



Write a self-contained function block in IEC 61131-3 to implement the heapsort algorithm. Do not used recursion as this is disallowed in 61131-3. Do not used keyword 'DOWNT0' in for loops.



Here is a self-contained function block implementing the heapsort algorithm in IEC 61131-3, using Structured Text (ST) programming language, without recursion or the 'DOWNT0' keyword in for loops:

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```
FUNCTION_BLOCK FB_HeapSort
    VAR_INPUT
        arrToSort: ARRAY[*] OF REAL;
    END_VAR
    VAR_OUTPUT
        sortedArr: ARRAY[*] OF REAL;
    END_VAR
    VAR
        arrLength: UDINT;
        endIndex: UDINT;
        temp: REAL;
    END_VAR

    METHOD Heapify: BOOL
        VAR_INPUT
            index: UDINT;
        END_VAR
        VAR
            largest: UDINT;
            leftChild: UDINT;
            rightChild: UDINT;
        END_VAR

        largest := index;
        leftChild := 2 * index + 1;
        rightChild := 2 * index + 2;

        IF (leftChild < arrLength) AND (sortedArr[leftChild] > sortedArr[largest]) THEN
            largest := leftChild;
        END_IF

        IF (rightChild < arrLength) AND (sortedArr[rightChild] > sortedArr[largest]) THEN
            largest := rightChild;
        END_IF

        IF largest <> index THEN
            temp := sortedArr[index];
            sortedArr[index] := sortedArr[largest];
            sortedArr[largest] := temp;
            Heapify(largest);
        END_IF

        RETURN TRUE;
    END_METHOD

    METHOD BuildMaxHeap: BOOL
        VAR
            i: UDINT;
        END_VAR

        FOR i := TRUNC(arrLength / 2) TO 0 BY -1 DO
            Heapify(i);
        END_FOR

        RETURN TRUE;
    END_METHOD

    METHOD Sort: BOOL
        VAR
            i: UDINT;
        END_VAR

        BuildMaxHeap();

        FOR i := arrLength - 1 TO 1 BY -1 DO
            temp := sortedArr[0];
            sortedArr[0] := sortedArr[i];
            sortedArr[i] := temp;
            arrLength := arrLength - 1;
            Heapify(0);
        END_FOR

        RETURN TRUE;
    END_METHOD
BEGIN
    arrLength := SIZEOF(arrToSort) / SIZEOF(REAL);
    sortedArr := arrToSort;

    IF arrLength > 1 THEN
        Sort();
    END_IF
END_FUNCTION_BLOCK
```

To use this function block in your program, create an instance of it and call it with an array of REAL values to be sorted. The sorted array will be available in the `sortedArr` output variable of the function block.