

Lesson 3: Algorithms

Book acknowledgment:

“Introduction to Algorithms” by Cormen, Leiserson, Rivest, and Stein. *Third Edition*

Goals

- Introduce definition, purpose, and outline of algorithms
- Study some example algorithms
- Provide some preliminary algorithmic analysis

1 COVID-19 Contact Tracing Example

Suppose that there is an outbreak of COVID-19 within a small group of the 1st company. We want to conduct a contact tracing study to see who needs to quarantine. Consider the following details.

- We know that Professor Curry contracted COVID-19. (I don’t have COVID-19. This is just an example.)
- We want to study a small group of ten possible mids that *could* because they are supposed to be traveling on an MO tomorrow. If they are found in the contact tracing tree, then they are unable to go on the MO. Set of students {Jim, Dre, Sean, Connor, Ana, Caroline, Mike, Jayla, Xavier, Ashley}.
- We know that Jayla, Xavier, and Caroline were all in Prof Curry’s office without masks on.
- Jayla, Caroline, and Ana are all roommates.
- Xavier and Mike are roommates.
- Mike, Xavier, and Connor all ate lunch inside together today.

1. Now, who can and cannot go on the MO?

2. Try drawing pictures to help you visualize this problem.

3. What steps did you take?

2 What is an Algorithm?

How would you define an algorithm?

Definition:

An *algorithm* is any well-defined procedure (or set of steps) that takes some (s) and produces some ***output*** (s) . An algorithm is a sequence of steps that transform the input into the output.”

What algorithms can you think of?

An algorithm can also be viewed as a tool for solving a defined and specific computational problem. The problem statement specifies the desired input/output relationship. The algorithm describes a specific computational procedure for achieving that input/output relationship.

Example:

Assume that you need to sort a sequence of numbers into non-decreasing order. This is commonly referred to as the Sorting Problem.

What is the input for this problem?

What is the output for this problem?

What is the purpose of an algorithm for solving this problem?

What types of problems can be solved using algorithms?

Parts of an algorithm:

- Variables
 - What values can change?
- Parameters
 - What values must remain the same?
 - *These are often the inputs.*
- Sequencing
 - In what order should tasks be performed?
- Conditionals
 - If X occurs, then Y must be performed.
 - ◊ *If*-statements
 - ◊ *While*-statements
 - ◊ *Do*-statements
- Repetition
 - When some set of tasks must be repeatedly performed.
- Subroutines
 - You can think of these as subtasks.

3 Group Examples

For the following examples, identify each of the aforementioned parts of an algorithm for solving the problem.

Tying your shoes

Finding a minimum value among a set of numbers

Service Selection Assignments

4 Written Steps

Determine the maximum among values x , y , and z .

1. If $x > y$, then proceed to Step 2 Otherwise, proceed to Step 3.
2. If $x > z$, then return x as the maximum value. Otherwise, return z as the maximum value.
3. If $y > z$, then return y as the maximum value. Otherwise, return z as the maximum value.

5 Pseudocode

You can think of pseudocode is a transition between writing out the steps and the code of an algorithm.

Algorithm 1 Determine maximum among values x , y , and z

```
if  $x > y$  then
  if  $x > z$  then
    Maximum value =  $x$ .
  else
    Maximum value =  $z$ .
  end if
else
  if  $y > z$  then
    Maximum value =  $y$ .
  else
    Maximum value =  $z$ .
  end if
end if
```

Now, Let's Code This!