

Problem 1. Is Insertion sort stable? Why or why not?

Problem 2. Design a strategy that makes any sorting algorithm stable. How much additional time, asymptotically, does it add to the algorithm?

Problem 3. Design an algorithm to sort  $n$  integers in the range 0 to  $n^3 - 1$  in linear time.

Problem 4. We are given  $n$  points in the unit circle,  $p_i = (x_i, y_i)$ , such that  $0 < x_i^2 + y_i^2 \leq 1$  for  $i = 1, 2, \dots, n$ . Suppose that the points are uniformly distributed; that is, the probability of finding a point in any region of the circle is proportional to the area of that region. Design an algorithm with an average-case running time of  $\theta(n)$  to sort the  $n$  points by their distances  $d_i = \sqrt{x_i^2 + y_i^2}$  from the origin.