Properties of Data Structures and Algorithms

University of Massachusetts Amherst
ECE 242 – Data Structures and Algorithms
Lecture 2
Quality measures for data structures

• What do you expect from a “good” data structure?
Quality measures for algorithms

• What do you expect from a “good” algorithm?
Correctness

• In some cases absolute
  – E.g., what is the sum of all values in array?
• Some algorithms have multiple solutions
  – Examples?
• Some algorithms may have solutions where correctness is hard to define
  – Examples?
Multiple solutions

• Data set for number of wins by pitcher (2011):
  – {(Halladay, 21),
    (Jiminez, 19),
    (Lester, 19),
    (Price, 19),
    (Sabathia, 21),
    (Wainwright, 20)}

• Which pitcher has most wins?
Unclear “correctness”

• Make image square:
Running time performance

• “The algorithm finishes in 12 seconds.”
  – How to express performance more accurately?
Memory use performance

• “The data structure requires 727 bytes.”
  – How to express memory requirements in a more meaningful way?
It all depends…

• Quality of data structure depends on operation
  – Example: unsorted “pile” of papers
    • Very fast for adding item
    • Not very fast for finding item
  – Example: papers sorted by last name
    • Slower for adding item
    • Faster for finding item (if search is by last name)
    • However: also slow if search is by first name
Data types

• What are typical data types to store information?
Data types

• Common types
  – Numeric types: integer, floating point
  – Boolean
  – Text types: character, string
  – Composite types
  – References ("pointer")
Algorithms and data types

• Many algorithms can be used with different data types
  – Sorting of integers
  – Sorting of strings
  – Sorting of composite types
• May require small adaptation in code
  – Different comparison functions
  – Different code for “moving data around”
• Why is this point important?
  – I do not want you to leave this course saying: “Useless. We only learned how to sort numbers!”
Example

• Code: change type of object used in program
  – Given: code with integers (ArrayProgram.java)
  – Need to develop: code for composite type (ArrayProgramSkeleton.java)
  – Solution: ArrayProgramObject.java
Objects

• For algorithm discussion, we can think of “objects” in a very general way

• Operations on objects
  – Creation (and destruction)
  – Comparison

• Operations on objects in data structures
  – Insertion
  – Deletion
  – Algorithm-specific operations: search, sort, etc.
Next Steps

• Start Homework 1 early
• Lecture on Monday