

how computers put things in order

Have you ever wondered how computers can put things like words and numbers in order so quickly? It's pretty easy for small lists, but it's much harder to put all the words in the world's first dictionary in order! Or how about the names in the telephone book? Can you imagine looking for your friend's number in a telephone book that wasn't in alphabetical order?

Luckily, there are some special ways the computer can put things in order, and some of these are quite fast even for really big lists. We'll try out some sorting techniques in this experiment.

What You Need

We'll try sorting some books by how many pages they have. That way we'll have a list of these books with the shortest one at the beginning, and the longest one at the end. Each book in between will be longer than the book before it.

All you need to find is **eight books** from anywhere in your house. Try finding some short ones, some long ones, and maybe some really heavy ones (like the phone book!).

Find the Shortest Book

Look at each of your books one by one to find the shortest one.

Hint: You may want to keep track of the shortest book as you go along, and compare its length (number of pages) to the length of each new book to see if there is new shortest book.

Did you notice you had to look at all the books to find the shortest one? How would having a list of books from shortest to longest help you find the shortest faster?

Sort By Increasing Length

Think about it: How would you figure out the order of your items if you wanted to sort

them by **increasing length** (fewest number of pages to the largest number of pages)?

Try it: Pick three of your books. By only comparing the number of pages in two books at a time, place the books in order of increasing length.

A little harder: Now try sorting all eight books in order of increasing length with any method you like.

Do It Again With 'Quicksort'

Now let's see how a computer might sort your items using a method called 'Quicksort' (sounds fast, doesn't it?).

Here's how to do it:

Pick one book at random and check how many pages it has.

Now we're going to make two smaller piles on either side of the random book. Check the number of pages in each of the other books and do one of two things:

1. If the book is shorter, place it in a pile to the left of your randomly chosen book.
2. If the book is longer, place it in a pile to the right of your randomly chosen book.

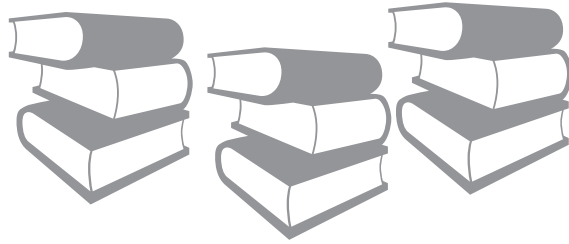
It's ok if one pile is empty. (What would this mean about the book you randomly chose?)

Now repeat the previous step for the pile of books to the left of the random book, then the pile to the right of it. Keep doing this with all the smaller piles until each pile has only one (or zero) books in it.

When making and sorting a new pile, it's important that you leave all other books in place (otherwise, you will not end up with all your books placed in increasing length). Take a look at the picture on the next page to see what how this works.

When you are done, your objects will be in the right order, like magic!

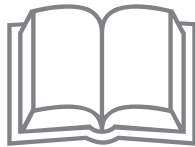




Pick a random book from the pile



Shorter books go on the left



This book stays put



Longer books go on the right

Choose a random book from this mini-pile and put it in the middle of this space. Then put the shorter books to the left, and the longer books to the right, but still in this space. Repeat with any piles with more than one book.

Choose a random book from this mini-pile and put it in the middle of this space. Then put the shorter books to the left, and the longer books to the right, but still in this space. Repeat with any piles with more than one book.

What's It All About?

You probably noticed that Quicksort was a lot faster than the first way you sorted your items. You probably made fewer comparisons between the weights of your objects, right? Even though we only used eight items this time, the faster way of sorting the Quicksort way would be super helpful when working with, say, one hundred items.

Computer scientists are always looking for new ideas for working with huge lists of stuff, which can sometimes have as many as one million items! They want to know how computers can efficiently sort the list, search in it, and figure out other useful things.

And the coolest thing is that you don't even need a computer to come up with new ways of sorting objects. You can do it anywhere with any item, just like you did now!

This activity was adapted from a CS Unplugged activity.

If you happen to have access to a computer, you can find more activities at <http://www.csunplugged.org/>.