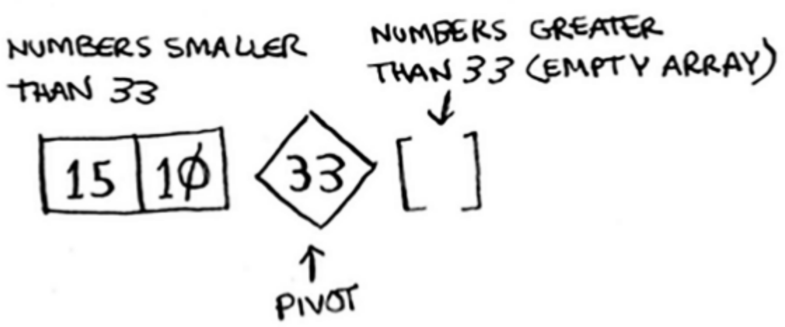
Quicksort

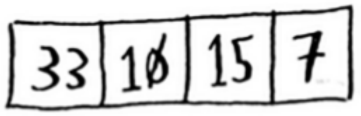
- When you get a new problem, you don't have to be stumped. Instead, you can ask, "Can I solve this if I use divide and conquer?"
- Quicksort is an example of divide-and-conquer, and it is much more faster than selection sort.
- Binary search was also an example of divide-and-conquer. From this viewpoint, we can say that they are similar, since we split the problem into smaller parts.
- Lets use quicksort to sort an array. What is the simplest array that a sorting algorithm can handle? Well, some arrays don't need to be sorted at all, such as empty arrays and arrays with just one element will be the **base case**:

```
def quicksort(array):
  if len(array) < 2:
    return array
```

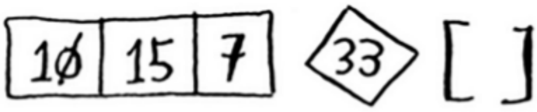
- For arrays with more than 2 items, we have to pick an item from the array, we call it **pivot**.
- Now find the elements smaller than the pivot and the elements larger than the pivot:



- This is called **partitioning**. Now you have:
  - A sub-array of all the numbers less than the pivot
  - The pivot
  - A sub-array of all the numbers greater than the pivot
- The two sub-arrays aren't sorted. They're just partitioned. But if they were sorted, then sorting the whole array would be pretty easy. If the sub-arrays are sorted, then you can combine the whole thing like this— left array + pivot + right array —and you get a sorted array. How do you sort the sub-arrays? Well, the quicksort base case already knows how to sort arrays of two elements (the left sub-array) and empty arrays (the right sub-array).
- What about an array of four elements?



Suppose you choose 33 as the pivot again.



The array on the left has three elements. You already know how to sort an array of three elements: call quicksort on it recursively.