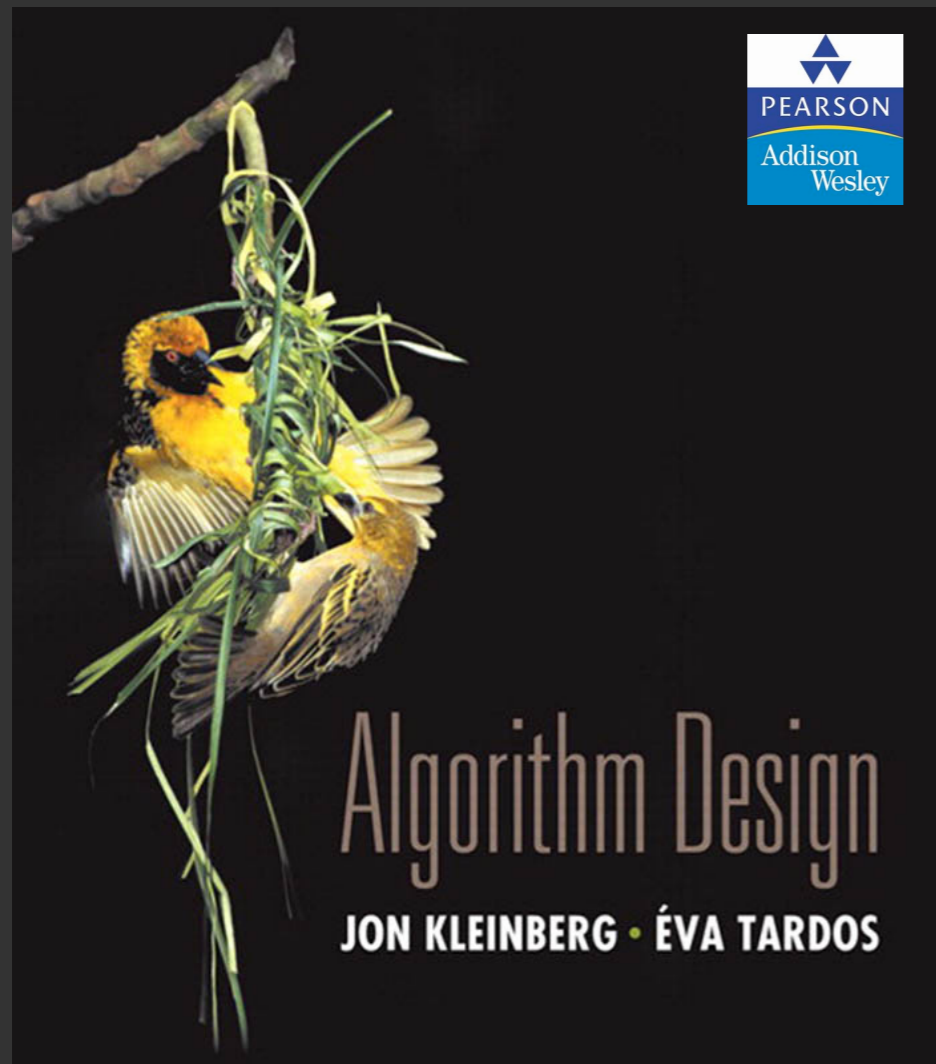


5. DIVIDE AND CONQUER I

▶ *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

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
---	---	----	----	----

sorted list B

2	11	16	20	23
---	----	----	----	----

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



sorted list C



$x = 5$
inversions = 0

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



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

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



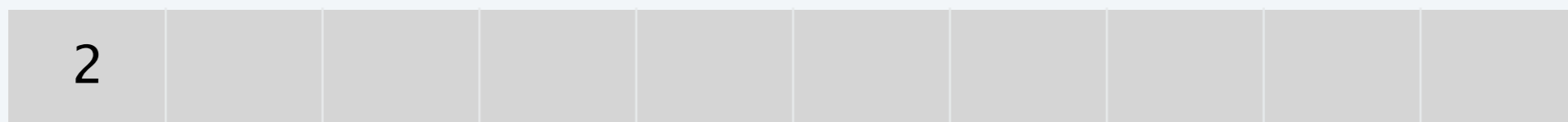
sorted list B



5



sorted list C



$x = 5$

inversions = 5

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

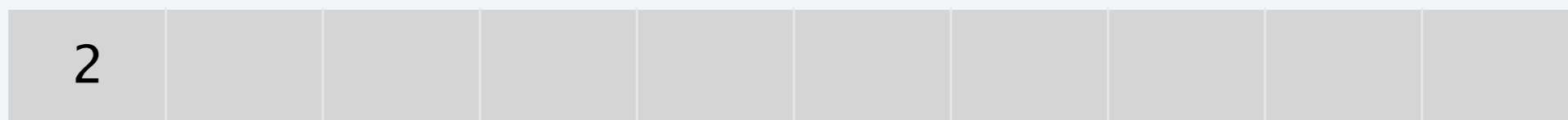


5



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

sorted list C



$x = 5$
inversions = 5

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



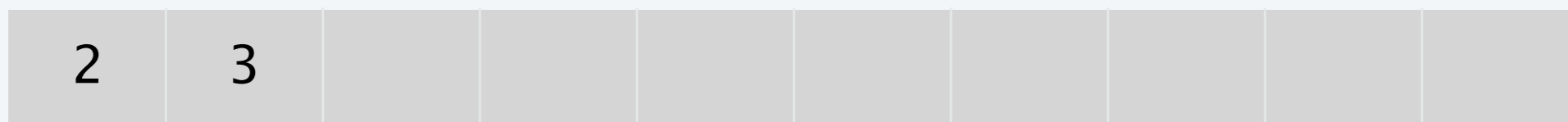
sorted list B



5



sorted list C



$x = 4$

inversions = 5

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



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

sorted list C



$x = 4$

inversions = 5

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



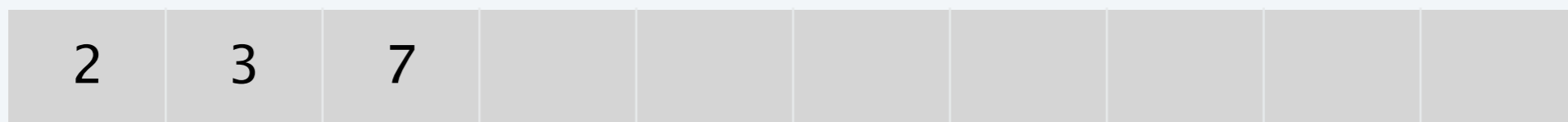
sorted list B



5



sorted list C



$x = 3$

inversions = 5

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

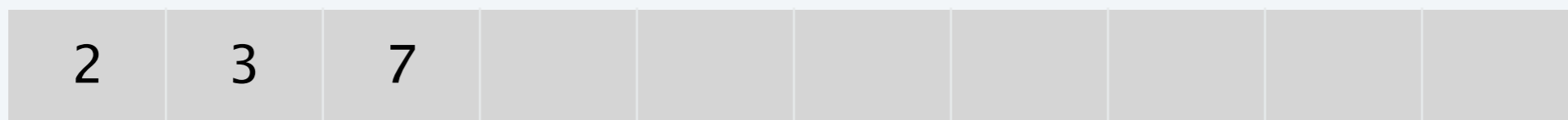


5



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

sorted list C



$x = 3$

inversions = 5

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



sorted list C



$x = 2$

inversions = 5

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

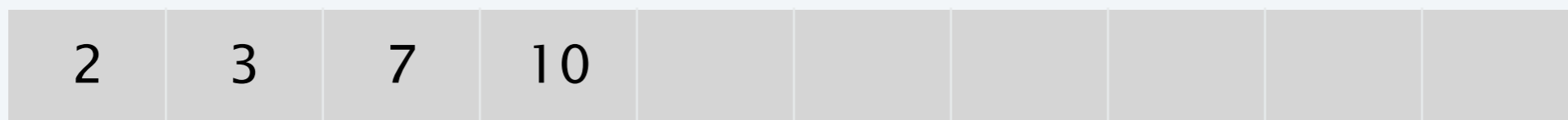


5



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

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



sorted list C



$x = 2$

inversions = 7

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



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

sorted list C



$x = 2$

inversions = 7

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



sorted list C



$x = 1$

inversions = 7

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



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

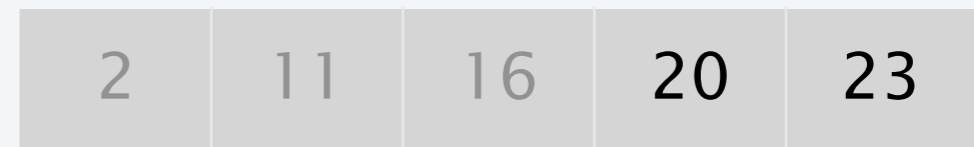
Given two sorted lists A and B ,

- 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

↑

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

↑

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

sorted list C



$x = 1$

inversions = 8

Merge and count demo

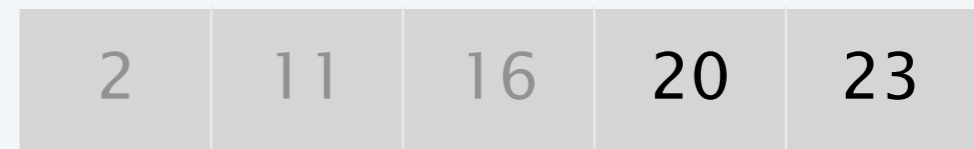
Given two sorted lists A and B ,

- 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



sorted list C



$x = 0$

inversions = 8

Merge and count demo

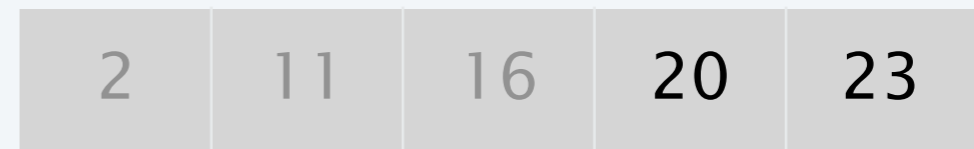
Given two sorted lists A and B ,

- 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



list A exhausted: copy 20

sorted list C



$x = 0$

inversions = 8

Merge and count demo

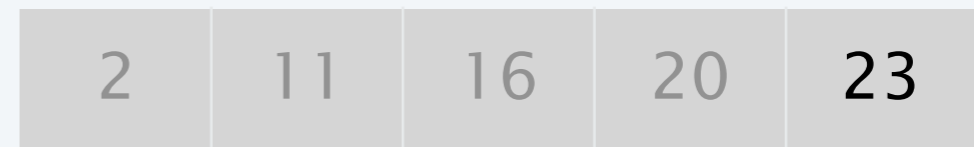
Given two sorted lists A and B ,

- 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

0

↑

sorted list C



$x = 0$

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

0

↑

list A exhausted: copy 23

sorted list C



$x = 0$

inversions = 8

Merge and count demo

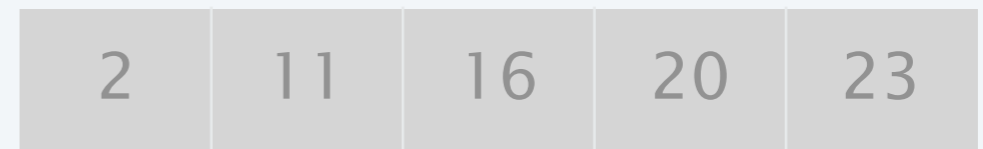
Given two sorted lists A and B ,

- 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

0

0



sorted list C



$x = 0$

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

0

0



done: return 8 inversions

sorted list C



$x = 0$

inversions = 8