CS 240: Data Structures and Data Management **Fall 2025**

Tutorial 03: September 26

1. **Expected Runtime**
   Give a tight bound on the expected number of iterations of the while loop in the following program.

```
def silly(n):
    while n != 0:
        n = randint(0, n) # random int in {0, ..., n}
    print("done")
```

2. **Hoare's Partition**
   Assume that you call *QuickSort* on an array of size n where all elements are the same. Derive (with an explanation) an asymptotically tight bound on the run-time, presuming you use Hoare's partition-algorithm from class.

3. **Multiplicity Sorting**
   Consider the problem of sorting an array A of n elements with multiplicity n/k. That is, A consists of k distinct elements $(y_1, y_2, \ldots, y_k)$, where each y_i occurs n/k times in A. Prove that any algorithm in the comparison model requires $\Omega(n \log k)$ comparisons to sort A in the worst-case.
   Note: $\forall m \geq 0, \left(\frac{m}{e}\right)^m \leq m! \leq m^m$.