

Execution of Merge Sort and Quick Sort

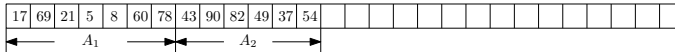
Junhao Gan

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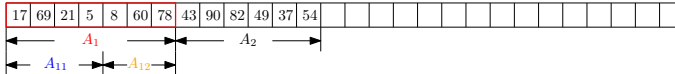
Merge Sort

Next, we will trace the execution of this algorithm on the following input:

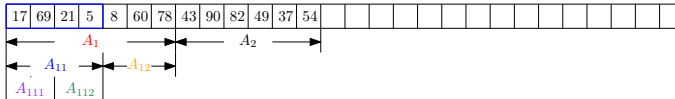
17	69	21	5	8	60	78	43	90	82	49	37	54																
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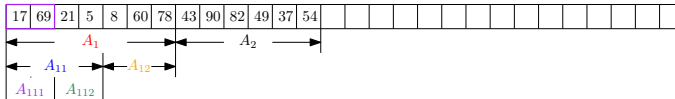
Control moves to A_1 :



Then to A_{11} :

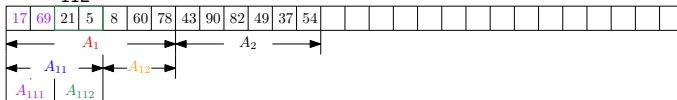


To A_{111} :

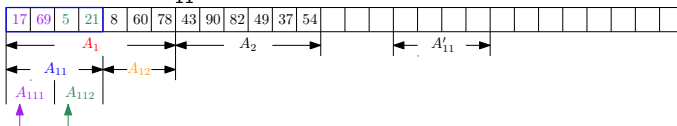


Different from the lecture, here we end the recursion when at most 2 elements are left.

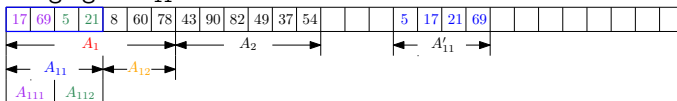
To A_{112} :



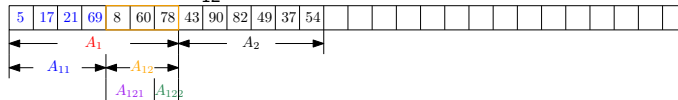
Backtrack to A_{11} :



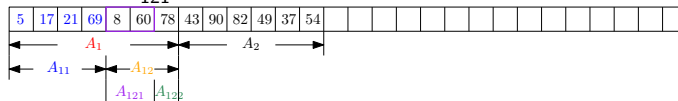
Merging at A_{11} :



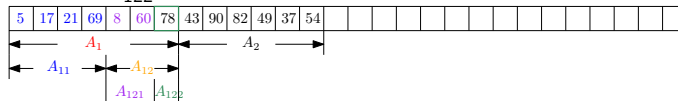
Control now at A_{12} :



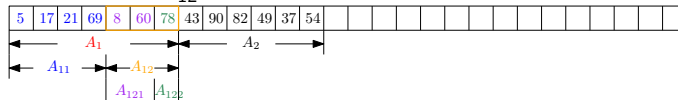
Moved to A_{121} :



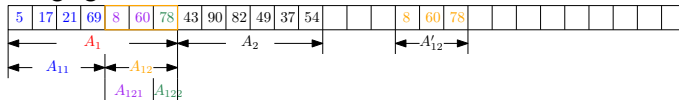
Then to A_{122} :



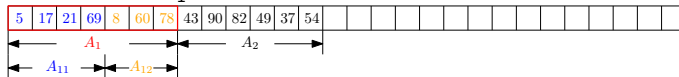
Backtrack to A_{12} :



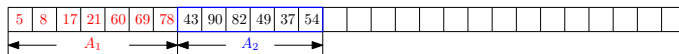
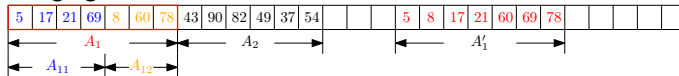
Merging:



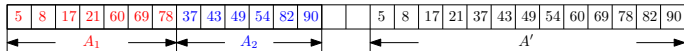
Backtrack to A_1 :



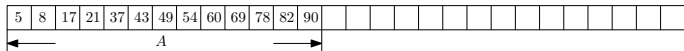
Merging:



Then, the algorithm sorts A_2 in the same manner (omitted). Now it backtracks to A , and performs merging there:



The end:



Quick Sort

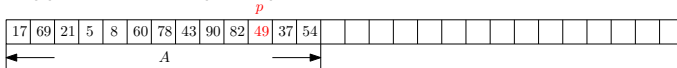
Now, we trace the execution of quick sort on the same example.

Recall:

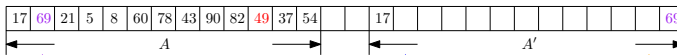
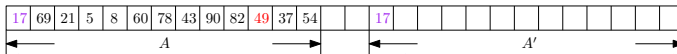
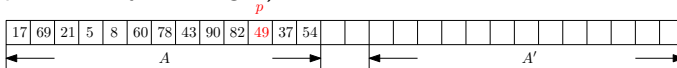
In the inductive cases, the quick sort algorithm runs the following steps:

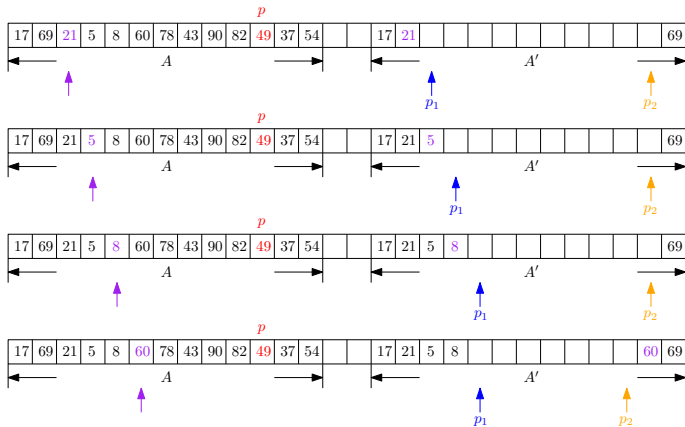
- Randomly pick an integer p in A – call it the **pivot**.
 - This can be done in $O(1)$ time using $\text{RANDOM}(1, n)$.
- Re-arrange the integers in an array A' such that:
 - All the integers **smaller** than p are positioned **before** p in A' .
 - All the integers **larger** than p are positioned **before** p in A' .
- Sort the part of A' before p recursively.
- Sort the part of A' after p recursively.

Suppose that the pivot picked is 49:

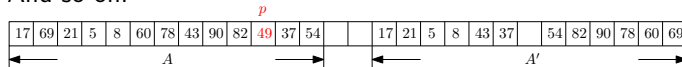


Now distribute the elements by comparing them to 49 (showing one possible way of doing it):

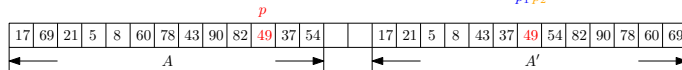




And so on:

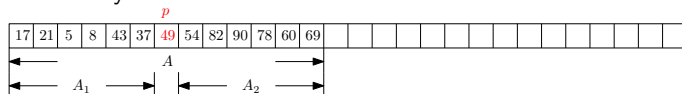


p_1 p_2

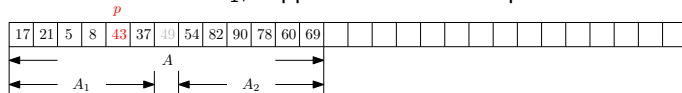


p_1 p_2

Now ready for recursion:



Control moved to A_1 ; suppose that the next pivot is 43:



p

p _____

p

5	8	17	37	21	43	49	54	82	90	78	60	6
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[illegible]

Diagram illustrating the construction of a sequence A from a sequence of numbers. The sequence is: 5, 8, 17, 21, 37, 43, 49, 54, 82, 90, 78, 60, 69. The number 78 is highlighted in red. Above the sequence, a red p is shown. Below the sequence, two arrows labeled A_1 and A_2 are shown, indicating the construction of the sequence A .

Finally, backtrack to A :

[illegible]

Done.