For the matrix b, the following criterion must hold:

1) The triples ⟨row, col, value⟩ are organized such that the row indices are in ascending order.

2) For all the triples in any row, the columns must also be in ascending order.

Proof of Correctness

Inner loop invariant: For the given column i of matrix a, ∀K where $1 \leq K < j$, if i is the corresponding column of the matrix element a[K], then the corresponding correct row, column no. in matrix b has been computed. The criterion in matrix b that the row indices are in ascending order and for triples ⟨row, col, value⟩ of a given row, the columns are in ascending order is maintained.

Precise Inner Loop Invariant (ChatGPT)

- At the start of each iteration of the inner loop (indexed by j), for all K such that $1 \leq K < j$, if a[K].col == i, then:

1) The corresponding transposed entry ⟨a[K].col, a[K].row, a[K].value⟩ has been correctly stored in the next available index of b[].

2) The sequence of elements inserted into b[] so far maintains ascending order of row indices (i.e. a[K].col), and within a given row, ascending order of column indices (i.e. a[K].row), as induced by the outer and inner loop traversal order.

Initialization: Before the start of the 1st iteration of the loop, j=1 (line 11). The range $1 \leq K < j=1$ is empty and doesn't make sense. The invariant automatically holds since the premise of the implication is False. (A universal quantifier over an empty set is vacuously true).