3. Random Walk in One Dimension

3d. Copy
`~kvollmay/classes.dir/capstone_s2005.dir/random_walks.dir/rand3b.cc`
into your working directory. You will modify this program in 3e. to determine $\langle x\rangle(N)$ and $\langle \Delta x^2\rangle(N)$. Explain what the program `rand3b.cc` does. Make a flow chart of the program.

3e. Get me before you work on this program. Modify `rand3b.cc` such that it stores your sums of x and x^2 in an array to obtain $\langle x\rangle(N)$ and $\langle x^2\rangle(N)$. As result of your program print three columns N, $\langle x\rangle(N)$, and $\langle \Delta x^2\rangle(N)$. Run your program with `executable.out > outfile`. Then look at $\langle x\rangle(N)$ with `xgraph outfile` and look at $\langle \Delta x^2\rangle(N)$ with `gawk '{print $1,$3}' outfile | xgraph` .Does your result agree with the theory?

3f. Repeat 3e but with $P = 0.2$ instead. Does your result agree with the theory?

Fractal Growth: DLA

1. Flow Chart Get together in groups of two and draw the flow chart for the DLA-program. Your flow chart should be for a program which grows a cluster of `NPARTMAX` particles. Which loops do you need? Which decision statements do you need?

2. Random Walk in Two Dimensions Copy
`~kvollmay/classes.dir/capstone_s2005.dir/fractal.dir/DLA2_sample.cc`
into your working directory. Add to the program the random walk step (see "`add here the random walk step in two dimensions (x,y)`"). Print the complete lattice after every random walk step. Look at your result with
`executable.out | DynamicLattice -nx 100 -ny 100 -matrix`.

Fractal Growth: DLA

2. Random Walk in Two Dimensions

Copy
`~kvollmay/classes.dir/capstone_s2005.dir/fractal.dir/DLA2_sample.cc`
into your working directory. Add to the program the random walk step (see "`add here the random walk step in two dimensions (x,y)`"). Look at your result with
`executable.out | DynamicLattice -nx 100 -ny 100 -matrix`.

3. Final DLA Program

Before you work on this part, please get me. Copy
~kvollmay/classes.dir/capstone_s2005.dir/fractal.dir/DLA3_sample.cc
into your working directory. Add to the program the check if your random walker is next to a particle of the cluster. If so then stick the particle to the cluster, stop the random walk, and update the maximum radius of the cluster `Rmax`.
Look at your result with
`executable.out | DynamicLattice -nx 100 -ny 100 -matrix -z 0 2`.
Have fun!
(If time allows, you may continue with your own program from 2. and add to your own program the equivalent lines of lines 33,34,39,40,48-51,62,70.)

Fractal Growth: Fractal Dimension

4. Regular Fractal

Determine the fractal dimension of the Triadic Kochkurve and of the Sierpinński Gasket.

5. Fractal Dimension of DLA Cluster

In the following you will analyze the pattern of the DLA model. You will determine the fractal dimension of one pattern.

5a. To avoid having to run the DLA program again and again, let us first prepare one pattern, which you then will analyze in 5b. Use your solution to the in class work 3. (daily assignment 1. for today) or
˜ kvollmay/classes.dir/capstone_s2005.dir/fractal.dir/DLA3.cc
and change `L` to `L=500`, `NPARTMAX` to `NPARTMAX = 10000`, and comment out the
`# commands` which were for DynamicLattice (pause and string). Print your final pattern only once at the end of the program into a file "bigDLAcluster.dat". In case you would like a hardcopy of this DLAcluster you may use

```
lattice2ps -color -nx 500 -ny 500 -matrix < bigDLAcluster.data >
bigDLAcluster.ps
```

This creates the psfile "bigDLAcluster.ps" which you could print on a color printer (or look at with `ghostview bigDLAcluster.ps`.

5b. Before you work on this part, please get me. Now write a program which reads in the 500x500 matrix from your file of 5a. To get the fractal dimension d_{f} we use the following relations.

$$M = c * b^{d_{\mathrm{f}}} \tag{1}$$

where M is the number of occupied sites, c is some constant and b is the length of your square for which you count the number of occupied sites. You see that Eq.(1) defines d_f. If you take the log of both sides of Eq.(1) you get

$$\ln(M) = \ln(c) + d_{\mathrm{f}} * \ln(b) \tag{2}$$

Eq.(2) tells us that if we plot $\ln(M)$ as a function of $\ln(b)$ then we should get a line with slope d_{f}. So our task is to get M and b. Add to your program that you count the number of occupied sites M for a lattice of lenght b, where you center your lattice of lenght b around the midpoint of your 500x500 lattice. Loop over the length of your lattice and print out $ln(M)$ as a function of $\ln(b)$.

5c. Next we fit a line to our data from 5b (stored in filename). For this we use gnuplot. So type in the command line "`gnuplot`". Then type "`plot "filename"`". Define a function $f(x)$ by typing "`f(x) = a*x + b`". Now fit your data within the xrange [1.0,4.7] to a line by typing "`fit [1.0:4.7] f(x) "filename" via a,b`". The resulting `a` is the fractal dimension d_{f}.