MA448 – Classwork #1
Numerical Methods for Initial Value Problems

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1. Modify your Matlab/Python code from Classwork 0 to implement Euler's method, the improved Euler's method, the second-order Taylor method and the fourth-order Taylor method on the initial value problem.

$$\frac{dy}{dt} = 1 + \frac{y}{t} \quad (1 \le t \le 6), \quad y(1) = 1$$

Exact solution: $y = t + t \ln t$

2. Compare the performance of each method.

   (1) Run your code with a fixed step-size $dt = 0.125$ and observe accuracy in the final value $y(6)$ from each method and plot (in a single window)

   (2) Run your codes with stepsize $dt = 1/2^n$ for $n = 1, 2, \cdots 15$ and observe the rate of convergence for each scheme and plot (in a single window)

   (3) Plot the error graph $(t_n, |y(t_n) - Y_n|)$ using Euler's method with $dt = 0.125$, improved Euler and second-order Taylor with $dt = 0.25$ and Fourth order Taylor with $dt = 0.5$.

3. Submit your code and the graphical output thru your course Canvas.