

## *PY 541 Problem Set 4: HW Exercises Due on Oct. 13th*

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*October 6, 2022*

Read the assigned material before class. Pre-class questions are due midnight the night before before Tuesday and Thursday classes and noon on Wednesdays when homeworks are not due (usually Thursdays), and otherwise should be turned in with the homeworks.

Welcome to PY 541 Statistical Physics. This is a graduate course that assumes you have taken an undergrad course on these topics (e.g. Thermal Physics, Statistical Physics, etc.). It also assumes some basic familiarity with core mathematical areas: probability, linear algebra, vector calculus as well as rudimentary programming skills (Python, Mathematica, etc). If you do not feel comfortable with these concepts, please come talk to me.

All exercises are from the second edition of Jim Sethna's book available at:

<https://www.lassp.cornell.edu/sethna/StatMech/index.html>.

There are also hints and code for computational exercises at this website.

### *Readings and Pre-class questions*

#### **Wednesday:**

Read: Chapter 5

Pre-class question: MacKay Problem 4.1

In-class: Discussion of Mutual Information.

#### **Thursday:**

Read: Rest of chapter 5.

In-class: Guest lecture by Anatoli Polkovnikov.

### *Homework Exercises*

All hints are available at: <https://www.lassp.cornell.edu/sethna/StatMech/EOPCHintsAndMaterials.html> or ask me directly.

1. 5.2 Information Engines
2. 5.7 Does entropy increase? (short introduction to conceptual problem)
3. 5.10 Diffusion Entropy. Please also add a few sentences with your take on how to reconcile answers to 5.7 and 5.10. <sup>1</sup>

<sup>1</sup> I actually don't have a precise answer (and I think neither does anyone else). In the quantum setting, Anatoli provided the answer in 2011 with the idea of diagonal entropy in this paper: "Microscopic diagonal entropy and its connection to basic thermodynamic relations." *Annals of Physics* 326.2 (2011): 486-499. I asked Anatoli and no-one knows how to translate this classical setting in a precise way though we do have some intuition. We are starting to

*Honor Code*

All students are expected to follow the [BU Honor Code](#). While collaboration is allowed and encouraged on HWs, each student should write up their own solutions. Copying HW is strictly forbidden. The students are allowed to consult all resources and books. However, students are NOT allowed to consult problem solutions from previous years or as found on the web.