The distribution of last hitting times of self avoiding walks on random networks

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Analytical results will be presented for the paths of self avoiding walks (SAWs) on random networks. Since these walks do not retrace their paths, they effectively delete the nodes they visit, together with their links, thus pruning the network. The walkers hop between neighboring nodes, until they reach a dead-end node (on the yet-unvisited sub-network) from which they cannot proceed.

Focusing on Erdos-Renyi networks we show that the pruned networks maintain a Poisson degree distribution with an average degree that decreases linearly in time. We enumerate the SAW paths of any given length and find that the number of paths increases dramatically as a function of their length. We also obtain analytical results for the distribution of the SAW path lengths for those paths which are actually pursued starting from a random initial node. This length is actually also the time at which the SAW inevitably hits its past trajectory and stops. We therefore refer to this time as the last hitting time - being the latest time at which a random walk can actually avoid itself. It turns out that it follows the Gompertz distribution, which means that the termination probability of an SAW path increases exponentially with its length. The implications of these results to various physical processes and their generalization to a broader class of networks will be discussed.

[1] I. Tishby, O. Biham and E. Katzav, The distribution of path lengths of self avoiding walks on Erdos-Renyi networks, J. Phys. A: Math. Theor. 49 (2016) 285002.