5. **DIVIDE AND CONQUER I**

- merge and count demo

---

**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**

\[
\begin{array}{cccccc}
3 & 7 & 10 & 14 & 18 \\
\end{array}
\]

**sorted list B**

\[
\begin{array}{cccccc}
2 & 11 & 16 & 17 & 23 \\
\end{array}
\]

---

**compare minimum entry in each list: copy 2 and add \( x \) to inversion count**

- \( x = 5 \)
- \( \text{inversions} = 0 \)

---

**sorted list C**

\[
\begin{array}{cccccc}
\end{array}
\]

---

**compare minimum entry in each list: copy 3 and decrement \( x \)**

- \( x = 5 \)
- \( \text{inversions} = 5 \)
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 $C$.

### Merge and Count Demo

**Sorted List A**

| 3 | 7 | 10 | 14 | 18 |

**Sorted List B**

| 2 | 11 | 16 | 17 | 23 |

**Sorted List C**

| 2 | 3 |

**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**

| 3 | 7 | 10 | 14 | 18 |

**Sorted List B**

| 2 | 11 | 16 | 17 | 23 |

**Sorted List C**

| 2 | 3 | 7 |

**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**

| 3 | 7 | 10 | 14 | 18 |

**Sorted List B**

| 2 | 11 | 16 | 17 | 23 |

**Sorted List C**

| 2 | 3 | 7 | 10 |

**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**

| 3 | 7 | 10 | 14 | 18 |

**Sorted List B**

| 2 | 11 | 16 | 17 | 23 |

**Sorted List C**

| 2 | 3 | 7 | 10 | 11 |

**x = 2**

inversions = 7
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 \( C \).

<table>
<thead>
<tr>
<th>Sorted list A</th>
<th>Sorted list B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 7 10 14 18</td>
<td>2 11 16 17 23</td>
</tr>
</tbody>
</table>

**Merge and count demo**

Compare minimum entry in each list: copy 16 and add \( x \) to increment count

<table>
<thead>
<tr>
<th>Sorted list C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 3 7 10 11 14</td>
</tr>
</tbody>
</table>

\( x = 1 \)

Inversions = 7

**Merge and count demo**

Compare minimum entry in each list: copy 17 and add \( x \) to increment count

<table>
<thead>
<tr>
<th>Sorted list C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 3 7 10 11 14 16</td>
</tr>
</tbody>
</table>

\( x = 1 \)

Inversions = 8

**Merge and count demo**

List \( A \) exhausted: copy 18 and decrement \( x \)

<table>
<thead>
<tr>
<th>Sorted list C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 3 7 10 11 14 16 17</td>
</tr>
</tbody>
</table>

\( x = 1 \)

Inversions = 9

**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 \( C \).

<table>
<thead>
<tr>
<th>Sorted list A</th>
<th>Sorted list B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 7 10 14 18</td>
<td>2 11 16 17 23</td>
</tr>
</tbody>
</table>

**Merge and count demo**

Count number of inversions \((a, b)\) with \( a \in A \) and \( b \in B \).

Merge \( A \) and \( B \) into sorted list \( C \).

<table>
<thead>
<tr>
<th>Sorted list A</th>
<th>Sorted list B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 7 10 14 18</td>
<td>2 11 16 17 23</td>
</tr>
</tbody>
</table>

**Merge and count demo**

Inversions count:

List \( A \) exhausted: copy 23

<table>
<thead>
<tr>
<th>Sorted list C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 3 7 10 11 14 16 17 18</td>
</tr>
</tbody>
</table>

\( x = 0 \)

Inversions = 9
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 $C$.

**Merge and count demo**

<table>
<thead>
<tr>
<th>sorted list A</th>
<th>sorted list B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 7 10 14 18</td>
<td>2 11 16 17 23</td>
</tr>
</tbody>
</table>

**done:** return 9 inversions

<table>
<thead>
<tr>
<th>sorted list C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 3 7 10 11 14 16 17 18 23</td>
</tr>
</tbody>
</table>

$x = 0$

inversions = 9