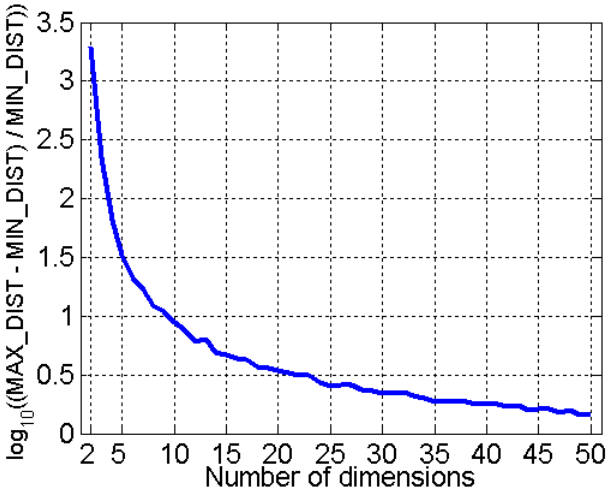
Due Date: See Webcampus
How to submit: Webcampus

General Guidelines:

- Please prepare a **typed** report that describes what you did. The report should be as concise as possible while providing all necessary information required to replicate your plots.
- For each problem, please provide, at the end of your report, a commented version of your python code files. **Python Notebook files are preferred. You may put the codes for all the problems in a SINGLE ipynb file with necessary texts to separate each problem.**

P1-1. Curse of Dimensionality.
Reproduce a figure similar to the figure in slide 37 in Chapter 2, i.e.,



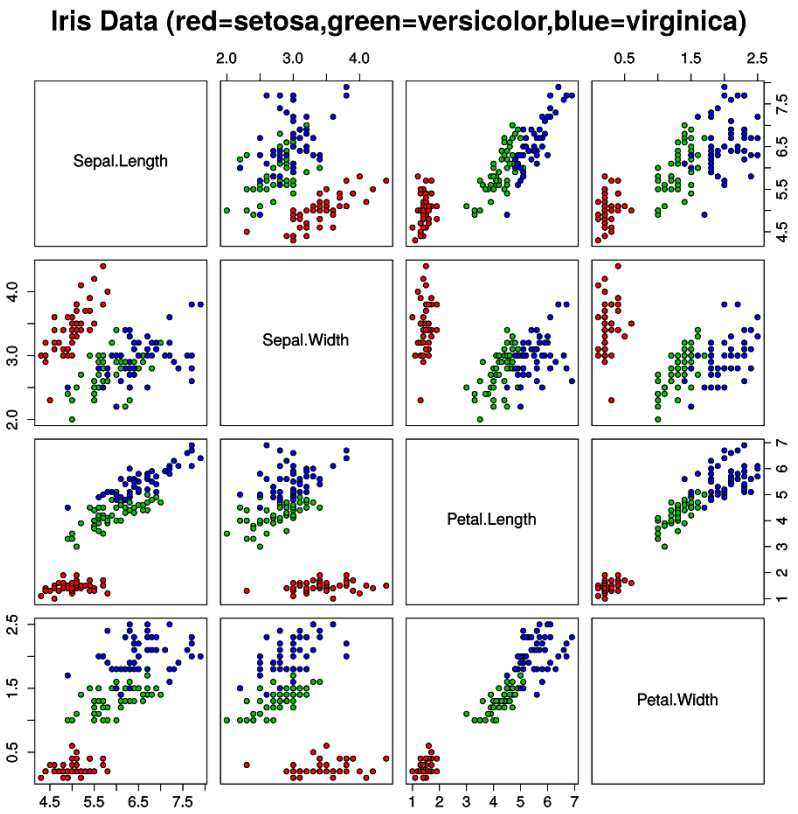
(a) Generate 1000 points following a uniform distribution under a given dimension, and then compute difference between max and min distance between any pair of points. *Hint: Refer to the tutorial "Introduction to Numpy and Pandas" on how to generate random points.*
(b) Repeat (a) for different dimensions from 2 to 50.
Plot $\log_{10} \frac{\max - \min}{\min}$ under different number of dimensions.

P1-2. The Iris Dataset (https://en.wikipedia.org/wiki/Iris_flower_data_set)
The Iris dataset is embedded in scikit-learn. You can install scikit-learn by following the instructions (https://scikit-learn.org/stable/install.html). Then you can load the Iris dataset using the following codes:

```
from sklearn import datasets
iris = datasets.load_iris()
```

The Iris dataset consists of 3 different types of irises' (Setosa, Versicolour, and Virginica) petal and sepal length, stored in a 150x4 numpy.ndarray.

Tasks:
a) Data Visualization. Duplicate the following figure using scatter plot.



b) Find the best discretization for the petal length and the petal width that can best separate the Iris data and plot a figure similar to the figure in slide 54 in Chapter 2. For each flower type, list in a table how many data samples are correctly separated and how many are not correctly separated.

P1-3. Principal Component Analysis for The Iris Dataset

You can use PCA embedded in scikit-learn by the following code:

```
from sklearn.decomposition import PCA
```

Tasks:

a) Use the Iris dataset and plot all the samples in a figure using Sepal Length and Sepal Width, i.e., xlabel('Sepal length') and ylabel('Sepal width').

b) The Iris dataset has 4 attributes (sepal length, sepal width, petal length, and petal width). Use PCA to reduce the dimension of the dataset from 4 to 2. Plot all the samples after the dimensionality reduction in a 2D figure. Compare this figure with the figure in (a) and discuss whether you can better separate the data samples after the dimensionality reduction.