CS-430 HW2 Fall 2022 9 points

Submission instructions

- Due date: Tuesday, Nov. 1, 11:59 pm Central Time (i.e. local time in Chicago)

- Late submissions and submissions violating these instructions will NOT be accepted.

*- **Absolutely no handwritten submissions. No credit will be given for such submissions.***

- Teamwork is allowed (max. 4 students/team). Individual submissions are also OK.

- Upload the following files to Blackboard:
*- (1) your HW report (**pdf format only; the reports in formats other than pdf will be disregarded**);*
- (2) the source codes of your programs
The Beacon students: upload your submissions to LMS.

*- **One submission per team only.** Write down names, A#, and section numbers (i.e. live, online, Beacon) of all the team members on the front page. Do **not** submit multiple copies of your HW (e.g. by each team member). It is very confusing and will be penalized. **Clearly indicate how each team members contributed to your teamwork.***

- If you use any additional materials to solve the HW problems (e.g. textbooks, research papers, websites, etc.), reference them.

- My TAs are responsible for grading this assignment. Don't send them or me:
- Your partial solutions with inquiries "Is that what you expect?".
- Questions the answers to, may give explicit hints on how to solve the problems.

- Feel free to ask questions if you have any doubts.

1. We would like to generate samples of a random variable X uniformly distributed over the interval (a,b), $0 < a < b$.

   (a) **(2 points)** What is the probability density function $f(x)$ of X? Find the corresponding cumulative distribution function (CDF) $F(x)$ of X.

   (b) **(2 points)** Use the inverse transform method to generate X given a generator of a random variable U uniformly distributed over the interval (0,1). Present a **formal mathematical justification** that your algorithm for generating X is correct.

   (c) **(4 points)** Generate three sequences $X_i=\{x_{i,1}, x_{i,2}, x_{i,3}, \ldots, x_{i,n}\}$, where $i=1,2,3,$ of numbers (n=10000 samples each) uniformly distributed over the intervals (a_i,b_i). Plot their **empirical CDFs** $F_i^{(e)}(x_j)$, where $j=1,2,3, \ldots, k.$ Assume $k << n.$ What **sorting algorithm** did you use to calculate numerical values of $F_i^{(e)}(x_j)$? Find the sorting algorithm **minimizing** the complexity $T(n)$.

   (d) **(1 point)** Compare your empirical $F_i^{(e)}(x)$ and theoretical $F_i(x)$ CDFs.

   Submit source codes of all the programs you need to produce your results.