

Algorithms and Data Structures 2

Recap Lectures 7-8

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Topics we covered so far

- **QUICKSORT**
 - Properties
 - Alternative partitioning schemes
- **HEAPSORT**
 - Properties
- **Lower bounds for comparison sorts**
 - Decision tree model

Question 1

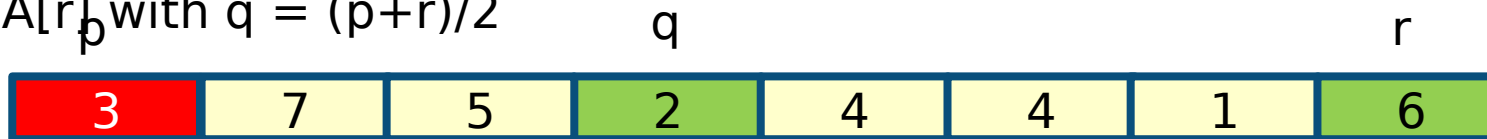
- **Memory requirements of MERGE-SORT**
- **Not in-place** as **MERGE** requires **$O(n)$ memory**
 - Needed to store auxiliary arrays **L** and **R**

```
MERGE(A, p, q, r)
   $n_1 := q - p + 1$ 
   $n_2 := r - q$ 
  copy A[p..q] to L[0.. $n_1$ ]
  copy A[q+1..r] to R[0.. $n_2$ ]
  L[ $n_1$ ] :=  $\infty$ 
  R[ $n_2$ ] :=  $\infty$ 
  i, j := 0
  for k = p to r
    if L[i]  $\leq$  R[j]
      A[k] := L[i]
      i := i + 1
    else
      A[k] := R[j]
      j := j + 1
```

Question 2

- **Median of three pivoting scheme**
- **Instead of selecting the right-most element as pivot we sample between three values**

– $A[p], A[q], A[r]$ with $q = (p+r)/2$

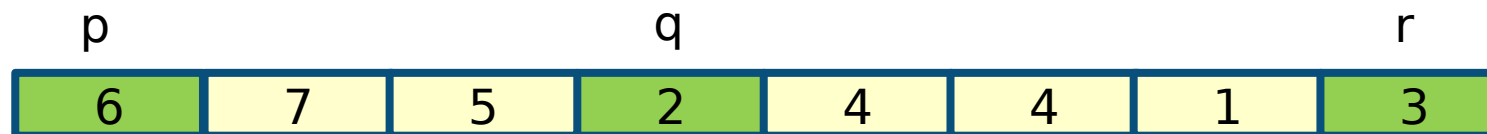


- **Median of 3, 2, 6 is the middle element of the sorted sequence 2, 3, 6: 3**
 - Left-most element in this case

Question 2 (cont.)

- Typically, we **swap** values around while computing the median
- At the end, the pivot is in position **A[r]** and the rest of the algorithm is defined as in standard QUICKSORT

- **Example with swaps**



- If $A[q] < A[p]$ SWAP($A[p]$, $A[q]$)
- Swap **6** with **2**

Question 2 (cont.)

- Typically, we **swap** values around while computing the median
- At the end, the pivot is in position **A[r]** and the rest of the algorithm is defined as in standard QUICKSORT

- **Example with swaps**



- If $A[r] < A[p]$ SWAP($A[p]$, $A[r]$)
- No swap

Question 2 (cont.)

- Typically, we **swap** values around while computing the median
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- **Example with swaps**



- If $A[q] < A[r]$ SWAP($A[q]$, $A[r]$)
- **No swap**

Question 2 (cont.)

- Typically, we **swap** values around while computing the median
- At the end, the pivot is in position **A[r]** and the rest of the algorithm is defined as in standard QUICKSORT

- **Example with swaps**



- A[r] is the pivot

Question 3

- **Exam format**
- **Similar as 2019 format**
 - 5 questions with sub questions for a total of 60 marks
- **Open book, online assessment**
- **Time allowed: 3 hours**