• The loop variable j updates to $(k+1)$ and it's easy to see that the loop invariant still holds.

$\boxed{\text{Termination:}}$ The loop terminates when $j = MAX\_SIZE$. $\therefore$ By the loop invariant, $\forall x \in N$, s.t. $i+1 \leq x < MAX\_SIZE$, the matrix element at row i, column x has been interchanged with the element at row x, column i.

$\therefore$ Row i elements has been interchanged with column i elements ~~such that~~ ~~the column~~ for all those column and row indices respectively which are bigger than i. $\square$

Outer loop invariant

• Just before the start of the iteration when $i = n$, all the rows from index 0 to $(n-1)$ have been respectively interchanged with the columns from index 0 to $(n-1)$.

$\boxed{\text{Initialization:}}$ $i = 0$. $\because n = 0$, the indices from 0 to -1 doesn't make sense.

$\therefore$ The loop invariant trivially holds.

$\boxed{\text{Maintenance:}}$ Let, the loop invariant hold ~~for the~~ just before the start of the iteration when $i = n$. $\therefore \forall x \in N$, $0 \leq x \leq n-1$, row x has been interchanged with column x. Now, $i = n$ currently. By correctness of inner loop, Row n has been interchanged with column n elements for all those column and row indices (respectively) which are greater than n. But, what about the elements $a[n][x]$, where $x < n$? By the loop invariant, $\because x < n$, row x has already interchanged its respective elements with column x.

$\therefore a[n][x]$ and $a[x][n]$ have already been interchanged previous to the iteration when $i = n$. Even when $0 \leq x < n$, for all such x, Row n elements are interchanged with column n elements. $\therefore$ The total Row n is interchanged with column n. Next, i updates to $(n+1)$, and it's easy to see that the Loop invariant holds

$\boxed{\text{Termination:}}$ The loop terminates when $i = MAX\_SIZE-1$. By the loop