PROBLEM SET 5 Due Friday October 28

Physics 115B– FALL 2011

This will be the last problem set before the Midterm Exam on Wednesday November 2.

Analytic:

[1.] Griffiths Problem 4.18

[2.] Griffiths Problem 4.19

[3.] Griffiths Problem 4.22

[4.] Griffiths Problem 4.24

[5.] Griffiths Problem 4.27

Comment: For the first part of the course, as you develop skill in programming, the computational problems will not necessarily have anything to do with quantum mechanics.

[6.] Write a C or C++ program to solve the discretized diffusion equation. One approach is to use two one dimensional arrays. First have a loop which gets the new density rhonew,

$$\text{rhonew}[n] = \text{rho}[n] + \frac{Ddt}{dx^2}\big(\,\text{rho}[n+1] - 2\,\text{rho}[n] + \text{rho}[n-1]\,\big)$$

Then follow it with a loop which resets the density to these newly computed values.

$$\text{rho}[n] = \text{rhonew}[n]$$

These loops (over n) need themselves to be enclosed by a loop which iterates over some number of time steps: "nested loops". Alternatively you could use a two dimensional array,

$$\text{rhonew}[n][m+1] = \text{rho}[n][m] + \frac{Ddt}{dx^2}\big(\,\text{rho}[n+1][m] - 2\,\text{rho}[n][m] - \text{rho}[n-1][m]\,\big)$$

(Here m is the time index.) What are the advantages/disadvantages of the two approaches?

[7.] So far in class we have not discussed the feasibility of numerical calculations. How can you estimate whether a calculation will be doable? A good crude approach is to think that the clock speed of the chip in your computer (about one GHz) means that the compute can do 10^9 operations (addition, subtraction, $\cdots$) per second. How long should your Kepler problem have taken to execute? Suppose you want to simulate the motion of 10^{11} stars in a galaxy with molecular dynamics. Could your computer do that problem? (How many time steps do you want to do?) If you can't simulate 10^{11} stars, how many could you study? (How long are you willing to run your computer? Will you use a super-computer with 10^5 processors? A petascale computer is described here: http://en.wikipedia.org/wiki/Blue_Waters).