CSSE 473 - DESIGN AND ANALYSIS OF ALGORITHMS

Day 1

Introducing Yourselves

Interview someone near you (2 min)

You'll introduce them to us

Questions
◦ Preferred Name
  ◦ Preferred Pronouns (she/her, he/him, they/them, etc.)
◦ Major
◦ What you did over break?
◦ (Fun) Fact about you
◦ % battery on their phone

Ways of organizing algorithms

- By area of application (230 approach) e.g.
  ◦ Sorting algorithms
  ◦ Search algorithms
  ◦ Algorithms based on what data structure is used
  ◦ Tree algorithms
  ◦ Graph algorithms
  ◦ Heap algorithms

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Ways of organizing algorithms

- By techniques used (473 approach), e.g.
  - Brute force
  - Decrease-and-Conquer
  - Divide-and-Conquer
  - Transform-and-Conquer
  - Space and Time Trade-Offs
  - Dynamic Programming
  - Greedy Technique
  - Iterative Improvement

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Definition of Algorithm

(Levitin definition) An *algorithm* is a sequence of unambiguous instructions for solving a problem, i.e., for obtaining a required output for any legitimate input in a finite amount of time.

Can be specified in code, pseudo-code, or plain English.

What Makes a Good Algorithm?

Time efficiency

Space efficiency

Simplicity
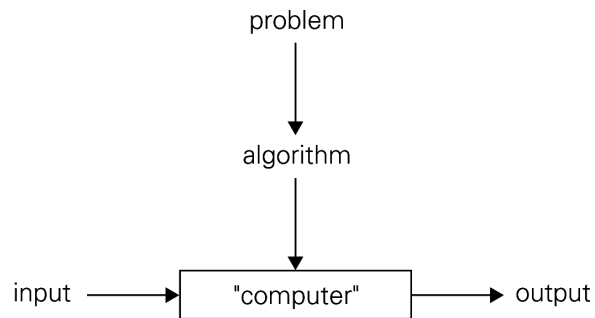
Generality

Optimality

Algorithm in Context

problem

↓

algorithm

↓

input → "computer" → output

FIGURE 1.1 Notion of algorithm

Algorithm Design Process

Understand the problem

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Decide on:
computational means,
exact vs. approximate solving,
data structure(s),
algorithm design technique

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Design an algorithm

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Prove correctness

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Analyze the algorithm

↓

Code the algorithm

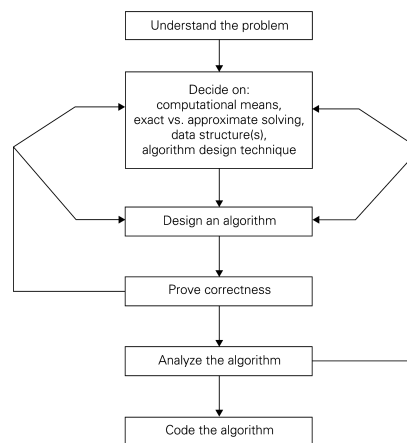**FIGURE 1.2** Algorithm design and analysis process

A Puzzle

There are four people who want to cross a rickety bridge.

They all begin on the same side.

They have 17 minutes to get them all across to the other side.

It is night, and they have one flashlight.

A maximum of two people can cross the bridge at one time.

Any party that crosses, either one or two people, must have the flashlight with them.

The flashlight must be walked back and forth; it cannot be thrown, for example.

Person 1 takes 1 minute to cross the bridge,

person 2 takes 2 minutes,

person 3 takes 5 minutes, and

person 4 takes 10 minutes.

A pair must walk together at the rate of the slower person's pace.