Distance dependent growth models

Irregular and stochastic growth appears all around us. For example: growth of plants, snowflakes, bacterial colonies, tumors, corals and many more. Mathematical study of growth is closely related to probability theory and it includes a variety of models aimed to describe different growth phenomena. In the simplest model, we observe particles on the Euclidean lattice $\mathbb{Z}^2$, start with a single particle at the origin, and at each time step add an additional particle to the existing particles according to some probabilistic law. Below are several examples of the aggregate obtained for different laws.
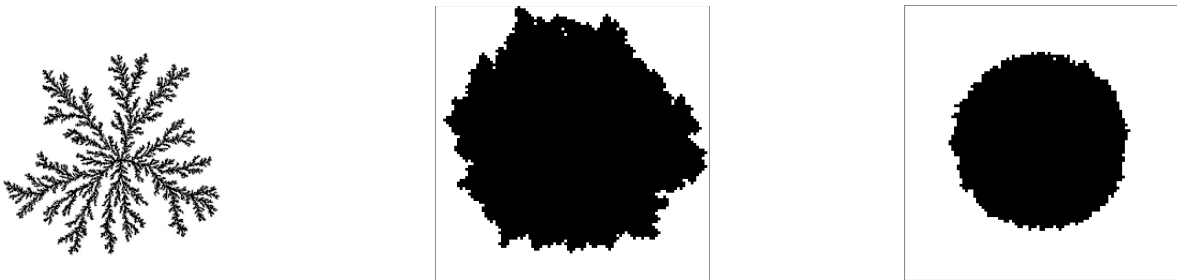

Figure 0.1: Different growth models with 10000 particles.

In the first part of the project, you will learn the precise definition of growth models and some part of the known theory for such models. Some time may be devoted to the simulation of different growth models in order to obtain some insights on such models. In the second part we will discuss models in which particles are added according to a rule involving their distance from the origin and we will try to prove several results regarding their behavior.

Prerequisites: Basic course in probability. Some programming skills can be an advantage (but are not necessary).