Assignment 1: Dimensionality Reduction and Visualization

Due: September 21 2019 11:59PM

Three datasets (Iris, Cho, Iyer) with cluster labels can be found on Piazza. In each dataset file, the last column is the cluster label, and the rest columns are attributes.

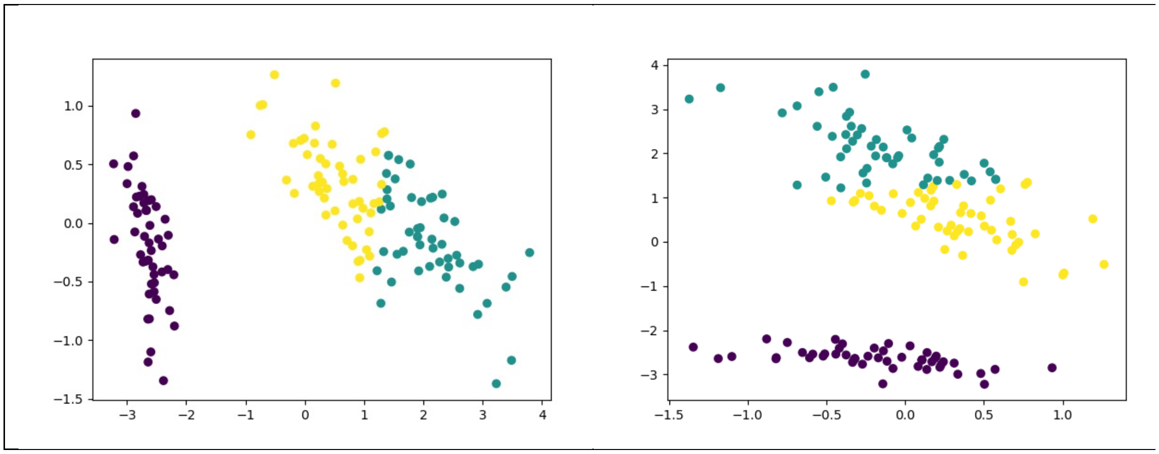
In this project, you need to implement Principle Components Analysis (PCA) algorithm by yourself to project high-dimensional data to 2 dimensions, and plot the 2-dimensional data points. You are not allowed to call existing PCA libraries directly.

Please take the following steps:

1.Choose your preferred programming language. The template based on Python is provided and is tested on both Python 2.7 and 3.6. 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 (figname).
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]
You can also run the template in an IDE such as PyCharm and specify the configuration.
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 TAs' office hour in case we cannot run your code smoothly due to the different environment configurations.

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 post your question on Piazza.



Iris Data

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.

4. Prepare your submission. Your final submission should be a zip file named as Assignment1.zip. In the zip file, you should include:

- A folder "Code", which contains all the codes used in this project. Inside the folder, please have a file "README" which describes how to run your code. If you use the template, then you don't need to include "README" unless you change the other functions that you are not asked to change.
- Report: A doc or pdf file named as Assignment1.doc or Assignment1.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.

5. Log in any CSE department server and submit your zip file as follows:
submit_cse469 Assignment1.zip

Please refer to Course Syllabus for late submission policy and academic integrity policy. We will take the submission time recorded by the server as the time of your submission. This assignment must be done independently. Running your submitted code should be able to reproduce the plots in the report.