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:
- \( T(1) \): constant time
  - \( O(1) \) \( \Rightarrow \) \( T(1) \) \( \Rightarrow \) \( O(1) \)
- \( O(\log n) \): log time (very good!)
  - \( \log n \ll n^{0.1} \)
- \( O(n^p) \): (\( p \) = constant) Poly time
  - eq. \( O(n^2) \)

### Hash Map
- \( O(1) \)

### Binary Search
- \( O(\log n) \)

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

### Geometric Search
- \( O(\log n) \)

### Asymptotic Analysis:
- Run time as a function of \( n \) = 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?

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

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