

numbers 157, 110, 147, 122, 111, 149, 151, 141, 146, 123, 112, 117, 133.

Quick sort - 1st elem as pivot

~~157~~, 110, 147, 122, 111, 149, 151, 141, 123, 112, 117, 133

110 → less than 157 → to the left

147 → less than 157 → to the left

122, 111, 149, 151, 141, 123, 112, 117,

133 → all to left.

steps → or iterations = 10 but 1 swap
(swap when $\text{elem} \leq \text{pivot}$)
left!

last elem as pivot.

~~last = [157, 110, 147, 122, 111, 149, 151, 141, 123, 112, 117, 133]~~

~~from 1st [end] till 1st [0]: i~~
~~pivot = 133~~
~~if arr[i] <= pivot~~
~~then swap~~

int, i=-1, j=0;

if arr[i] < pivot {
 i++;

else {

temp = arr[i];

j++;

arr[i] = arr[j];

arr[j] = temp;

temp = arr[i];

arr[i] = temp;

arr[j] = pivot;

(ii) median take 14.9

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Step 1 :

[133, 147, 122, 111, 149, 151, 141, 123, 112, 117];

Step 2:

$\{123, 117, 122, 111, 112, \boxed{13}, 141, 151, 149, 147\} \boxed{157}$

Step 3

$$[112, 117, 122, 111] \cdot [123, 133] \cdot [141, 151, 149, 147] \\ (157)$$

Step 4

$$[111, 112], [122, 117] \quad [123, 133], [141, 151, 149, 147]$$

Step 5:

$\{11, 112\}, \{122, 117\}, \{123, 133\}, \{141, 151, 144, 4\}$
 $\{142\}$

147

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Step 6

$[111, 112, 117, 122, 123, 133] \quad [141]$

$[151, 144, 147] \quad [157]$

Step 7

$[111, 112, 117, 122, 123, 133, 141]$

$[147, 144] \quad [157, 157]$

Step 8:

$\stackrel{110}{[111, 112, 117, 122, 123, 133, 141, 144, 147, 151, 157]}$

2. Last element:

Step 1: $\cancel{[157, 157]}$

$117, 110, 112, 122, 123, 111, 123, 133, 141, 144, 147, 157, 147]$

Step 2

\downarrow
 $[110, 122, 111, 123, 112, 17] \quad [133] \quad [141, 147]$

Step 3:

$[110, 111, 112] \quad [117] \quad [122, 123] \quad [133]$

$[141, 157, 147, 149, 157]$

step 4:

$\{110, \boxed{111}\} [112] [117] [122] [123] [133]$

step 5: $[141] \cdot [147, \boxed{149}] [151] [157]$

all combined:

$\{110, 111, 112, 117, 122, 123, 133, 141, 147, 149,$
 $151, 157\}$

Part 3: Random pivot element

let pivot be 149

$\{159, 110, 147, 122, 111, \boxed{149} [151, 141, 123,$
 $112, 117, 133\}$

Step 1:

~~left~~ $\{110, 147, 122, 111, 141, 123, 112, 117, 133\},$
 $\{149\}, \{151, 141, 123, 112, 117, 133\} \quad \begin{matrix} [157, 151] \\ \text{right} \end{matrix}$

Step 2: left

a random pivot is 123

~~147~~ $\{110, 122, 111, 112, 117\}, [123],$
 $\{147, 141, 133\}, \dots$

Step 3: right part random pivot: 157

$[151], [157]$

Step 4: ~~right part~~: ^{left}

in $[110, 112, 111, 112, 117]$
random pivot = 112.

$[110, 111, 112] [112] [117]$

Step 5: left part again:

for $[110, 117]$

random pivot = 111

$\rightarrow [110, 111]$

Step 6: ~~combining~~ combining ALL sorted sublists;

$[110, 111, 112; 117, 122, 123, 133, 141, 147,$
 $149, 151, 157]$

~~Time
Complexity~~

Pivot choice

approx steps
(pivots)

$O(n^2)$ first element

7 to 8

unbalanced

better than last element
 $O(n^2)$

6

Moderate

$O(n \log n)$ Random element

5

Most balanced