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

**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. \( O(n^3) \)

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

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

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

**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?

**Our approach:**
- Theoretical: Algorithms + Asymptotic Analysis
- Practical: Implementation + practical efficiency