

Material for Week 13

Physics 4488/6562: Statistical Mechanics

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

Exercises due Mon. May 01

Last correction at December 22, 2022, 2:10 pm

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For Wednesday's pre-class question, do part (a) only. We'll do the other parts in class.

Monday

In-class question: [12.1](#) *Ising self-similarity*

In-class question: [12.15](#) *Hearing chaos*

In-class question: [12.14](#) *Crackling noises*

Wednesday

Read: Chapter 12, Sec. 12.1 (Universality)

Pre-class question: [12.7](#) *Renormalization-group trajectories*

In-class question: [12.7](#) *Renormalization-group trajectories*

Friday

Read: Chapter 12, Sec. 12.2 (Scale Invariance)

Pre-class question: [12.3](#) *Scaling and coarsening*

In-class question: [12.8](#) *Superconductivity and the renormalization group*

Monday

Read: Chapter 12, Sec. 12.3 (Examples of critical points)

Pre-class question: [12.16](#) *Period doubling and the onset of chaos*

Exercises for everyone

- [12.11](#) *RG and the central limit theorem: long.* (Mathematics) Remember random walks produce Gaussians? Here's an RG derivation.

Select one (4488) or two (6562)

- [12.9](#) *Period doubling and the RG.* Recommended if you haven't seen it. (Mathematics, Complexity, Computation, Dynamical systems) The onset of chaos and the RG. Hints at <https://sethna.lassp.cornell.edu/StatMech/EOPCHintsAndMaterials.html>
- [12.18](#) *Random walks and universal exponents.* If a wiggly polymer cannot cross itself, when can we view it as a random walk?
- [12.4](#) *Bifurcation theory.* (Dynamical systems) Universality classes for differential equations.
- [12.5](#) *Mean-field theory.* (Condensed-matter) Assuming a spin feels the average magnetization of its neighbors gives the correct exponents above four dimensions. See also 12.26 and 12.27.
- [12.26](#) *Ising mean field derivation.* and 12.27 Mean-field bound for the free energy (Mathematics), gives Gibbs, Bogoliubov, and Feynman's rigorous mean-field bound for the free energy.
- [12.28](#) *Avalanche size distribution.* Deriving the mean-field avalanche size distribution.
- [12.31](#) *Singular corrections to scaling.* Irrelevant directions in the RG lead to new exponents.