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

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

**Asymptotic: “Big-O”**
- Ignore constants
- Focus on large \(n\)

\[ T(n) = 34n^2 + 15n \cdot \log n + 143 \]
\[ T(n) = O(n^2) \]

**Asymptotic Analysis:**
- Run time as a function of \(n \leftarrow \text{no. of items}\)
- Worst-case, average-case, randomized
- Amortized: Average over a series of ops.

**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?