

# Math 269A: Assignment 2

Assigned Monday Oct 15, due Monday Oct 22

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## Theory

[1] Prove convergence for the trapezoidal method by modifying the proof from class for the forward Euler method.

[2] Find the solution for the ODE, for general initial data:

$$\begin{aligned}\frac{dy}{dt} &= -100(y - \sin t) + \cos t \\ y(0) &= y_0\end{aligned}$$

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## Computation

[3](a) Implement the backward Euler methods and the trapezoidal method to solve

$$\begin{aligned}\frac{dy}{dt} &= -100(y - \sin t) + \cos t \\ y(0) &= y_0\end{aligned}$$

on the interval  $0 \leq t \leq \pi$  with  $dt = \pi / N$ .

(b) Apply your program and graph the solution and the error, for  $y_0 = 0$  and for  $N=20,40,80$ . Use the results to show that the Trapezoidal method is 2<sup>nd</sup> order, while the backward Euler method is 1<sup>st</sup> order.

(c) Apply your program and graph the solution and the error, for  $y_0 = 1$  and for  $N=20,40,80$ . Which method is more accurate?

**Note:** Perform this by modifying the following functions, which are written for forward and backward Euler. Please name the files BEulerTrap.m and TrapInv.m.

[FBEulerStiff.m](#)

[BEInv.m](#)

[G.m](#)

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## What You Should Turn In

- Answers to the theoretical problems.
- The graphs and answers to the computational problem **3(b)** and **3(c)** and a listing of your Matlab program.