Physics 4488/6562: Statistical Mechanics
http://www.physics.cornell.edu/sethna/teaching/562/
Material for Week 2
Exercises due Monday Feb 4
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Monday
   In-class question: 2.2 Photon diffusion in the Sun

Wednesday
   Read: Read: Chapter 2, Sec. 2.3 (Currents and forces)
   Pre-class question: 2.17 Local conservation
   In-class question: 2.15 Modified diffusion

Friday
   Read: Chapter 2, Sec. 2.4 (Solving: Fourier & Green)
   Pre-class question: 2.18 Absorbing boundary conditions
   In-class question: 2.6 Fourier and Green

Monday
   Read: Chapter 3, Sec. 3.1 (Microcanonical) and 3.2 (Ideal Gas)
   Pre-class question: 3.13 Weirdness in high dimensions

Supplement
   In-class question: 2.16 Density dependent diffusion

Exercises

Those in 4488 may choose one of the three exercises (plus Monday’s pre-class).

2.5 Generating random walks. (Hints are available in Python and Mathematica at http://pages.physics.cornell.edu/~sethna/StatMech/ComputerExercises.html.)

8.4 Red and green bacteria. Analyze the system as a random walk in the number of red bacteria. Full credit for sensible arguments that get within a factor of two of the right answer. (Assigned to me for my qualifying exam at Princeton.)

Class choose one

2.11 Stocks, volatility, and diversification. Stock prices are pretty well approximated as random walks, but have ‘fat tails’. (Hints are available in Python and Mathematica at http://pages.physics.cornell.edu/~sethna/StatMech/ComputerExercises.html.)
2.21 *Random walks, generating functions, and diffusion.* One can efficiently work with infinite series using generating functions. Here we consider the $f_t$, the probability that a random walk of length $t$ returns to the origin.

2.20 *Continuous time random walks: Ballistic to diffusive transition.* At short times (before the first collision), gas molecules and other diffusing particles typically move in straight lines, *ballistically*. This exercise discusses how the average behavior changes from straight-line to diffusive.

12.21 *Diffusion equation and universal scaling functions.* The diffusion equation takes the same form as the universal scaling functions we shall discuss in Chapter 12, derived using the renormalization group. You will at least need to read some of that chapter to find out what ‘relevant’, ‘marginal’, and ‘irrelevant’ mean. You’ll want to also read to find out why universal scaling functions and power laws are important.