Assignment 7

CO 330 (Fall 2026)

Due Friday, December 4, 2026 at 3pm Eastern time.

Instructions

To get full marks on this assignment you must do questions worth 12 marks total. Any additional questions you do beyond 12 marks-worth will not be counted. Each question has two possible point values, one if you would like it marked for correctness and one ("engagement") if you would like it marked for feedback after you have done some work on it. You will indicate which you want when you submit. *Note that this time there are two questions that cannot be submitted for engagement.*

All answers should be justified unless specifically indicated otherwise.

This assignment should be done and submitted individually. You are welcome to discuss with your classmates, but you should not use generative AI for your ideas and you must write up your solutions independently (neither writing it with other people nor with tools such as generative AI). In your write up explicitly acknowledge any discussions or non-class resources and tools that you may have used.

This assignment should be submitted in crowdmark.

Questions

(1) **{4 marks graded for content, 2 marks graded for engagement}** Implement recursive random generators (not Boltzmann) for plane rooted trees and labelled plane rooted trees. Generate at least two trees of size at least 50 with each generator and include them in your solution submission. Comment on the qualitative differences between them.

(2) **{4 marks graded for content, 2 marks graded for engagement}** This question is about combinatorial classes $\mathcal{C}$ where $C(x)$ has radius of convergence $\rho > 0$.
   (a) Find an example of such a combinatorial class where $\lim_{x\to\rho^-} C(x) = \infty$.
   (b) Find an example of such a combinatorial class where $\lim_{x\to\rho^-} C(x)$ is finite.
   (c) Find an example of such a combinatorial class where $\lim_{x\to\rho^-} \frac{xC'(x)}{C(x)} = \infty$.
   (d) Find an example of such a combinatorial class where $\lim_{x\to\rho^-} \frac{xC'(x)}{C(x)}$ is finite.

(3) **{4 marks graded for content, 2 marks graded for engagement}**
   (a) Implement a Boltzmann generator for binary strings with no 00 substring. What is the maximum value for x? Find the value of x such that the expected size is 100. Run the algorithm with this value of x until you get a string in the range 80 - 120. How many times did you have to run it?
   (b) Implement a Boltzmann generator for set partitions. Find the value of x such that the expected size is 100. Run the algorithm with this value of x until you get a set partition in the range 80 to 120. How many times did you have to run it? Compare your answer to the previous part.

(4) **{4 marks graded for content, 0 marks graded for engagement}** *This question cannot be submitted for engagement.* Read section 6 of `http://algo.inria.fr/`

`flajolet/Publications/DuFlLoSc04.pdf` (actually it is a good idea to read the whole paper). Give a summary of the main point of section 6 as a whole and the main point of each subsection of section 6. The summaries for each section and subsection should be at most a modest sized paragraph each and your whole summary should be less than a page.

(5) **{4 marks graded for content, 0 marks graded for engagement}** *This question cannot be submitted for engagement.* Find 8 units of typos in the lecture summaries or assignment solutions. A typo that causes no actual confusion (like a spelling error or a mathematical typo where the intent is entirely clear) is a single unit. A typo of significance is two units.