What about when the analysis gets more complex?

What if things get "complex"?

What is $\sum_{i=1}^{n} i^4$?

We can attempt to solve this using one of three different techniques:

- Constructive Induction.
- Bound it with integral approximations.
- Do an overestimation of it.

We will perform these techniques in class. They will each give different equations. We will discuss whether any of these differences "matter" within the scope of our concerns.

Big-O Notation

BubbleSort is $\in O(n^2)$

What does this mean?

- Informally, it means that any constants or lower order terms are "dominated" by n^2 as n grows.
- Formally, $f(n) \in O(g(n))$ means that $\exists n_0 \in \mathbf{Z}, c \in \mathbf{R}^+ | \forall n \in \mathbf{Z}^{\geq n_0}, f(n) \leq c \cdot g(n)$

We will discuss this, as well as other asymptotic classifications shortly. One important point for now is that this is an "at worst" analysis bound, so we will need an "at best" bounds as well to tightly bind a runtime.

Applied Algorithms

Question: Is an algorithm that is in $O(n)$ always better than an algorithm that is in $O(n\log n)$?

We often discuss that "for sufficiently large input sizes" classes like Big-O help us make choices, but in day to day applications of algorithms, we will sometimes want to focus on the size of the input and the constant factors that asymptotic bounds do not take into account.