MA522M-Data Science Programming Laboratory

Exercise-4　　　　　　Duration: 120 Minutes　　　　　　P1 Slot　　　　　　15:00-17:00

17 February 2025　　　　　　　　　　Practical　　　　　　　　　12 Marks, Weight: 3

Answer All Questions. Usage of Internet is Allowed

1. Complete all problems given in the slide　　　　　　　　　　　　　　　　　　[2]

2. Using NumPy Library, compute the following　　　　　　　　　　　　　　　　[3]

   (a) Generate 100 points between 0 and 2π using NumPy and save it in a variable x

   (b) Create a 100×100 matrix A as follows

   $$a_{ij} = rand() + \sin(x[i] + \cos(x[j]))$$

   (c) Compute the determinant of A and eigenvalues of A. Print the largest eigenvalue.

3. Using the SciPy Library, compute the following integral $f(x)$, for the given interval I. You can use trapezoid or quadrature　　　　　　　　　　　　　　　　　　　　　　　[2]

   (a) $f(x) = \exp(-x^2)$, $I = \mathbb{R}$

   (b) $f(x) = x^3 - 2x + 1$, $I = [0, 2]$

4. Using the SymPy Library, complete the following exercises　　　　　　　[1+2+1+1]

   (a) Compute the partial derivatives F_x, F_y, F_{xx}, F_{yy} for the function $F(x, y) = e^y - e^x + xy$

   (b) Find the minimum for the function $f(x, y) = x^2 + y^2 - xy + 3x - 2y + 1$. Hint: Compute derivatives f_x, f_y, and solve the system of equations $f_x = 0, f_y = 0$ and then check whether $f_{xx}f_{yy} - f_{xy}^2 > 0$ and $f_{xx} > 0$ at the solution of the above system.

   (c) Compute the limit of the function $f(x) = \frac{x^2 + 4x - 12}{x^2 - 2x}$ as $x \to 2$

   (d) Compute the following integral

   $$\int_0^\infty e^{-x} dx$$