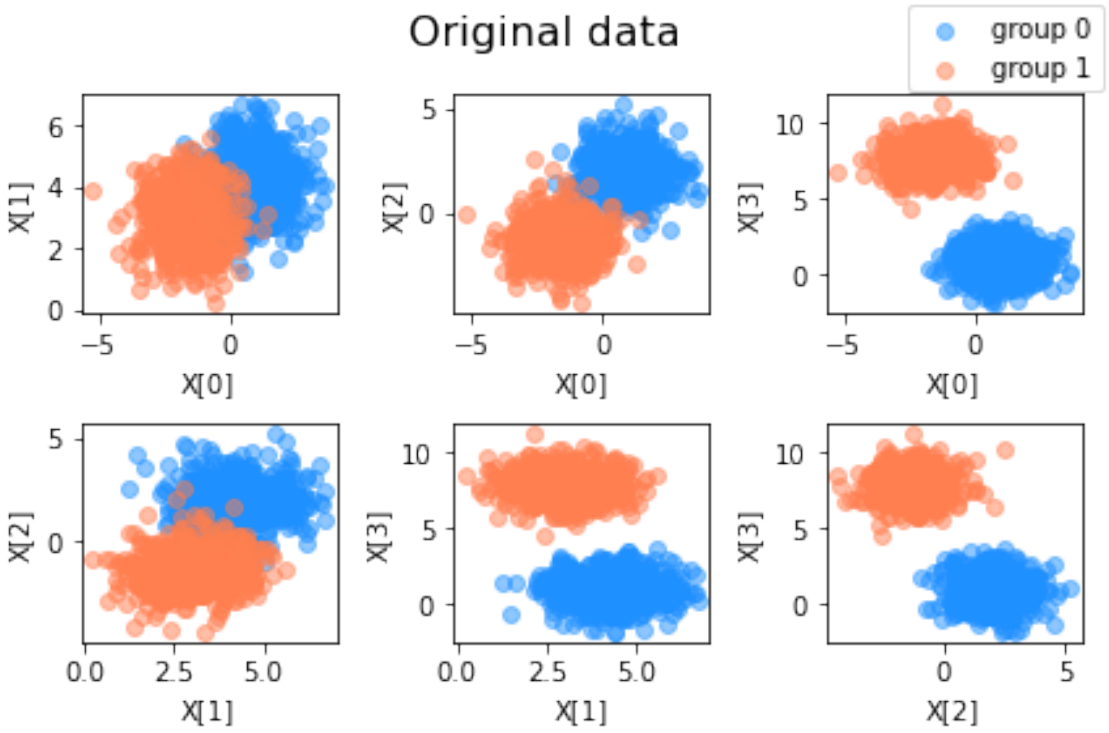
Exercise 15

June 5, 2022

1 Exercise 15

1.0.1 a)

[1]:
```
import matplotlib.pyplot as plt
from sklearn.datasets import make_blobs

# generating dataset X: data, group:
X, group = make_blobs(n_samples = 1000, centers = 2, n_features = 4,␣
 ↪random_state = 0)

# Scatter-plot of any 2 dimensions
fig, axs = plt.subplots(2, 3)

# help function to shorten code
def plotfunc(ax1, ax2, row1, row2):
    axs[ax1, ax2].scatter(X[group == 0][:,row1], X[group == 0][:,row2], color =␣
 ↪"dodgerblue", alpha = 0.5, label = "group 0")
    axs[ax1, ax2].scatter(X[group == 1][:,row1], X[group == 1][:,row2], color =␣
 ↪"coral", alpha = 0.5, label = "group 1")
    axs[ax1, ax2].set_xlabel("X[{}]".format(row1))
    axs[ax1, ax2].set_ylabel("X[{}]".format(row2))

plotfunc(0, 0, 0, 1)
plotfunc(0, 1, 0, 2)
plotfunc(0, 2, 0, 3)
plotfunc(1, 0, 1, 2)
plotfunc(1, 1, 1, 3)
plotfunc(1, 2, 2, 3)

fig.suptitle('Original data', fontsize=16)
handles, labels = axs[0,0].get_legend_handles_labels()
fig.legend(handles, labels)
plt.tight_layout()
```



1.0.2 b)

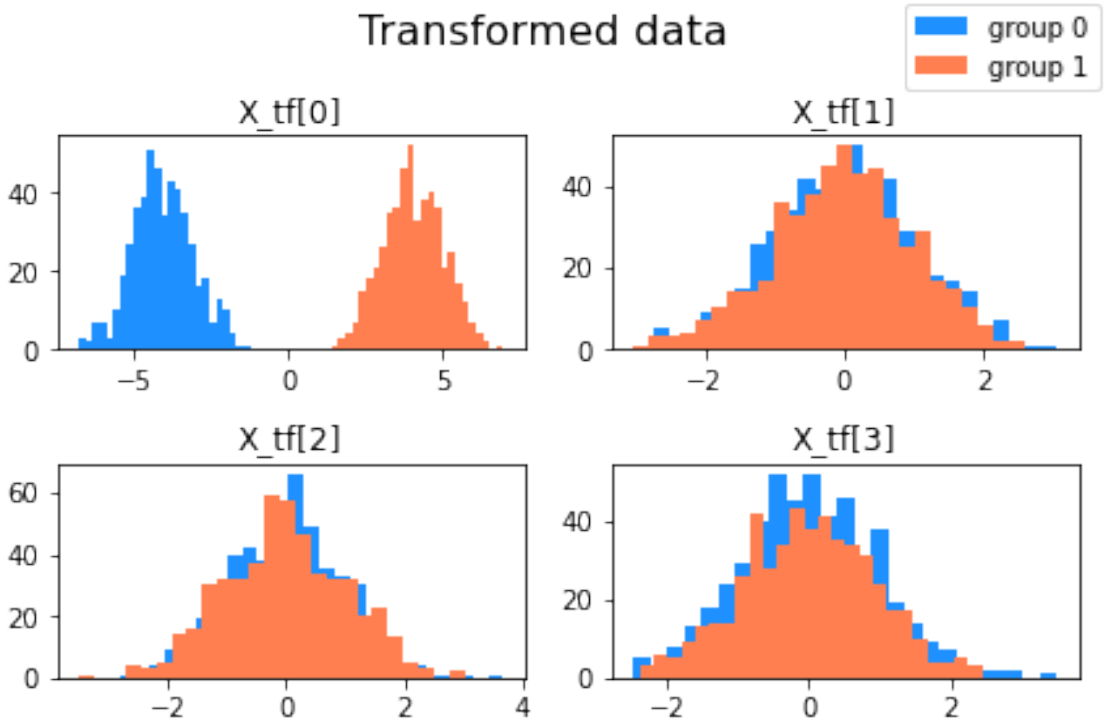
[2]:
```
from sklearn.decomposition import PCA

pca = PCA()

# transformation of X via the pca
X_tf = pca.fit_transform(X)

# Eigenvalues of the covaraince matrix of transformed data
eig = pca.explained_variance_
print("Eigenvalues: ", eig)
```

```
Eigenvalues:  [17.51933024  0.99958442  0.98813673  0.89875061]
```

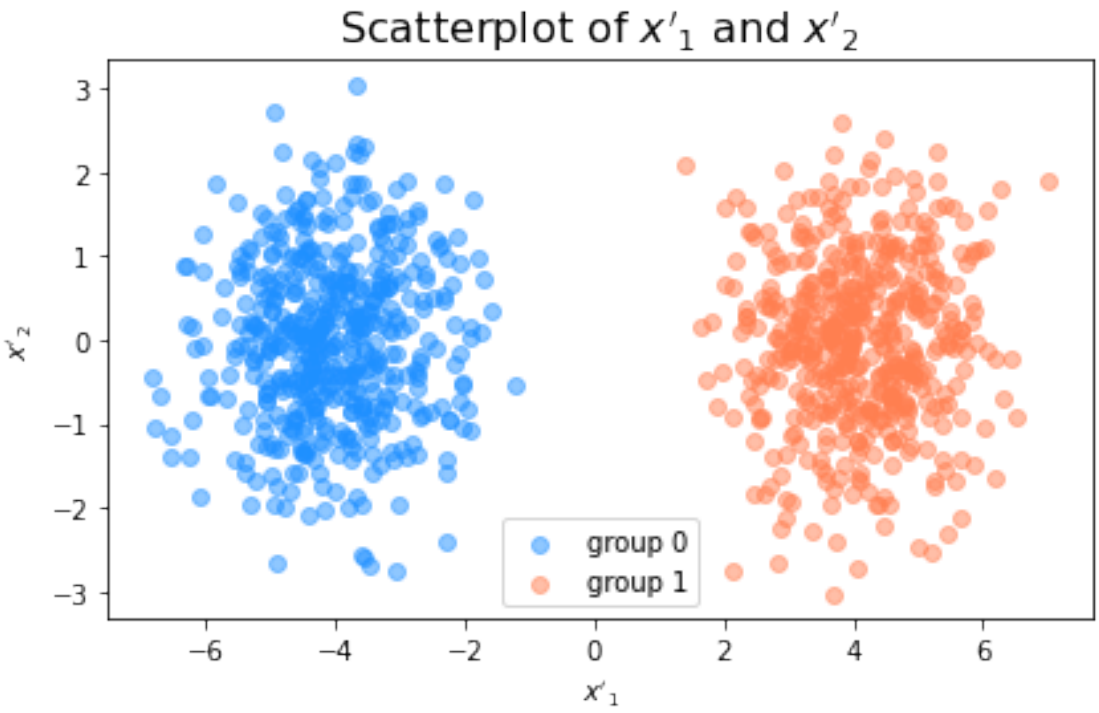
The first eigenvalue is siginificantly bigger than the others, so only the first feature of the transformed dataset should be kept. All others should be discarded, since their eigenvalues are smaller and similar to each other.

1.0.3 c)

[3]:
```
# Histogram plot
fig, axs = plt.subplots(2, 2)

def plotfunc(ax1, ax2, row):
    axs[ax1,ax2].hist(X_tf[group == 0][:,row], bins = 25, color = "dodgerblue",␣
 ↪label = "group 0")
    axs[ax1,ax2].hist(X_tf[group == 1][:,row], bins = 25, color = "coral",␣
 ↪label = "group 1")
    axs[ax1,ax2].set_title("X_tf[{}]".format(row))

plotfunc(0, 0, 0)
plotfunc(0, 1, 1)
plotfunc(1, 0, 2)
plotfunc(1, 1, 3)

fig.suptitle('Transformed data', fontsize=16)
handles, labels = axs[0,0].get_legend_handles_labels()
fig.legend(handles, labels)
plt.tight_layout()
```

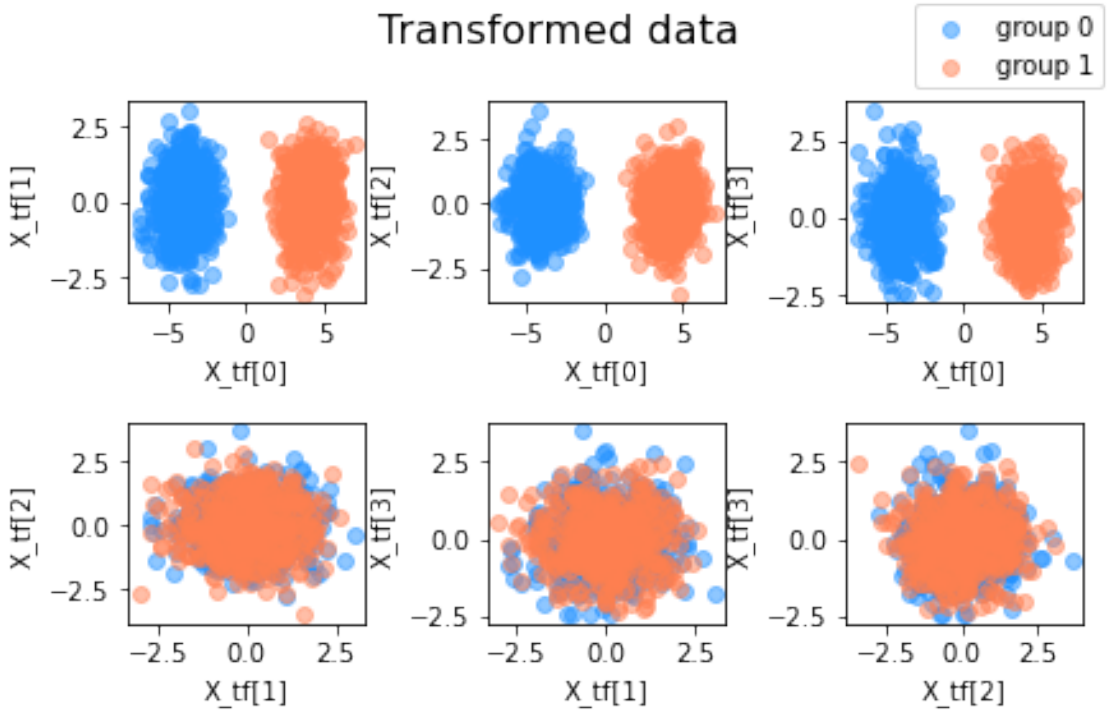


[4]:
```
fig2 = plt.subplot()
fig2.scatter(X_tf[group == 0][:,0], X_tf[group == 0][:,1],
                          color = "dodgerblue", alpha = 0.5, label = "group 0")
fig2.scatter(X_tf[group == 1][:,0], X_tf[group == 1][:,1],
                          color = "coral", alpha = 0.5, label = "group 1")
fig2.set_title(r"Scatterplot of $x'_1$ and $x'_2$" , fontsize=16)
fig2.set_xlabel(r"$x'_1$")
fig2.set_ylabel(r"$x'_2$")
handles, labels = fig2.get_legend_handles_labels()
fig2.legend(handles, labels)
plt.tight_layout()
```



[5]:
```
# All dimensions of the transformed dataset in a scatter plot

# Plot (same as in a))
fig, axs = plt.subplots(2, 3)

def plotfunc(ax1, ax2, row1, row2):
    axs[ax1, ax2].scatter(X_tf[group == 0][:,row1], X_tf[group == 0][:,row2],
                          color = "dodgerblue", alpha = 0.5, label = "group 0")
    axs[ax1, ax2].scatter(X_tf[group == 1][:,row1], X_tf[group == 1][:,row2],
                          color = "coral", alpha = 0.5, label = "group 1")
    axs[ax1, ax2].set_xlabel("X_tf[{}]".format(row1))
```

```
    axs[ax1, ax2].set_ylabel("X_tf[{}]".format(row2))

plotfunc(0, 0, 0, 1)
plotfunc(0, 1, 0, 2)
plotfunc(0, 2, 0, 3)
plotfunc(1, 0, 1, 2)
plotfunc(1, 1, 1, 3)
plotfunc(1, 2, 2, 3)

fig.suptitle('Transformed data', fontsize=16)
handles, labels = axs[0,0].get_legend_handles_labels()
fig.legend(handles, labels)
plt.tight_layout()
```



[ ]: