

Laboratory Assignment 7
PH 508 NUMERICAL METHODS & PROGRAMMING

Problem 1 Write a program to solve the differential equations by

1. Euler method
2. Runge-Kutta second order
3. Runge-Kutta fourth order
4. Adam-Moulton Predictor-Corrector formula

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Problem 2 Show that the polynomial of degree 3 passing through the data set

$$\begin{array}{cccc} 0 & -h & -2h & -3h \\ f_3 & f_2 & f_1 & f_0 \end{array}$$

is given by

$$f(x) = f_3 + \frac{1}{6} \frac{9f_1 + 11f_3 - 18f_2 - 2f_0}{h} x + \frac{1}{2} \frac{4f_1 + 2f_3 - 5f_2 - f_0}{h^2} x^2 + \frac{1}{6} \frac{3f_1 + f_3 - 3f_2 - f_0}{h^3} x^3$$

Problem 3 Using the polynomial $f(x)$ in the previous problem, obtain the Adams multistep formula

$$\begin{aligned} y_4 &= y_3 + \int_0^h f(x) dx \\ y_4 &= y_3 + \frac{h}{24} (55f_3 - 59hf_2 + 37hf_1 - 9hf_0). \end{aligned} \tag{1}$$

Problem 4 Write a program to solve the differential equation

$$\begin{aligned} \frac{dy}{dx} &= x + y \\ y(0) &= 1. \end{aligned}$$

Choose the step size $h = 0.01$. Obtain $y(1)$ using the programs written above for various methods. Tabulate results and compare the accuracy with the exact solution.