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Assignment 3

Computational Geometry

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Exercise 4

We assume that we have a random number generator, RANDOM(k), which has an integer k as input and generates a random integer between 1 and k in constant time. Now consider the following algorithm:

Algorithm RANDOMPERMUTATION(A)
Input: An array $A[1..n]$.
Output: The array $A[1..n]$ with the same elements, but rearranged into a random permutation.

1. **for** $k \leftarrow n$ **downto** 2 **do**
2. $\quad j \leftarrow$ RANDOM(k);
3. $\quad$ Exchange $A[k]$ and $A[j]$
4. **od**

Prove that every possible permutation of A is equally likely to be the output of RANDOMPERMUTATION(A). Also show that the algorithm is no longer correct (it no longer produces every permutation with equal probability) if we change the k in line 2 to n.

Exercise 5

A simple polygon P is called *star-shaped* if it contains a point q such that for any point p in P the line segment $[p, q]$ is contained in P. Give an algorithm whose expected running time is linear to decide whether a simple polygon is star-shaped.