Growth Models: Eden and DLA

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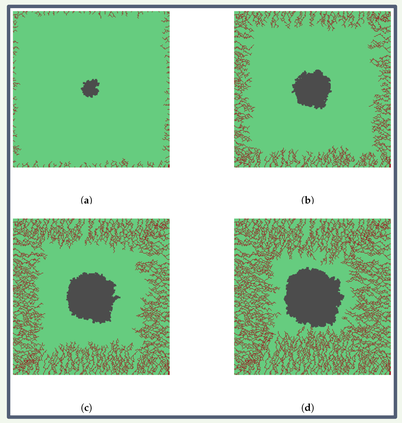
What are Growth models?

- Growth models are used to model seemingly natural random phenomenon, such as bacterial colonies or electrodeposition.
- We will be looking at two algorithms to illustrate two approaches to growth; **Eden clusters** and **Diffusion Limited Aggregation(DLA).**
- Eden clusters are used to model things where the material accumulates on the whole surface of a starting point
- DLA aggregates point by point in a random direction



Eden model simulation of re-epithelization(resurfacing of a wound)

Other applications: Growth models for Art

Below is a rendering of the DLA process applied onto a spiral curve in 3D space. Growth models can create organic designs:

3D rendering of DLA model

Eden Growth model

Eden Clusters are the random accumulation of materials around the **boundary,** as illustrated at the bottom:

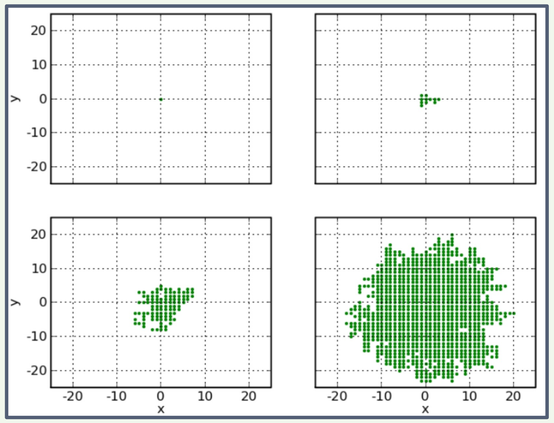
Applications include the modelling of:

- Polar ice caps
- Tumor growth
- Forest fires
- Bacterial colonies

Eden model of polar icecap expansions

Creating an Eden Cluster:

1.Start with a central seed which represents the initial cluster
2.Select an empty, neighboring site to the boundary of the cluster randomly, and add it to the cluster.
3.Repeat step 2 iteratively, until a cluster of desired size is created.



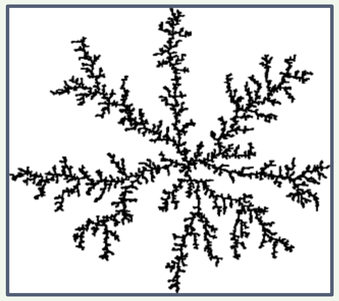
Different stages of Eden growth model

Diffusion limited Aggregation (DLA)

DLA clusters are in the form of **Brownian trees**. Brownian trees have numerous branches growing from the center, resembling a snowflake.

Applications include the modelling of:

- Ore vein in a mineral
- Electrodeposition
- Formations of snowflakes



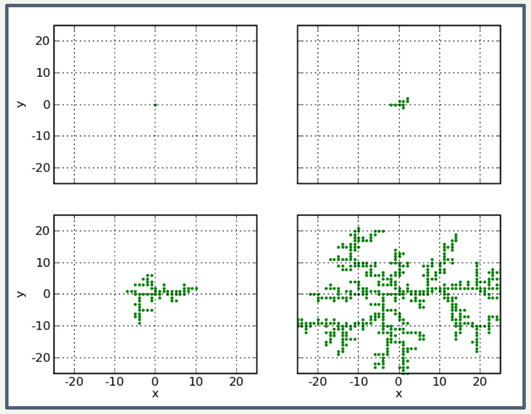
Brownian Tree generated via DLA

Random walks

An integral part of DLA are **random walks,** where a particle is moving around a 2d space and constantly changes its direction at random.

Creating a DLA Cluster:

1. Start with a central seed.
2. Initialize a random walk.
3. If the particle performing the random walk meets the cluster, it will stick and become part of it.
4. If the random walk strays too far from the cluster, it can be terminated, and another random walk is initialized.
5. Repeat 2~5 until a cluster of desired size is created



Different stages of DLA growth model