In-Class Work: Reading Scientific Papers, Fractal Growth Intro, DLA, 2d random walk

We will start class with a quick look at the random walk in 1dim (see solutions in `~kvollmay/share.dir/inclass2025.dir/classrndwalk2f.py`. Then I will give you an intro to Reading Scientific Papers. I will then introduce Cellular automata, Fractal Growth, and the DLA model.

1. Fractal Growth: Random Walk in Two Dimensions

1a. For the fractal growth DLA model we will need a random walk in two dimensions. Write a python-program for a random walker on a two dimensional lattice (all four directions being equally likely). Note, that you do not (yet) need a lattice for that, you only need x and y. Starting with $x = 0$ and $y = 0$ and (print and) look at $x(t)$ and $y(t)$. You may use the solution program `~kvollmay/share.dir/inclass2025.dir/classrndwalk2a.py`.
Use `NSTEPS=5000` random walk steps. For looking at $x(t)$ and $y(t)$ in the same figure, you can use the command (assuming that your program is called `classfractal1a.py`)

```
./classfractal1a.py > j; xmgrace -block j -bxy 1:2 -bxy 1:3
```

1b. Movie

Next let's make a movie of your random walk. Define a lattice (`lattice`) of size 30x30 and initialize it for all sites equal to zero. Put your initial walker at site $x = 15$ and $y = 15$. We want to make a movie of the random walker where we mark on the lattice the current random walker site with the lattice value 2 and we mark any previously visited site with 1 (This is just for our fun.). To make a movie we first make an image for every random-walk step. (**So please use only `NSTEPS=50` random walk steps!**) To see how to make these pictures see the example
`~kvollmay/share.dir/pythonsamples.dir/sample_latticemovie.py` Once you have all pictures in `frame*` you can run the movie with

```
animate -delay 30 -pause 5 frame*png
```

2. Fractal Growth: DLA

Read in our Gould & Tobochnik textbook about the model we will use, that is about Diffusion-Limited Aggregation (DLA): chapter 13, read bottom of page 529 (skip pages 530 & 531) and read on page 532 the first two sentences of Problem a. (For a link to this book, see our course webpage.) Confirm that the rules are consistent with the rules I introduced earlier in class.

3. Start Random Walker on Circle

Initialize the lattice with all lattice sites being zero and only in the middle of the lattice is a seed with value one. Use a lattice size `LATSIZE=100`. We want next to implement that a new random walker starts randomly somewhere on a circle with midpoint in the middle of the lattice and with radius `RMAX+2`. For the DLA-program we will use as starting value `RMAX=2` but for now use `RMAX=20`. To check that you draw your random walker indeed equally likely on a circle, add to your program that you put 50 initial walkers on their starting point (not yet with random walk steps) and mark for each of these 50 starting points the lattice with the value 2. Make only one image of your lattice after these 50 markings on the lattice. To get a pdf-file of your frame use in the header of program

```
import matplotlib.pyplot as plt
```

and for example

```
plt.imshow(lattice,interpolation='nearest')
plt.savefig('frame3.pdf')
```

Think about how you would program this task. When you have planned your strategy, you may go straight to not writing the program but instead you may copy the solution program
`~kvollmay/share.dir/inclass2025.dir/classfractal3.py`
into your working directory. Read the program, to convince yourself what it does and run the program. Look at the resulting `frame3.pdf`.

4. DLA: Random Walk Copy `classfractal3.py` into another file, e.g. into `classfractal4.py`. Modify `classfractal4.py`. Take out of this program now the loop over 50 starting points, instead start the random walker at **only one** point on the circle and use `RMAX=2`. Add to your program a loop over `NSTEP=50` random walk steps. To check your program, assign to each site, which is visited by the random walker, the value 2. Print the lattice after this random walk and look at it. Hint: Use your work above from step 1a of the fractal growth section.