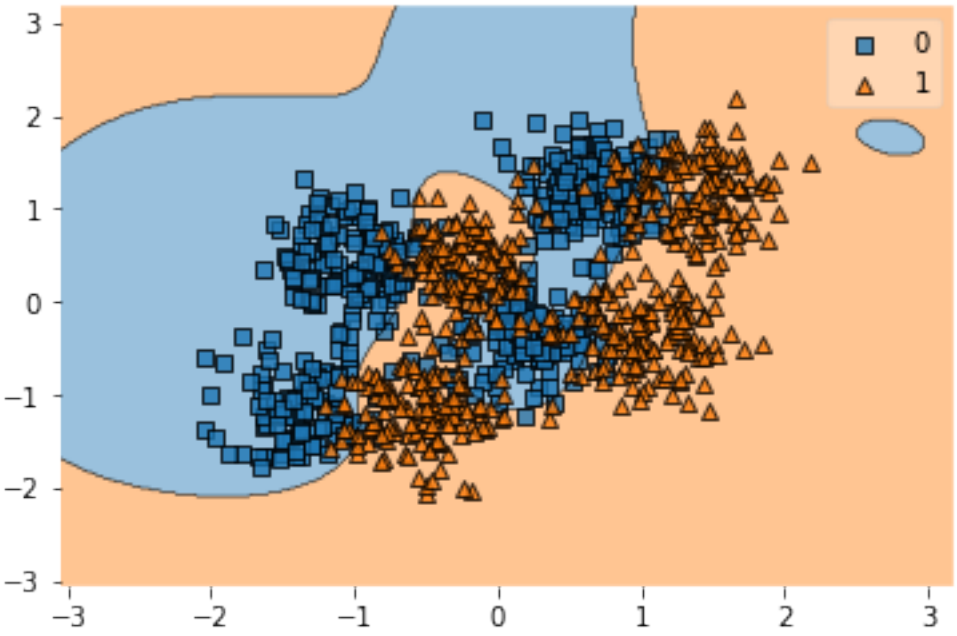
```
===
SVM com C = 10 e kernel = rbf
Acurácia: 0.864, F1-score: 0.868, AUC: 0.864
```



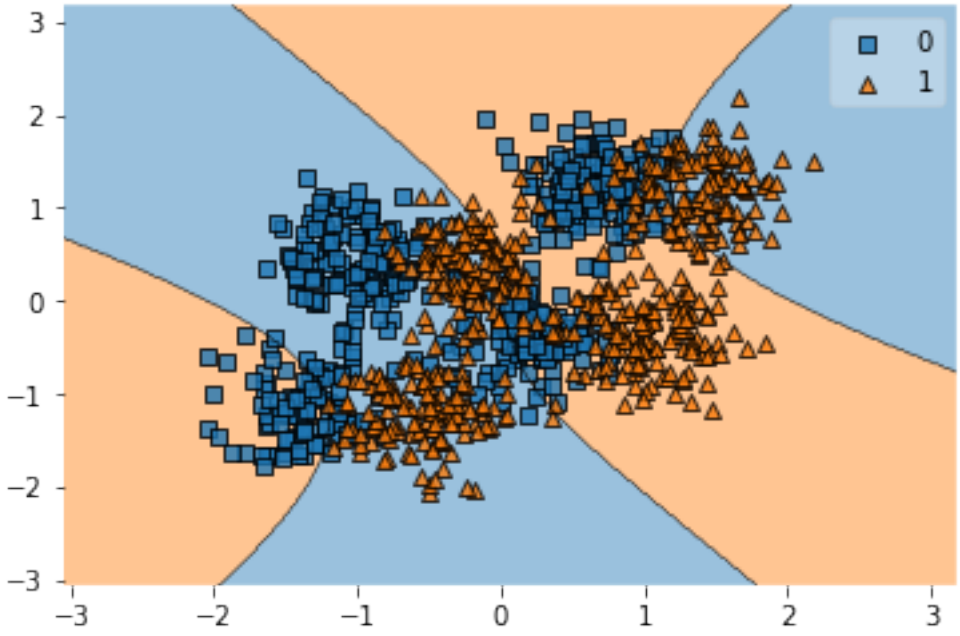

```
===
SVM com C = 50 e kernel = rbf
Acurácia: 0.867, F1-score: 0.871, AUC: 0.867
```



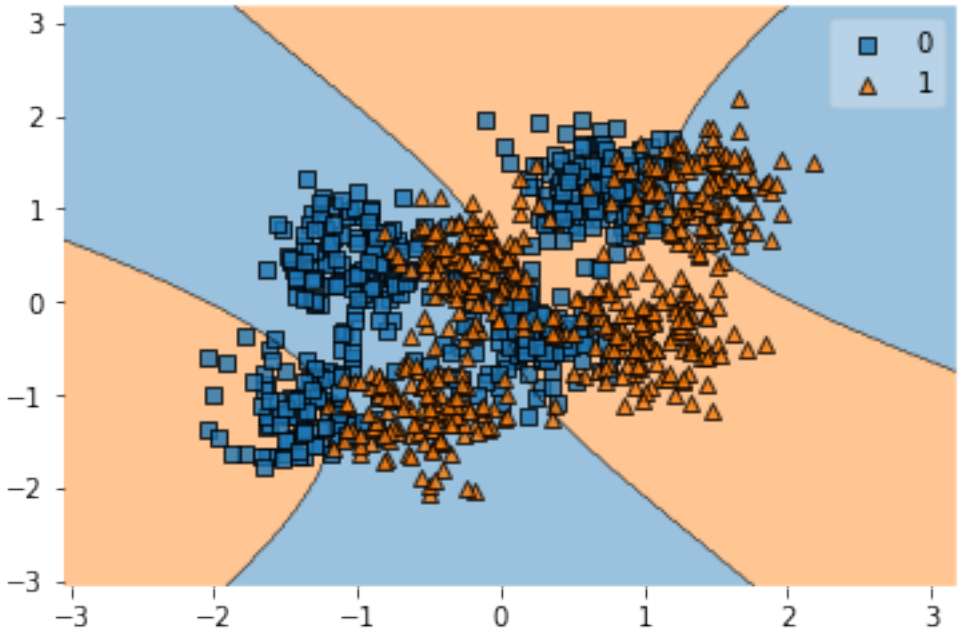
===
SVM com C = 100 e kernel = rbf
Acurácia: 0.866, F1-score: 0.870, AUC: 0.866



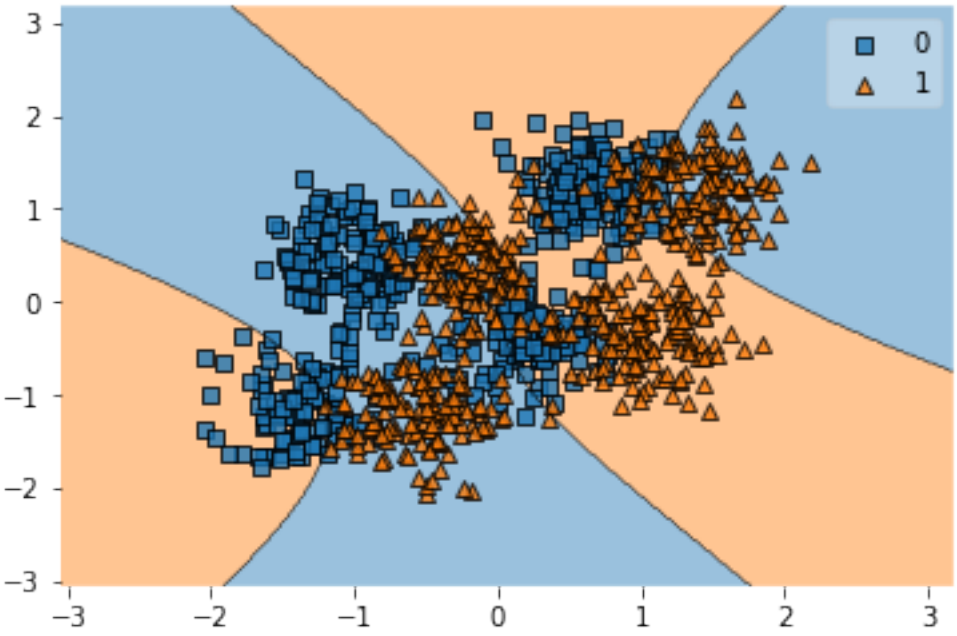
===
SVM com C = 1 e kernel = sigmoid
Acurácia: 0.415, F1-score: 0.421, AUC: 0.415



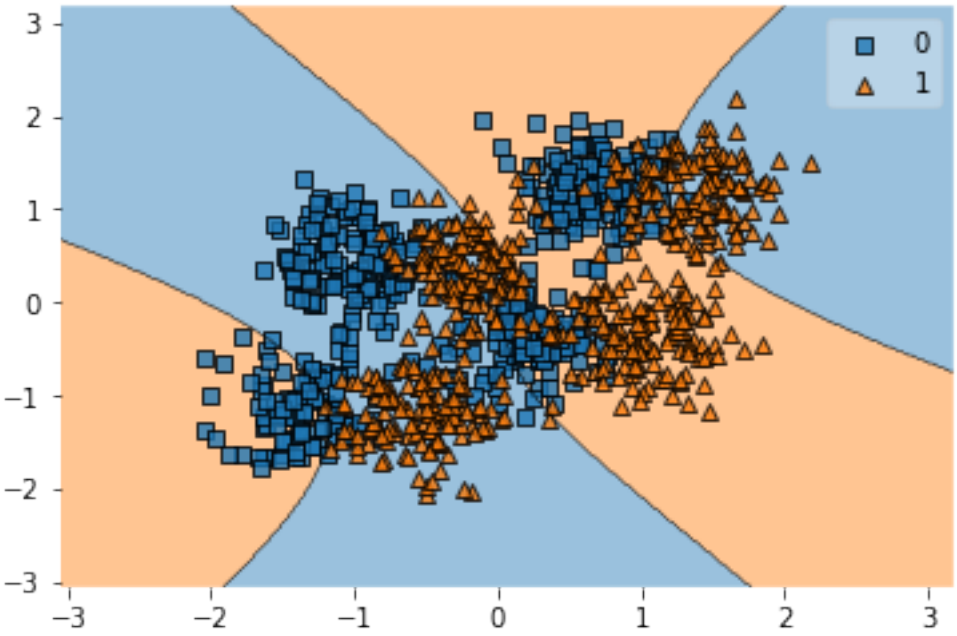
===
SVM com C = 10 e kernel = sigmoid
Acurácia: 0.413, F1-score: 0.421, AUC: 0.413



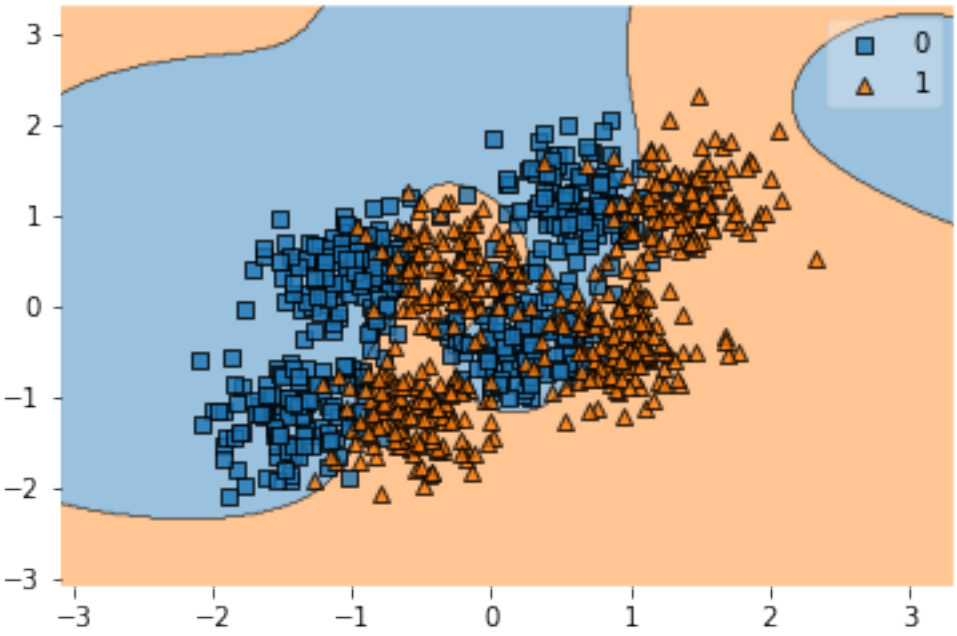
```
===
SVM com C = 50 e kernel = sigmoid
Acurácia: 0.414, F1-score: 0.422, AUC: 0.414
```




```
===
SVM com C = 100 e kernel = sigmoid
Acurácia: 0.414, F1-score: 0.422, AUC: 0.414
```



===
SVM com C = 50 e kernel = rbf
Acurácia: 0.874, F1-score: 0.873, AUC: 0.874



Fim fonte 2 html