Information Processing Letters

Step Sort

--Manuscript Draft--

Manuscript Number:	
Article Type:	Regular Submission
Keywords:	Sorting Algorithm; Step Sort
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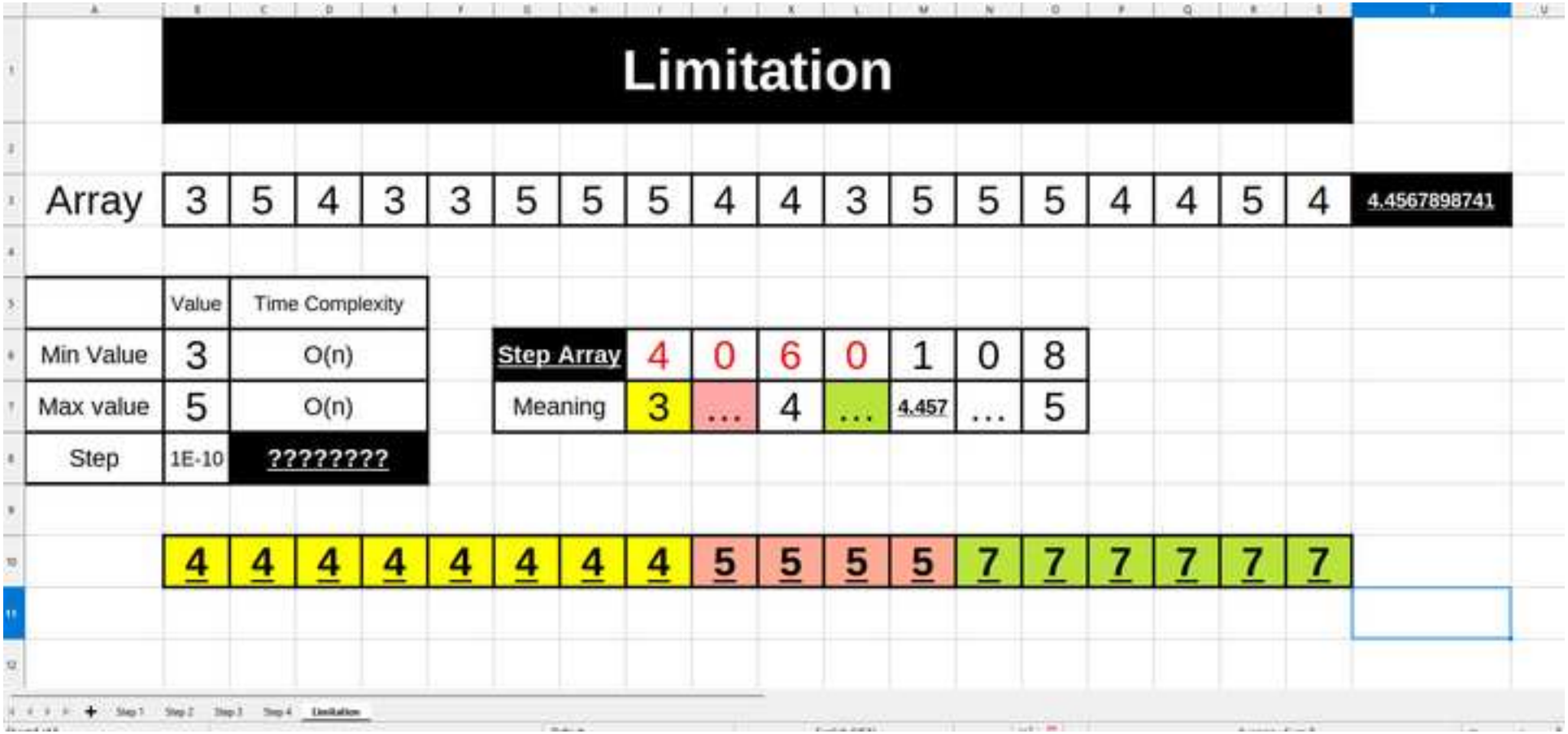
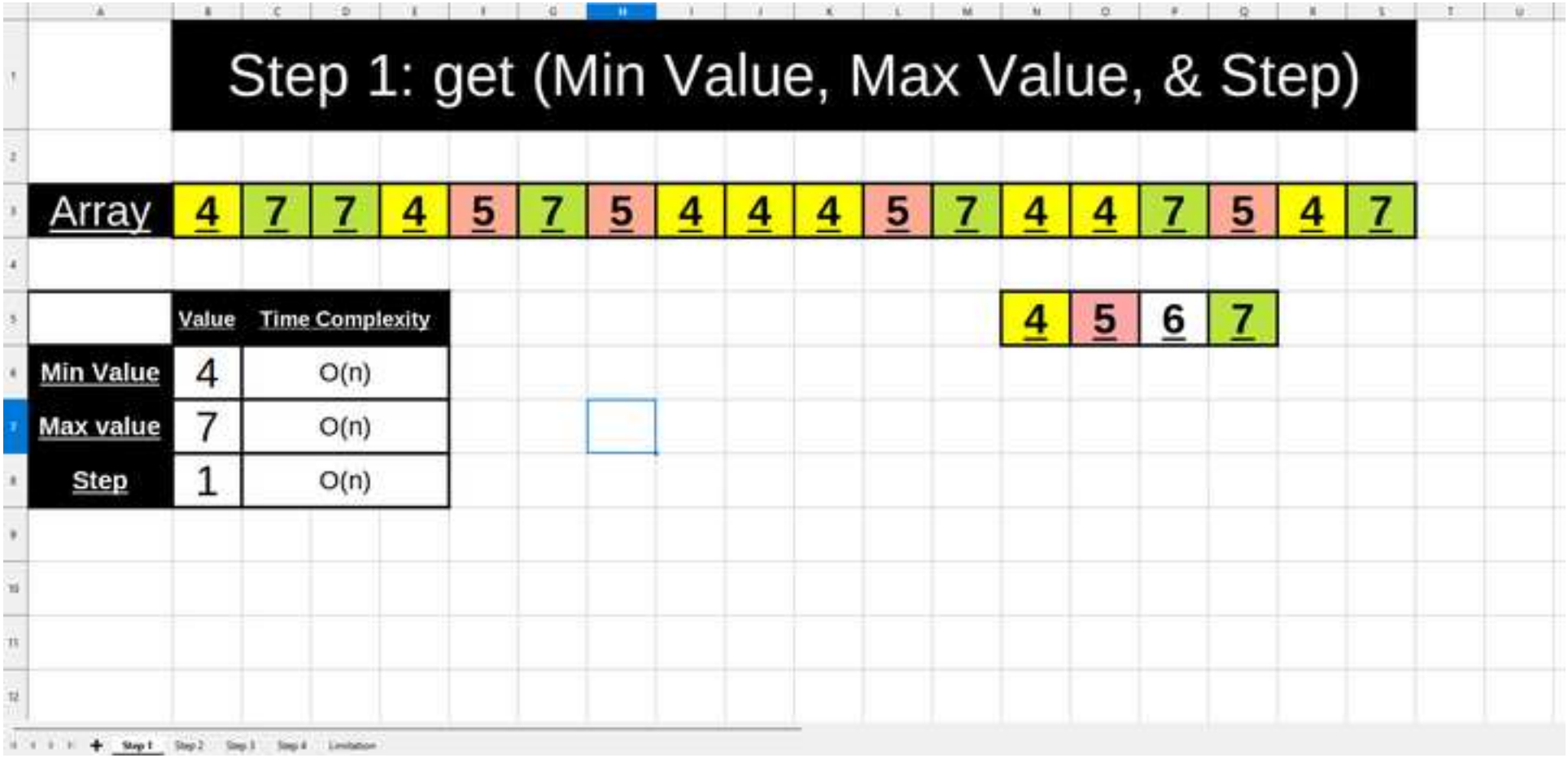
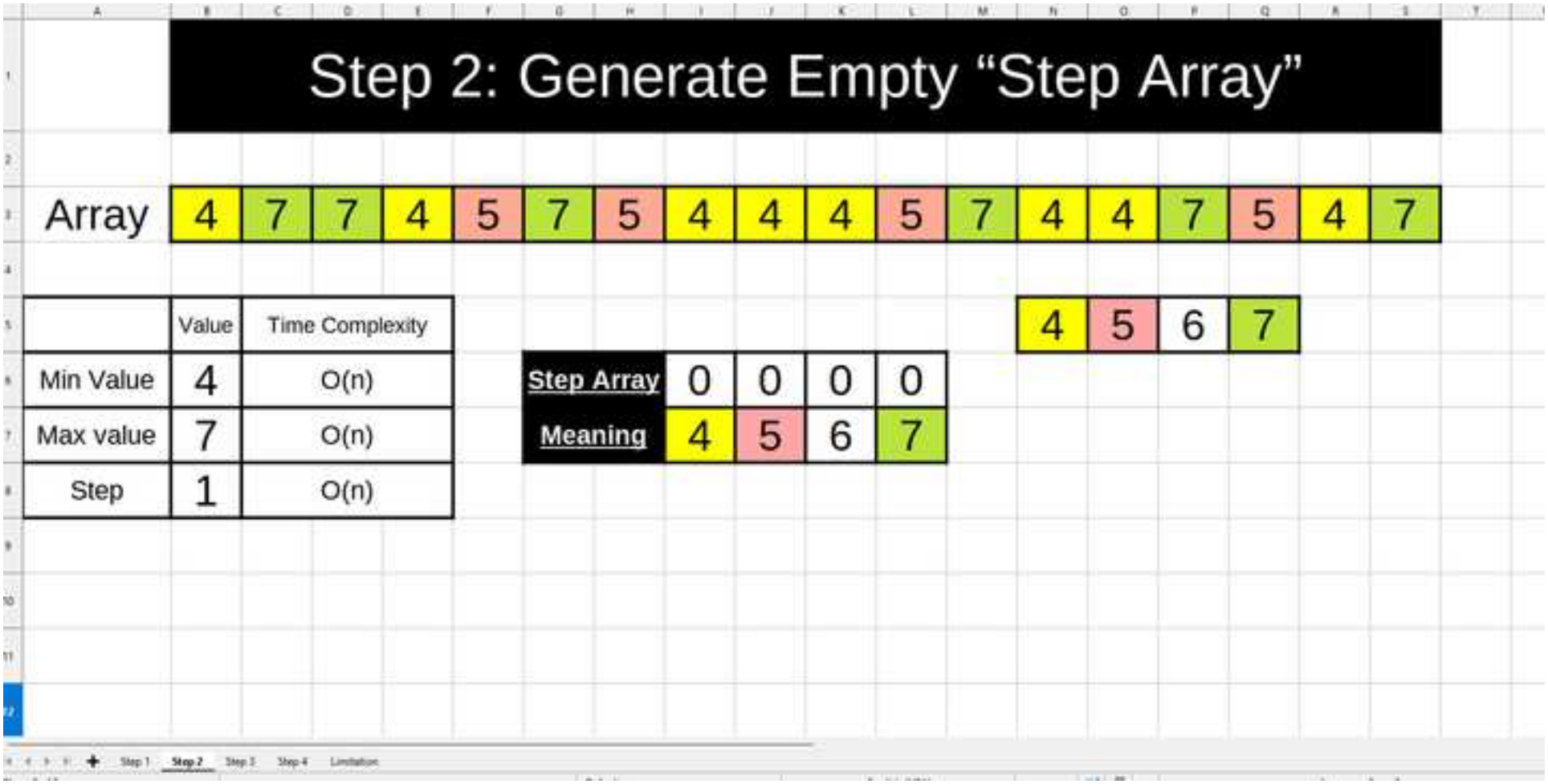
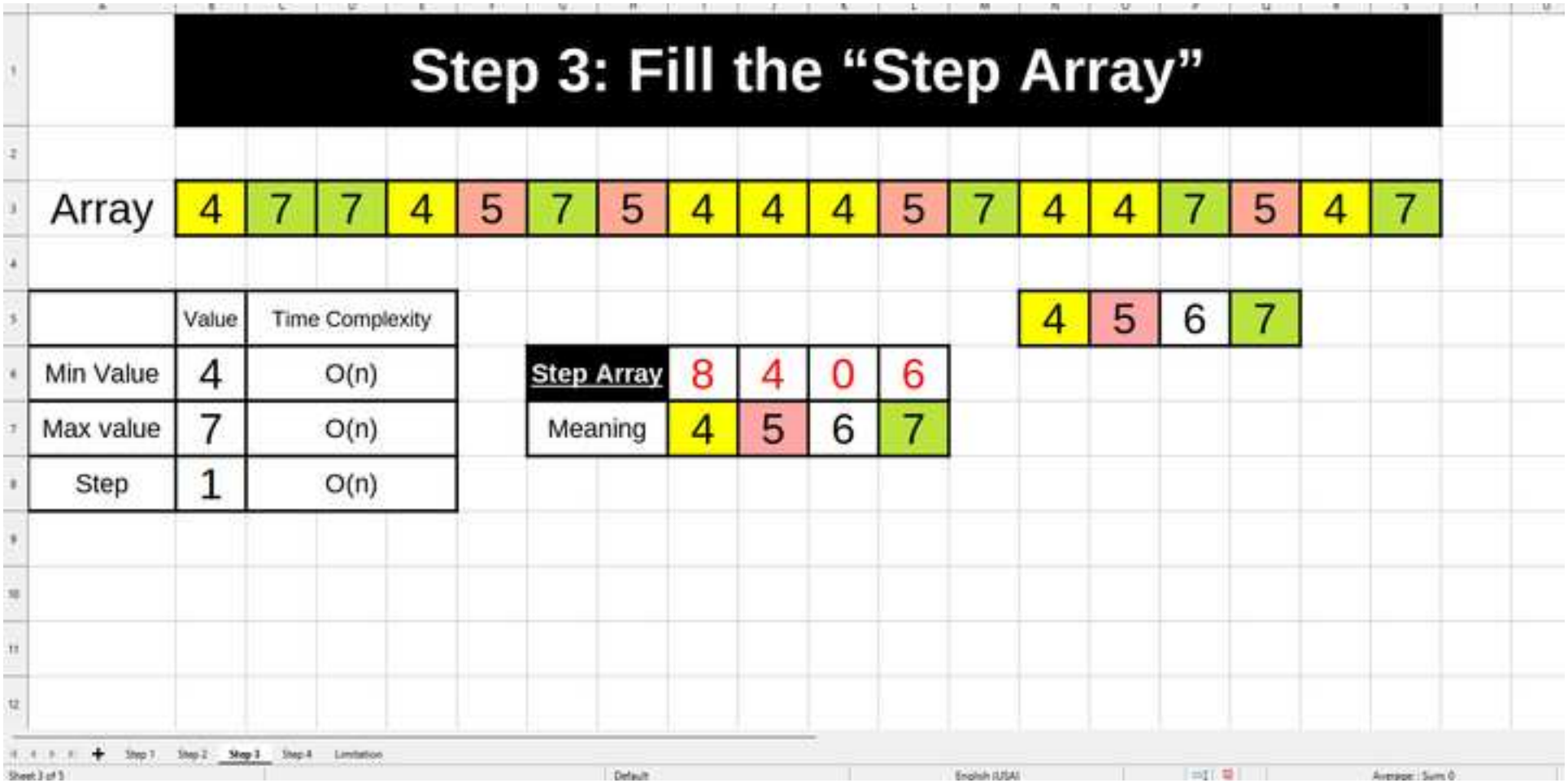
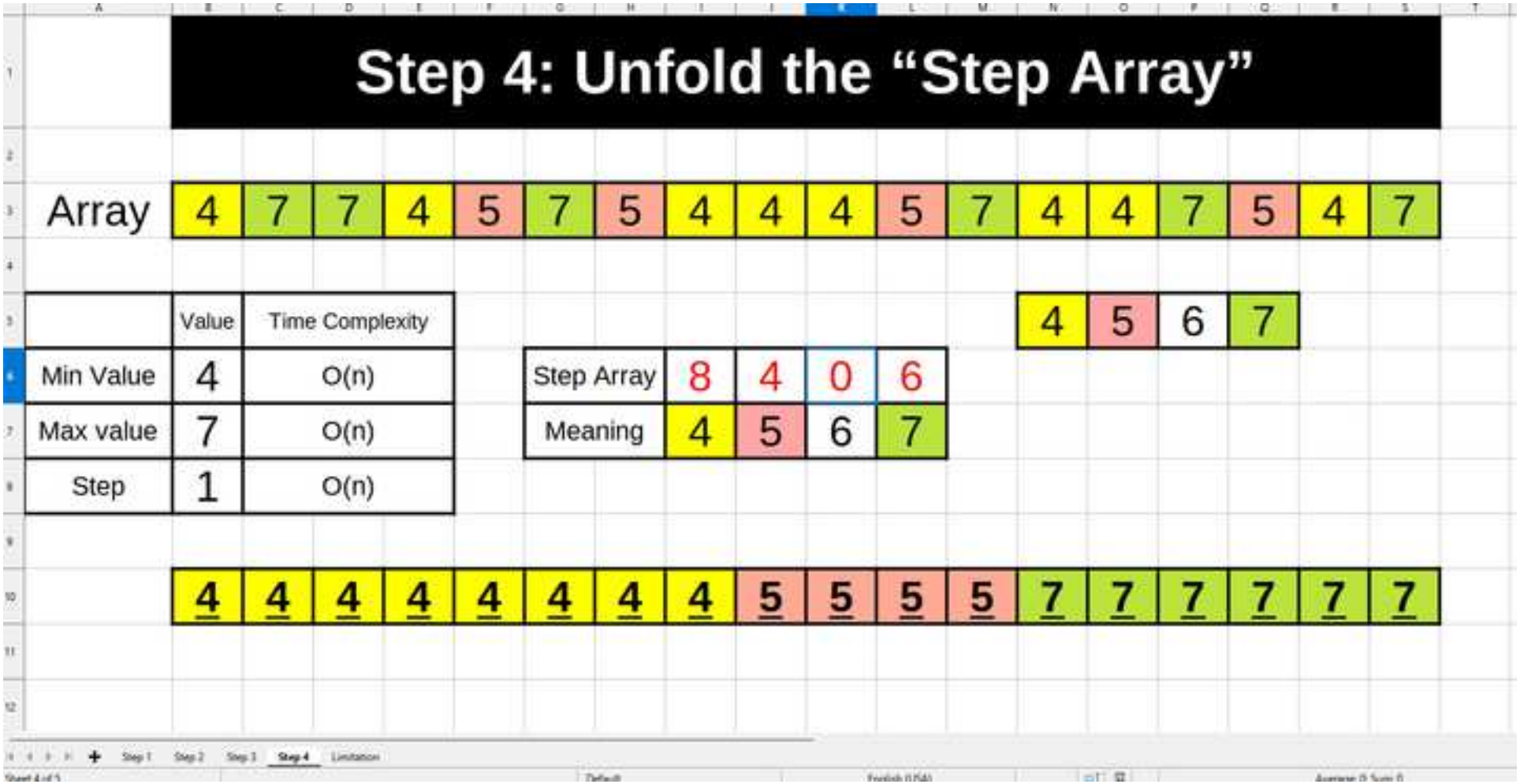
Abstract:	











Highlights

An efficient sorting algorithm that has a time complexity of O(n) if the limitation is fulfilled.

Step Sort

Efficient sorting algorithm.
This sorting algorithm has a Time Complexity of `O(n)`, only if used within the limitation that I will talk about in the end.

My name:

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- In Arabic: عمر مجدي السيد يس

How it works:

It works on `4 Steps`:

Step 1: get (Min Value, Max Value, & Step):

Iterate over each element of the list to get these three variables:

1. Minimum Value
2. Maximum Value
3. The Step (If not provided)

- Time Complexity: `O(n)`

Step 2: Generate Empty “Step Array”:

Using the:

1. Minimum Value
2. Maximum Value
3. The Step

We can generate the Empty `Step Array`

Step 3: Fill the “Step Array”:

Iterate over each element in the Step Array, and increment the value at the correct index for that element.

Step 4: Unfold the “Step Array”:

Let's apply on the example above:

- We create an empty list called `sorted_list`
- We Iterate on each element in the Step Array
    - First Element: Add 8 fours to sorted_list
    - Second Element: Add 4 fives to sorted_list
    - Third Element: Empty. Do not add any thing to sorted_list
    - Fourth Element: Add 6 sevens to sorted_list
- If `reversed` was true, reverse `sorted_list`
- return `sorted_list`

The Limitation:

Since an array that can contain every possible element will be created, so it souldn't be that the number of possibilities is very large.
This is represented by the `Step`.

For Example:

Let's imagine these two arrays:

- `[1, 2, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1]`
    - This is suitable
    - Min Value = 1, Max value = 2, step = 1
    - `step_array` = [12, 11]
        - 12 elements have the value of 1
        - 11 elements have the value of 2
- `[1, 1.065465789, 2, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1]`
    - Not suitable, You should use a general purpose sorting algorithm
    - Min Value = 1, Max value = 2, step = 0.000000001
    - `step_array` = [12, ...(Lots of zeros here)..., 1, ...(Lots of zeros here)..., 11]

If the limitation is not met, then there will be a huge consumption in computational resources.

Examples where the limitation is met:

- `[1, 2, 2, 1, 1, 4, 4, 4, 4, 4]`
- `[0.1, -0.4, 1.1, 0.6]`
- `[0, 100, 200, 800, 400, -100]`

Examples where the limitation NOT is met:

- `[0.87654512, 100.54546578, 2.2145468432]`

Custom Types:

- `Number`:
  - Code: `Number = Union[int, float]`
  - Explanation: a number, that can be Integer or Float

Function Parameters:

```
def step_sort(
    numbers: List[Number],
    step: Optional[Number] = None,
    reversed: Optional[bool] = False,
    accuracy: Optional[int] = 12,
)
```

- `numbers`
  - Explanation: List of numbers to be sorted
  - Required: Yes
  - Type: `List[Number]`
  - Examples:
    - `[3, 6, 7, 4, 5, 6, 2]`
    - `[-1.1, 1.9, 5.7, 9, 5]`
- `step`
  - Explanation: The step between the numbers
  - Required: No

        - If not provided, it will be calculated.
        - But if provided it will save some calculation time
    - Type: `Number`
    - Condition:
        - `> 0`
    - Examples:
        - `1`
        - `0.1`
        - `100`
        - `2`
- `reversed`
    - Explanation:
        - If `True`: Order ascendingly
        - If `False`: Order descendingly
    - Required: No
    - Default Value: `False`
    - Type: `Boolean`
    - Examples:
        - `True`
        - `False`
- `accuracy`
    - Explanation:
        - This is NOT the step
        - This is the number of numbers after the floating point the be rounded at
        - Because division is not very accurate in most programming languages
    - Required: No
    - Default Value: `12`
    - Type: `Integer`
    - Examples:
        - `5`
        - `3`

Source Code:

- Code (Python): /Code/Python/app.py
- Testing: /Code/Python/test_app.py
- I also tried coding using JS and TS, but I stopped midway

AI Generative tools used:

I used AWS Code Whisperer to assist me while writing the code.


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index.tsx

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Video

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An efficient sorting algorithm that has a time complexity of O(n) if the limitation is fulfilled.