**Question 4 [12 marks]:**

The following is a sequence of eight numbers.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 70 | 20 | 50 | 80 | 60 | 10 | 40 | 30 |

 Use QuickSort to sort the numbers in the sequence in **ascending** order. Show the result of each step by showing the whole sequence in a new line with sorted numbers underlined.

Key idea of QuickSort

1. **Initialize:**

Choose a pivot.

Place head at the start.

Place tail at the end.

1. **Compare Pivot to Head:**

If pivot > head and head hasn't reached the end: move head right.

Return to step 2. Otherwise, proceed to step 3.

1. **Compare Pivot to Tail:**

If pivot ≤ tail and tail hasn't reached the start: move tail left. Return to step 3. Otherwise, proceed to step 4.

1. **Check Head and Tail Position:**

If they've met or crossed: swap pivot with tail. End process.

Otherwise, proceed to step 5.

1. **Swap and Move:**

Swap values at head and tail.

Move head right.

Move tail left.

Return to step 2.

Step 1: Use the first number 70 as the pivot.

From the right pointer: 20 !=> 70 ( index + 1 ), 50 !=> 70 ( index + 1 ), 80 > 70 ( header = 80 )

From the left pointer:

And swap them.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Value | 70 | 20 | 50 | 80 | 60 | 10 | 40 | 30 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Value | 70 | 20 | 50 | 30 | 60 | 10 | 40 | 80 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Value | 70 | 20 | 50 | 30 | 60 | 10 | 40 | 80 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Value | 40 | 20 | 50 | 30 | 60 | 10 | 70 | 80 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Value | 40 | 20 | 50 | 30 | 60 | 10 | 70 | 80 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|  | 70 | 20 | 50 | 80 | 60 | 10 | 40 | 30 |
| Step 1 | 40 | 20 | 50 | 30 | 60 | 10 | 70 | 80 |
| Step 2 | 30 | 20 | 10 | 40 | 60 | 50 | 70 | 80 |
| Step 3 | 10 | 20 | 30 | 40 | 60 | 50 | 70 | 80 |
| Step 4 | 10 | 20 | 30 | 40 | 60 | 50 | 70 | 80 |
| Step 5 | 10 | 20 | 30 | 40 | 60 | 50 | 70 | 80 |
| Step 6 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| Step 7 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| Step 8 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |