

22C : 031 Algorithms
Homework 3
Due Thursday, October 9

You are expected to do the homework assignments on your own without consulting human and non-human sources (like web pages or books) for the solutions.

The first part of this assignment requires you to write a program, for which the only input or parameter is n , an integer greater than 1. We may think of the starting point of the program as a graph with n vertices and no edges. The program goes through a sequence of iterations, and in each iteration it generates one edge at random – such an edge is just a pair (i, j) where $1 \leq i \leq n$ and $1 \leq j \leq n$ and $i \neq j$. Our generator must be designed so that it is equally likely to output any such pair. The program stops when the edges generated thus far results in a connected graph. At this point, the program outputs the number of edges generated.

For example, if $n = 3$, and we generated the edges $(1, 3)$, $(1, 3)$, and $(2, 3)$, then our output should be 3.

You should write the program so that it employs a Union-Find data structure to keep track of the connected components induced by the set of edges generated. This use of the Union-Find structure is similar to that of Kruskal’s minimum spanning tree algorithm in Section 4.6. The data structure you should implement is the one described in the Subsection titled “A Simple Data Structure for Union-Find” in Section 4.6. This is essentially the same as the final data structure we discussed for Kruskal’s algorithm in class.

For each of the following values of n , run the program 10 times and note the minimum, maximum, and average value of the program outputs. Submit a hard copy that contains the resulting table. The values of n you should use are 200, 400, 600, 800, 1000, 2000, 4000, 6000, 8000, and 10000.

You should also submit your source code using icon’s submit feature which will be activated for this assignment.