10920ASTR660000
Computational Astrophysics
計算天文物理

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Due in class: 2020.03.04
(submit to google classroom)

Problem Set 1

Reading Assignments

1. Learn the Command Line: Bash Scripting
   (https://www.codecademy.com/learn/bash-scripting)

2. Read the article "Computational Astrophysics: The New Astronomy for the 21st Century" (http://adsabs.harvard.edu/abs/1997ASPC..123....3N).

3. Read the first chapter of the "Scientific Computing: An Introductory Survey"
   (https://books.google.com.tw/books?id=f6Z8DwAAQBAJ)

Written Assignments

1. You wanna be the best angry bird player. For a given initial velocity, which inclination angle can you fire an angry bird on the ground the furthest? Please write down your assumptions, approximations and possible errors.

2. Suppose we want a simple approximation to the cosine function $y = f(x) = \cos(x)$ for $x = 1$. The cosine function is given by the infinite series

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + ..., \tag{1}$$

so we might consider truncating the series after, say, two terms to get the approximation.

$$\hat{y} = \hat{f}(x) = 1 - \frac{x^2}{2}, \tag{2}$$

What are the forward error, backward error, and condition number for $x = 1$.

3. If you want to simulate all stars in our Milky Way at once, how much of memory do you need in your computer? Assuming that you want to store at least 10 variables of each star (a tag of the star, the positions, velocities, and accelerations in each spacial dimension), all stars have to be stored in memory in order to calculate the forces, and there are 250 billion stars in our Milky Way.

Programming Assignments

1. Write a bash script to prompt the branch name of your current git repo, assuming the current path is tracked by git.

2. Make sure you have installed the GNU compilers (`gcc`, `gfortran`, and g++) on your machine. What are the screen outputs when you type "`which gcc`", "`which gfortran`", "`gfortran -v`", and "`gcc -v`"? Do they have the same version?

3. Make sure you have installed `Python` (version 3) on your machine. What is the screen output when you type "`python --version`"?

4. Install JupyterLab with conda by "`conda install -c conda-forge jupyterlab`". What is the screen output when you type "`jupyter notebook --version`"?

5. Install `gnuplot` in your system. Use the command "`plot sin(x)`" to make a simple plot of a sine function. Add labels and a legend in your plot. You could save your plot to images by typing "`set term png`", "`set out "myplot.png"`", and then "`replot`".