CS 240: Data Structures and Data Management **Winter 2021**

Tutorial 1: January 25

1. Prove from first principles that $\log(n!) \in \Theta(n \log n)$.

2. Prove from first principles that $n \in \omega\left(2^{\sqrt{\log n}}\right)$.

3. Prove or disprove the following claim. If $h_1(n) \in \Theta(f(n))$ and $h_2(n) \in \Theta(g(n))$, then $\frac{h_1(n)}{h_2(n)} \in \Theta\left(\frac{f(n)}{g(n)}\right)$. You should prove the statement from first principles or provide a counter example.

4. Provide a tight Θ bound on the following pseudocode as a function of n:

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