CS 240: Data Structures and Data Management **Winter 2024**

Tutorial 02: January 22

1. **Loop Analysis - Iteration**
   Provide a tight Θ bound on the following pseudocode as a function of n:

Algorithm 1: Iterative Pseudocode

```
k ← 1
for i from 1 to n do
    j ← 0
    while j ≤ n do
        j ← j + k
    end
    k ← 2k
end
```

2. **Loop Analysis - Recursion:**
   Provide a tight O bound for the runtime of the following algorithm. You may assume that at each recursive step, n is a power of 3.

Algorithm 2: Stooge(A, i, j)

Input: Array A of size n, index i (initially 0), index j (initially $n-1$)
Output: No output but the subarray $A[i \dots j]$ will be sorted

```
if A[j] < A[i] then
    Swap(A[i], A[j])
end
if j − i + 1 > 2 then
    t ← ⌊(j − i + 1)/3⌋;
    Stooge(A, i, j − t);
    Stooge(A, i + t, j);
    Stooge(A, i, j − t);
end
```

3. **Algorithm Design - Heaps**
   How would you implement a stack using a heap? Analyse the complexity of the push and pop operations.

4. **Max-Heap Operations**
   Insert 27 and 9 into the following heap, and then perform a delete-max operation on the resulting heap.