Methodic and Practical Foundations of Computer Science 1

09-Quick Sort

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Objectives

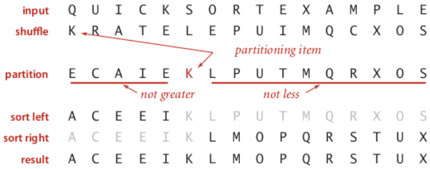
1. Quick Sort
2. Quick Sort
3. Question

Two classic sorting algorithms: mergesort and quicksort

- Full scientific understanding of their properties has enabled usto develop them into practical system sorts.
- Quicksort honored as one of top 10 algorithms of 20th century in science and engineering.

Quicksort overview

1. Shuffle the array.
2. Partition the array so that, for some j
   - Entry a[j] is in place.
   - No larger entry to the left of j .
   - No smaller entry to the right of j .
3. Sort each subarray recursively.



input	Q	U	I	C	K	S	O	R	T	E	X	A	M	P	L	E
shuffle	K	R	A	T	E	L	E	P	U	I	M	Q	C	X	O	S
partition	E	C	A	I	E	K	L	P	U	T	M	Q	R	X	O	S
sort left	A	C	E	E	I	K	L	P	U	T	M	Q	R	X	O	S
sort right	A	C	E	E	I	K	L	M	O	P	Q	R	S	T	U	X
result	A	C	E	E	I	K	L	M	O	P	Q	R	S	T	U	X

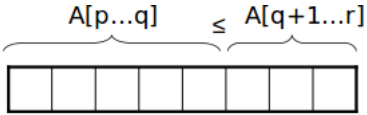
Quick Sort vs other algorithms

- Quicksort works in place.
- its worst-case running time is as bad as selection sort's and insertion sorts: $O(n^2)$

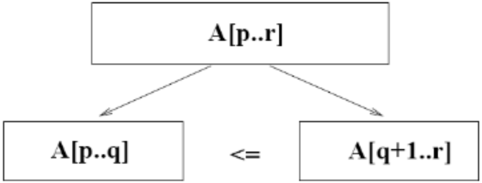
Sorting Files That are Almost in Order

- Selection sort?
  - NO, always takes quadratic time
- Bubble sort?
  - NO, bad for some definitions of almost in order
  - Ex: B C D E F G H I J K L M N O P Q R S T U V W X Y Z A
- Insertion sort?
  - YES, takes linear time for most definitions of almost in order
- Mergesort or custom method?
  - Probably not: insertion sort simpler and faster

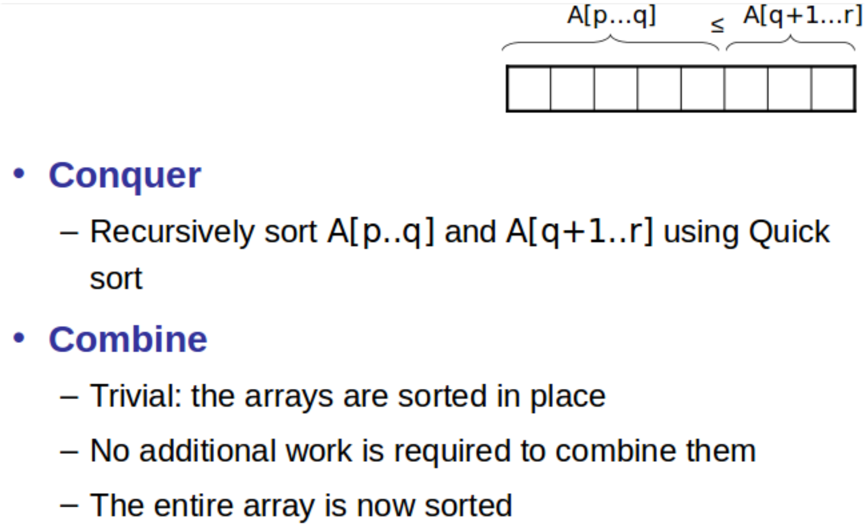
Quick Sort



- Sort an array A[p…r]
- **Divide**
  - – Partition the array A into 2 sub arrays A[p..q] and A[q+1..r], such that each element of A[p..q] is smaller than or equal to each element in A[q+1..r]
  - – Need to find index q to partition the array



Quick Sort



- **Conquer**
  - Recursively sort A[p..q] and A[q+1..r] using Quick sort
- **Combine**
  - Trivial: the arrays are sorted in place
  - No additional work is required to combine them
  - The entire array is now sorted

Question