Math 269A: Assignment 6

Assigned Friday Nov 16, due Monday November 26

Theory

[1] For the Adams-Bashforth (i.e., explicit Adams) method, derive the formulas on page 126 of Ascher & Petzold for coefficient β_j and γ_j, using divided difference interpolation formulas. The relevant interpolation polynomial has time running backwards; i.e.,

$$\phi(t) = f[t_l] + f[t_l, t_{l-1}](t - t_l) + \ldots + f[t_l, t_{l-1}, \ldots, t_{l-k}](t - t_l)(t - t_{l-1})\ldots(t - t_{l-k+1}).$$

Apply integration to φ to get the formulas.

Computation

[2] Implement 4th order (i.e. p=4) Adams-Bashforth and Adams-Molton for the nonlinear equation

$$y' = -(y^2 - \sin^2 t) + \cos t$$

using Newton's method to solve the resulting nonlinear equations (note that this is the same ODE as in HW5, but not stiff). Do this for initial data y(0) = 0, for which the solution is y = sin t. Use this knowledge to prescribe the values for the few timesteps (alternatively, you could use RK4 to supply these values). Also use the time interval $[0,\pi]$ and time step h =0.1 and 0.01. Plot the resulting solutions.

What You Should Turn In

- Answers to the theoretical problems.
- A printout of the code and the graphs for the computational problems.