

Motivations of Data Structures and Algorithms

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March 3, 2020

Introduction of Algorithms

What is Algorithm?

descriptions to get something done
correctly/efficiently by computer

Five Criteria of Algorithm

input, output, definiteness, finiteness, effectiveness

getMinIndex with Sequential Search Algorithm

returns index to minimum element within array

Correctness Proof of Algorithm

e.g. loop invariance by mathematical induction
—discrete math helps!

Efficiency of Algorithm

knockout tournament for `getMinIndex`: not much faster overall,
but possibly faster if done in parallel

Expressing Algorithms with Pseudo Code

Pseudo Code for `getMinIndex`

pseudo code: “spoken language” of programming

Bad Pseudo Code: Too Detailed

goal of pseudo code: communicate efficiently

Bad Pseudo Code: Too Mysterious

goal of pseudo code: communicate correctly

Bad Pseudo Code: Too Abstract

goal of pseudo code: communicate effectively

Good Pseudo Code of `selSort`

no “formal definition” and depends on the speaker/listener

Introduction of Data Structures

What is Data Structure?

scheme of organizing data
within computer

How to Organize 200 Exam Sheets?

different use cases
⇒ different organization scheme (data structure)

Good Algorithm Needs Proper Data Structure

*if having data structure such that `getMinIndex` faster,
⇒ `Sort` also faster (we will see)*

algorithm :: data structure ~ recipe :: kitchen structure

Good Data Structure Needs Proper Accessing Algorithms: `get`, `insert`

rule of thumb for speed: often-`get` \Leftrightarrow “nearby”

Good Data Structure Needs Proper Maintenance

Algorithms: `construct`, `update`, `remove`

hidden “cost” of data structure: maintenance effort

Why Data Structures and Algorithms?

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use storage/computation resources properly \implies good program

Proper Use: Tradeoff of Different Factors

understand tradeoff \implies good program

Different Tradeoff on Different Platforms

important to learn other CS subjects

Programming \neq Coding

programming :: building house \sim coding :: construction work

C Programming versus DSA

moving from coding to designing