Homework Assignment 4

Due: Sunday October 11, 11:59 pm, UBlearns Digitial Dropbox

PHY 410: choose any two problems. **PHY 505: work all three problems**

1. Use `http://www.physics.buffalo.edu/phy410-505/topic2/dla.cpp` to measure the fractal dimension of DLA clusters. Generate a large sample of clusters with some fixed number of occupied sites. Compute the average mass (number of particles) inside a circle of radius r centered on the seed particle. Plot mass inside $m(r)$ versus radius and determine the fractal dimension by fitting your data. Compare your result with that of Witten and Sander `http://link.aps.org/doi/10.1103/PhysRevLett.47.1400`.

   `http://www.physics.buffalo.edu/phy410-505/topic2/lec-2-4.pdf`

2. Adapt the neutron transport code to model the diffusion of photons through the radiation layer of the Sun. You can model the Sun as a two dimensional circle so that code does not need to be generalized to three dimensions. From NASA's Solar website `http://solarscience.msfc.nasa.gov/interior.shtml`, choose reasonable values for the simulation parameters. Run the Monte Carlo to compute the average time it takes for a photon to diffuse through the radiation layer. Hint: It takes a photon a long time to get through the layer, so start with a scaled-down model, figure how the time depends on the scale factor, and then scale up to the real thing.

   `http://www.physics.buffalo.edu/phy410-505/topic2/lec-2-5.pdf`

3. Write a program to generate the normal Gaussian distribution

$$P(x) = \frac{e^{-x^2/2}}{\sqrt{2\pi}} \tag{1}$$

   using two algorithms, the Box-Muller change of variable algorithm, and the Metropolis algorithm. Compare the efficiencies of the two algorithms by measuring their rates of convergence to $P(x)$ as functions of the number of random deviates used.

   `http://www.physics.buffalo.edu/phy410-505/topic2/lec-2-6.pdf`