**Discrete Mathematics**
Recurrence Relation

Introduction to Merge sort – 2

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I'm sure you all gave it a thought, and I'm sure you are even tried solving it, it is not at all difficult, so when you have 2 sorted lists, how do you merge these things is what we asked with a teachers puzzle that we said just now.

Let me explain with an example, let the first sorted list be 8, 6, 1, 3, 4,
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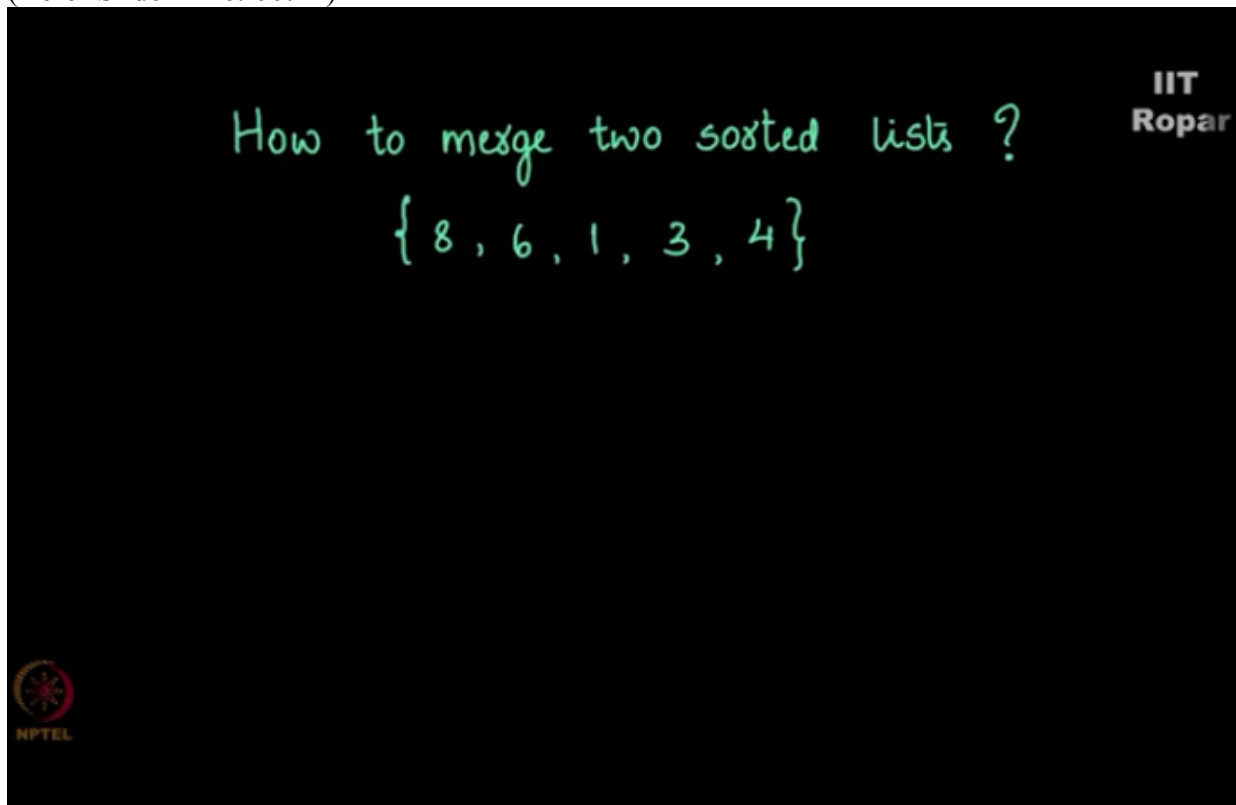
and the second list, I'm not sorted, unsorted 8, 6, 1, 3, 4, and the second unsorted list be 2, 7, 5, 9, 10, 5 and 5 totally 10,
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How to merge two sorted lists ?

$\{8, 6, 1, 3, 4\}$

$\{2, 7, 5, 9, 10\}$

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and assume that teacher gives 8, 6, 1, 3, 4 for Ram, I said 16 and 16, but for simplicity sake let me take only 5 and 5. 8, 6, 1, 3, 4 when sorted Ram writes this down as 1, 3, 4, 6, 8,
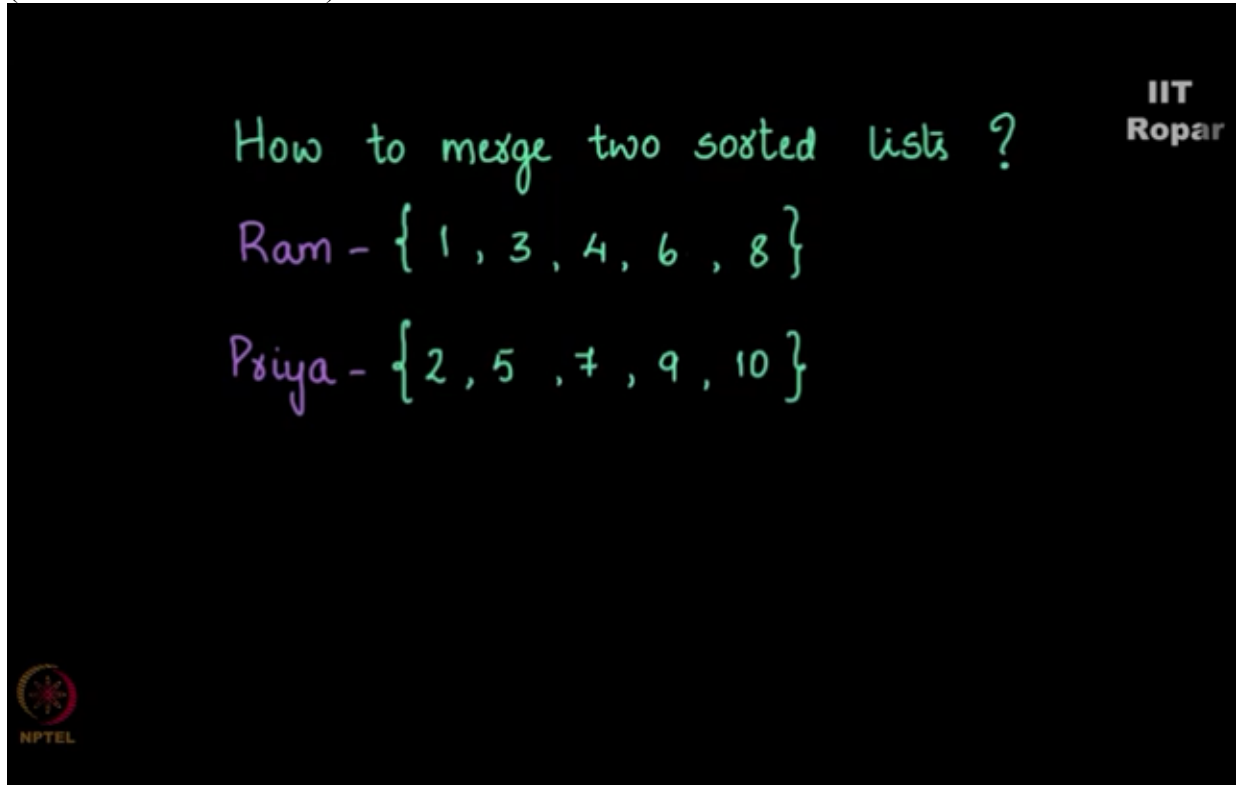
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How to merge two sorted lists ?

Ram – $\{1, 3, 4, 6, 8\}$

$\{2, 7, 5, 9, 10\}$

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isn't that the sorted order? By hook or crook he sorts it like this, and then Priya takes 2, 7, 5, 9, 10 and sorts it, which becomes 2, 5, 7, 9, 10.
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Now here are 2 lists that are sorted, 2 bunch of let's say answer scripts that are sorted, now how do you merge these two things? Let me employ a nice technique, look at this 1 and 2 the top most,
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How to merge two sorted lists ?

Ram - {①, 3, 4, 6, 8}

Priya - {②, 5, 7, 9, 10}

the least one should be one of the two, correct, why? Think about it, you should answer it, right, the least should be one of the these two, 1 and 2, so 1 is the least I write that down here and say the first element of the bigger list in its sorted order is confirmed, it is going to be 1, the first one will be 1, the next one is I write down 2 here and strike 2 off, I struck one off, I'm striking 2 off, and then I see that it is 3 on this side and 5 on this side, which one is the least amongst these two, I compare and I get 3, I put 3 next, and then now I have to compare 4 and 5 which is the smaller one here? 4, I put 4 here, and then 6 and 5 which is smaller? 5 is smaller, I put 5 here, and then 6, then 7, and then 8, and then 9, and then 10, I purposefully have avoided explaining in detail here,
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How to merge two sorted lists?

Ram - {1, 3, 4, 6, 8}

Priya - {2, 5, 7, 9, 10}

{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}

I want you to read between the lines of my explanation, do you see that whenever we keep our, let's say fingers on the first two numbers and move this fingers as and when we pull them down in the universal sorted list, your finger definitely goes down whenever you compare two numbers, and ultimately you merge these two lists onto a mega list.

Now let me ask this question, how many transactions did I take? How much of work did I do to merge two lists? First of all I'm going to assume that the lists are sorted, I'm not going to look at the work involved in sorting this two lists, assume I've given 2 sorted list, how do I merge them? What is the amount of work involved? The amount of work simply involves comparing an element on this list with an element on this list and picking a number and putting it down, every time I compare I get a number, right, so how much of work do I do?
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Is equivalent to how many comparisons you make, you compare and you pull an element and then put it down, correct, whenever you compare you get one element in the mega list, the universal, bigger list, correct, so if there are 10 elements here you have done 10 comparisons, right, definitely in 10 comparisons you would have got all these numbers.

So let us look at the previous example, I said the teacher gives Ram 16 answer scripts, and the teacher gives Priya 16 answer scripts, and Ram takes some time to sort it, we will not worry about how much time he takes to sort it, he sorts it, Priya sorts the 16 numbers, and then Ram and Priya surrender their two sorted answer scripts to madam and ma'am what she does is she merges these two things, how much effort does she put forth? She does 32 operations, correct, just the way we saw that 5 and 5 elements if they are sorted to merge them you require 10 amount of transactions, if it is 16 and 16 you require 32 amount of transactions, right, if you have n elements this side and n elements this side in sorted order, to merge them you require $2n$, $n+n$, $2n$ number of transactions, think about it.
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Ram — 16   Priya — 16

32 operations

2n transactions