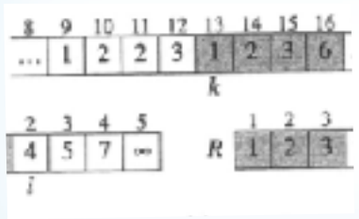
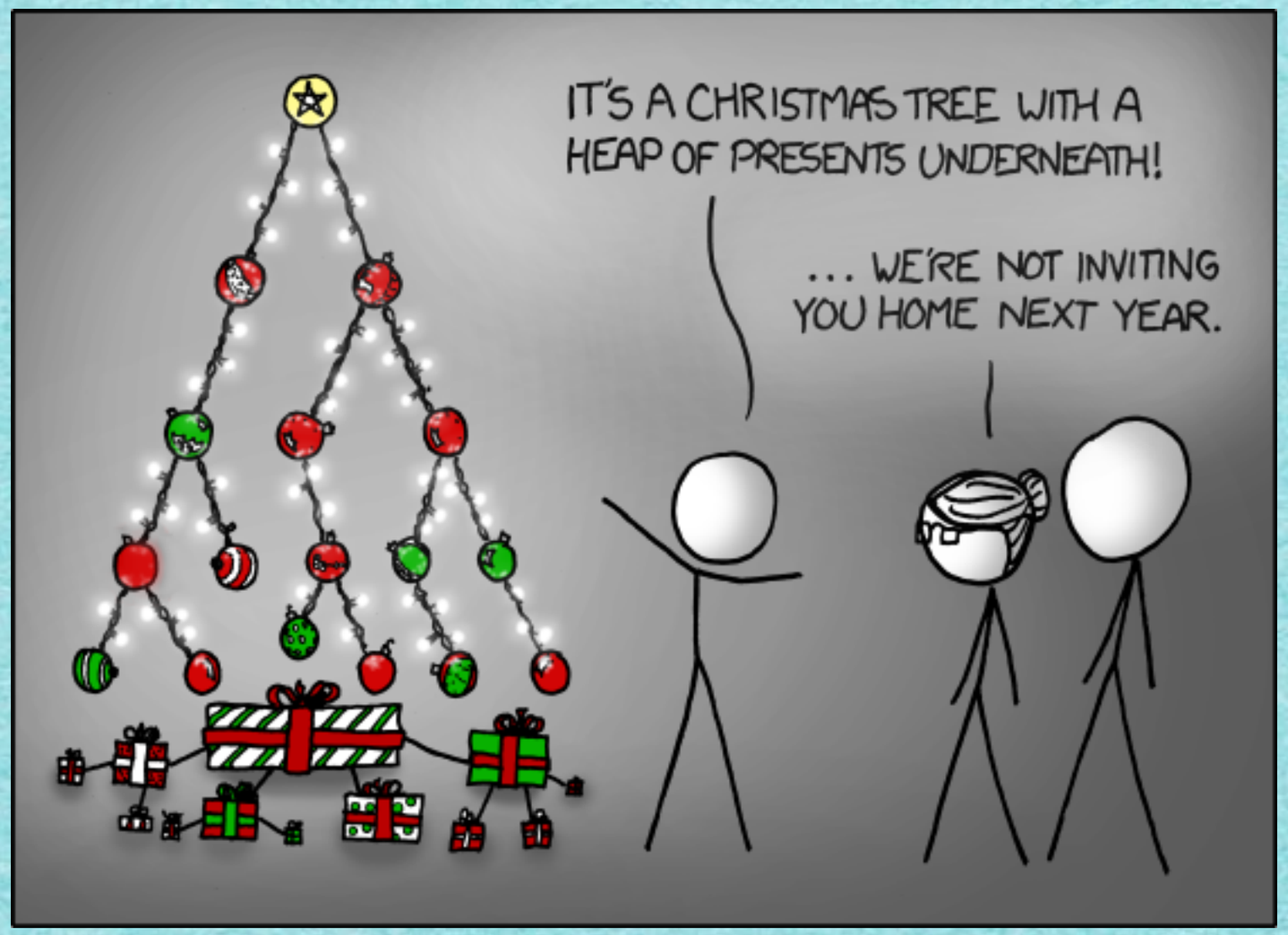


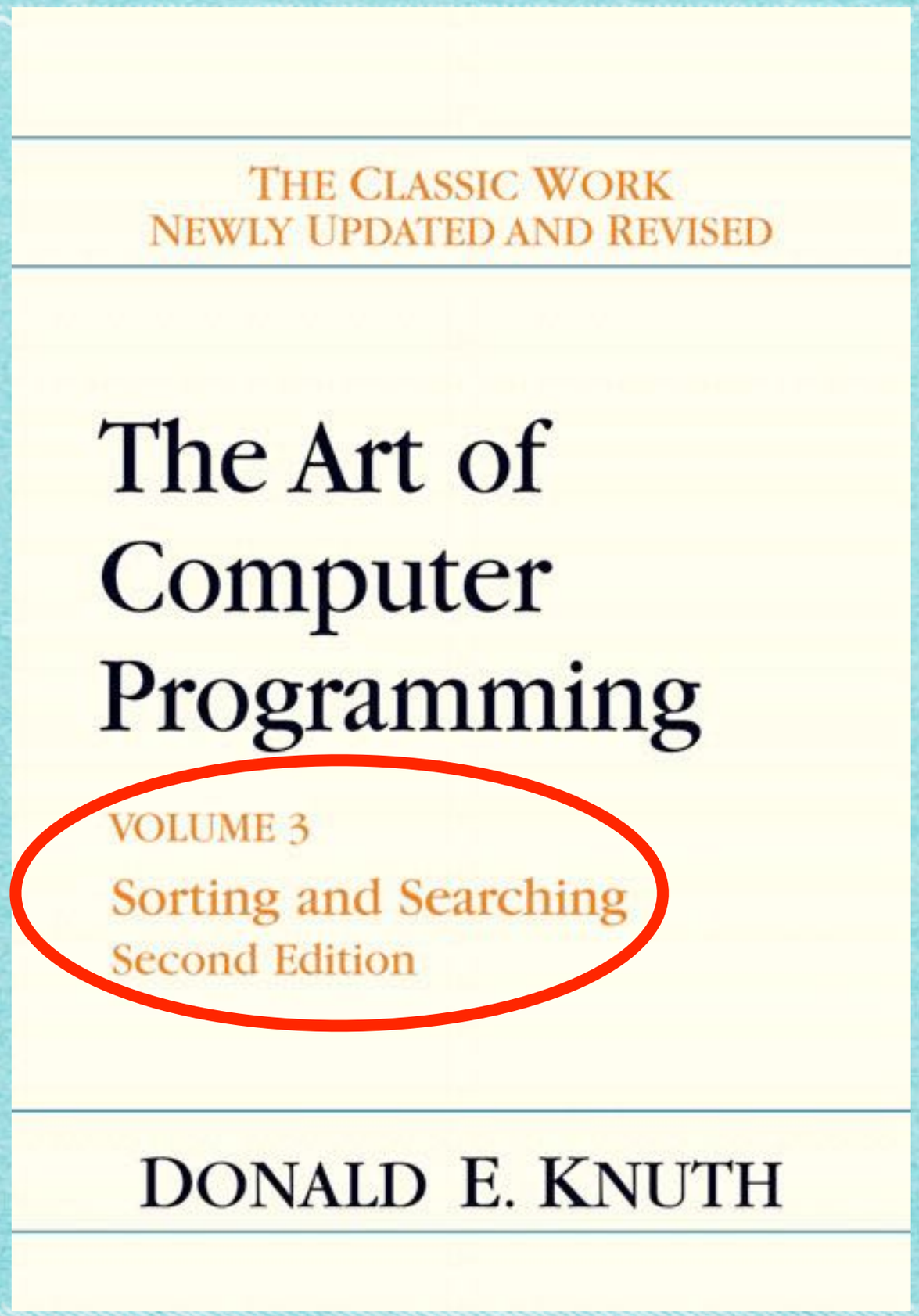
Kapitel 5: Sortieren

Algorithmen und Datenstrukturen
WS 2019/20

Prof. Dr. Sándor Fekete


IT'S A CHRISTMAS TREE WITH A HEAP OF PRESENTS UNDERNEATH!
... WE'RE NOT INVITING YOU HOME NEXT YEAR.

Vorsicht: KNUTH


THE CLASSIC WORK
NEWLY UPDATED AND REVISED
The Art of Computer Programming
VOLUME 3
Sorting and Searching
Second Edition
DONALD E. KNUTH

5.1 Aufgabenstellung

Sortieren von Objekten

Gegeben: n Objekte unterschiedlicher Größe

23 17 13 19 33 28 15

Gesucht: Eine Sortierung nach Größe

Sortieren von Objekten

Gegeben: n Objekte unterschiedlicher Größe

13 15 17 19 23 28 33

Gesucht: Eine Sortierung nach Größe

Sortieren von Objekten

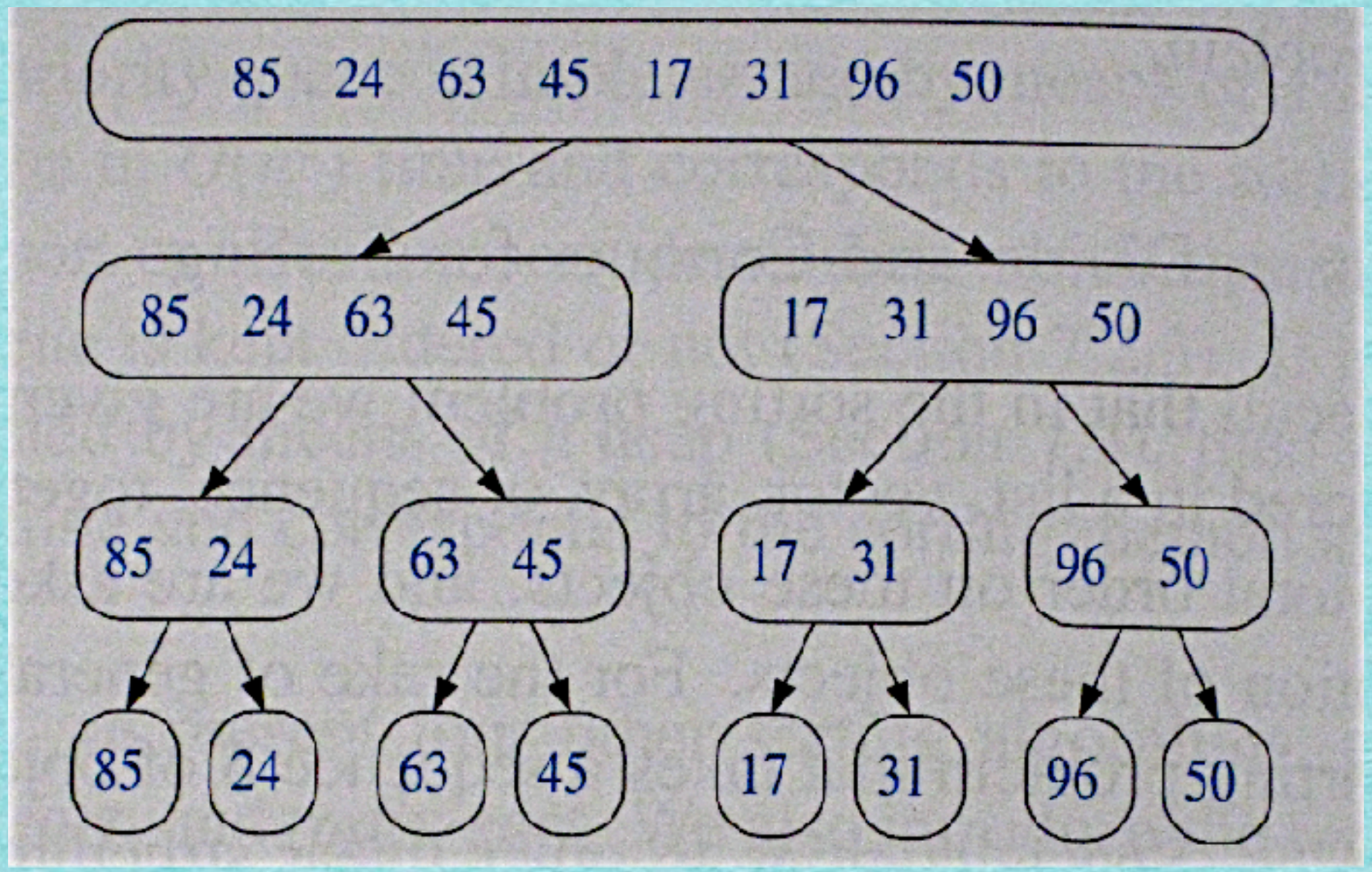
Gegeben: n Objekte unterschiedlicher Größe

13 15 17 19 23 28 33

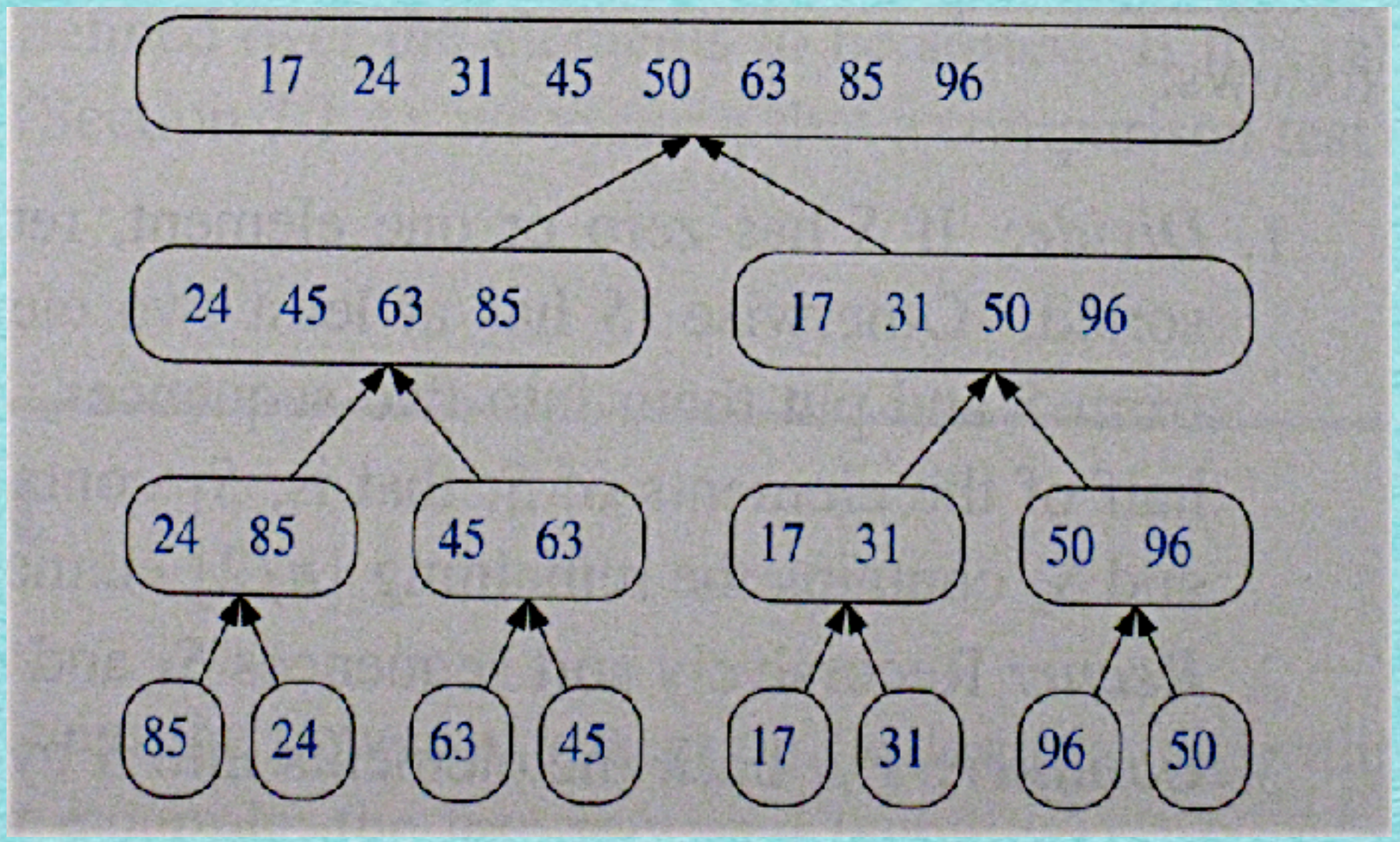
Zahl der Vergleiche: $O(n^2)$

„Geht‘s nicht noch etwas schneller?“

5.2 Mergesort



5.2 Mergesort



5.2.2 Algorithmische Beschreibung

Algorithmus 5.1

<u>INPUT:</u> Subarray von A=[1,...,n],
der bei Index p beginnt und bei Index r endet, d.h. A[p,...,r]

<u>OUTPUT:</u> Sortierter Subarray

MERGE-SORT(A,p,r)

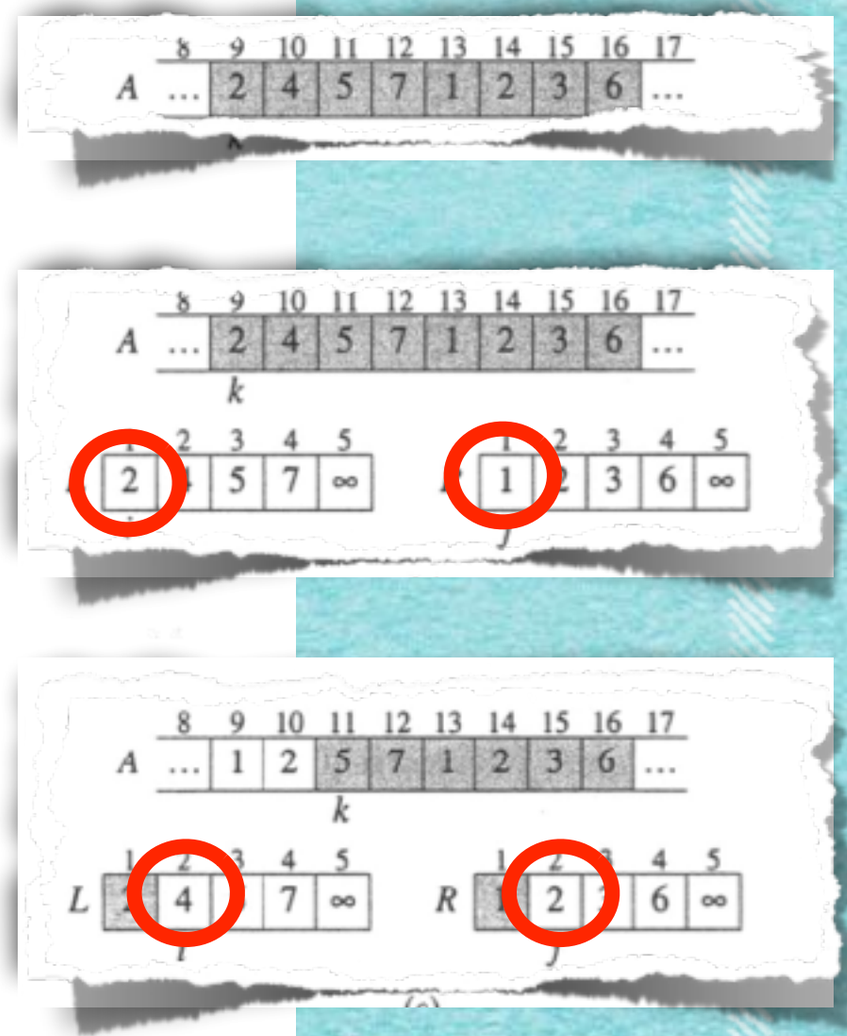
```
if p < r
    then q ← ⌊(p + r)/2⌋
         MERGE-SORT(A, p, q)
         MERGE-SORT(A, q + 1, r)
         MERGE(A, p, q, r)
```

Subroutine 5.2

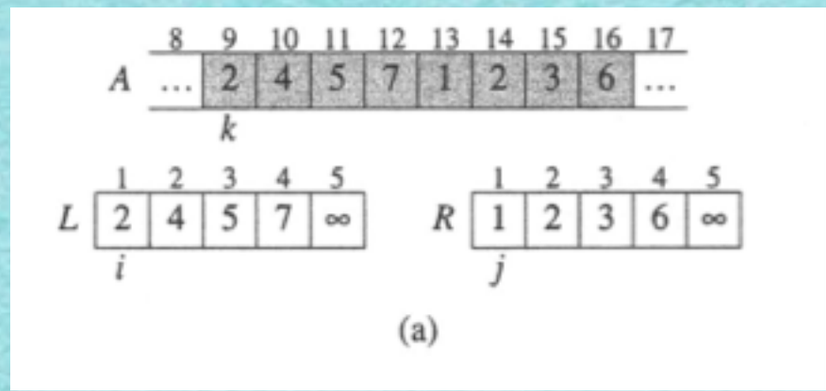
<u>INPUT:</u> Zwei sortierte Subarrays von A=[1,...,n], d.h. A[p,...,q] und A[q+1,...,r]

<u>OUTPUT:</u> Sortierter Subarray A[p,...,r]

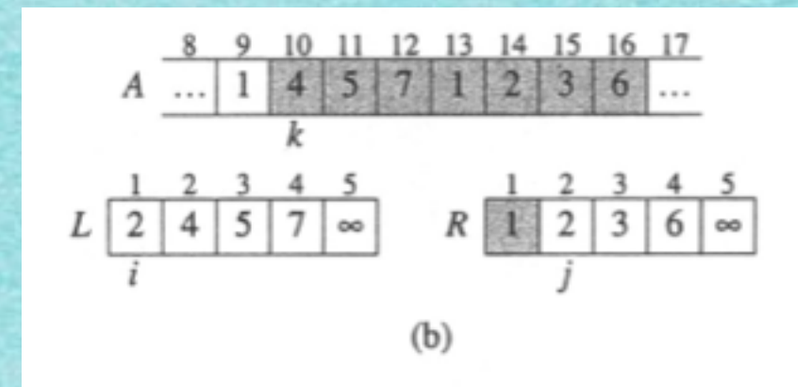
```
MERGE(A, p, q, r)
n1 ← q − p + 1
n2 ← r − q
erzeuge die Felder L[1 .. n1 + 1] und R[1 .. n2 + 1]
for i ← 1 to n1
        do L[i] ← A[p + i − 1]
for j ← 1 to n2
        do R[j] ← A[q + j]
L[n1 + 1] ← ∞
R[n2 + 1] ← ∞
i ← 1
j ← 1
for k ← p to r
        do if L[i] ≤ R[j]
                then A[k] ← L[i]
                     i ← i + 1
                else A[k] ← R[j]
                     j ← j + 1
```



5.2 Mergesort



(a)



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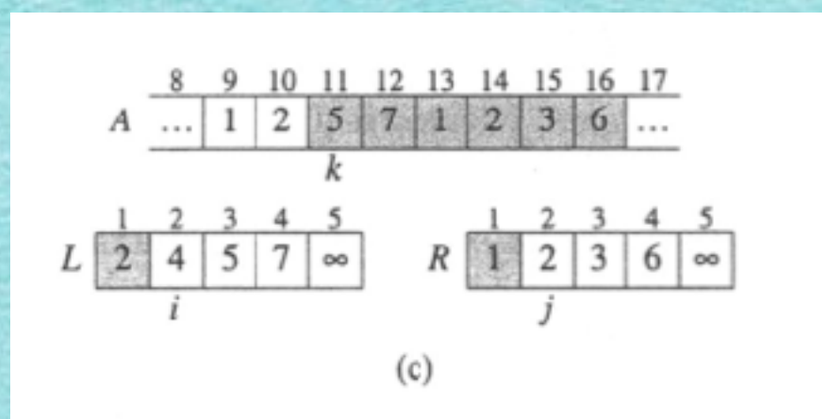

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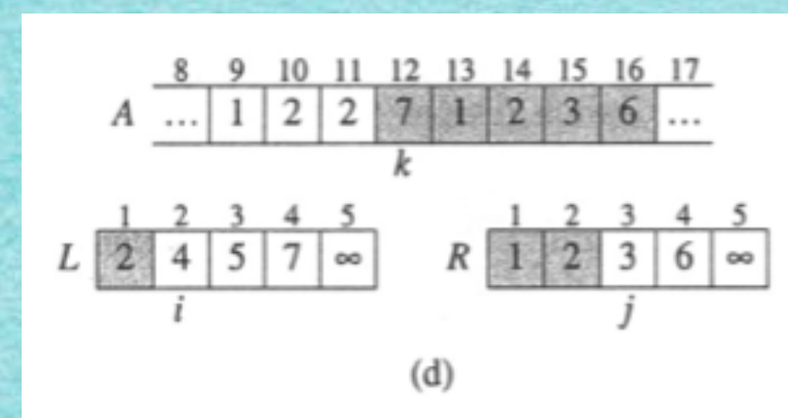

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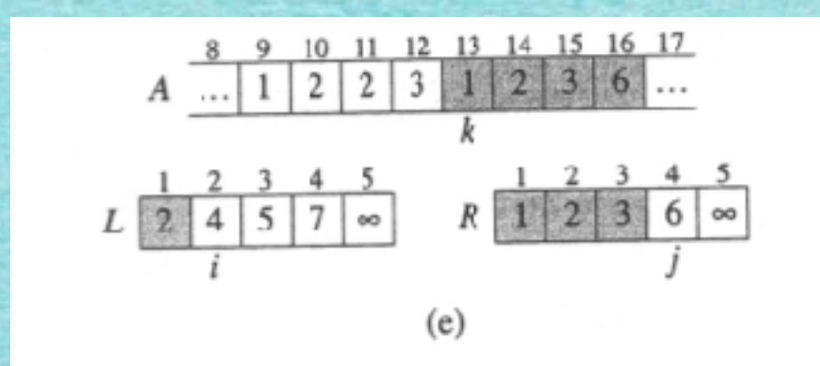

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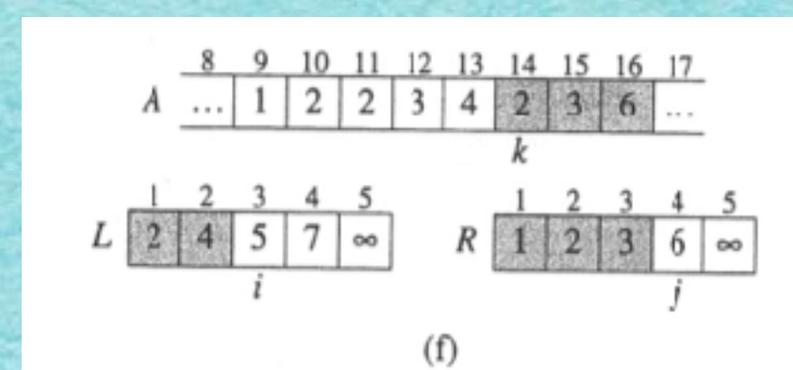
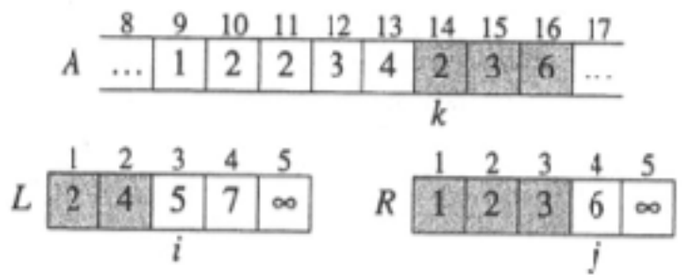


(f)

5.2 Mergesort



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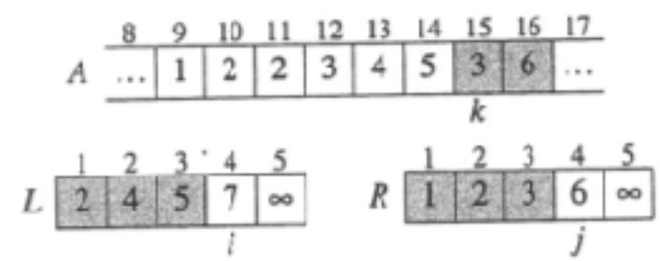
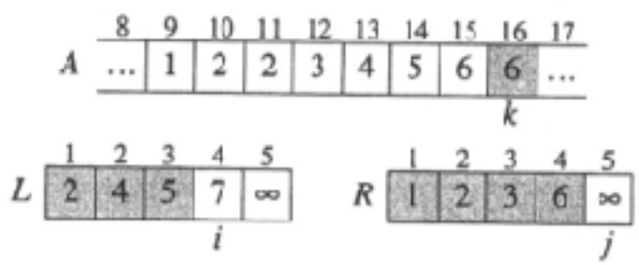


(g)



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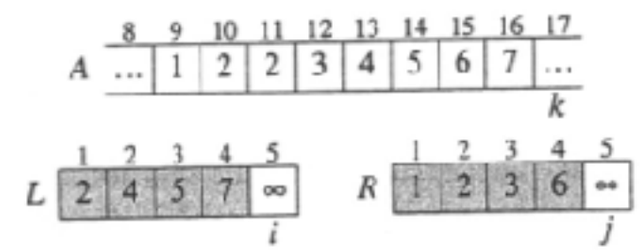
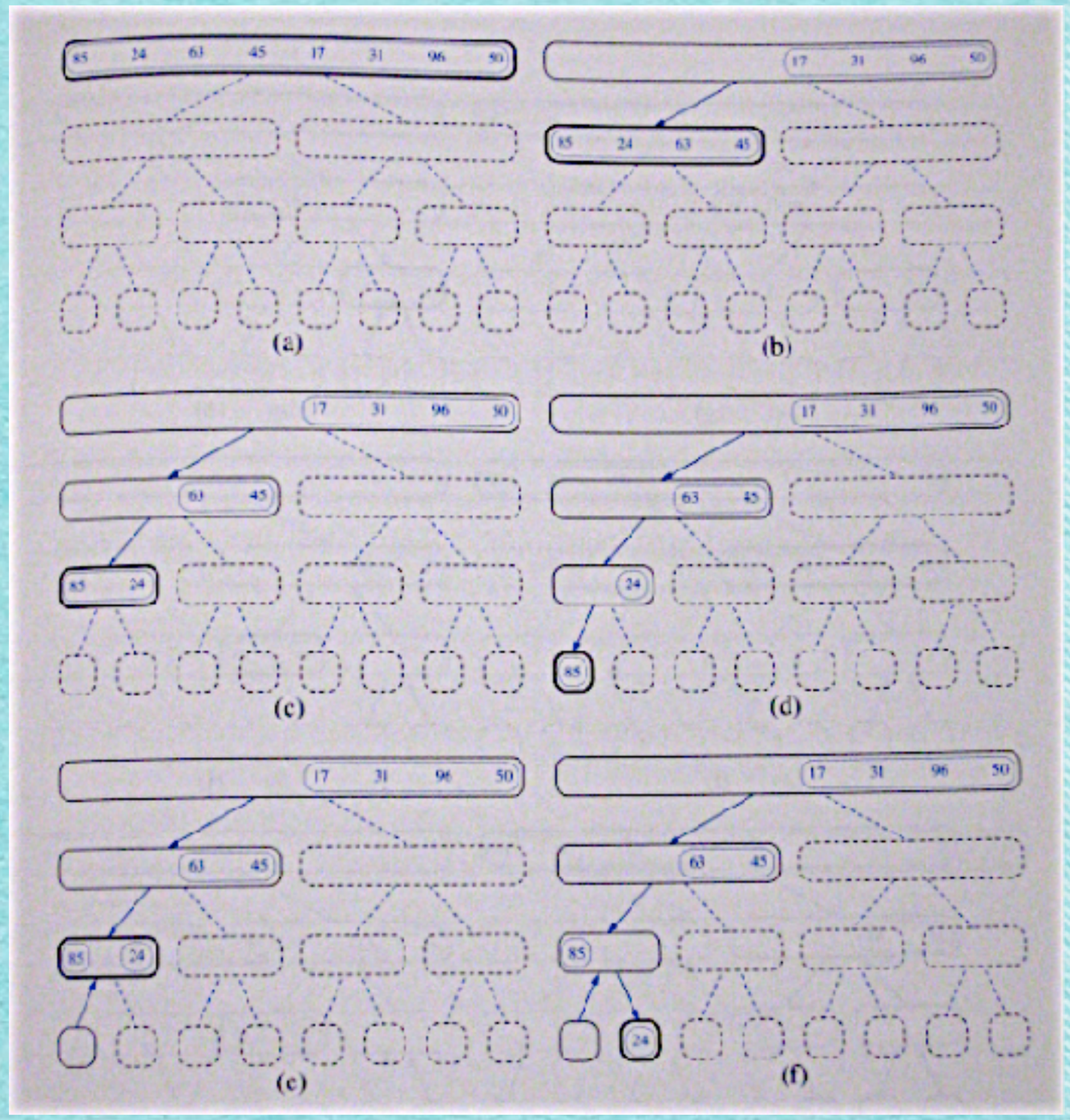


(i)

Ablauf makroskopisch

```
if p < r
    then q ← ⌊(p + r)/2⌋
         MERGE-SORT(A, p, q)
         MERGE-SORT(A, q + 1, r)
         MERGE(A, p, q, r)
```



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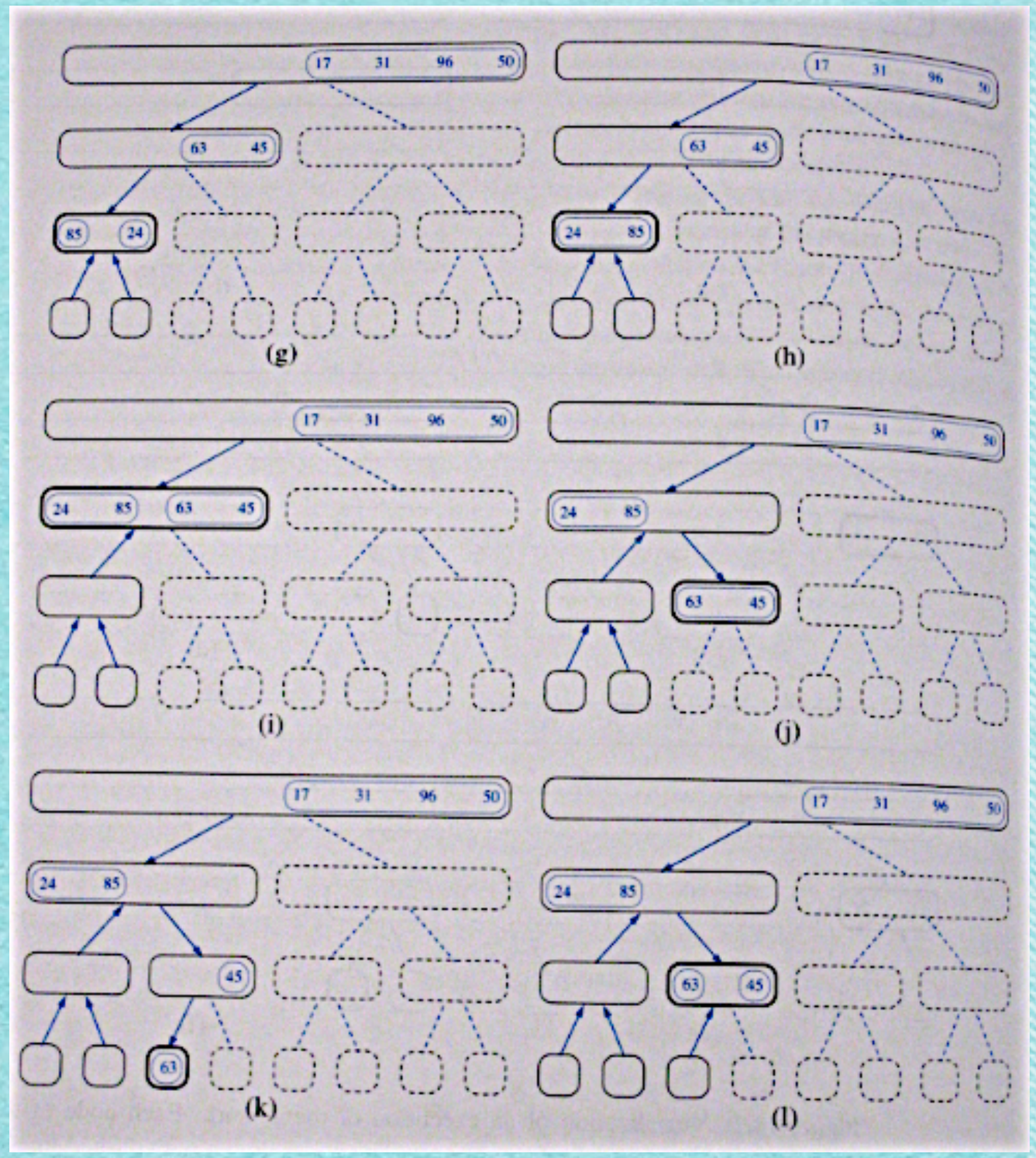

Ablauf makroskopisch

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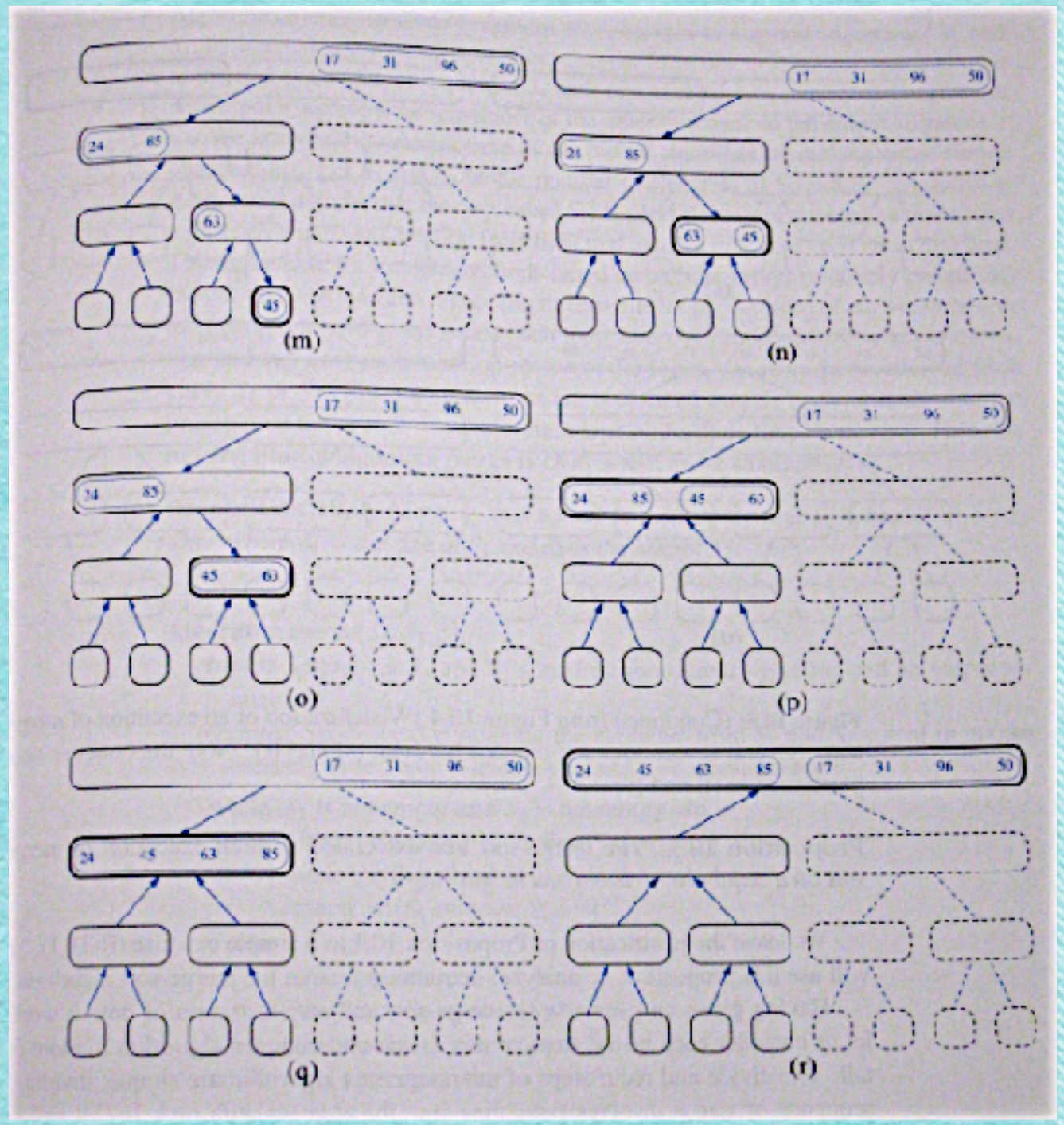

Ablauf makroskopisch

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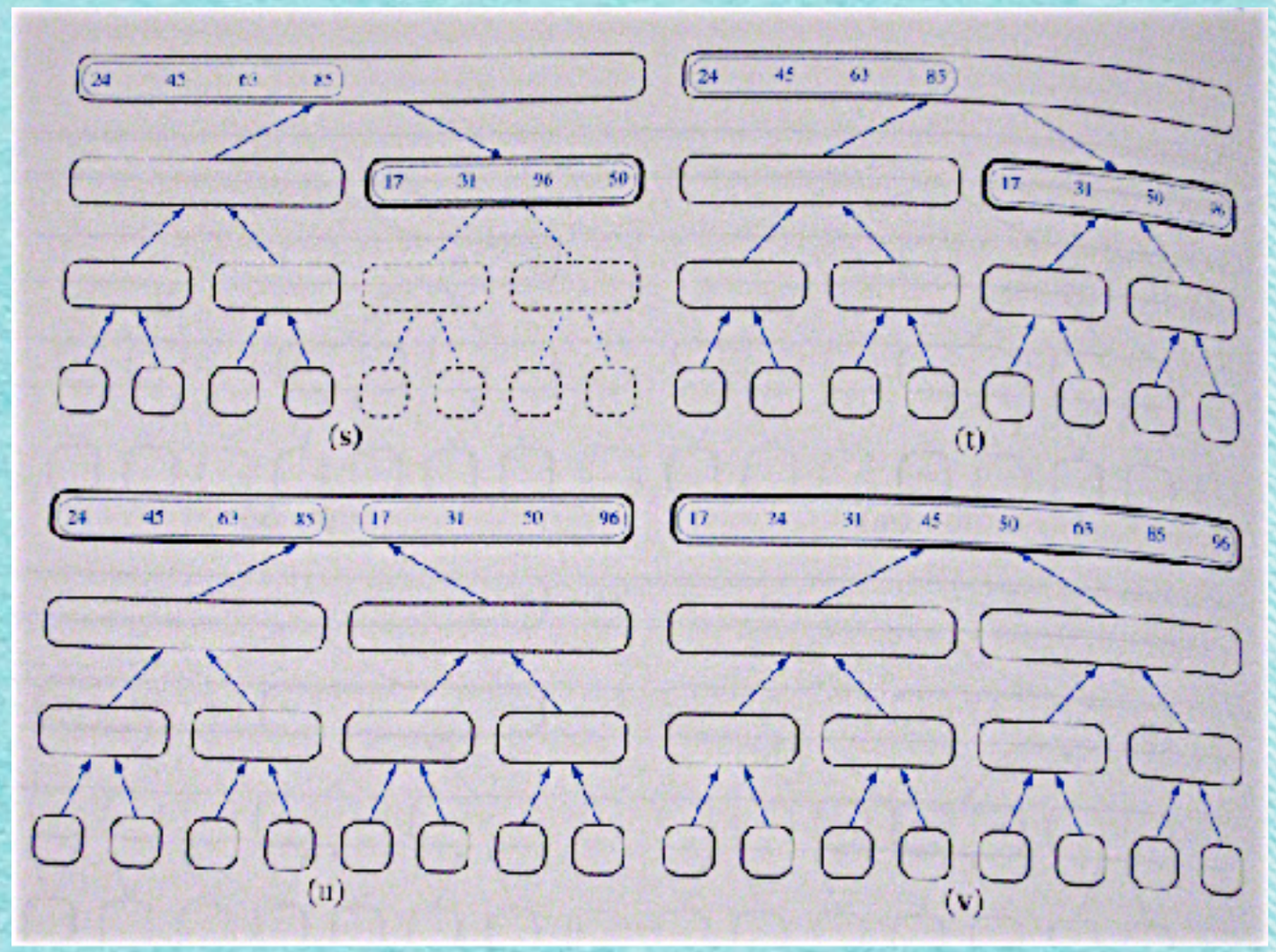
```

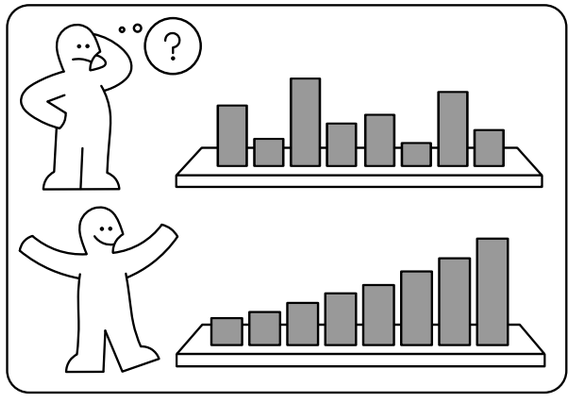


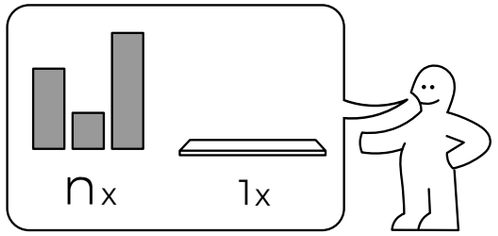
5.2 Mergesort

MERGE SÖRT

idea-instructions.com/merge-sort/
v1.0, CC by-nc-sa 4.0

IDEA





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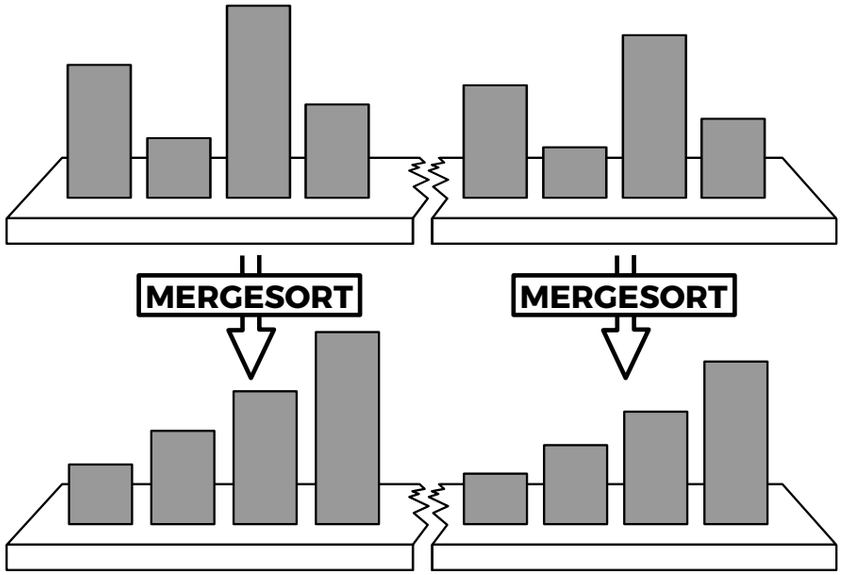

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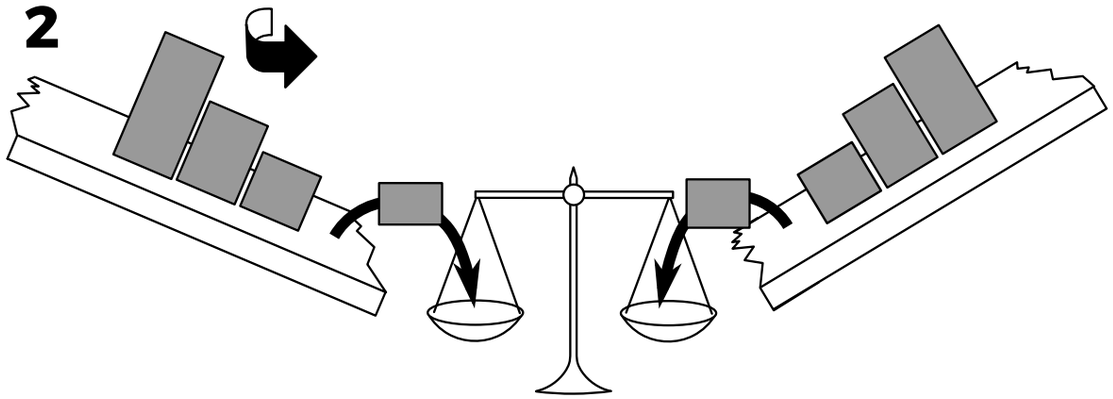

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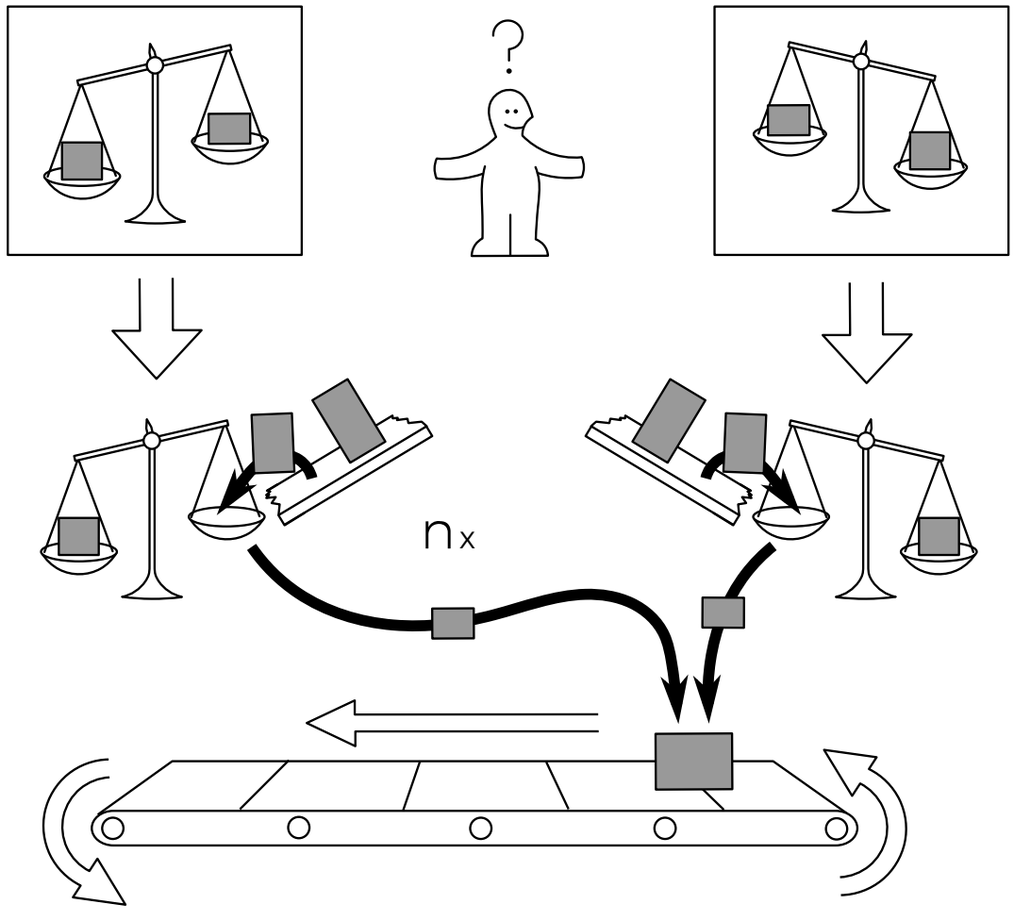

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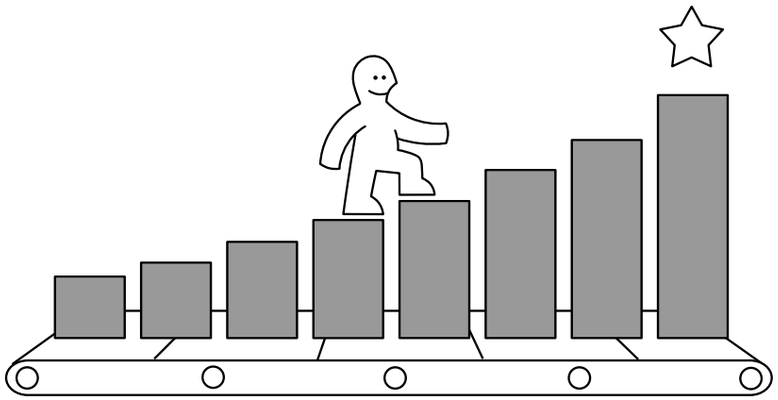


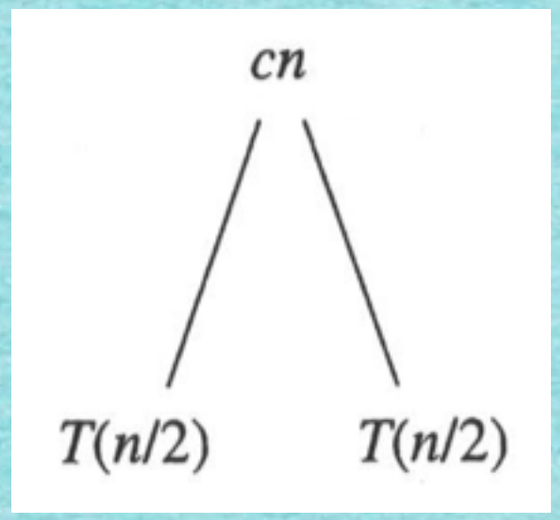
5.2.3 Laufzeit von Mergesort

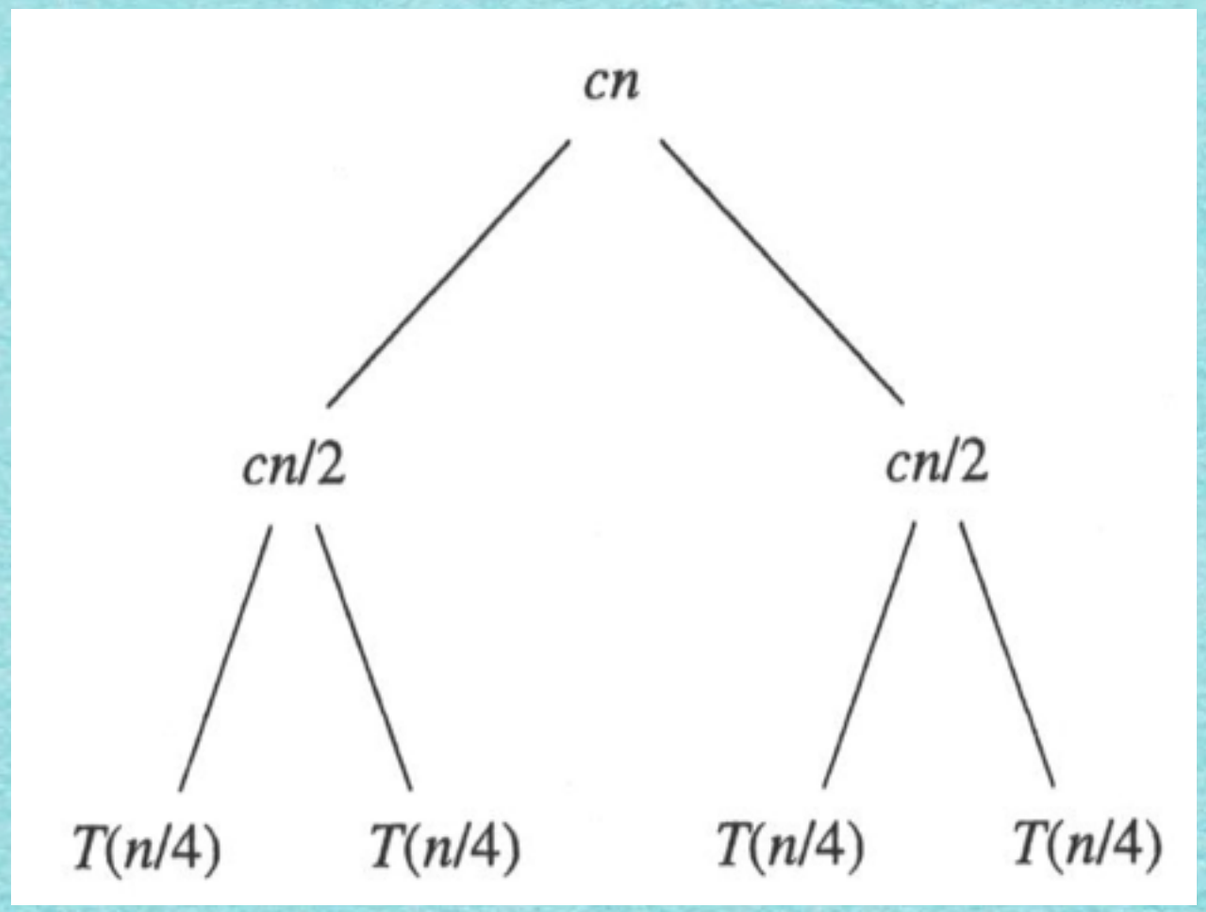
Wie viele Schritte benötigt Merge-Sort für einen Array der Länge n?

$T(n)$

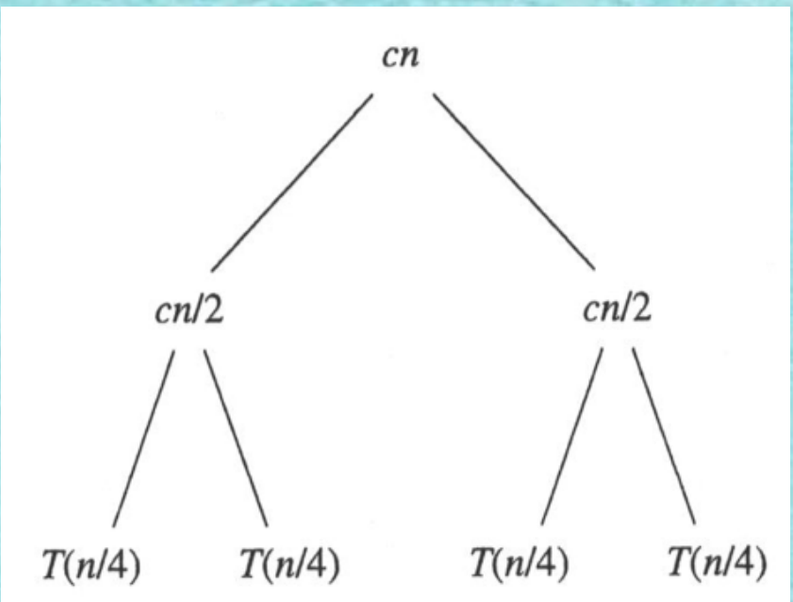
5.2.3 Laufzeit von Mergesort

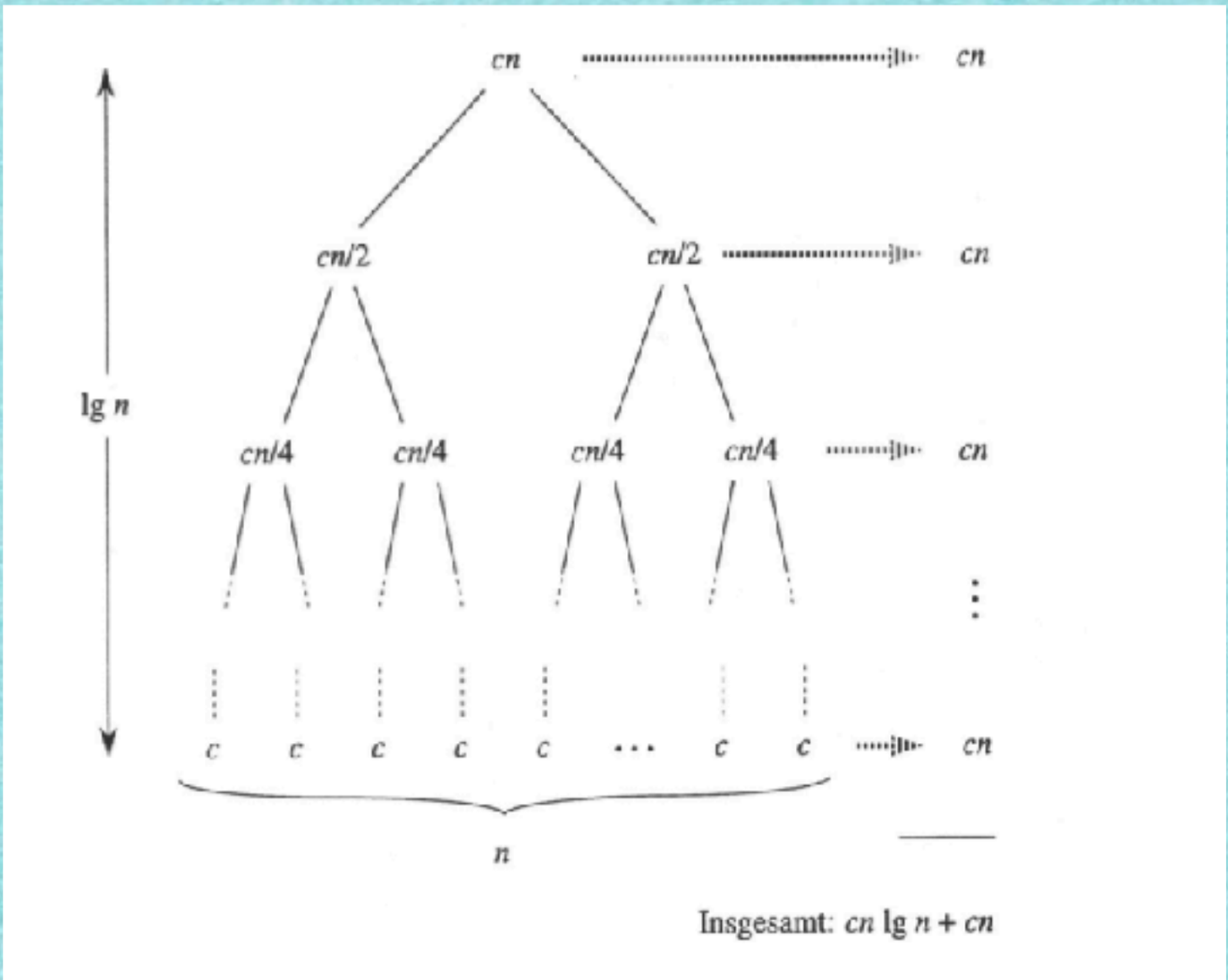
$T(n)$





5.2.3 Laufzeit von Mergesort





5.2.3 Laufzeit von Mergesort

<u>Satz 5.3 (Komplexität von Mergesort)</u>
Für einen n-elementigen Array A hat Mergesort eine Laufzeit von O(n log n).

Mehr an der Tafel!

s.fekete@tu-bs.de