



## 5. DIVIDE AND CONQUER

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- ▶ *merge and count demo*

Lecture slides by Kevin Wayne

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<http://www.cs.princeton.edu/~wayne/kleinberg-tardos>

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A

3	7	10	14	18
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sorted list B

2	11	16	17	23
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# Merge and count demo

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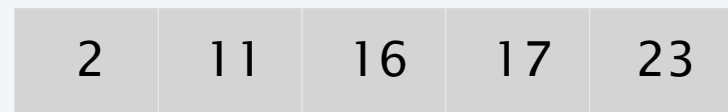
Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A

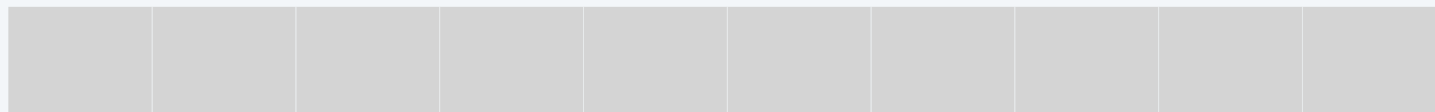


sorted list B



compare minimum entry in each list: copy 2 and add x to inversion count

sorted list C



$x = 5$

inversions = 0

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B

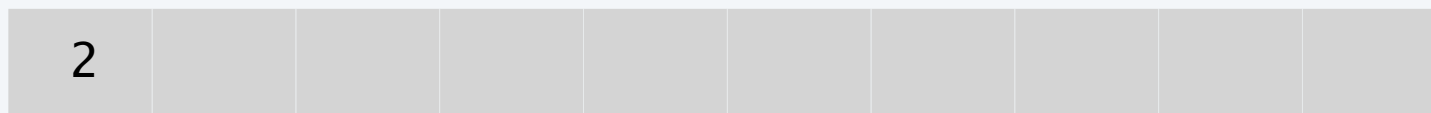


5



compare minimum entry in each list: copy 3 and decrement  $x$

sorted list C



$x = 5$

inversions = 5

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B

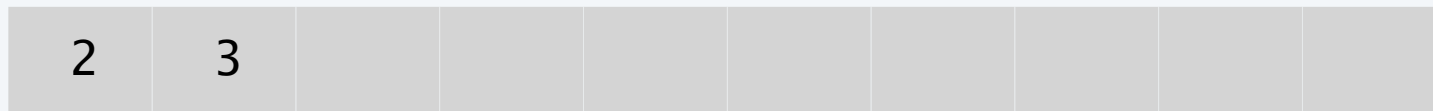


5



compare minimum entry in each list: copy 7 and decrement  $x$

sorted list C



$x = 4$

inversions = 5

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5



compare minimum entry in each list: copy 10 and decrement  $x$

sorted list C



$x = 3$

inversions = 5

# Merge and count demo

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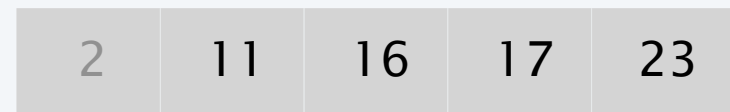
Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B

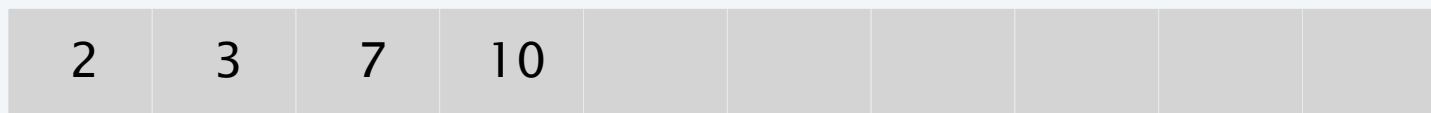


5



compare minimum entry in each list: copy 11 and add x to increment count

sorted list C



$x = 2$

inversions = 5

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5

2



compare minimum entry in each list: copy 14 and decrement  $x$

sorted list C



$x = 2$

inversions = 7



# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5

2



compare minimum entry in each list: copy 16 and add  $x$  to increment count

sorted list C



$x = 1$

inversions = 7

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5

2

1



compare minimum entry in each list: copy 17 and add  $x$  to increment count

sorted list C



$x = 1$

inversions = 8

# Merge and count demo

---

Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5

2

1

1

↑

compare minimum entry in each list: copy 18 and decrement  $x$

sorted list C



$x = 1$

inversions = 9

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5

2

1

1

1



list A exhausted: copy 23

sorted list C



$x = 0$

inversions = 9

# Merge and count demo

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Given two sorted lists  $A$  and  $B$ ,

- Count number of inversions  $(a, b)$  with  $a \in A$  and  $b \in B$ .
- Merge  $A$  and  $B$  into sorted list  $C$ .

sorted list A



sorted list B



5

2

1

1

0



**done: return 9 inversions**

sorted list C



$x = 0$

inversions = 9