

Tree Propagation



Motivation

Naturalists come up with a futuristic question how the different kinds of trees in Vienna will propagate if nobody is taking care of them. Thus we assume that all people in Vienna are gone and the the seeds of the trees can grow everywhere. Moreover the considered trees are reproducing themselves only by spreading their seeds by the wind. As a modeler at the TU-Wien you are asked to build them a model.

Model

The goal is to implement an agent based model, where the agents are trees. These trees have three attributes: species, age and height. The height is categorical and listed in Table 2. Trees can die with a certain probability depending on their age. For further planting there is a spreading factor which specifies how far a seed can travel by wind, this factor differs per species and is given in Table 1. How many seeds a tree can have is based on its height, see Table 2. Depending on how much trees are in the environment of a landed seed, there will either grow a tree or not. The wind is defined by a direction given by a unit vector e and a positive factor s for the wind strength. For every step the wind can change its direction and strength. One step in the model takes a year. The model should simulate tree propagation in a specific area. Your final model should work on the map of Vienna.

You are given an edited CSV-file named "Baumkataster" for Task 4 and 5. The original data set is from https://www.data.gv.at/katalog/en/dataset/stadt-wien_baumkatasterderstadtwien#resources

Kind of tree	Spreading factor
Ahorn	1.5
Akazie	1.2
Buche	0.4
Esche	1.1
Kastanie	0.2
Kiefer	1.0
Kirsch	0.9
Linde	1.3
Pappel	1.8
Platane	0.7
Zürgelbaum	0.8

Table 1: Different kind of tress with spreading factor

level	interval	amount of seeds
0	0m	0
1	0-5m	10
2	6-10m	50
3	11-15m	100
4	16-20m	200
5	21-25m	400
6	26-30m	750
7	31-35m	1250
8	>35m	2000

Table 2: Levels of height and the associated amount of seeds

To Do's

Task 1

Create a random generation of trees in a simple area, e.g. in a rectangle or in a circle. You can start with only a few kinds of trees and extend it afterwards to the eleven species in Table 1.

Task 2

Create a nice visualization for the initialization. This visualization style should also be used for later simulations.

Task 3

Implement a model which satisfies the specifications. Empirically find a sensible total time for the simulation. Think about what can be suitable values for the wind parameters. Find sensible probabilities for the rules of dying and growing. Explain your choices. (Be careful when setting the conditions for an environment of a landed seed, e.g. look up the principle of bounding boxes.)

Task 4

Load the given data set "Baumkataster". Use this as your new initialization. Consider how the wind have to be scaled such that the distance is reasonable in longitude and latitude. Which species will prevail?

Task 5

Experiment with your model. Play around with parameters. Interpret, visualize and compare your results.

Suggested Programming Languages

Python