PHY566 Group Project #2 (version A)

Due Date: April 8th, 10:00am via Sakai

Percolation

1. Write a program to simulate the percolation transition on a $N \times N$ lattice by subsequently (randomly) filling lattice sites corresponding to an increase in occupation probability, p.

   a) Determine the critical probability p_c by checking, after each new entry, for the appearance of a spanning cluster, and plot the latter when it first appears (once for each value of N). Repeat this procedure for $N = 5, 10, 15, 20, 30, 50, 80$ using an average over 50 simulations for each N and plot $p_c(N^{-1})$ to extrapolate to the infinite size limit $p_c(0)$. [25 points]

   b) For a fixed lattice size of $N = 100$, compute the fraction

   $$F(p > p_c) = \frac{\text{no. of sites in spanning cluster}}{\text{no. of occupied sites}} \tag{1}$$

   as a function of p above the critical p_c. Average your results for each p over 50 simulations. Fit your results to a power-law ansatz

   $$F = F_0(p - p_c)^\beta \tag{2}$$

   by plotting the logarithm of both sides and extracting the slope of a straight-line fit (note that the power-law only applies for p not "too far" above p_c). [25 points]

Your homework submission should consist of:

- a public Github account, containing the code and revision history for all codes developed in this project. You need to invite the instructor (Github account: `sabass`) to become a member of your repository.
- a document outlining the problem, detailing your solution and discussion of your results - the document should include the requested figures. The document should be in pdf format
- the source code of your program should be downloadable from the Github account - do not submit the code via Sakai, but provide a link to your repository in your document.
- a group presentation to be given in class