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A Common-Sense Guide to Data Structures and Algorithms

Level Up Your Core Programming Skills

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Jay Wengrow

edited by Brian MacDonald

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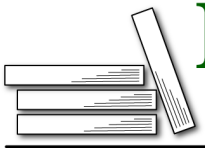

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Publisher: Andy Hunt
VP of Operations: Janet Furlow
Executive Editor: Susannah Davidson Pfalzer
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Recursion in Action

While previous examples of the NASA countdown and calculating factorials can be solved with recursion, they can also be easily solved with classical loops. While recursion is interesting, it doesn't really provide an advantage when solving these problems.

However, recursion is a natural fit in any situation where you find yourself having to repeat an algorithm within the same algorithm. In these cases, recursion can make for more readable code, as you're about to see.

Take the example of traversing through a filesystem. Let's say that you have a script that does something with every file inside of a directory. However, you don't want the script to only deal with the files inside the *one* directory—you want it to act on all the files within the *subdirectories* of the directory, and the subdirectories of the subdirectories, and so on.

Let's create a simple Ruby script that prints out the names of all subdirectories within a given directory.

```
def find_directories(directory)
  Dir.foreach(directory) do |filename|
    if File.directory?("#{directory}/#{filename}") &&
    filename != "." && filename != ".."
      puts "#{directory}/#{filename}"
    end
  end
end

# Call the find_directories method on the current directory:
find_directories(".")
```

In this script, we look through each file within the given directory. If the file is itself a subdirectory (and isn't a single or double period, which represent the current and previous directories, respectively), we print the subdirectory name.

While this works well, it only prints the names of the subdirectories *immediately* within the current directory. It does not print the names of the subdirectories *within* those subdirectories.

Let's update our script so that it can search one level deeper:

```
def find_directories(directory)
  # Loop through outer directory:
  Dir.foreach(directory) do |filename|
    if File.directory?("#{directory}/#{filename}") &&
    filename != "." && filename != ".."
      puts "#{directory}/#{filename}"
```

```
      # Loop through inner subdirectory:
      Dir.foreach("#{directory}/#{filename}") do |inner_filename|
        if File.directory?("#{directory}/#{filename}/#{inner_filename}") &&
        inner_filename != "." && inner_filename != ".."
          puts "#{directory}/#{filename}/#{inner_filename}"
        end
      end

    end
  end
end

# Call the find_directories method on the current directory:
find_directories(".")
```

Now, every time our script discovers a directory, it then conducts an identical loop through the subdirectories of *that* directory and prints out the names of the subdirectories. But this script also has its limitations, because it's only searching two levels deep. What if we wanted to search three, four, or five levels deep? What if we wanted to search as deep as our subdirectories go? That would seem to be impossible.

And *this* is the beauty of recursion. With recursion, we can write a script that goes arbitrarily deep—and is also simple!

```
def find_directories(directory)
  Dir.foreach(directory) do |filename|
    if File.directory?("#{directory}/#{filename}") &&
    filename != "." && filename != ".."
      puts "#{directory}/#{filename}"
      find_directories("#{directory}/#{filename}")
    end
  end
end

# Call the find_directories method on the current directory:
find_directories(".")
```

As this script encounters files that are themselves subdirectories, it calls the find_directories method upon that very subdirectory. The script can therefore dig as deep as it needs to, leaving no subdirectory unturned.

To visually see how this algorithm applies to an example filesystem, examine the diagram on page 7, which specifies the order in which the script traverses the subdirectories.

Note that recursion in a vacuum does not necessarily speed up an algorithm's efficiency in terms of Big O. However, we will see in the following chapter that recursion can be a core component of algorithms that *does* affect their speed.