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

Tutorial 01: Sep 12

1. **Θ-notation** and **Little-o**

   (a) Prove from first principles that $n^3 \in \Theta(4n^3 - 3n^2 + 2n - 1)$.

   (b) Prove from first principles that $2000n^2 \in o(n^n)$.

2. **Fraction between Big-O and Little-Omega**
   Prove or disprove the following claim. If $f(n) \in O(h_1(n))$ and $g(n) \in \omega(h_2(n))$, then $\frac{f(n)}{g(n)} \in o\left(\frac{h_1(n)}{h_2(n)}\right)$, assuming $f(n), g(n), h_1(n)$ are all positive $\forall n \geq 0$. You should prove the statement from first principles or provide a counter example.

3. **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
```