Project Name: Dimensionality Reduction With PCA

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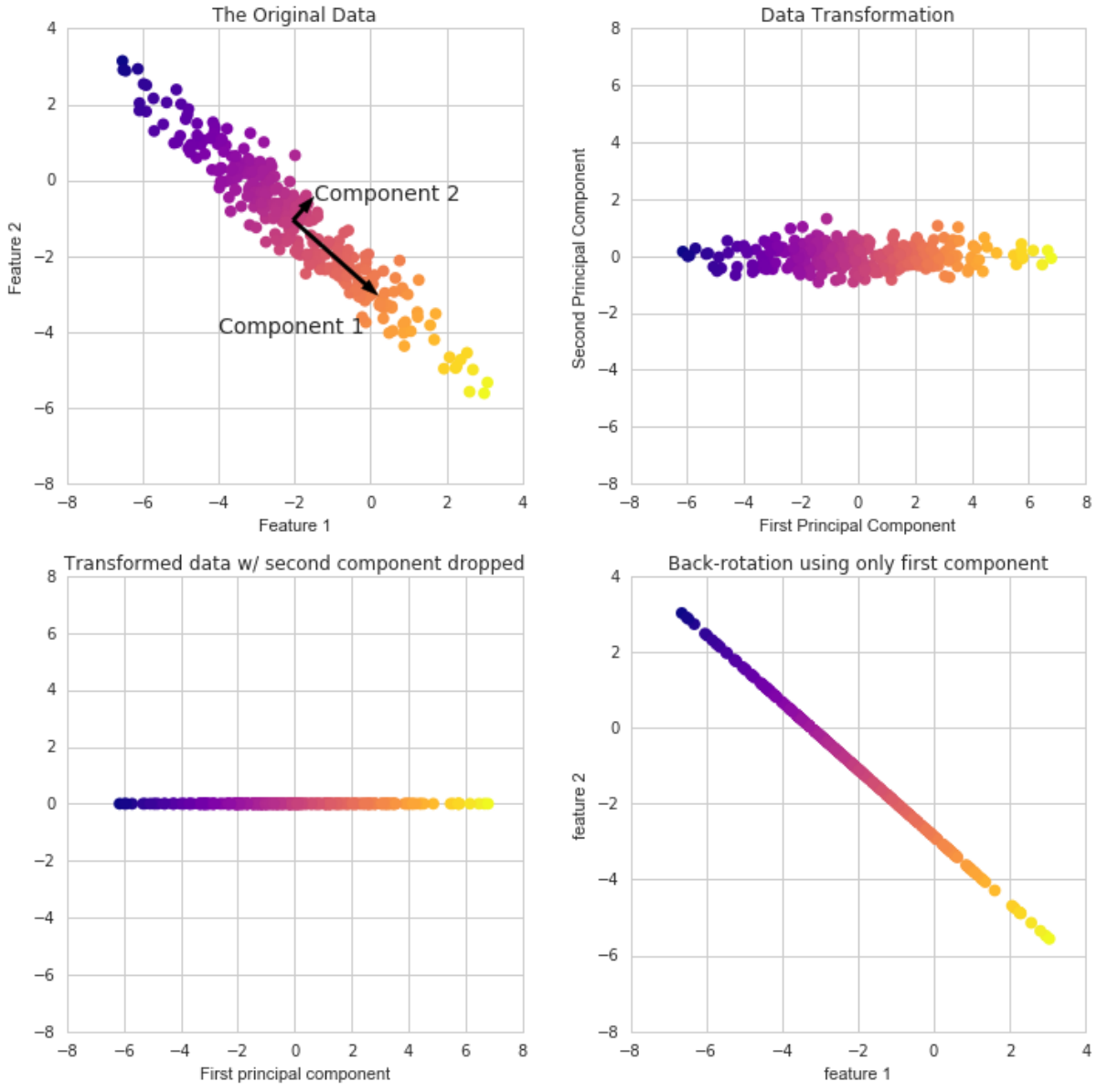
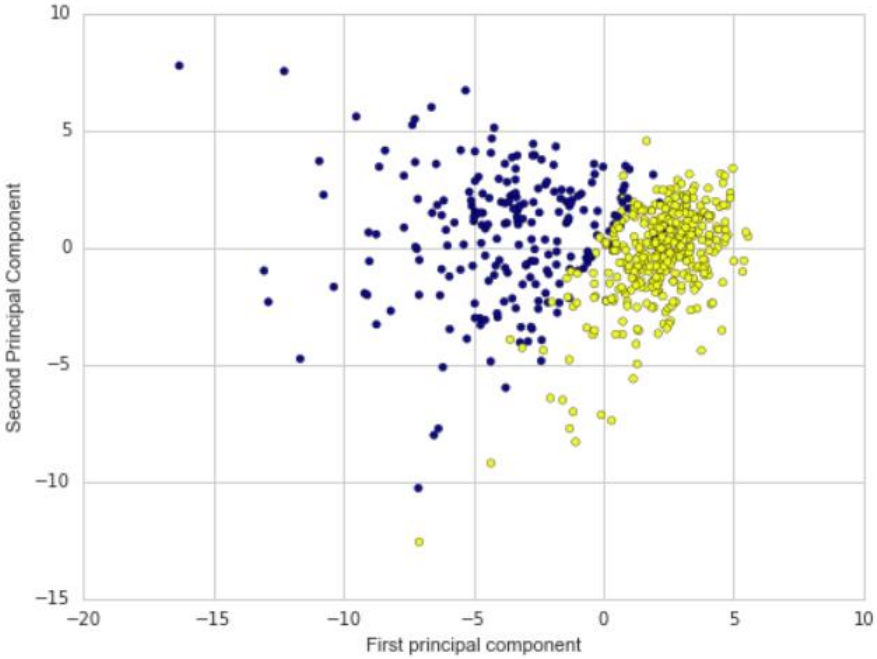
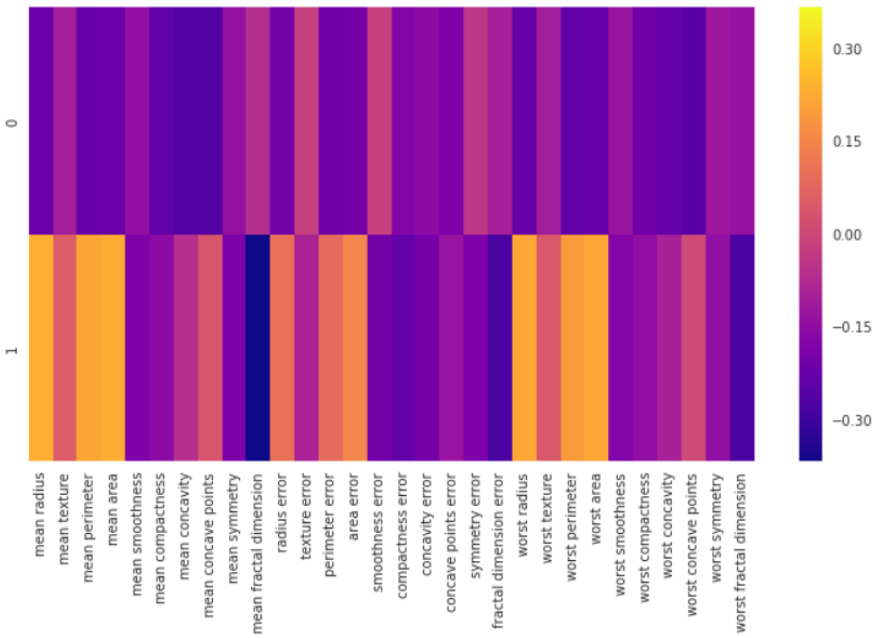
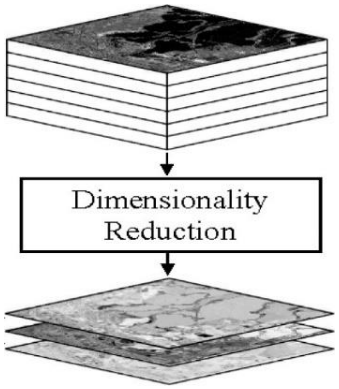
Demo




Second Principal Component
First principal component
10
5
0
−5
−10
−15
−20
−15
−10
−5
0
5
10


0
1
0.30
0.15
0.00
−0.15
−0.30
mean radius
mean texture
mean perimeter
mean area
mean smoothness
mean compactness
mean concavity
mean concave points
mean symmetry
mean fractal dimension
radius error
texture error
perimeter error
area error
smoothness error
compactness error
concavity error
concave points error
symmetry error
fractal dimension error
worst radius
worst texture
worst perimeter
worst area
worst smoothness
worst compactness
worst concavity
worst concave points
worst symmetry
worst fractal dimension

Overview


Dimensionality
Reduction

This is a Dimensionality Reduction means transformation of data from high-dimensional space into a low-dimensional space using PCA algorithm.
This repository contains the code for Dimensionality Reduction using python's various libraries.
It used Numpy, Pandas, Matplotlib, Seaborn and Sklearn libraries.
These libraries help to perform individually one particular transformation.
Numpy is used for working with arrays. It stands for Numerical Python.
Pandas objects rely heavily on Numpy objects.
Matplotlib is a plotting library.
Seaborn is data visualization library based on matplotlib.
Sklearn has 100 to 200 models.
The purpose of creating this repository is space is less required, less computation needed.
These python libraries raised knowledge to hands on with this algorithm.
It leads to growth in my ML repository.
The above screenshots will help you to understand flow of output.

Motivation

The reason behind building this project is, these algorithm captures essence of data. Simple logic is that even we as humans understands quickly if taught in simple words rather than complex words and ambiguous sentence structure. Similarly, reducing its dimension presents data in compact form. Another reason is that while model building, some algorithms do not perform well when we have large dimensions. Major necessity to reduce dimension is, space required to store data is reduced as the number of dimensions comes down and another is less dimensions lead to less computation and training time. At the same time, it maintains most of the key information. It reduces overfitting. As this is import for companies because tremendous increase in the way sensors are being used in the industry and these sensors continuously record data and because of respective errors in recording, problem arises of high unwanted dimensions and so the need of dimension reduction. For example, bike riders' movements get measured by GPS, set top box collects data about program preferences, casinos capturing data using cameras.

Technical Aspect

Numpy contains a multi-dimensional array and matrix data structures. It works with the numerical data. Numpy is faster because is densely packed in memory due to its homogeneous type. It also frees the memory faster.
Pandas module mainly works with the tabular data. It contains DataFrame and Series. Pandas is 18 to 20 times slower than Numpy. Pandas is seriously a game changer when it comes to cleaning, transforming, manipulating and analyzing data.
Matplotlib is used for EDA. Visualization of graphs helps to understand data in better way than numbers in table format. Matplotlib is mainly deployed for basic plotting. It consists of bars, pies, lines, scatter plots and so on. Inline command display visualization inline within frontends like in Jupyter Notebook, directly below the code cell that produced it.

Seaborn provides a high-level interface for drawing attractive and informative statistical graphics. It provides a variety of visualization patterns and visualize random distributions.
Sklearn is known as scikit learn. It provides many ML libraries and algorithms for it. It provides a range of supervised and unsupervised learning algorithms via a consistent interface in Python.
There are two main categories of dimensionality reduction: feature selection and feature extraction. Via feature selection, we select a subset of the original features, whereas in feature extraction, we derive information from the feature set to construct a new feature subspace.
PCA is a technique used as a data preparation technique to create a projection of a dataset prior to fitting a model. First, standardize, second, covariance matrix computation performs, third compute eigenvectors and eigenvalues of covariance matrix to identify the principal components.
Principal Component Analysis (PCA) is an unsupervised linear transformation technique that is widely used across different fields, most prominently for feature extraction and dimensionality reduction. Other popular applications of PCA include exploratory data analyses and de-noising of signals in stock market trading, and the analysis of genome data and gene expression levels in the field of bioinformatics.
Reason for selecting PCA is because PCA helps us to identify patterns in data based on the correlation between features. That is, in a nutshell, PCA aims to find the directions of maximum variance in high-dimensional data and projects it onto a new subspace with equal or fewer dimensions than the original one.
Note that the PCA directions are highly sensitive to data scaling, and we need to standardize the features *prior* to PCA if the features were measured on different scales and we want to assign equal importance to all features.
Before looking at the PCA algorithm for dimensionality reduction in more detail, let's summarize the approach in a few simple steps:

1. Standardize the *d*-dimensional dataset.
2. Construct the covariance matrix.
3. Decompose the covariance matrix into its eigenvectors and eigenvalues.
4. Sort the eigenvalues by decreasing order to rank the corresponding eigenvectors.
5. Select *k* eigenvectors which correspond to the *k* largest eigenvalues, where *k* is the dimensionality of the new feature subspace ($k \leq d$).
6. Construct a projection matrix *W* from the "top" *k* eigenvectors.
7. Transform the *d*-dimensional input dataset *X* using the projection matrix *W* to obtain the new *k*-dimensional feature subspace.

Other techniques for dimensionality reduction are Linear Discriminant Analysis (LDA) and Kernel PCA (used for non-linearly separable data).

Installation

Using intel core i5 9th generation with NVIDIA GFORECE GTX1650.
Windows 10 Environment Used.
Already Installed Anaconda Navigator for Python 3.x
The Code is written in Python 3.8.
If you don't have Python installed then please install Anaconda Navigator from its official site.
If you are using a lower version of Python you can upgrade using the pip package, ensuring you have the latest version of pip, *python* -m pip install --*upgrade pip and press Enter*.

Run/How to Use/Steps

Keep your internet connection on while running or accessing files and throughout too.
Follow this when you want to perform from scratch.
Open Anaconda Prompt, Perform the following steps:
cd <PATH>
pip install numpy
pip install pandas
pip install matplotlib
pip install seaborn
pip install sklearn
You can also create requirement.txt file as, pip freeze > requirements.txt
run files.

Follow this when you want to just perform on local machine.
Download ZIP File.
Right-Click on ZIP file in download section and select Extract file option, which will unzip file.
Move unzip folder to desired folder/location be it D drive or desktop etc.
Open Anaconda Prompt, write cd <PATH> and press Enter.
eg: cd C:\Users\Monica\Desktop\Projects\Python Projects 1\7)Dimensionality_Reduction
In Anconda Prompt, pip install -r requirements.txt to install all packages.
Open in Jupyter Notebook, Dimensionality_Reduction_With_PCA_1.ipynb
Please be careful with spellings or numbers while typing filename and easier is just copy filename and then run it to avoid any silly errors.
Note: cd <PATH>
[Go to Folder where file is. Select the path from top and right-click and select copy option and paste it next to cd one space <path> and press enter, then you can access all files of that folder] [cd means change directory]

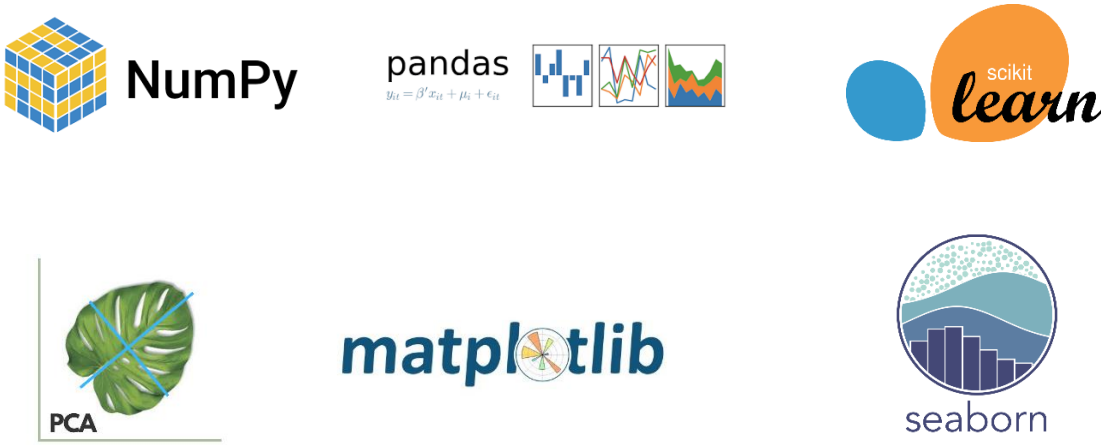
Directory Tree/Structure of Project

Folder: 7)Dimensionality_Reduction
Dimensionality_Reduction_With_PCA_1.ipynb

To Do/Future Scope

Can try with other dimensionality reduction techniques.

Technologies Used/System Requirement/Tech Stack



Credits

Krish Naik Channel