Numerical Methods for the Solution of Differential Equations (AM 213B)
Homework 4 - grading form

Name: Dante Buhl

Final score: write your final score here, for instance, 93/100.

Point allocation explanation

Question 1 (20/20 points):

a) The same result is obtained in the work (that is consistent with order 1 in time and order 2 in space). The result shown is obtained using taylor expansions however the exact expansions used are not explicitly shown except after substitution.

b) Using the Von Neumann Stability theory, the same result is obtained which shows the eigenvalues of $\boldsymbol{G}$ being less than 1 in absolute magnitude.

Question 2 (30/30 points):

a) Student successfully proves through two bouts of integration that the value of the integral is conserved in time.

b) Plots obtained are identical except for the variation in plotting method. (Mine just shows the contour lines where Daniele's shows a filled in plot)

Question 3 (50/50 points):

a) Plots are similar with an exeptiopn of what seems to be small errors present in Daniele's finite difference scheme. Mine is slightly different and enforces periodicity in the differentiation matrix rather than overly in the timestepping scheme. Thus I am able to get a plot which looks better and only used N gridpoints (as opposed to N+2 as assignment instructed).

b) Plot of the integral value of the finite difference scheme behaves as expected and remains constant at 1.

c) The maximum pointwise error plot while having slightly different magnitudes of error has the same general trend in time.

d) Though I claimed that the scheme's mean squared error decayed quadratically, after doing some more analysis on the plotted line, it seems that the decay is closer to order 3 or order 4. This is obtained by actually fitting a slope to the line in log-log space. This is futher abetted by the fact that the error decay in Daniele's plot seems to be steeper than an order 2 convergence suggesting that his plot is actually order 3 or 4 as well. Note that I forgot to produce a log log plot on my actual assignment, so I've attached a log log plot of the same data here. (See Figure 1).
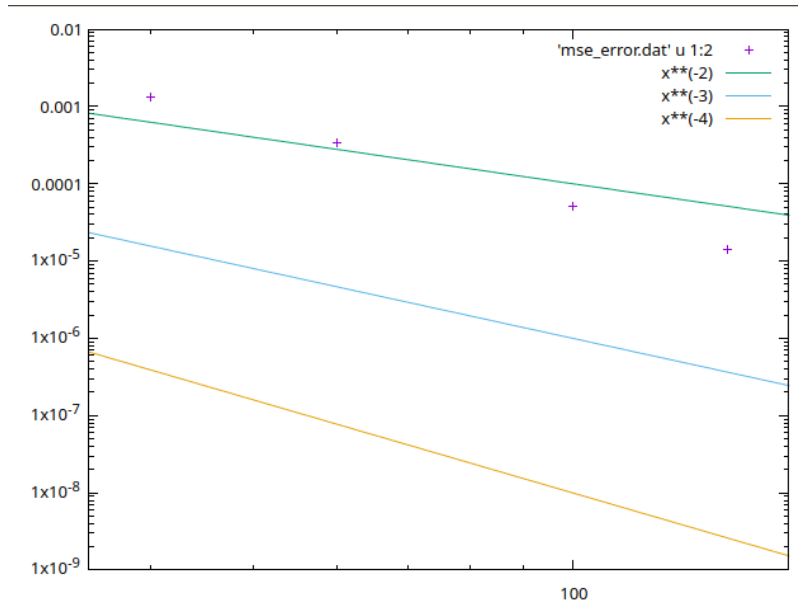
Figure 1: Updated MSE on a log-log plot with order 2, 3, and 4 convergence for comparison.