First Mandatory Project in DM851 (2016)

This project is based on the article *Boltzmann Samplers for the Random Generation of Combinatorial Structures* by P. Duchon, P. Flajolet, G. Louchard and G. Schaeffer (http://algo.inria.fr/flajolet/Publications/DuFlLoSc04.pdf), published in Combinatorics, Probability and Computing (2004) 13, pages 577-625. Your task is to implement two Boltzmann samplers. You can chose any programming language that you like.

1.) *Words without long runs:* (Example 1 in the paper on page 13)
Implement a Boltzmann sampler that allows to sample words of length n that never have more than m consecutive occurrences of any letter. Your alphabet should be $\mathcal{A} = \{a, b\}$. The inference of the parameter x that determines the expected size of the sampled structure does not have to be inferred but should be given as a parameter. Also n and m as well as the numbers of repetition should be given as a parameter. The following execution should illustrate the output of the sampler. In the example below the parameters to the python program are n, m, x, number of samples. A sample of incorrect length should be rejected.

```
daniel@mymachine:/home/daniel$ python boltz589.py 4 2 0.502 10000
aaba: 955
aabb: 892
abaa: 1029
abab: 1060
abba: 982
baab: 994
baba: 1004
babb: 1018
bbaa: 982
bbab: 1084
```

2.) *Rooted plane trees:* (Example 2 on page 14) Proceed similar as in the first part of the project. However, as inferring the value x that determines the expected value of the sampled structure can be easier calculated, the command line should use only the arguments n, which is the expected size of the sampled tree. The value x needed for the sampler should be calculated in your program.

2a.) Plot a random tree of size around 100 (Hints will be added.)
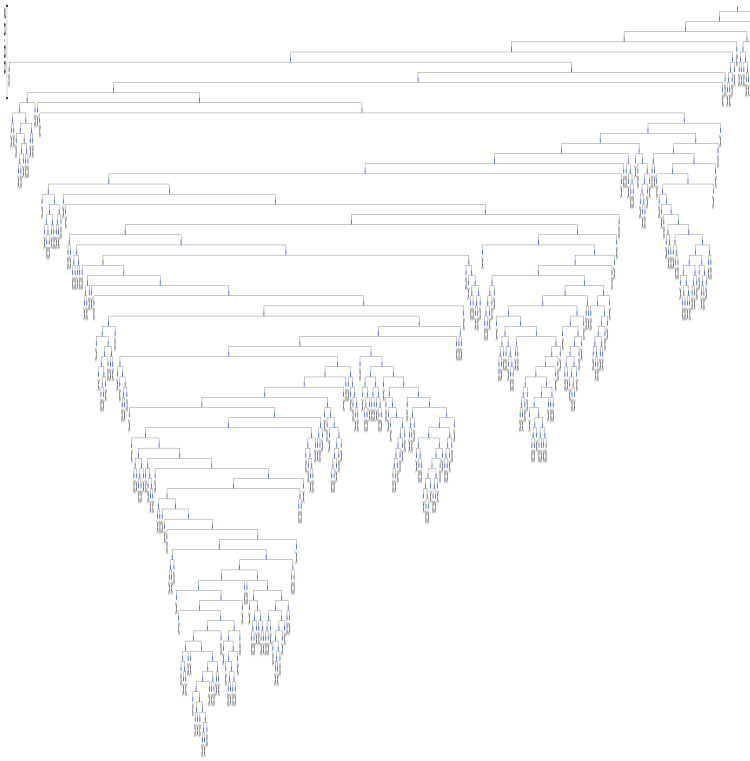
2b.) Sample many trees for a given expected size n and plot the average size (vertical axis) vs. the number of sampled trees (horizontal axis).

3.) Write a small report (max. 5 pages) where you include all of the above and briefly describe your implementation details.

The deadline for submitting the report as well as the source code (via email) is Nov. 08