

CS140

- Who Am I?
- Who Are You?
- Course Overview
- Some Basics

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Course Overview

1. How to analyze algorithms
2. How to design algorithms
3. NP-completeness

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Course Requirements

- Homework
- Exams
- Class participation

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Course Requirements-Homework

- Posted on Monday and Wednesday
(Yes! Two assignments each week.)
- Monday assignment due Wednesday at noon,
Wednesday assignment due Friday at noon
- Solutions will be posted at due time so no late
homework will be accepted
- Your 3 lowest homework grades will be dropped
- Solutions should be prepared in LaTeX

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Course Requirements – Exams (Tentative Schedule)

- Exam I: Wed. 9/25
- Exam II: Wed. 9/8
- Final:

- Exams will be in-class, closed book

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Course Requirements – class participation

- Show up to class
- Speak up in class
- Hand in daily “worksheets”

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Advice

- Stay on top of things
- Seek help when necessary

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The Problem

Computational Problem: Specified by input/output pair

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Sorting

- Sorting Integers in Ascending Order (SIAO):
Input: A list of integers
Output: The input integers sorted in ascending order
- Example:
Input: 5,3,8,1,2
Output:

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The Algorithm

- Computational Problem: Specified by input/output pair.
- Algorithm: Well-defined sequence of computational steps that produce a correct output for every valid input.

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What should an algorithm for SIAO do?

- Example 1:
 - Input: 5,3,8,1,2
 - Output: 1,2,3,5,8
- Example 2:
 - Input: 3,a,5.27,mudder
 - Output: we don't care

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An Algorithm for SIAO?

Sort1(S)

While there are integers x and y in S such that x precedes y in S and $x > y$

Swap x and y in S

Return S

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Sort1 Example

Input: 5, 3, 8, 1, 2

Swap 3 and 2: 5, 2, 8, 1, 3

Swap 3 and 5: 3, 2, 8, 1, 5

Swap 3 and 2:

Swap 2 and 1:

Swap 3 and 2:

Swap 8 and 5:

Swap 5 and 3:

Stop

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Sort1 Example cont.

Input: 5, 3, 8, 1, 2

Swap 3 and 2: 5, 2, 8, 1, 3

Swap 3 and 5: 3, 2, 8, 1, 5

Swap 3 and 2: 2, 3, 8, 1, 5

Swap 2 and 1: 1, 3, 8, 2, 5

Swap 3 and 2: 1, 2, 8, 3, 5

Swap 8 and 5: 1, 2, 5, 3, 8

Swap 5 and 3: 1, 2, 3, 5, 8

Stop

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Is Sort1 an algorithm?

Is Sort1(S) well-defined?

No! We need to specify a selection rule.

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Software Development

The problem:
Huh?

The idea:
A-ha!

The program:
Ta-da!



The algorithm exists somewhere between
a-ha and ta-da.

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An Algorithm for SIAO?

Sort2(S)

Assume a fixed order on pairs of elements in S

While there are integers x and y in S such that x precedes y
in S and $x > y$

 Choose first pair x, y that is out of order

 Swap x and y in S

Return S

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Is Sort2 an algorithm?

Is Sort2(S) well-defined? Yes.

Does it produce the correct output for
any valid input?

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Proof of correctness

- When the algorithm halts S is sorted.
- The algorithm halts on all input.
Claim: The number of out-of-order pairs in S decreases with each swap.

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Sort2 Example revisited

Input: 5, 3, 8, 1, 2

Swap 3 and 2:	5, 2, 8, 1, 3	6
Swap 3 and 5:	3, 2, 8, 1, 5	5
Swap 3 and 2:	2, 3, 8, 1, 5	4
Swap 2 and 1:	1, 3, 8, 2, 5	3
Swap 3 and 2:	1, 2, 8, 3, 5	2
Swap 8 and 5:	1, 2, 5, 3, 8	1
Swap 5 and 3:	1, 2, 3, 5, 8	0
Stop		

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Is Sort2 a good algorithm?

- Is it easy to understand?
- Is it easy to implement?
- Is it fast?
- Is it space-efficient?

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How fast is Sort2?

- At most n^2 comparisons are used to find an out of order pair.
- At most n^2 pairs are initially out of order.

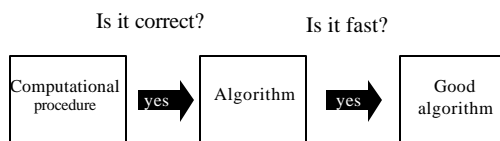
Sort2 is $O(n^4)$.

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CS140: Two questions



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