

CSE 469 Homework 1:

Dimensionality Reduction and Visualization

Due: September 21, 2023 11:59PM ET

This assignment must be done individually.

Three datasets (Iris, Cho, Iyer) with cluster labels can be found in Piazza under “Homeworks - > HW 1”. In each datasetfile, the last column is the cluster label, and the remaining columns are attributes.

In this assignment, you need to implement Principle Components Analysis (PCA) algorithm by yourself to map high-dimensional data to 2 dimensions, and plot the 2- dimensional data points. **You are not allowed to call existing PCA libraries directly.**

Please take the following four steps:

STEP 1:

The template based on Python is provided. In the template, necessary libraries are imported. You only need to complete the required functions (*pca* and *plot*) in that template if you choose to use Python. Please do not change the input and output provided in the template. The details of the template are explained as follows:

There are four functions in the template: ***loadDataSet***, ***pca***, ***plot*** and ***the main function***. The *loadDataSet* function is to load the dataset from the csv file. The input of this function is the filename of the dataset and the outputs are the data matrix (*dataMat*) and corresponding labels (*labelMat*). Each row in the *dataMat* represents an observation and each column in the *dataMat* represents an attribute. Each entry of *labelMat* is the label corresponding to each row of *dataMat*.

You need to implement PCA algorithm in the *pca* function. The input of the *pca* function is *dataMat* obtained from the *loadDataSet* function and the number of dimensions after PCA transformation which is set to be 2. The output of the *pca* function is the two- dimensional data (*lowDDataMat*) after PCA transformation.

In the *plot* function you need to plot all observations as scatter plots and color the data points according to their labels. You also need to save the figure. The input to the *plot* function is the data matrix after PCA transformation (*lowDDataMat*) obtained from the *pca* function, the label vector (*labelMat*) obtained from the *loadDataSet* function and the name of the saved figure (filename).

The aforementioned functions are called in the main function. To run the template, you can use the command line and then type the following command:

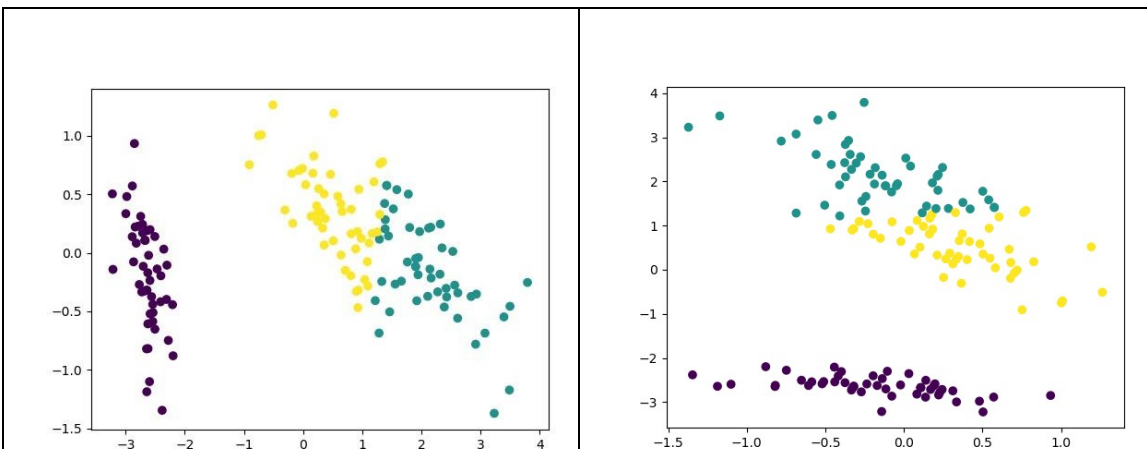
Python pca_template.py [filename]

The parameter filename is an optional parameter to specify the name of the data file you want to read. If it is not specified, the default value ('iris_with_cluster.csv') will be used.

The use of Python is highly recommended but not required. If you choose to use other language, you may be required to give a demo during instructor office hour in case I cannot run your code smoothly due to the different environment configuration.

STEP 2:

Apply PCA on the Iris dataset and get the two-dimensional data points. Draw them in a scatter plot, and color them according to their cluster labels. Compare the scatter plot with the given plots below and see if you get the plot correctly. If your plot matches either of the following plots, it is correct. Note that it is NOT permitted to use an existing function/package that directly achieves the final results. If you are not sure about whether it is OK to use a certain function, please ask your question over Piazza (in a private or public post).



Iris Data

STEP 3:

If Step 2 works fine, then apply PCA on the Cho and Iyer datasets and draw a scatter plot for each dataset following the same procedure discussed in Step 2.

Prepare your submission. Your final submission should be a zip file named as LastName_FirstName_Hw1.zip (e.g., Sariyuce_Erdem_Hw1.zip). In the zip file, you should include:

- **A folder “Code”:** This must contain all the codes used in this assignment. Inside the folder, please have a file “README” which describes how to run your code. If you use the Python template, then you don’t need to include “README” unless you change the other functions that you are asked not to change.
- **Report:** A pdf file named as lastName_firstName_Hw1.pdf. The report should consist of the following parts: 1) Two scatter plots obtained by running PCA on Cho and Iyer datasets. Please label them properly by the dataset names and have tick marks along both axes in each plot. 2) The codes of PCA and plot drawing.

STEP 4:

Submit your zip file to AutoLab.

Please refer to course syllabus for late submission policy and academic integrity policy. This assignment must be done independently. **Running your submitted code should be able to reproduce the plots in the report.**