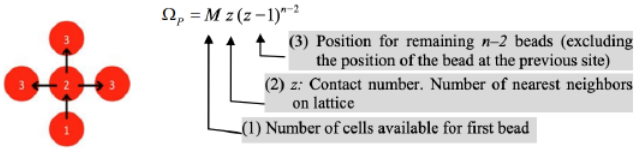
8.1: Entropy of Single Polymer Chain

Entropy of Single Polymer Chain

Calculate the number of ways of placing a single homopolymer chain with n beads on lattice. Place beads by describing the number of ways of adding a bead to the end of a growing chain:



A random walk would correspond to the case where we allow the chain to walk back on itself. Then the expression is $\Omega_P = Mz^{n-1}$

Note the mapping of terms in $\Omega_P = Mz(z-1)^{n-2}$ onto $\Omega_P = \Omega_{trans}\Omega_{rot}\Omega_{conf}$.

$$\text{For } n \to \infty \quad M \gg N \quad \Omega_P \approx M(z-1)^{n-1}$$

$$\begin{aligned} S_p &= k_B \ln \Omega_P \\ &= k_B((n-1)\ln(z-1) + \ln M) \end{aligned}$$

This expression assumes a dilute polymer solution, in which we neglect excluded volume, except for the preceding segment in the continuous chain.