Laboratory Exercise - 2 : Scientific Computation with Python

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Objective:

1. learn basic command in python.
2. Matrix manipulation and scientific computation using numpy.

Task

1. Create a row and column vector using input method and manually.

2. Create a matrix (5x5) using input method and manually say ”a”.

3. Get 3rd row out of the matrix.

4. Get 4th column out of the matrix.

5. Sort matrix row wise and column wise.

6. Apply for loop in matrix, if element is greater than 2 , multiply element by 10 say it as ”b”.

7. Add matrix a and b.

8. Subtract matrix b from a.

9. Multiply matrix a by b element wise and matrix multiplication.

10. Divide each element of matrix a and b by 18.

11. Find inverse,rank,condition number,singular value decomposition,norm of matrix a and b.

12. Find the norm, inner product and outer product of column vector.

13. Write a function called derivative which takes input parameters f (functionf(x)), a, method (forward,backward and central) and h(step size) (with default values method=’central’ and h=0.01) and returns the corresponding difference formula for derivative of function at a with step size h.
    Test your function on e(x) and cos(x) at x = 0.5.(Formulas are given below)

14. Write a function called trapezoidal which takes input parameters f (function f(x)), a,b (interval of integration) and N(number of subintervals) and returns the approximation Tn(f) .Assign default value N=50.
    Test your function on e(x) and cos(x) with a = 0 , b = 1.57.

15. Write a function called simpson which takes input parameters f(function f(x)) , a ,b (interval of integration) , N(number of subintervals) and returns the approximation Sn(x).Assign a default value N = 50.
    Test your function on e(x) and sin(x) with a = 0 , b = 1.57.

Forward, backward and central differences formulas

Forward Difference $$f'(x_0) \cong \frac{f(x_0+h)-f(x_0)}{h}$$

Backward Difference $$f'(x_0) \cong \frac{f(x_0)-f(x_0-h)}{h}$$

Central Difference $$f'(x_0) \cong \frac{f(x_0+h)-f(x_0-h)}{2h}$$

Trapezoidal Rule

$$\frac{b-a}{2n}[f(a)+2f(x_1)+2f(x_2)+\cdots+2f(x_{n-1})+f(b)]$$

Simpson 1/3rd rule

$$\int_a^b f(x)\,dx \approx \frac{h}{3}\sum_{j=1}^{n/2}\left[f(x_{2j-2})+4f(x_{2j-1})+f(x_{2j})\right]$$

$$= \frac{h}{3}\left[f(x_0)+2\sum_{j=1}^{n/2-1}f(x_{2j})+4\sum_{j=1}^{n/2}f(x_{2j-1})+f(x_n)\right]$$