York University

EECS 3101Z

## Homework Assignment #4 Due: February 14, 2023 at 7:00 p.m.

A point in the plane can be represented using Cartesian coordinates (x, y). The distance of (x, y) from the origin is  $\sqrt{x^2 + y^2}$ . Suppose we wish to sort a set of n points  $(x_1, y_1), \ldots, (x_n, y_n)$  according to their distance from the origin.

- [4] 1. Suppose the two coordinates of each of the *n* points are integers between -n and *n*. Describe how to sort the points according to their distance from the origin in O(n) time. You do not have to give a formal proof in your solution, but you should briefly explain why your answer is correct.
- [4] 2. Now consider n points whose coordinates are floating point numbers. Assume the points are drawn uniformly, randomly and independently from the disc given by  $x^2 + y^2 < 1$ . How can you adapt bucket sort to sort the points according to their distance from the origin in O(n) expected time? Be explicit about how you calculate the index of the bucket that each point belongs to.

Hint: One way to solve this is to ensure that approximately the same number of elements fall into each bucket.