111B Data Science and Python Programming
Homework Assignment #6

Due: 5/26 12:00:00

Problem #1. Generate a $N \times N$ matrix satisfying SDD condition.

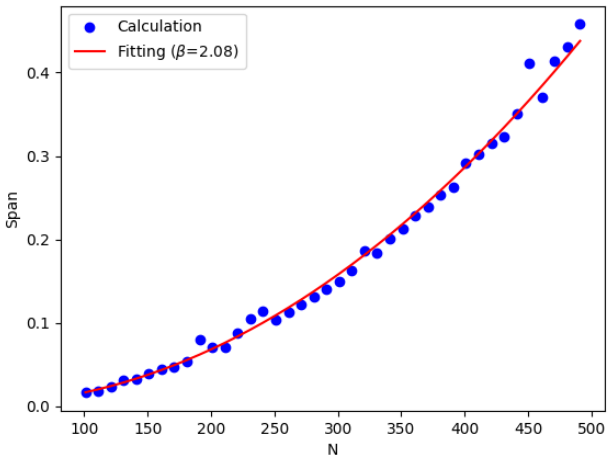
Please define a function called '*generateSDDmatrix*' with parameter N. This function will randomly generate a $N \times N$ matrix A. Then, use any method to make matrix A satisfy the strict diagonally dominant (SDD) condition and return it.

Problem #2. Time Complexity of Gaussian Elimination

Please define a function called '*Plot_GaussianElimination.*' In this function, using your defined function '*generateSDDmatrix*' to generate a matrix A of size $N \times N$ and randomly generate a vector y of size $N \times 1$. Use Gaussian elimination to solve for x in $Ax = y$, and use the '*time*' module to calculate the time taken for different values of N. Following pseudo code illustrating the procedures:

```
for N = range(10, 501, 10)
    start = time.time()
    solving Ax = y by gaussian elimination
    span = start – time.time()
```

After above calculation, use model fitting by **log tricks** or **scipy.optimize.curve_fit** for exponential function $\text{span} = \alpha N^{\beta}$. Please plot both spans from calculation and fitting with '*matplotlib.pyplot*' like figure below. Show your estimated β in the figure.



Problem #3. Time Complexity of Gauss-Seidel method

Please define a function called '*Plot_GSmethod*' with same process as **Problem#2** but using G-S method to solve for x in $Ax = y$.

Please accomplish this homework with an organized code (e.g., with main script and function script). For example, you can package your scripts that related to the class object in a module "**obj.py**", some useful functions in other module, and remain the main content in the main script "**main_hw6.py**" clear. In addition, you should use "**argparse**" to set all related parameters of this homework. Here is a template for your code structure:

```
111B_hw6_0123456789
      ├─ obj.py          # Objects
      ├─ ???.py          # ??? for hw6
      └─ main_hw6.py     # Main script of hw6
```

You don't need to follow this structure, just keep your main script clean.

Hand in procedure:

As we had mentioned in the lecture, you should list all your collaborators in your programs. Here is the template:

```
"""
Created on Sun Aug 7 01:23:45 2022

@author: Xi Winnie, student ID

@collaborators: Jane Doe, her student ID
                John Doe, his student ID
"""
```

Please save your code as a "**.zip**", "**.7z**", or "**.rar**" file, where the file name should follow this format:

111B_hw6_ID.zip

For example,

111B_hw6_0123456789.zip

Please be aware. **We are not going to accept any homework file with wrong file name or without signature**. Please double check the content of your files.

Once you have accomplished your works, you can upload your homework to the "E3@NYCU" system. There will be a section for uploading your homework.