CS 351: Data Structures and Algorithms

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Week 2

Asymptotic Notation

- Way to describe the runtime of an algorithm based on the size of the input and the operations
- Big O Notation: a function or algorithm is upper bounded by another function
  - f(n) is O(g(n)) if $f(n) \leq c*g(n)$ and $c > 0$
  - Growth rate of f(n) is bounded by growth rate of g(n)
- Approximation
  - Generalize
  - Choose dominant term
  - Ignore coefficients
  - Ex: 5n is O(n); we don't say 5n is O(6n)

Specification vs Implementation

Specification

- Description of behavior
- Input, output, possible errors
- Rules/requirements of a method/ADT

Example:

- Blueprints for a house:
  - Number of beds/baths
  - Location of windows
  - No details about implementation

Example from homework?

Implementation

- Details of how something is done
- Code, data structure

Example:

- House:
  - How cables run through the house
  - Materials Used
  - Houses with different implementation details are often interchangeable

Example from homework?

Abstract Data Type vs Data Structure

Abstract Data Type

- Specification
- Object with behaviors
- Implementation details and data are encapsulated
- Examples
  - Dynamic Array
  - BallSeq

Data Structure

- Stores data
- Implementation
- An ADT may be a data structure for another ADT
- Examples
  - Dynamic Array
  - Array and Effective Size

Invariant

- Rules that dictate how data structure and variables are used
- Critical for implementer
- Catches errors with DS that unit tests will not catch
- Be sure to write descriptive error message when testing rules--will save you time debugging!

Dynamic Arrays

Specification

- Container ADT for objects
- (Almost) no restriction on number of items
- Does order matter?
- What behaviors may a dynamic array have?

Implementation

- Components:
  - Array
  - Effective size
- Implementation details:
  - Effective size tracks how many items are in the container
  - When effective size reaches the capacity, make a bigger array
  - In add:
    - Ensure capacity
    - Insert element where it belongs (depends on specification)
    - Increase effective size
- Flaws:
  - Add and remove are less efficient with arrays, depending on specification

Sequence ADT

Specification

- Ordered collection
- Elements accessed with a cursor
- Elements added in specific spot
- Only current element may be removed

Implementation

- Can use various data structures
  - Dynamic array for HW 2
- currentIndex
  - Used to implement cursor