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 (good) [Binary search]
$O(n^p)$: p = constant: poly time
$O(\sqrt{n})$

Asymptotic: "Big-O"
- Ignore constants
- Focus on large n

$T(n) = 34n^2 + 15n\log n + 143$
$T(n) = O(n^2)$

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 operations performed?

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

Asymptotic Analysis:
- Run time as function of n: no. of items
- Worst-case, average case, randomized, ...
- **Amortized** - average over series of ops.