RUNGE KUTTA 4th order IMPLEMENTATION IN PYTHON

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ASSIGNMENT 9

NUMERICAL METHODS (CS-406)

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def runge\_kutta(*f*, *x0*, *y0*, *xf*, *h*):

    # Initialize x and y lists with initial values

    x\_list = [x0]

    y\_list = [y0]

    # Loop until final value of x is reached

    while x0 < xf:

        # Calculate k1, k2, k3, k4 using the 4th order Runge-Kutta method

        k1 = h \* f(x0, y0)

        k2 = h \* f(x0 + h/2, y0 + k1/2)

        k3 = h \* f(x0 + h/2, y0 + k2/2)

        k4 = h \* f(x0 + h, y0 + k3)

        # Calculate the next value of y using the weighted sum of k1, k2, k3, k4

        y\_next = y0 + (k1 + 2\*k2 + 2\*k3 + k4) / 6

        # Update x, y and append them to the respective lists

        x0 += h

        y0 = y\_next

        x\_list.append(x0)

        y\_list.append(y\_next)

    # Return the x and y lists

    return x\_list, y\_list

# Get input from the user

ode\_eqn = input("Enter the differential equation in terms of x and y: ")

y0 = *float*(input("Enter the initial value of y: "))

x0 = *float*(input("Enter the initial value of x: "))

xf = *float*(input("Enter the final value of x: "))

h = *float*(input("Enter the step size: "))

# Define the function f(x, y) from the input equation

f = lambda *x*, *y*: eval(ode\_eqn)

# Compute the numerical solution using the 4th order Runge-Kutta method

x\_vals, y\_vals = runge\_kutta(f, x0, y0, xf, h)

# Print the results

print("Numerical solution:")

for x, y in zip(x\_vals, y\_vals):

    print(f"x = {x:.2f}, y = {y:.4f}")

SAMPLE OUTPUT

Enter the differential equation in terms of x and y: x+y

Enter the initial value of y: 0

Enter the initial value of x: 0

Enter the final value of x: 1

Enter the step size: 0.1

Numerical solution:

x = 0.00, y = 0.0000

x = 0.10, y = 0.0052

x = 0.20, y = 0.0214

x = 0.30, y = 0.0499

x = 0.40, y = 0.0918

x = 0.50, y = 0.1487

x = 0.60, y = 0.2221

x = 0.70, y = 0.3138

x = 0.80, y = 0.4255

x = 0.90, y = 0.5596

x = 1.00, y = 0.7183

x = 1.10, y = 0.9042