PHYSICS 212 Final Paper Proposal

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I would like to follow a mixture of #4 and #5 of the suggested paper topics. I would like to

- Study the Monte Carlo Renormalization Group (MCRG) and understand how it works.
- Write an implementation of MCRG for the Ising Model on a 2D square lattice, find the critical exponents, and compare my results to original work in literature[6].
- Write an implementation of MCRG for the $O(3)$ Heisenberg model on a 2D square lattice and reproduce various results in original work in literature[5]. Confirm the model does not have a phase transition.

So far I have found: earliest formulation of MCRG by Ma[4]; reviews of the methodology and results of MCRG by Gupta[1, 2]; two descriptions of MCRG by Swendsen[7, 8]. Textbook by Binder[3] provide general background on Monte Carlo methods applied to statistical physics problems and a modern perspective on MCRG.

References

[1] R. Gupta, *Monte Carlo Renormalization Group: A Review*, Springer US, Boston, MA, 1986, pp. 37–65.

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[3] D. P. Landau and K. Binder, *Monte Carlo renormalization group methods*, Cambridge University Press, 4 ed., 2014, p. 364–377.

[4] S.-k. Ma, *Renormalization group by monte carlo methods*, Phys. Rev. Lett., 37 (1976), pp. 461–464.

[5] S. H. Shenker and J. Tobochnik, *Monte carlo renormalization-group analysis of the classical heisenberg model in two dimensions*, Phys. Rev. B, 22 (1980), pp. 4462–4472.

[6] R. H. Swendsen, *Monte carlo renormalization group*, Phys. Rev. Lett., 42 (1979), pp. 859–861.

[7] R. H. Swendsen, *Monte carlo renormalization-group studies of critical phenomena*, Journal of Applied Physics, 53 (1982), pp. 1920–1924.

[8] R. H. Swendsen, *Monte carlo renormalization group*, Journal of Statistical Physics, 34 (1984), pp. 963–973.