Visualizing properties of random spanning trees

In this project, you will implement, in Java, a program which visualizes a random process together with current and statistical data.

The process works like this. An initial spanning tree of an input graph (a complete graph for example, or a graph read from a file) is constructed in some arbitrary way. (I'll explain how, if you want to know.) Then a simple random modification is performed on the tree (I'll explain exactly how it works), yielding a new tree, to which again the simple random modification is applied, and so on.

Each tree is displayed in one part of the window in which the program runs. In the other parts of the window, important statistical data about the tree is visualized. Statistical data is, e.g., maximum degree; number of leaves; diameter---I'll explain that. The visualization should show the current values of these parameters, and the average and standard deviation over all trees since the beginning.

The projects naturally splits into sub-tasks, which have to be combined at certain stages. I imagine that you'd approach the project as follows.

- Phase 0a: Produce a prototype which just creates a spanning tree and modifies it, without any visualization.
- Phase 0b: Produce a prototype which draws a given spanning tree
- Phase 0c: Amend the code in 0b to visualize one modification step.
- Phase 1: Combine the two parts to obtain the first version of the program.
- Phase 2a: Add functionality for gathering some statistical data.
- Phase 2b: Add functionality for visualizing the statistical data.
- Phase 3: Combine the two to obtain the 2nd version of the program.
- Phase 4: Design and implement an interface into which a future developer can plug functions for gathering and visualizing additional data. This makes the program inherently extendable. Test the interface by plugging in a couple more statistical data.

In the list, I omitted things like “agree on a data structure for ….”.

Ultimately, the purpose of the finished project is to help researchers in discrete math in the analysis of properties of random spanning trees. Based on the statistical data, conjectures can be made about how interesting parameters behave. (After that, of course, the work for the theoretician starts: he has to prove those conjectures!)