Computational Homework 2, due Monday, 23rd February

Consider the following initial value problems:

$$(1) \qquad \begin{aligned} \frac{dy}{dt} &= -30y, \ \ 0 \le t \le 1 \\ y(0) &= 1. \end{aligned}$$

$$(2) \qquad \begin{aligned} \frac{dy}{dt} &= 1 + \frac{y}{t}, \ \ 1 \le t \le 2 \\ y(1) &= 2. \end{aligned}$$

i. Numerically determine for which values of $h > 0$ is Euler's method unstable when applied to the i.v.p (1). Compare the values of h with the interval of stability estimate.

ii. Use the Adams-Bashforth fourth-order method to solve the initial value problem (2) using $h = 0.1$ amd $h = 0.01$. Computing the starting values, $w_0, w_1, w_2,$ and w_3, using the Runge-Kutta fourth-order method. The true solution is $y(t) = t \log t + 2t$. Compare your numerical results with the approximation using Runge-Kutta fourth-order scheme and with the true solution.

iii. Implement the Adams Fourth-Order Predictor-Corrector algorithm by solving the initial value problem (2). Compare your results with those approximations in problem ii.

Note: Plot the necessary graphs for each problem.