Merge Sort

- divide and conquer algorithm – involves splitting the array you want to sort into a bunch of smaller arrays

- usually implemented using recursion

- can be written using loops

- involves two phases: Splitting and Merging

- Time complexity O(nlogn) – base 2

- Stable algorithm

Splitting Phase

- Start with an unsorted array
- Divide the array into two arrays, which are unsorted
  The first array is the left array and the second array is the right array
- Split the left and arrays into two arrays each
- Keep splitting until all the arrays have only one element each – the are sorted arrays

Merge Phase

- Merge every left / right pair of sibling arrays into a sorted array
- After the first merge, we'll have a bunch of 2 element sorted arrays
- Then merge those sorted arrays (left / right siblings) to end up with a bunch of 4 element sorted arrays
- Repeat until you have a single sorted array
- Not in-place. Uses temporary arrays

Merging process

- We marge sibling left and right arrays
- We create temporary array large enough to hold all the elements int the arrays we're merging
- We set I to the first index of the left array, and j to the first index of the right array
- We compare left[i] to right[j]. If left us smaller, we copy it to the temp array and increment j by j
- We repeat this process until all elements in the two arrays have been processed
- At this point, the temporary array contains the merged values in sorted order
- We then copy this temporary array back to the original input array, at the correct position
- If the left array is at positions x to y, and the right array is at positions y + 1 to z, then after the copy, positions x to z will be sorted in the original array

SI – start index

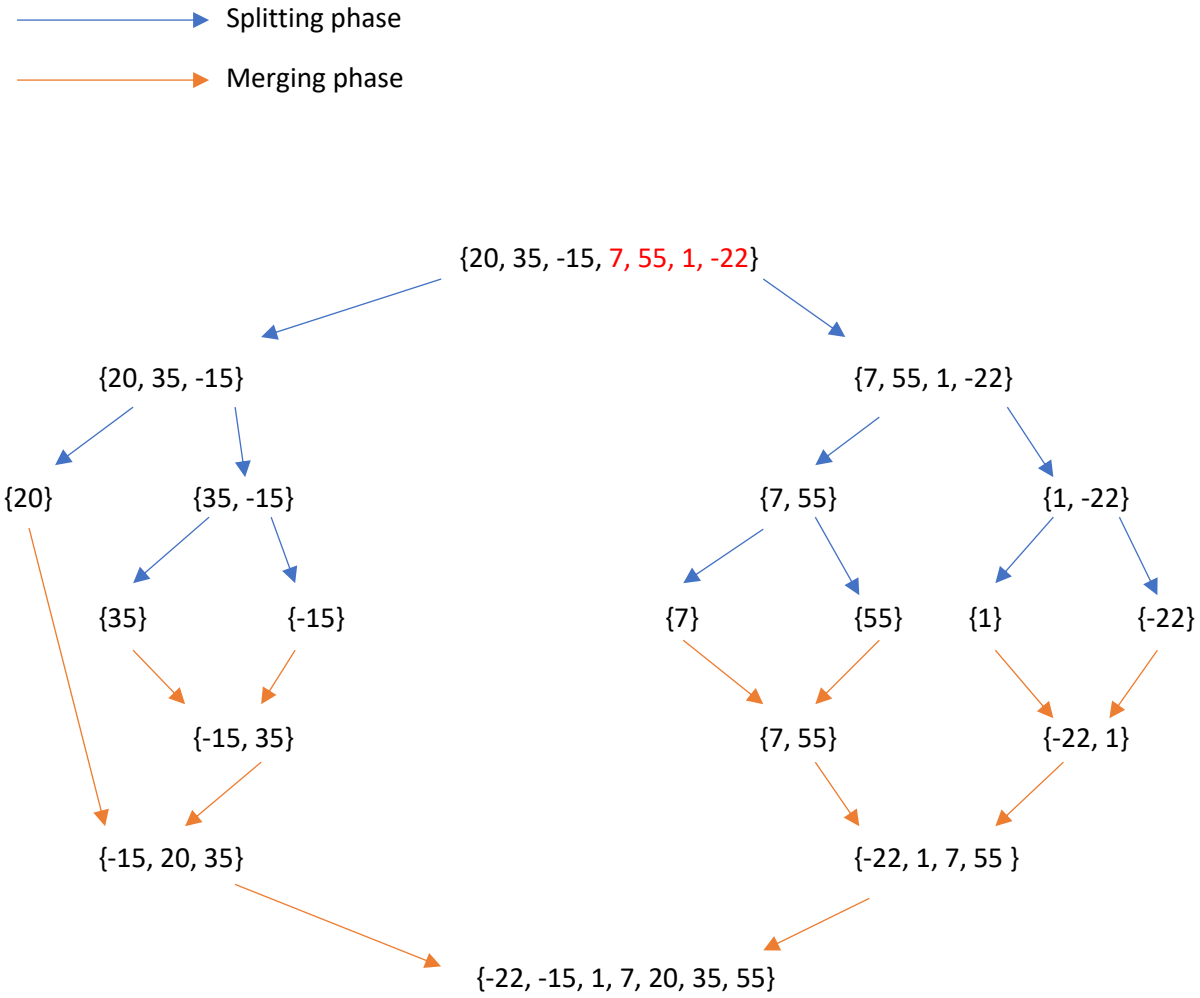
EI – end index

SPLT L – split left array

SPLT R – split right array

MRG - merge

	0	1	2	3	4	5	6	SI, EI	Desc	TEMP ARRAY
Step	20	35	-15	7	55	1	-22	0, 7		
1	20	35	-15	7	55	1	-22	0, 3	SPLT L	
2	20	35	-15	7	55	1	-22	1, 2	SPLT R	
3	20	35	-15	7	55	1	-22	3, 7	SPLT R	
4	20	35	-15	7	55	1	-22	3, 5	SPLT L	
5	20	35	-15	7	55	1	-22	5, 7	SPLT R	
6	20	35	-15	7	55	1	-22	1 , 2	MRG	{-15, 35}
7	20	-15	35	7	55	1	-22	0 – [1,2]	MRG	{-15,20,35}
8	-15	20	35	7	55	1	-22	3 , 4	MRG	{7,55}
9	-15	20	35	7	55	1	-22	5, 6	MRG	{-22,1}
10	-15	20	35	7	55	-22	1	[3,4]-[5,6]	MRG	{-22,1,7,55}
11	-15	20	35	-22	1	7	55	[0,2]-[3,6]	MRG	{-22,-15,1,7,20,35,55}
12	-22	-15	1	7	20	35	55	SORTED		


Splitting phase
Merging phase
{20, 35, -15, 7, 55, 1, -22}
{20, 35, -15}
{7, 55, 1, -22}
{20}
{35, -15}
{7, 55}
{1, -22}
{35}
{-15}
{7}
{55}
{1}
{-22}
{-15, 35}
{7, 55}
{-22, 1}
{-15, 20, 35}
{-22, 1, 7, 55 }
{-22, -15, 1, 7, 20, 35, 55}