HUST

ĐẠI HỌC BÁCH KHOA HÀ NỘI

HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY

ONE LOVE. ONE FUTURE.

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Applied Algorithm Lab

Inversions

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Inversions

- Count the number of inversions (số cặp nghịch thế) of a permutation
- Input: a sequence of integers $a_1, a_2, \ldots, an$.
- Output: The number of pairs (i, j) that $i < j$ and $a_i > a_j$

- Example

stdin	stdout
6 3 2 4 5 6 1	6

Inversions

- Idea to solve #1: Brute-force from left -> right
  - At each element: count number of its right elements smaller than it -> number of inversions
  - Complexity: $O(n^2)$

Inversions

- Idea to solve #2: similar to merge sort
  - Fix the code mergeSort to sort and count inversions at the same time
  - Idea of mergeSort(int left, int right):
    - divide the array into 2 parts
    - Sort the subarray (left, mid) and subarray (mid +1, right)
    - Merge the two subarrays
    - Complexity: O(n log n)

Inversions

- Idea to solve #2: similar to merge sort
  - Code Merge sort:
  - Fix the code mergeSort to sort and count inversions at the same time

```
void mergeSort(int left, int right) {
    if (right <= left) return;
    int mid = (left + right) / 2;
    mergeSort(left, mid);
    mergeSort(mid + 1, right);

    int i = left, j = mid + 1, k = left;
    while (i <= mid && j <= right) {
        if (a[i] <= a[j]) {
            temp[k++] = a[i++];
        } else {
            temp[k++] = a[j++];
        }
    }
    while (i <= mid) temp[k++] = a[i++];
    while (j <= right) temp[k++] = a[j++];

    for (int i = left; i <= right; i++)
        a[i] = temp[i];
}
```

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THANK YOU !