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,

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

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

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

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,

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

(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, \(\ldots\)) 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).