Data structures are **FUNDAMENTAL!**

- All fields of CS involve storing, retrieving and processing data
- Information retrieval
- Geographic Inf. Systems
- Machine Learning
- Text/String processing
- Computer graphics
- ...

Course Overview:
- Fundamental data structures + algorithms
- Mathematical techniques for analyzing them
- Implementation

Introduction to Data Structures
- Elements of data structures
- Our approach
- Short review of asymptotics

Basic elements in study of data structures

- Modeling: How real-world objects are encoded
- Operations: Allowed functions to access + modify structure
- Representation: Mapping to memory
- Algorithms: How are ops. performed?

Common:
- $O(1)$: constant time 😊
  [Hash map]
- $O(\log n)$: log time (very good!)
  [Binary search]
- $O(n^p)$: ($p =$ constant) Poly time
  eq. $O(n^{\log n})$ [Geometric search]

Asymptotic: “Big-O”
- Focus on large $n$
- Ignore constants $\ll$ ??

$$T(n) = 34n^2 + 24n \log n + 328.5$$

$$T(n) = O(n^3)$$

Asymptotic Analysis:
- Run time as a function of $n \ll$ no. of items
- Worst-case, average-case, randomized
- Amortized: Average over a series of ops.