Partitioning subroutine

PARTITION(A, p, q) ▷ $A[p . . q]$
   $x \leftarrow A[p]$ ▷ pivot $= A[p]$
   $i \leftarrow p$
   for $j \leftarrow p + 1$ **to** q
      do if $A[j] \leq x$
         then $i \leftarrow i + 1$
             exchange $A[i] \leftrightarrow A[j]$
   exchange $A[p] \leftrightarrow A[i]$
   return i

> Running time $= O(n)$ for n elements.

Invariant:

x	$\leq x$	$\geq x$	?
p	i	j	q