CS 240: Data Structures and Data Management **Spring 2023**

Tutorial 02: May 23

1. **Relationships Between Order Notations**
   Prove or disprove following statements. To prove a statement, provide a proof or justification based on the definition of order notation. To disprove the statement, you can either provide a counter example and explain it or show truth of the statement leads to contradiction.

   (a) If $f(n) \in o(g(n))$, then $f(n) \notin \Omega(g(n))$. Assume that both $f(n), g(n) > 0$ for $n > 0$. Note that this statement is part of slides for Module 01.

   (b) There exists $f(n)$ and $g(n)$ such that $f(n) \in o(g(n))$ and $f(n) \in \omega(g(n))$

   (c) If $f(n) \in O(g(n))$, then $2^{f(n)} \in O(2^{g(n)})$.

2. **Little-o / Little-ω: Electric Boogaloo**
   Prove following using first-principles. Find n_0 value that satisfies the inequality.

   (a) Prove that $3^n - 2n^2 \in \omega(2.9^n)$. (You are allowed to use calculator for this question.)

   (b) Prove that $2000n^2 \in o(n^n)$. Note that $n > 0$.

3. **Pseudo-code Runtime Analysis**
   Analyze the following piece of pseudo-code and give a tight (Θ) bound on the running time as a function of n.

```
i = 2
x = 0
while (i < n):
    for j = 1 to n:
        for k = 1 to j:
            x = x + 1
    i = i * i
```