Monte Carlo Simulation

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1 Special Design for the Simulation

1.1 Simulation on the Free Expansion

In C++'s Standard template library, there are 9 predefined random number generators. In each configuration, I randomly choose one of the generators(use the tenth generator '*std* :: *default_random_engine*'), and use the '*std* :: *random_device*' object to set a new seed. The simple method is just reset the seed when entering a new configuration.

1.2 Simulation on the Random Network Growth

Because this 'project' only ask me to show the degree distribution of the final network, I haven't implement the network data structure(e.g. adjacent list, or adjacent matrix). The linked list is used to store the degree of each nodes.

To get the unique n integer, I choose the insertion sort. Using the sort algorithm, I can get the *unique* integers. There are some better sorting algorithm, but the insertion sort is easy to implement(and I don't have much time to implement the quick sort).

2 Result

2.1 Simulation on the Free Expansion

There are 10000 molecules in the left side of the box. Simulate the expansion process for 50000 simulation steps. At the first time I perform 10 configuration runs; The second time, I perform 1000 configuration runs.

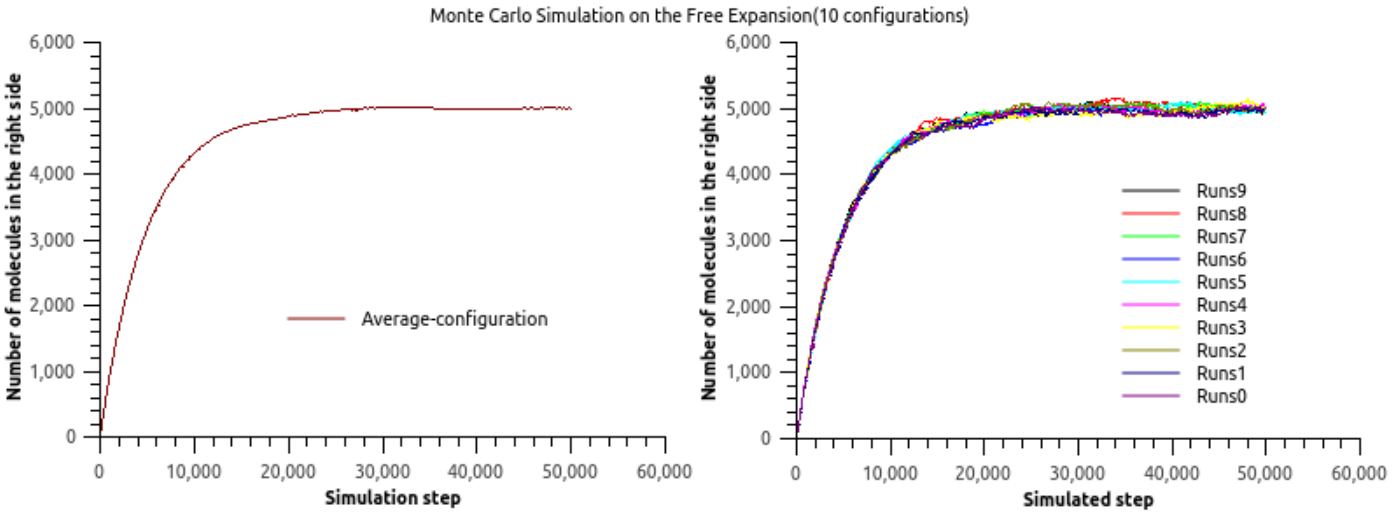

Figure 1: Monte Carlo Simulation on the Free Expansion for only 10 configuration runs. Lift panel shows the average on the 10 runs. The right panel shows all the 10 runs. Each run shows clear fluctuation, and the left panel is smoother.

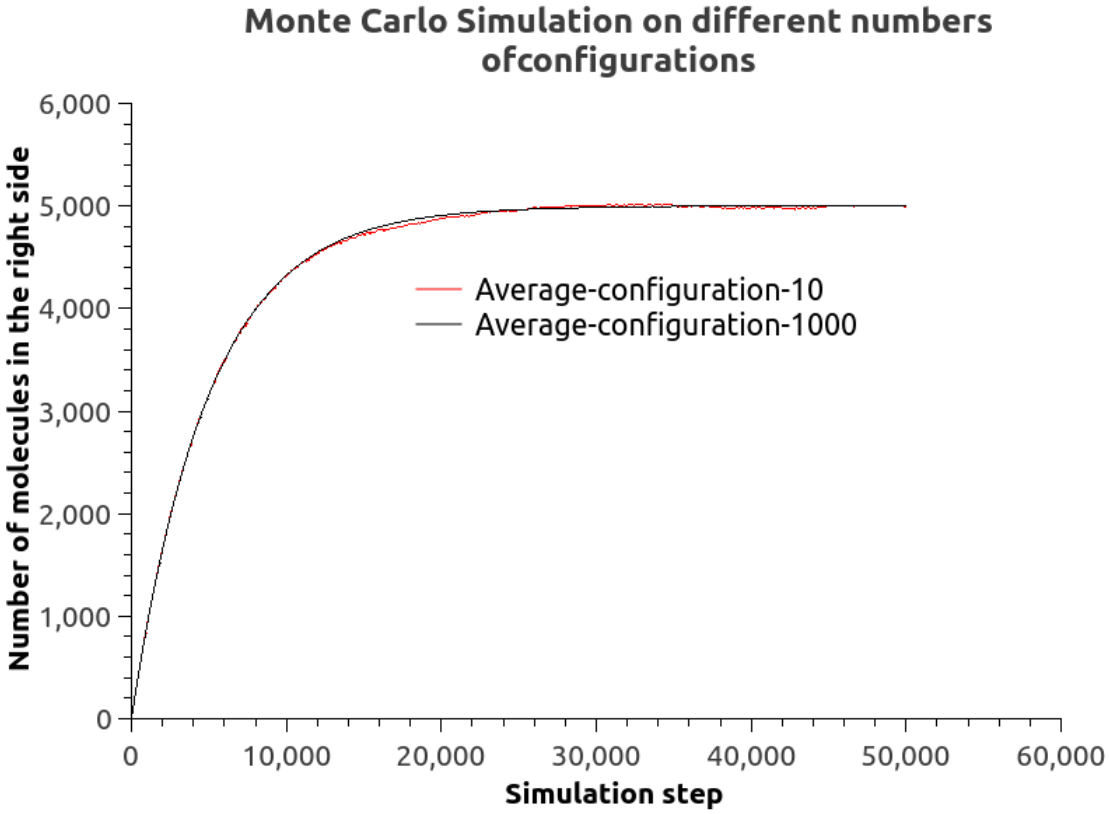

Figure 2: Monte Carlo Simulation on the Free Expansion for 10(red curve) and 1000(black curve) configuration runs. The more configures you run, the smoother the curve is.

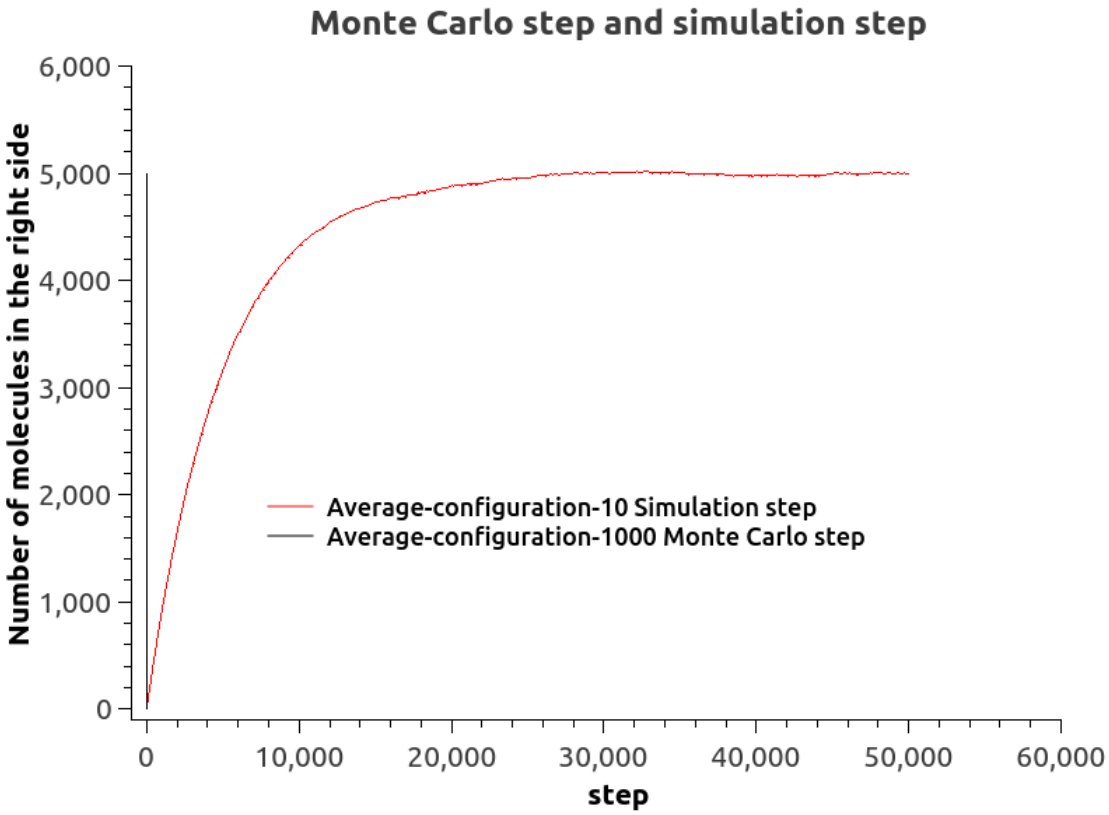

Figure 3: Monte Carlo Simulation on the Free Expansion for 10(red curve) and 1000(black curve) configuration runs. This figure shows the notion of Monte Carlo step per site, see the near vertical black 'curve'.

2.2 Simulation on the Random Network Growth

The number of nodes in the initial fully complete graph is 4; Each time, when a new node join in the network, it choose 4 nodes based on their degree. 10000 growth steps should be run for each configuration.

Because this simulation is time consuming(about 11 minutes one configuration in my computer), I only perform 5 configurations.

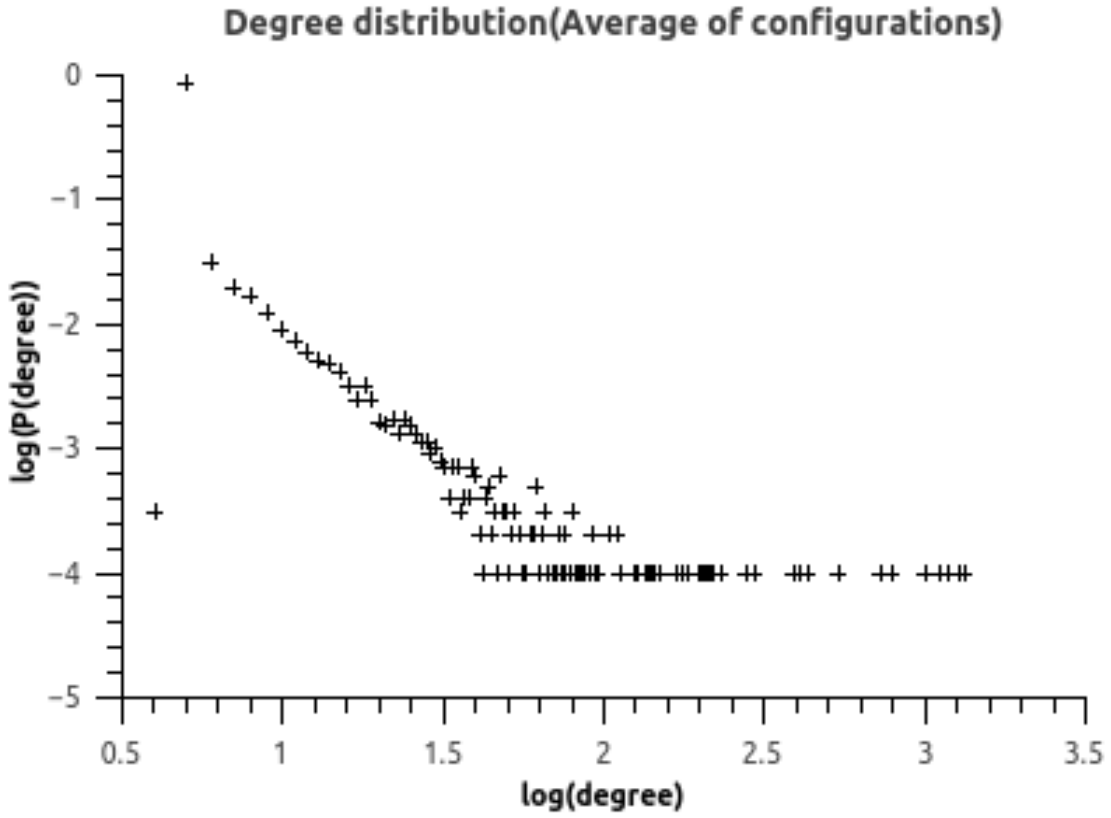

Figure 4: Monte Carlo Simulation on the Network Growth. This is the average case of five configurations.