

*Computational Physics*  
Spring 2014, Shoemaker  
Homework 2 (Due date March 7 end of day)

Email homework as an attachment to ([deirdre@gatech.edu](mailto:deirdre@gatech.edu) and [kjani3@gatech.edu](mailto:kjani3@gatech.edu)). Include a **README** file that lists the files included with a short description (e.g. programs, plots, etc).

Your homework will be to finish the in-class work on **pendulum.m**. Specifically, produce a program that solves the non-linear pendulum as discussed in class. Your code must

1. take as user input on the command line or as an input file `theta0`, `omega0`, `tmax`, `level`
2. solve the non-linear pendulum for a set of first-order ODEs,
3. implement THREE methods: Euler, Runge-Kutta 2 and Runge-Kutta 4 for solving the ODEs,
4. run the code for several values of `tmax`, for each ODE method - what is the maximum `tmax` that you could run before errors began to accumulate?
5. using a reasonable value of `tmax`, compare your result for the linear-case (i.e. when `theta` is very small) again the linear solution in the lecture notes
6. using a reasonable value of `tmax`, conduct a convergence test over three grids (fine, medium and coarse) for all three methods and plot the result versus time,

$$\frac{\theta_\ell(t) - \theta_{\ell+1}(t)}{\theta_{\ell+1}(t) - \theta_{\ell+2}(t)}$$

7. finally, discuss your results (convergence tests, linear test).