Merge Sort Algorithm – part 2

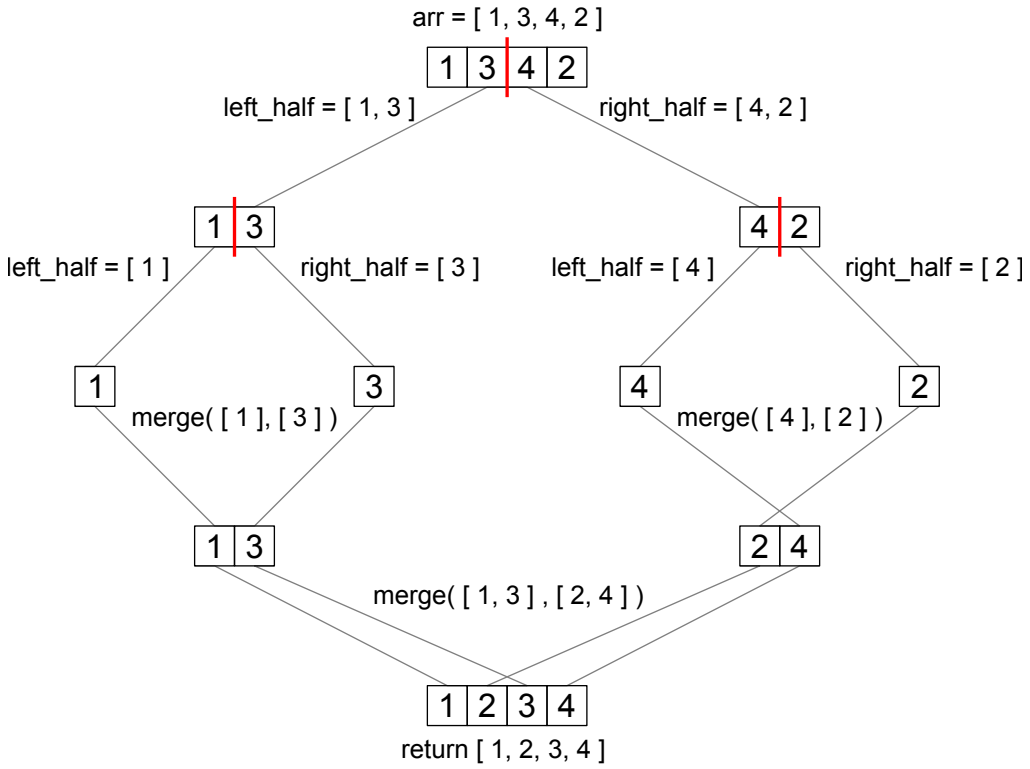
The *merge sort* algorithm is a recursive algorithm. As with all recursive algorithms, the problem is solved by breaking it down into a similar, smaller problem, then combining the solutions of those smaller problems into the solution for the larger problem. We already looked at an algorithm, `merge`, that merges two sorted arrays into a larger sorted array. This is used for the larger merge sort algorithm, the steps for which are:

- Break the list into two smaller lists (usually break it approximately in half)
- Call `merge_sort` to sort each of the smaller lists.
- Call `merge` to merge the two sorted lists into the final sorted list.

The base case (when to stop breaking down the problem) is when there is only a single element in the list – because a list with a single item is necessarily sorted. Examine the given code for `merge_sort`.

```
1  def merge_sort(arr):
2      """Sort a list using the merge sort algorithm."""
3      # Base case: a list of 0 or 1 elements is already sorted
4      if len(arr) <= 1:
5          return arr
6      # Divide the list into two halves
7      mid = len(arr) // 2
8      left_half = arr[:mid]
9      right_half = arr[mid:]
10     # Recursively sort both halves
11     left_sorted = merge_sort(left_half)
12     right_sorted = merge_sort(right_half)
13     # Merge the sorted halves
14     return merge(left_sorted, right_sorted)
```

Examine the diagram showing the merge sort algorithm operating on an example list with four elements:



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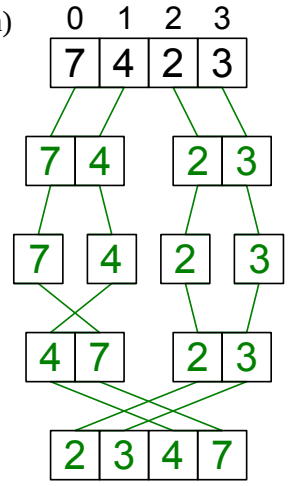
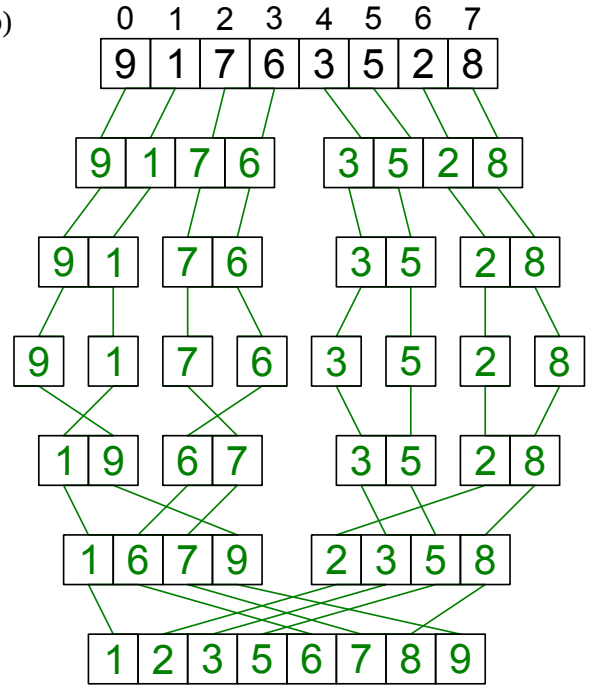
1. Sort the lists using the merge sort algorithm.

a)



b)



c)