Material for Week 5

Physics 4488/6562: Statistical Mechanics

https://sethna.lassp.cornell.edu/Teaching/562/

Exercises due Mon. Feb 24

Last correction at January 16, 2025, 6:35 pm

The exercises with numbers N1.xxx are to be found in https://sethna.lassp.cornell.edu/StatMech/SethnaExercises.pdf

Wednesday

In-class question: 5.10 *Entropy increases: diffusion*

In-class question: 5.15 *Shannon entropy*

Friday

Read: Chapter 6, Sec. 6.1 (Canonical Ensemble), 6.2 (Uncoupled Systems), and 6.3 (Grand canonical ensemble)

Pre-class question: 5.14 *Information entropy*

In-class question: 6.18 *Langevin dynamics*

Monday

Read: Chapter 6, Sec. 6.4 (What is thermodynamics?) and 6.5 (Mechanics: friction and fluctuations)

Pre-class question: 6.16 *Rubber band free energy*

Assigned exercise for everyone

6.8 *Euler.* **Do part (a) only.** $E - TS + PV - \mu N$ is *not* another free energy.

Special topic exercises (6562 do one; 4488 do 7 during 14 weeks)

N1.20 *Zeros in a byte.* (Computer Science) Test your wisdom about information entropy.

N1.11 *Entropy of Mastermind*^{TM}. Inspired by Wordle, entropic strategy in a guessing game.

6.3 *Negative temperature.* Temperature can be negative in the microcanonical ensemble. See how it compares to the canonical ensemble.

5.21 *Data compression.* Using compression algorithms to estimate entropy. Contrast png, giv, gzip, & entropy using the Ising model.

5.24 *Nucleosynthesis and the arrow of time.* (Astrophysics) How we understand why the stars can shine and the arrow of time. Treat the expanding Universa as a piston.

5.26 *Phase conjugate mirror.* Entropy tells us you can't see through a cloud. But you can pass the light back through the cloud and reconstruct the image! When the entropy increases depends on what you keep track of. It's ignorance that matters.

5.17 *Deriving entropy.* (Mathematics) How Shannon's entropy uniquely satisfies our three key properties.