EXERCISES

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(1) Create the matrices (matrix or ndarray)
- The matrix S whose entries are $a_{ij} = i + j$
- The matrix P whose entries are $a_{ij} = i * j$
- The following matrices

$$A = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{pmatrix}$$

$$B = \begin{pmatrix} 0 & 2 & 3 & 4 \\ 5 & 0 & 7 & 8 \\ 9 & 10 & 0 & 12 \\ 13 & 14 & 15 & 0 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 5 & 4 & 7 & 8 \\ 9 & 10 & 9 & 12 \\ 13 & 14 & 15 & 16 \end{pmatrix}$$

(2) Solve the following linear system using Python

$$\begin{aligned} 4x - 2y + z &= 1 \\ x + y - z &= 2 \\ x + 2y + z &= 6 \end{aligned}$$

(3) Normalize a 5×5 random matrix (between 0 and 1)

(4) Represent graphically (from mayavi.mlab import mlab)

$$f(x,y) = x^2 + y^2$$

$$f(x,y) = a * \exp\left(-\frac{(x-h)^2 + y^2}{s}\right) + b * \exp\left(-\frac{(x+h)^2 + y^2}{s}\right)$$

$$f(x,y,z) = a * \exp\left(-\frac{(x-h)^2 + y^2 + z^2}{s}\right) + b * \exp\left(-\frac{(x+h)^2 + y^2 + z^2}{s}\right)$$

(5) Minimize the following functions (from scipy import optimize)

$$\begin{aligned} f(x) &= 3x^4 + (x-1)^2 \\ f(x) &= x + \cos(x^2) \\ f(x,y) &= (4 - 2.1x^2 + \frac{x^4}{3})x^2 + xy + (4y^2 - 2)y^2 \end{aligned}$$

(6) Use the following function *optimize.curve_fit(func, xdata, ydata, guess)* to fix the functions. Note: First generate a set of points $(xdata, ydata) = (x, f(x) + \eta))$ where η is a gaussian noise.

$$\begin{aligned} f(x) &= ax^2 + bx + c \\ f(x) &= ax^2 + bsin(x) \\ f(x) &= a\exp(-bx) + c \\ y &= ax^3 + bx \\ y &= ax^2 + bx + cexp(x) \end{aligned}$$

Plot the data, the original function and the estimate function.