Exercise 1

Introduction to Macromolecular Physics

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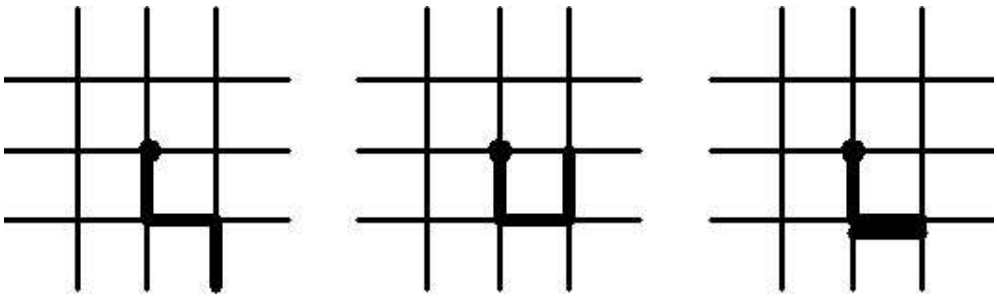
Problem 1: A Polymer Model on a Square Lattice

For better understanding of some of the definitions we consider a very simple 'polymer': it consists of only 2, 3 or 4 monomers and is drawn on a square lattice. The length a of the monomer is set to 1. In this case one can draw explicitly the conformations of this model-polymer. It is best to use a checkered paper.

1. Try to sketch all possible configurations for N=3, assuming the model chain is an *ideal* chain.
   Hint: Start with $N = 1$ and draw all possible variations. Next, draw the configurations with $N = 2$. For $N = 3$ it is enough to draw only 1/4 of the possible configurations. The following figure shows three examples.



2. How many configurations W can be found for the model of an ideal chain and how many are left over, if a self avoiding random walk model is used, in which each site can be occupied by one monomer only (an excluded-volume interaction)?

3. Assume the starting point of the chains is at the coordinate (0,0). Mark all positions on the lattice, where the end points of the possible configurations are located.

4. Calculate the mean squared end-to-end distance

$$< R^2 >= \frac{1}{W} \sum_{i=1}^{W} R_i^2$$

   for the ideal chain model and for the excluded volume model.

Happy New Year !