Material for Week 2

Physics 4488/6562: Statistical Mechanics

http://www.physics.cornell.edu/sethna/teaching/562/

Exercises due Mon. Feb 22

Last correction at January 7, 2021, 1:25 pm

All exercises are from the second edition of the text: http://pages.physics.cornell.edu/∼sethna/StatMech/EntropyOrderParametersComplexity20.pdf

Monday

In-class question: 2.15 *Diffusion of nonconserved particles*

In-class question: 2.16 *Density dependent diffusion*

Wednesday

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*

Friday

Read: Chapter 3, Sec. 3.1 (Microcanonical) and 3.2 (Ideal Gas)

Pre-class question: 3.13 *Weirdness in high dimensions*

In-class question: 3.1 *Temperature and energy*

In-class question: 3.2 *Large and very large numbers*

In-class question: 3.10 *Triple product relation*

Monday

Read: Chapter 3, Sec. 3.3 (Temperature) and 3.4 (Pressure & Chemical Potential; 3.4.1 is optional), Sec. 3.5 (Entropy & fussy stuff).

Pre-class question: 3.16 *Taste, smell, and* μ

Exercises for everyone (4488 and 6562)

2.5 *Generating random walks.* Hints are available in Python, Mathematica, and Matlab at http://pages.physics.cornell.edu/~sethna/StatMech/EOPCHintsAndMaterials.html or http://www.lassp.cornell.edu/sethna/StatMech/EOPCHintsAndMaterials.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.)

2.11 *Stocks, volatility, and diversification.* Stock prices are pretty well approximated as random walks, but have 'fat tails'. Hints are available in Python, Mathematica, and Matlab at http://pages.physics.cornell.edu/~sethna/StatMech/EOPCHintsAndMaterials.html or http://www.lassp.cornell.edu/sethna/StatMech/EOPCHintsAndMaterials.html

Exercises for Graduate Course (6562 only)

2.20 *Flocking.* Animal migration as a random walk in orientation space.

2.19 *Run & tumble.* Here we study the eating strategies of bacteria. When to sit and wait for food to come by? How long to keep swimming, and when to turn?