L10-18-11-14-P1-Perceptron-Live

November 15, 2018

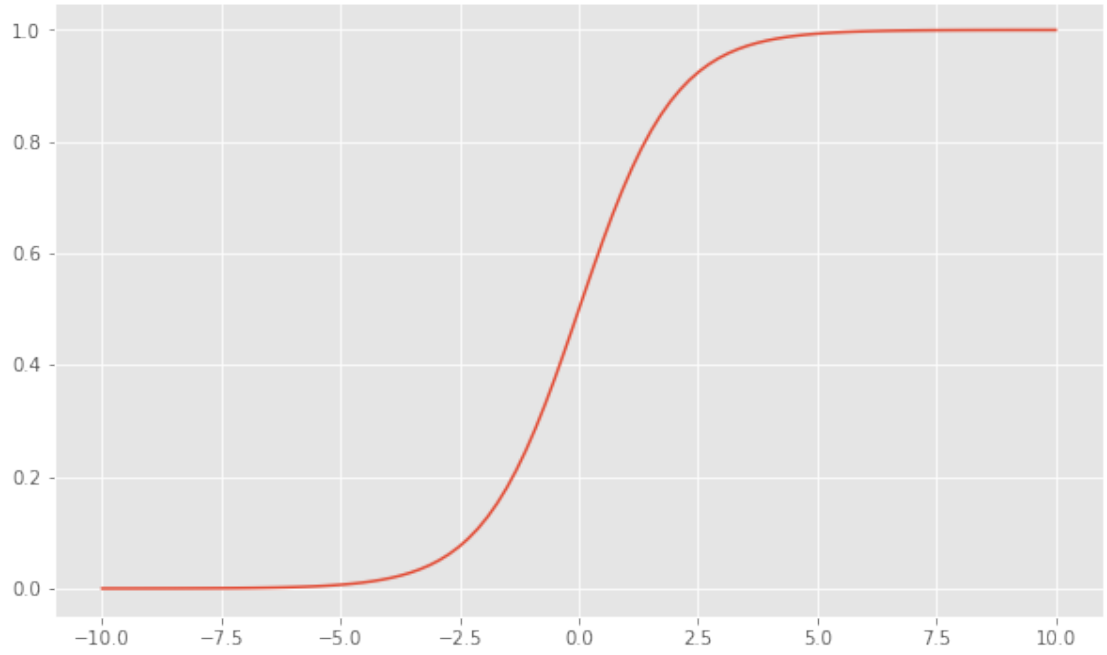
In [1]:
```
import numpy as np
from matplotlib import pyplot as plt
import seaborn as sns
import pandas as pd
plt.style.use('ggplot')
%matplotlib inline
```

0.1 Create Fake Data

In [2]:
```
samples = 1000
data_seed = 42
np.random.seed(42)
classMeans = np.vstack([np.array([-1,1]),np.array([1,-1])])
classStd=[0.75, .5]
target = np.array([np.random.randint(0,2) for _ in range(samples)])
inputFeatures = np.array([
    classMeans[label,:] + np.random.randn(2)*classStd[label]
    for label in target]
)
df = pd.DataFrame({'x0':inputFeatures[:,0],
                   'x1':inputFeatures[:,1],
                   'target':np.array(['Positive','Negative'])[target]

})
df.head()
```

In [3]:
```
fig, ax = plt.subplots(1,figsize=(10,6))
_ = sns.scatterplot(x='x0',y='x1',hue='target', data =df, ax=ax)
```


```
In [4]: def sigmoid(z):
            """Logistic Sigmoid"""
            return (np.exp(z*(-1.0))+1)**(-1)

In [5]: _, ax = plt.subplots(1,figsize=(10,6))
        xaxis = np.linspace(-10,10,100)
        _ = ax.plot(xaxis,sigmoid(xaxis))
```




```
In [6]: seed = 56
        np.random.seed(seed)

        weights_0 = np.random.randn(2)
        bias_0 = np.random.randn(1)
        print(weights_0, bias_0)
```

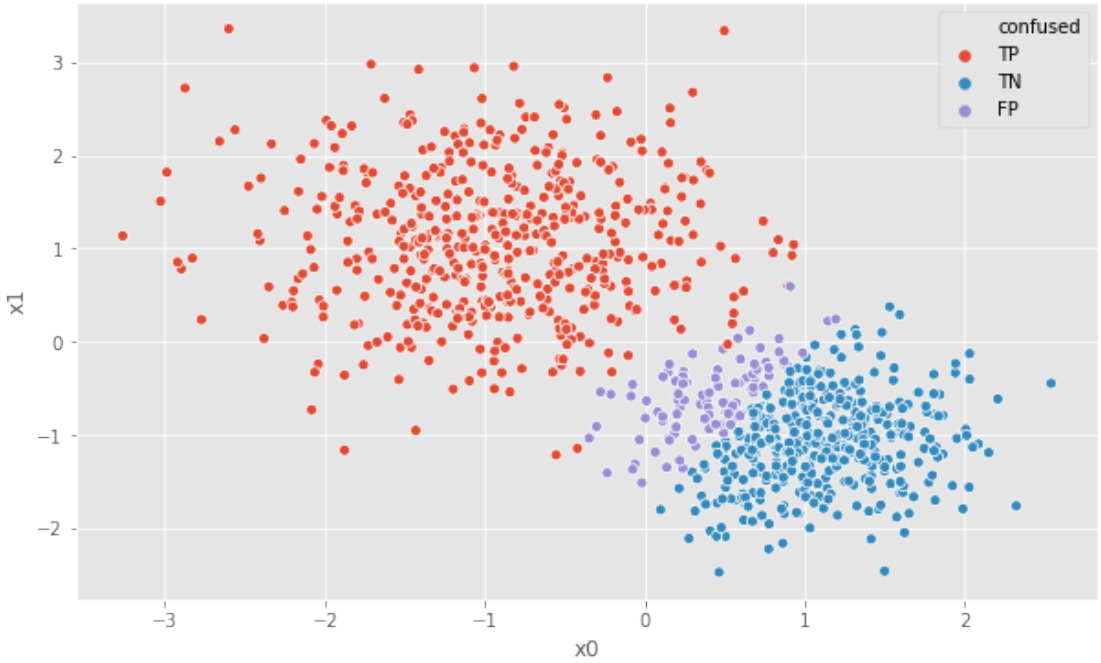
```
[-1.03764318  0.59365816] [1.10268062]
```

```
In [7]: def predict(X, weights, bias):
            return sigmoid(np.dot(X,weights)+bias)
```

```
In [8]: X = df[['x0','x1']]
        df['p_prob'] = predict(X,weights_0,bias_0)
        df['p_label']=df['p_prob']>0.5
```

```
In [9]: _, ax = plt.subplots(1,figsize=(10,6))
        _ = sns.scatterplot(x='x0',y='x1',hue='p_label',ax=ax,data=df)
```

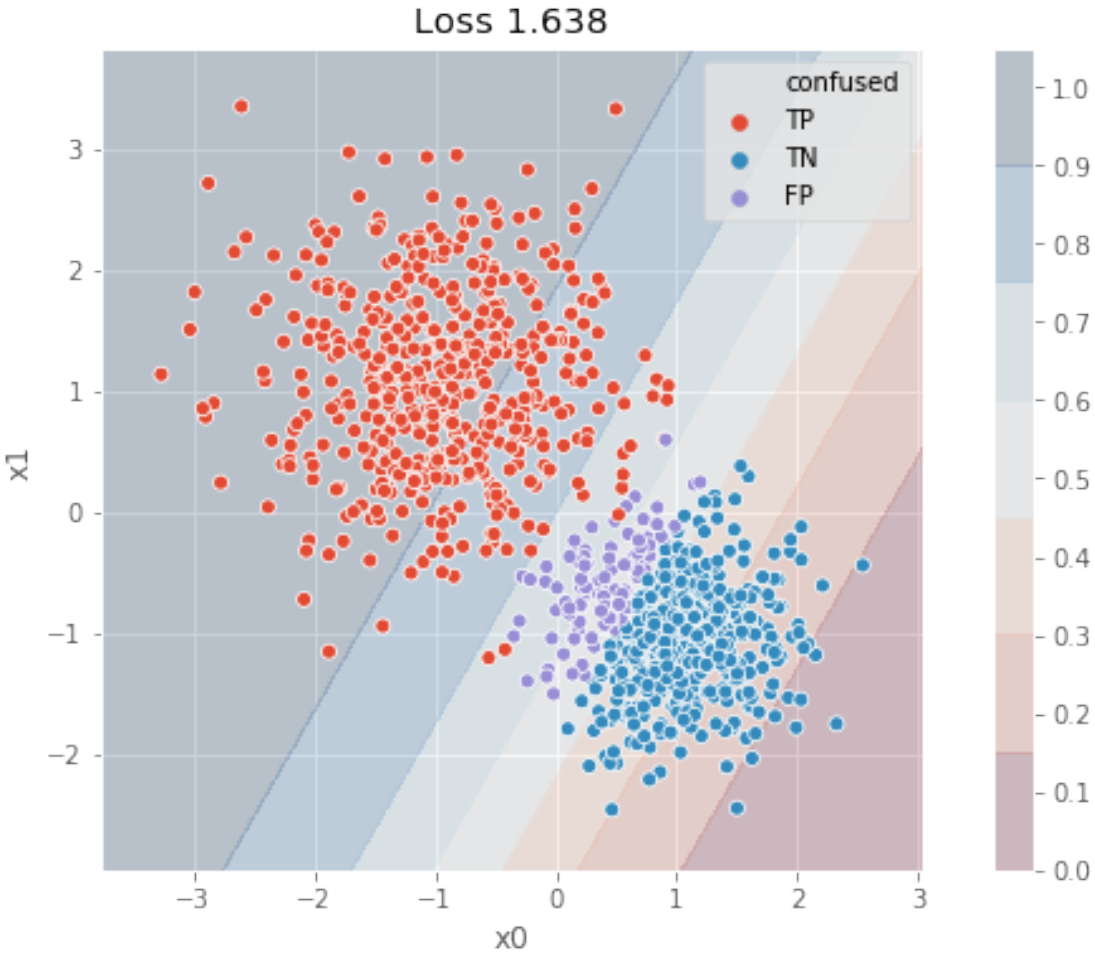

```
In [10]: lab_table = np.array([['TN','FP'],['FN','TP']])
         df['confused']=np.array([lab_table[int(target=='Positive'),int(p_label)]
          for target, p_label in df[['target','p_label']].values
         ])
         df.head()

In [11]: _, ax = plt.subplots(1,figsize=(10,6))
         _ = sns.scatterplot(x='x0',y='x1',hue='confused',ax=ax,data=df)
```



In [12]:
```
# loss fucntion

def cross_entropy_loss(y,y_pred):
    loss=np.zeros(y.shape[0])
    loss[y==1]=-np.log(y_pred[y==1])
    loss[y!=1]=-np.log(1-y_pred[y!=1])
    return loss.mean()
```

In [13]:
```
import matplotlib.colors as colors

y = (df['target']=='Postive').values

def show_classification(X,y,weights,bias):
    cm = plt.cm.RdBu
    bounds = np.arange(0,11)*.1
    norm = colors.BoundaryNorm(boundaries=bounds,ncolors=256)
    x_min, x_max = X.values[:,0].min() - .5, X.values[:,0].max() + .5
    y_min, y_max = X.values[:,1].min() - .5, X.values[:,1].max() + .5
    h = .2
    xx, yy = np.meshgrid(np.arange(x_min,x_max,h),np.arange(y_min,y_max,h))
    Z = predict(np.c_[xx.ravel(),yy.ravel()], weights, bias)
    Z = Z.reshape(xx.shape)
    df['p_prob'] = predict(X,weights,bias)
    df['p_label']=df['p_prob'] > 0.5
    df['confused']=np.array([lab_table[int(target=='Positive'),int(p_label)]
```

```
 for target, p_label in df[['target','p_label']].values
])
loss = cross_entropy_loss(y,df['p_prob'])
fig, ax = plt.subplots(1,figsize=(10,6))
pcm = ax.contourf(xx,yy,Z,norm=norm,cmap=cm,alpha=0.2)
_ = sns.scatterplot(x='x0',y='x1',hue='confused',ax=ax,data=df)
ax.set_title("Loss {:03.3f}".format(loss))
fig.colorbar(pcm, ax=ax,ticks=bounds)
ax.legend()
ax.set_aspect('equal')
plt.show()

return fig,ax

_ = show_classification(X,df['target'],weights_0,bias_0)
```

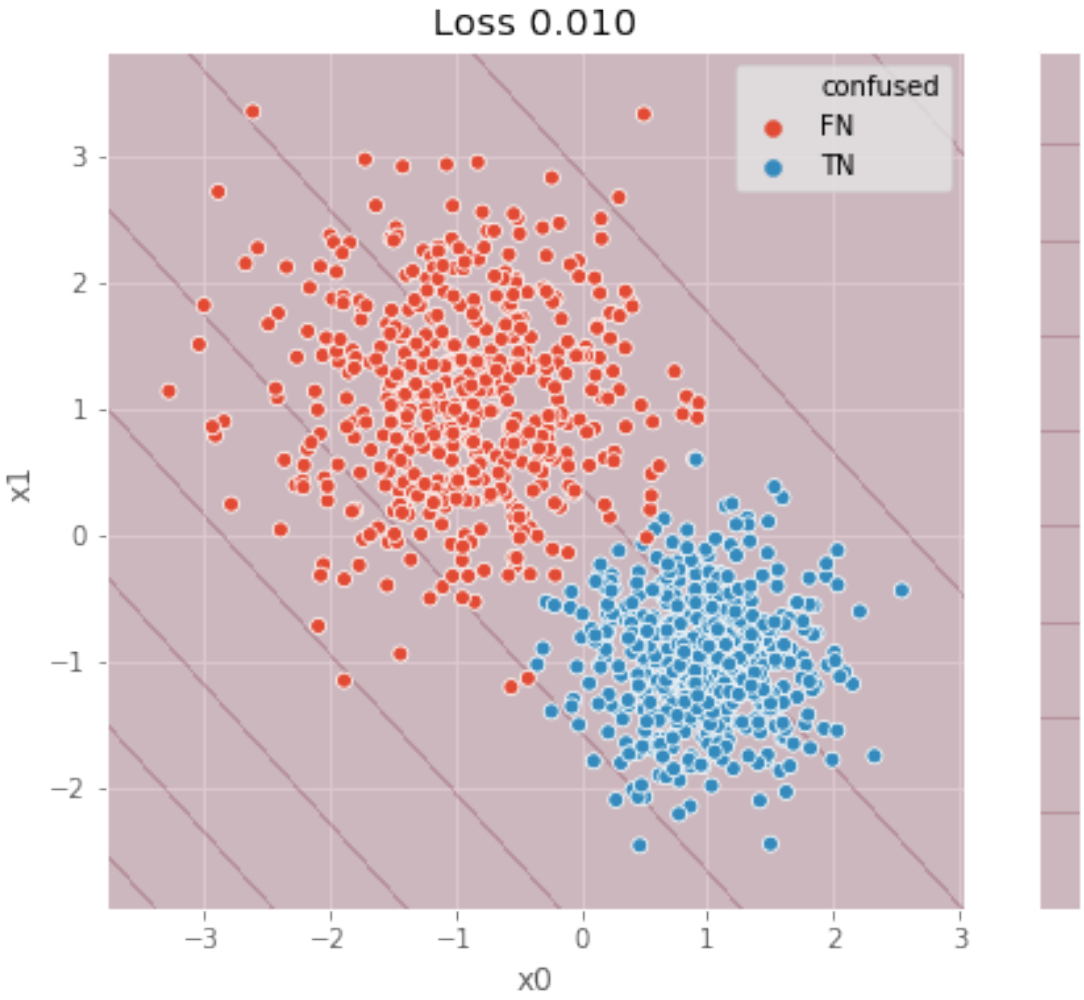


In [14]:
```
def gradient(X,y, weights, bias):
    num_obs, num_feats=X.shape
```

```
    y_pred = predict(X, weights,bias)
    errors = (y_pred-y).reshape(num_obs,1)
    return np.hstack([(X*errors).mean(axis=0),np.array(errors.mean())])
```

In [15]:
```
grad = gradient(X.values,y, weights_0, bias_0)
learning_rate=0.1
weights_1, bias_1 = (weights_0-learning_rate*grad[:2],
                     bias_0-learning_rate*grad[2])
_=show_classification(X,y,weights_1,bias_1)
```

In [16]:
```
weights_n, bias_n = weights_1, bias_1
for _ in range(1000):
    grad = gradient(X.values,y, weights_n, bias_n)
    weights_n, bias_n = (weights_n-learning_rate*grad[:2],
                         bias_n-learning_rate*grad[2])

_=show_classification(X,y,weights_n,bias_n)
```


Loss 0.010
confused
FN
TN
x1
x0
3
2
1
0
−1
−2
−3
−2
−1
0
1
2
3