CSE 373: Wrap-up

Brad Chamberlain
University of Washington
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Algorithm Requirements

Space and **Time**:

- asymptotic analysis for primary effects
- evaluation of secondary effects
  - by inspection
  - by experimentation

Q: How fast/space-efficient is "good enough?"

(*e.g.*, O(*n*) was bad for `Delete()`, but O(*n*log*n*) was great for `Sort()`...)

A:

Criteria for Good Running Time

Your resources

– how much time/memory can you afford?

Nature of the problem

– some problems are just harder than others
(*e.g.*, sorting is harder than deletion)

Characteristics of your application

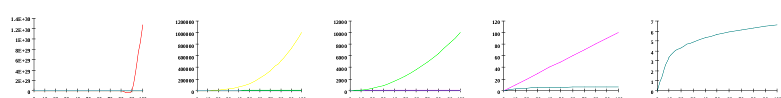
– what problem sizes/input sets will you typically be running on? (be sure to plan for the future)

Maintainability/Elegance

– this tends to dominate software development costs

Evaluating Running Time/Space

O(1)	– ideal
O(log$n$)	– generally as good as ideal
O(n)	– could be better, could be worse
O($n$log$n$)	– could be better, could be worse
O(n^2)	– could be better, could be worse
O(2^n)	– unusable



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Games Theoreticians Play

Prove that an algorithm is $\Omega(f(n))$ by nature

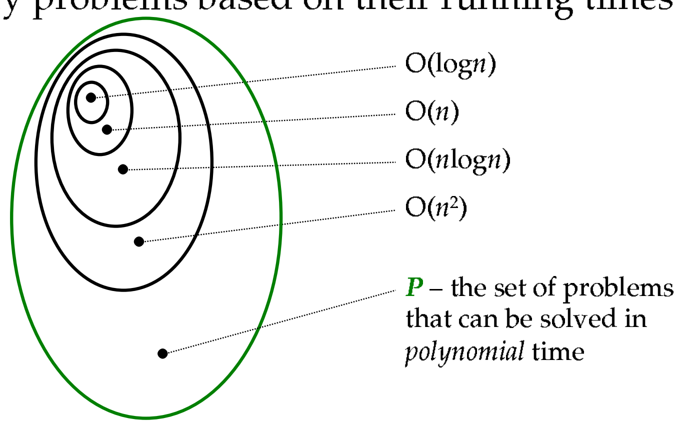
– *e.g.*, sorting using only comparison (<, >, ==) cannot be done in less than $n\log n$ time (Chapter 7)

What's wrong with this claim:

"I wrote a `FindMin()` operation that runs in $O(\log n)$ time on an unsorted list of integers"

More Games Theoreticians Play

Classify problems based on their running times



Observation

- Data is an attribute common to all programs
  - programs *process, manipulate, store, display, gather*
  - data may be *information*, *numbers*, *images*, *sound*
- Each program must decide how to store data
- Choice influences program at every level:
  - execution speed
  - memory requirements
  - maintenance (debugging, extending, etc.)

ADT Tensions

Ideal: a fast, elegant ADT that uses little memory

Generates tensions:

- time *vs.* space
- performance *vs.* elegance
- generality *vs.* simplicity
- one operation's performance *vs.* another's

The Myth of ADTs

Not a perfect black box:

- knowing how an ADT will be used can lead to a good choice of implementation
- also, knowledge of an ADT's implementation may change how a client uses it

But... ADTs are still a useful concept

Use motivates design

Course Goals

- To introduce several standard data structures
- To teach how data structures are evaluated
- To determine when each data structure is useful
- To give you the ability to design, build, and evaluate your own data structures