Appendicies

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Appendix A - QuickSort Pivot Selection Experimentation Data

1. Sorted Array

Pivot Strategy: last

Original Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10] Sorted Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 0
Total Comparisons: 55

Total Pivot Selection Cost: 110.0000

Pivot Strategy: first

Original Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10] Sorted Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 20 Total Comparisons: 55

Total Pivot Selection Cost: 110.0000

Pivot Strategy: random

Original Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10] Sorted Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 12 Total Comparisons: 32

Total Pivot Selection Cost: 52.0000

Pivot Strategy: median

Original Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10] Sorted Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 14 Total Comparisons: 22

Total Pivot Selection Cost: 26.0000

2. Unsorted Array:

Pivot Strategy: last

Original Array: [20, 382, 78, 292, 1000, 889, 2, 10, 92, 3, 11] Sorted Array: [2, 3, 10, 11, 20, 78, 92, 292, 382, 889, 1000]

Total Swaps: 12

Total Comparisons: 23

Total Pivot Selection Cost: 30.0000

Pivot Strategy: first

Original Array: [20, 382, 78, 292, 1000, 889, 2, 10, 92, 3, 11] Sorted Array: [2, 3, 10, 11, 20, 78, 92, 292, 382, 889, 1000]

Total Swaps: 18 Total Comparisons: 26

Total Pivot Selection Cost: 40.0000

Pivot Strategy: random

Original Array: [20, 382, 78, 292, 1000, 889, 2, 10, 92, 3, 11] Sorted Array: [2, 3, 10, 11, 20, 78, 92, 292, 382, 889, 1000]

Total Swaps: 14
Total Comparisons: 25

Total Pivot Selection Cost: 38.0000

Pivot Strategy: median

Original Array: [20, 382, 78, 292, 1000, 889, 2, 10, 92, 3, 11] Sorted Array: [2, 3, 10, 11, 20, 78, 92, 292, 382, 889, 1000]

Total Swaps: 20 Total Comparisons: 23

Total Pivot Selection Cost: 32.0000

3. Array in reverse order:

Pivot Strategy: last

Original Array: [10, 9, 8, 7, 6, 5, 4, 3, 2, 1] Sorted Array: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 5
Total Comparisons: 45

Total Pivot Selection Cost: 90.0000

Pivot Strategy: first

Original Array: [10, 9, 8, 7, 6, 5, 4, 3, 2, 1] Sorted Array: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 13 Total Comparisons: 45

Total Pivot Selection Cost: 90.0000

Pivot Strategy: random

Original Array: [10, 9, 8, 7, 6, 5, 4, 3, 2, 1] Sorted Array: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 15 Total Comparisons: 26

Total Pivot Selection Cost: 42.0000

Pivot Strategy: median

Original Array: [10, 9, 8, 7, 6, 5, 4, 3, 2, 1] Sorted Array: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 15 Total Comparisons: 19 Total Pivot Selection Cost: 24.0000

4. Nearly Sorted:

Pivot Strategy: last

Original Array: [11, 12, 13, 14, 2, 1, 20, 30, 19] Sorted Array: [1, 2, 11, 12, 13, 14, 19, 20, 30]

Total Swaps: 7

Total Comparisons: 20

Total Pivot Selection Cost: 32.0000

Pivot Strategy: first

Original Array: [11, 12, 13, 14, 2, 1, 20, 30, 19] Sorted Array: [1, 2, 11, 12, 13, 14, 19, 20, 30]

Total Swaps: 11 Total Comparisons: 17

Total Pivot Selection Cost: 24.0000

Pivot Strategy: random

Original Array: [11, 12, 13, 14, 2, 1, 20, 30, 19] Sorted Array: [1, 2, 11, 12, 13, 14, 19, 20, 30]

Total Swaps: 11 Total Comparisons: 20

Total Pivot Selection Cost: 34.0000

Pivot Strategy: median

Original Array: [11, 12, 13, 14, 2, 1, 20, 30, 19] Sorted Array: [1, 2, 11, 12, 13, 14, 19, 20, 30]

Total Swaps: 9 Total Comparisons: 18

Total Pivot Selection Cost: 28.0000

5. Duplicate Values Test 1

Pivot Strategy: last

Total Swaps: 30 Total Comparisons: 465

Total Pivot Selection Cost: 930.0000

Pivot Strategy: first

1, 1, 1, 1, 1, 1, 1, 1, 1, 1] Total Swaps: 60

Total Comparisons: 465

Total Pivot Selection Cost: 930.0000

Pivot Strategy: random

Total Swaps: 56

Total Comparisons: 465

Total Pivot Selection Cost: 930.0000

Pivot Strategy: median

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]

1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]

Total Swaps: 60

Total Comparisons: 465

Total Pivot Selection Cost: 930.0000

6. Duplicate Values Test 2

Pivot Strategy: last

Total Swaps: 41

Total Comparisons: 134

Total Pivot Selection Cost: 234.0000

Pivot Strategy: first

Original Array: [100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90]

Total Swaps: 70
Total Comparisons: 135

Total Pivot Selection Cost: 238.0000

Pivot Strategy: random

Original Array: [100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90, 100, 49, 90]

Total Swaps: 61
Total Comparisons: 134

Total Pivot Selection Cost: 234.0000

Pivot Strategy: median

Total Swaps: 64
Total Comparisons: 134

Total Pivot Selection Cost: 234.0000

7. Duplicate Test 3

Pivot Strategy: last

Original Array: [10, 4, 10, 4, 10, 4, 10, 4, 10, 4, 10, 4] Sorted Array: [4, 4, 4, 4, 4, 10, 10, 10, 10, 10, 10]

Total Swaps: 14 Total Comparisons: 41

Total Pivot Selection Cost: 72.0000

Pivot Strategy: first

Original Array: [10, 4, 10, 4, 10, 4, 10, 4, 10, 4, 10, 4] Sorted Array: [4, 4, 4, 4, 4, 10, 10, 10, 10, 10, 10]

Total Swaps: 24
Total Comparisons: 36

Total Pivot Selection Cost: 62.0000

Pivot Strategy: random

Original Array: [10, 4, 10, 4, 10, 4, 10, 4, 10, 4, 10, 4] Sorted Array: [4, 4, 4, 4, 4, 4, 10, 10, 10, 10, 10, 10]

Total Swaps: 22 Total Comparisons: 41

Total Pivot Selection Cost: 72.0000

Pivot Strategy: median

Original Array: [10, 4, 10, 4, 10, 4, 10, 4, 10, 4, 10, 4] Sorted Array: [4, 4, 4, 4, 4, 10, 10, 10, 10, 10, 10]

Total Swaps: 23 Total Comparisons: 41

Total Pivot Selection Cost: 72.0000

Appendix B - Simulated Annealing Experimentation Data

1. SA 1st Test Run

Iteration 0, Temperature 10.000, Best Evaluation 22.33582
Iteration 100, Temperature 0.099, Best Evaluation 13.98957
Iteration 200, Temperature 0.050, Best Evaluation 13.97990
Iteration 300, Temperature 0.033, Best Evaluation 13.97983
Iteration 400, Temperature 0.025, Best Evaluation 13.97983
Iteration 500, Temperature 0.020, Best Evaluation 13.97983
Iteration 600, Temperature 0.017, Best Evaluation 13.97983
Iteration 700, Temperature 0.014, Best Evaluation 13.97983
Iteration 800, Temperature 0.012, Best Evaluation 13.97983
Iteration 900, Temperature 0.011, Best Evaluation 13.97983
Best Solution: [-1.9898819672332864, 4.41573127420101]

Best Score: 13.979831371929222

2. SA 2nd Test Run

Iteration 0, Temperature 10.000, Best Evaluation 39.82215
Iteration 100, Temperature 0.099, Best Evaluation 18.95464
Iteration 200, Temperature 0.050, Best Evaluation 18.95464
Iteration 300, Temperature 0.033, Best Evaluation 18.95464
Iteration 400, Temperature 0.025, Best Evaluation 18.95464
Iteration 500, Temperature 0.020, Best Evaluation 18.95464
Iteration 600, Temperature 0.017, Best Evaluation 18.95464
Iteration 700, Temperature 0.014, Best Evaluation 18.95464
Iteration 800, Temperature 0.012, Best Evaluation 18.95464
Iteration 900, Temperature 0.011, Best Evaluation 18.95464
Best Solution: [2.985108632648188, -0.0301710866328396]

Best Score: 18.95461387700815

3. SA 3rd Test Run

Iteration 0, Temperature 10.000, Best Evaluation 11.17406
Iteration 100, Temperature 0.099, Best Evaluation 10.99496
Iteration 200, Temperature 0.050, Best Evaluation 10.99496
Iteration 300, Temperature 0.033, Best Evaluation 10.99496
Iteration 400, Temperature 0.025, Best Evaluation 10.99496
Iteration 500, Temperature 0.020, Best Evaluation 10.99496
Iteration 600, Temperature 0.017, Best Evaluation 10.99496
Iteration 700, Temperature 0.014, Best Evaluation 10.99496
Iteration 800, Temperature 0.012, Best Evaluation 10.99496
Iteration 900, Temperature 0.011, Best Evaluation 10.99496
Best Solution: [0.9948409805553339, -2.7760036686385074]

Best Score: 10.99496180208096

4. SA 4th Test Run

Iteration 0, Temperature 10.000, Best Evaluation 29.50219
Iteration 100, Temperature 0.099, Best Evaluation 7.96064
Iteration 200, Temperature 0.050, Best Evaluation 7.96064
Iteration 300, Temperature 0.033, Best Evaluation 7.96064
Iteration 400, Temperature 0.025, Best Evaluation 7.96064
Iteration 500, Temperature 0.020, Best Evaluation 7.96064
Iteration 600, Temperature 0.017, Best Evaluation 7.96064
Iteration 700, Temperature 0.014, Best Evaluation 7.96064
Iteration 800, Temperature 0.012, Best Evaluation 7.96064
Iteration 900, Temperature 0.011, Best Evaluation 7.96064
Best Solution: [1.9917569855167407, 1.9886703218871031]

Best Score: 7.960641665036977

SA 5th Test Run

Iteration 0, Temperature 10.000, Best Evaluation 50.67021 Iteration 100, Temperature 0.099, Best Evaluation 49.74787 Iteration 200, Temperature 0.050, Best Evaluation 49.74787 Iteration 300, Temperature 0.033, Best Evaluation 49.74787 Iteration 400, Temperature 0.025, Best Evaluation 49.74787 Iteration 500, Temperature 0.020, Best Evaluation 49.74787 Iteration 600, Temperature 0.017, Best Evaluation 49.74787 Iteration 700, Temperature 0.014, Best Evaluation 49.74787 Iteration 800, Temperature 0.012, Best Evaluation 49.74787 Iteration 900, Temperature 0.011, Best Evaluation 49.74787 Iteration 900, Temperature 0.011, Best Evaluation 49.74787 Best Solution: [-4.97351998724881, 4.97379330463322]

Best Score: 49.74787253457849

Appendix C - SA-Optimized QuickSort Experimentation Data

1. Sorted Array

--- Simulated Annealing for Subarray [0:10] --Initial Pivot: Index=9. Value=9. Cost=18.0000

Iteration 0 | Temp: 10.000 | Current: idx=9, value=9, cost=18.0000 | Best: idx=9, value=9, cost=18.0000 | Iteration 10 | Temp: 0.909 | Current: idx=7, value=7, cost=14.0000 | Best: idx=7, value=7, cost=14.0000 | Iteration 20 | Temp: 0.476 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 30 | Temp: 0.323 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 40 | Temp: 0.244 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 50 | Temp: 0.196 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 60 | Temp: 0.164 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 80 | Temp: 0.123 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 90 | Temp: 0.110 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Iteration 90 | Temp: 0.110 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 | Selected Pivot: Index=5, Value=5, Cost=10.0000 | Selected Pivot: Index=5, Value=5, Cost=10.0000

--- Simulated Annealing for Subarray [0:4] ---

Initial Pivot: Index=4, Value=4, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=3, value=3, cost=6.0000 | Best: idx=3, value=3, cost=6.0000 | Iteration 10 | Temp: 0.909 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 40 | Temp: 0.244 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 60 | Temp: 0.164 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 70 | Temp: 0.123 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 90 | Temp: 0.123 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=2, value=2, cost=4.0000 | Best: idx=2, value=2, cost=4.0000 | Selected Pivot: Index=2, Value=2, Cost=4.0000 | Selected Pivot: Index=

--- Simulated Annealing for Subarray [0:1] ---

Initial Pivot: Index=1, Value=1, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 10 | Temp: 0.909 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 20 | Temp: 0.476 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 30 | Temp: 0.323 | Current: idx=0, value=0, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 40 | Temp: 0.244 | Current: idx=0, value=0, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 50 | Temp: 0.196 | Current: idx=0, value=0, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 60 | Temp: 0.164 | Current: idx=0, value=0, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 70 | Temp: 0.141 | Current: idx=0, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=1, value=1, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=

Iteration 90 | Temp: 0.110 | Current: idx=0, value=0, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Iteration 99 | Temp: 0.100 | Current: idx=0, value=0, cost=2.0000 | Best: idx=1, value=1, cost=2.0000 | Selected Pivot: Index=1. Value=1, Cost=2.0000

--- Simulated Annealing for Subarray [3:4] ---

Initial Pivot: Index=4, Value=4, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=4, value=4, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 10 | Temp: 0.909 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 20 | Temp: 0.476 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 30 | Temp: 0.323 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 40 | Temp: 0.244 | Current: idx=4, value=4, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 50 | Temp: 0.196 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 60 | Temp: 0.164 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 70 | Temp: 0.121 | Current: idx=4, value=4, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 80 | Temp: 0.123 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.110 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.110 | Current: idx=3, value=3, cost=2.0000 | Best: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
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Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
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Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 |
Iteration 90 | Tem

--- Simulated Annealing for Subarray [6:10] ---

Initial Pivot: Index=10, Value=10, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=10, value=10, cost=8.0000 | Best: idx=10, value=10, cost=8.0000 | Iteration 10 | Temp: 0.909 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 40 | Temp: 0.2241 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 60 | Temp: 0.164 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 70 | Temp: 0.121 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000 | Best: idx=8, value=8, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=8, cost=4.0000

--- Simulated Annealing for Subarray [6:7] ---

Initial Pivot: Index=6, Value=6, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 10 | Temp: 0.909 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 20 | Temp: 0.476 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 30 | Temp: 0.323 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 40 | Temp: 0.244 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 50 | Temp: 0.196 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 60 | Temp: 0.164 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 70 | Temp: 0.141 | Current: idx=6, value=6, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=6, value=6, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 90 | Temp: 0.110 | Current: idx=6, value=6, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=6, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Best: idx=6, value=6, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=7, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=8, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=9, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=9, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=9, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=9, cost=2.0000 | Iteration 90 |

--- Simulated Annealing for Subarray [9:10] ---

Initial Pivot: Index=10, Value=10, Cost=2.0000

Iteration 0 | Temp: 0.000 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 10 | Temp: 0.909 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 20 | Temp: 0.476 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 30 | Temp: 0.323 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 40 | Temp: 0.244 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 50 | Temp: 0.196 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 60 | Temp: 0.164 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 70 | Temp: 0.123 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=9, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.110 | Current: idx=10, value=10, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=9, cost=2.0000 | Best: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0

Sorted Array: [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 8 Total Comparisons: 22

2. Unsorted Array

--- Simulated Annealing for Subarray [0:10] ---

Initial Pivot: Index=9, Value=3, Cost=18.0000

0 | Temp: 10.000 | Current: idx=10, value=11, cost=14.0000 | Best: idx=10, value=11,

Iteration 20 | Temp: 0.476 | Current; idx=2, value=78, cost=10.0000 | Best; idx=2, value=78, cost=10.0000 Iteration 30 | Temp: 0.323 | Current; idx=2, value=78, cost=10.0000 | Best: idx=2, value=78, cost=10.0000 $Iteration \ \ 40 \ | \ Temp: \ \ 0.244 \ | \ Current: \ idx=2, \ value=78, \ cost=10.0000 \ | \ Best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ According to the cost=10.00000 \ | \ According to the cost=10.0000 \ | \ According to the cost=10.00$ Iteration 50 | Temp: 0.196 | Current: idx=2, value=78, cost=10.0000 | Best: idx=2, value=78, cost=10.0000 $Iteration \ \ 70 \ | \ Temp: \ \ 0.141 \ | \ \ Current: \ idx=2, \ value=78, \ cost=10.0000 \ | \ Best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ Best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ value=78, \ cost=10.0000 \ | \ best: \ idx=2, \ idx$ Iteration 80 | Temp: 0.123 | Current; idx=2, value=78, cost=10.0000 | Best; idx=2, value=78, cost=10.0000 Iteration 90 | Temp: 0.110 | Current: idx=2, value=78, cost=10.0000 | Best: idx=2, value=78, cost=10.0000 Iteration 99 | Temp: 0.100 | Current: idx=2, value=78, cost=10.0000 | Best: idx=2, value=78, cost=10.0000 Selected Pivot: Index=2. Value=78. Cost=10.0000

--- Simulated Annealing for Subarray [0:4] ---

Initial Pivot: Index=2, Value=2, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=1, value=11, cost=6.0000 | Best: idx=1, value=11, cost=6.0000 Iteration 10 | Temp: 0.909 | Current: idx=3, value=10, cost=4.0000 | Best: idx=3, value=10, cost=4.0000 $Iteration \ \ 20 \ | \ Temp: \ \ 0.476 \ | \ Current: \ idx=3, \ value=10, \ cost=4.0000 \ | \ Best: \ idx=3, \ value=10, \ cost=4.0000 \ | \ According to the cost=4.0000 \ | \ According to$ $Iteration \ \ 30 \ | \ Temp: \ \ 0.323 \ | \ Current: \ idx=3, \ value=10, \ cost=4.0000 \ | \ Best: \ idx=3, \ value=10, \ cost=4.0000 \ | \ According to the cost=4.0000 \ | \ According to$ Iteration 40 | Temp: 0.244 | Current: idx=3. value=10. cost=4.0000 | Best: idx=3. value=10. cost=4.0000 Iteration 50 | Temp: 0.196 | Current: idx=3, value=10, cost=4.0000 | Best: idx=3, value=10, cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=3, value=10, cost=4.0000 | Best: idx=3, value=10, cost=4.0000 Iteration 70 | Temp: 0.141 | Current: idx=3, value=10, cost=4,0000 | Best: idx=3, value=10, cost=4,0000 Iteration 80 | Temp: 0.123 | Current: idx=3, value=10, cost=4.0000 | Best: idx=3, value=10, cost=4.0000 Iteration 90 | Temp: 0.110 | Current: idx=3, value=10, cost=4.0000 | Best: idx=3, value=10, cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=3, value=10, cost=4.0000 | Best: idx=3, value=10, cost=4.0000 Selected Pivot: Index=3, Value=10, Cost=4.0000

--- Simulated Annealing for Subarray [0:1] ---

Initial Pivot: Index=1, Value=3, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=0, value=2, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=1, value=3, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=1, value=3, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=1, value=3, cost=2,0000 | Best: idx=1, value=3, cost=2,0000 Iteration 40 | Temp: 0.244 | Current: idx=1, value=3, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=0, value=2, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 60 | Temp: 0.164 | Current: idx=0, value=2, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=1, value=3, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=0, value=2, cost=2,0000 | Best: idx=1, value=3, cost=2,0000 Iteration 90 | Temp: 0.110 | Current: idx=0, value=2, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=0, value=2, cost=2.0000 | Best: idx=1, value=3, cost=2.0000 Selected Pivot: Index=1, Value=3, Cost=2.0000

--- Simulated Annealing for Subarray [3:4] ---

Initial Pivot: Index=3, Value=11, Cost=2.0000

 $Iteration \quad 0 \mid Temp: \ 10.000 \mid Current: \ idx=3, \ value=11, \ cost=2.0000 \mid Best: \ idx=3, \ cost=3.0000 \mid Best: \ idx=3, \ cost=3.0000$ $Iteration \ \ 10 \ | \ Temp: \ \ 0.909 \ | \ \ Current: \ idx=3, \ value=11, \ cost=2.0000 \ | \ Best: \ idx=3, \ value=11, \ cost=2.0000 \ | \ Best: \ idx=3, \ value=11, \ cost=2.0000 \ | \ cost=2.00000 \ | \ cost=2.0000 \ | \ cost=2.00000 \ | \ cost=2.0000 \ | \ cost=2.00000 \ | \ cost=2.0000 \$ Iteration 20 | Temp: 0.476 | Current: idx=4, value=20, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=3, value=11, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=3, value=11, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=3, value=11, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 60 | Temp: 0.164 | Current: idx=4, value=20, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=4, value=20, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=3, value=11, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 90 | Temp: 0.110 | Current: idx=3, value=11, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=4, value=20, cost=2.0000 | Best: idx=3, value=11, cost=2.0000 Selected Pivot: Index=3, Value=11, Cost=2.0000

--- Simulated Annealing for Subarray [6:10] ---

0 | Temp: 10.000 | Current: idx=10, value=889, cost=6.0000 | Best: idx=10, value=889,

Iteration 10 | Temp: 0.909 | Current: idx=9, value=1000, cost=8.0000 | Best: idx=6, value=382

Iteration 20 | Temp: 0.476 | Current: idx=10, value=889, cost=6.0000 | Best: idx=6, value=382, cost=4 0000

Iteration 30 | Temp: 0.323 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Iteration 40 | Temp: 0.244 | Current: idx=6, value=382, cost=4,0000 | Best: idx=6, value=382, cost=4,0000 Iteration 50 | Temp: 0.196 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Iteration 70 | Temp: 0.141 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Iteration 80 | Temp: 0.123 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Iteration 90 | Temp: 0.110 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=6, value=382, cost=4.0000 | Best: idx=6, value=382, cost=4.0000 Selected Pivot: Index=6, Value=382, Cost=4.0000

--- Simulated Annealing for Subarray [6:7] ---

Initial Pivot: Index=6. Value=292. Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=7, value=92, cost=2,0000 | Best: idx=6, value=292, cost=2,0000 Iteration 10 | Temp: 0.909 | Current: idx=6, value=292, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=6, value=292, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=7. value=92. cost=2.0000 | Best: idx=6. value=292. cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=7, value=92, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=7, value=92, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 60 | Temp: 0.164 | Current: idx=6, value=292, cost=2,0000 | Best: idx=6, value=292, cost=2,0000 Iteration 70 | Temp: 0.141 | Current: idx=6, value=292, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=6, value=292, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 90 | Temp: 0.110 | Current: idx=6, value=292, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=7, value=92, cost=2.0000 | Best: idx=6, value=292, cost=2.0000 Selected Pivot: Index=6 Value=292 Cost=2 0000

--- Simulated Annealing for Subarray [9:10] ---

Initial Pivot: Index=10 Value=889 Cost=2 0000

0 | Temp: 10.000 | Current: idx=10, value=889, cost=2.0000 | Best: idx=10, value=889, cost=2 0000

Iteration 10 | Temp: 0.909 | Current: idx=9, value=1000, cost=2.0000 | Best: idx=10, value=889. cost=2.0000

Iteration 20 | Temp: 0.476 | Current: idx=10, value=889, cost=2.0000 | Best: idx=10, value=889,

Iteration 30 | Temp: 0.323 | Current: idx=9, value=1000, cost=2.0000 | Best: idx=10, value=889,

Iteration 40 | Temp: 0.244 | Current: idx=9, value=1000, cost=2.0000 | Best: idx=10, value=889, cost=2 0000 Iteration 50 | Temp: 0.196 | Current: idx=10, value=889, cost=2.0000 | Best: idx=10, value=889,

cost=2.0000 Iteration 60 | Temp: 0.164 | Current: idx=10, value=889, cost=2.0000 | Best: idx=10, value=889, cost=2.0000

70 | Temp: 0.141 | Current: idx=10, value=889, cost=2.0000 | Best: idx=10, value=889, cost=2.0000

Iteration 80 | Temp: 0.123 | Current: idx=9, value=1000, cost=2.0000 | Best: idx=10, value=889, cost=2.0000

Iteration 90 | Temp: 0.110 | Current: idx=9, value=1000, cost=2.0000 | Best: idx=10, value=889,

Iteration 99 | Temp: 0.100 | Current: idx=9, value=1000, cost=2.0000 | Best: idx=10, value=889,

Selected Pivot: Index=10, Value=889, Cost=2.0000

Sorted Array: [2, 3, 10, 11, 20, 78, 92, 292, 382, 889, 1000]

Total Comparisons: 22

Total Pivot Selection Cost: 26.0000

3. Array in Reverse Order

--- Simulated Annealing for Subarray [0:9] ---

Initial Pivot: Index=1 Value=9 Cost=16 0000

Iteration 0 | Temp: 10.000 | Current: idx=0, value=10, cost=18.0000 | Best: idx=1, value=9, cost=16.0000 Iteration 10 | Temp: 0.909 | Current: idx=9, value=1, cost=18.0000 | Best: idx=1, value=9, cost=16.0000 Iteration 20 | Temp: 0.476 | Current: idx=6, value=4, cost=12.0000 | Best: idx=6, value=4, cost=12.0000 Iteration 30 | Temp: 0.323 | Current: idx=4, value=6, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Iteration 40 | Temp: 0.244 | Current: idx=4, value=6, cost=10.0000 | Best: idx=5, value=5, cost=10.0000

Iteration 50 | Temp: 0.196 | Current: idx=4, value=6, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Iteration 60 | Temp: 0.164 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Iteration 70 | Temp: 0.141 | Current: idx=4, value=6, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Iteration 80 | Temp: 0.123 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Iteration 90 | Temp: 0.110 | Current: idx=5, value=5, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Iteration 99 | Temp: 0.100 | Current: idx=4, value=6, cost=10.0000 | Best: idx=5, value=5, cost=10.0000 Selected Pivot: Index=5. Value=5. Cost=10.0000

--- Simulated Annealing for Subarray [0:3] ---

Initial Pivot: Index=2, Value=3, Cost=4.0000

 $Iteration \quad 0 \mid Temp: 10.000 \mid Current: idx=3, value=2, cost=4.0000 \mid Best: idx=2, value=3, cost=4.0000 \mid Best: idx=3, value=3, cost=4.0000 \mid Best: idx=3, cost=4.0000 \mid Best: idx=3,$ Iteration 10 | Temp: 0.909 | Current: idx=3, value=2, cost=4.0000 | Best: idx=2, value=3, cost=4.0000

Iteration 20 | Temp: 0.476 | Current: idx=3, value=2, cost=4,0000 | Best: idx=2, value=3, cost=4,0000 Iteration 30 | Temp: 0.323 | Current: idx=2, value=3, cost=4.0000 | Best: idx=2, value=3, cost=4.0000 Iteration 40 | Temp: 0.244 | Current: idx=3, value=2, cost=4.0000 | Best: idx=2, value=3, cost=4.0000 Iteration 50 | Temp: 0.196 | Current: idx=2, value=3, cost=4.0000 | Best: idx=2, value=3, cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=2, value=3, cost=4.0000 | Best: idx=2, value=3, cost=4.0000 Iteration 70 | Temp: 0.141 | Current: idx=2, value=3, cost=4.0000 | Best: idx=2, value=3, cost=4.0000 Iteration 80 | Temp: 0.123 | Current: idx=2, value=3, cost=4.0000 | Best: idx=2, value=3, cost=4.0000 Iteration 90 | Temp: 0.110 | Current: idx=3. value=2. cost=4.0000 | Best: idx=2. value=3. cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=2, value=3, cost=4.0000 | Best: idx=2, value=3, cost=4.0000

Selected Pivot: Index=2, Value=3, Cost=4.0000

--- Simulated Annealing for Subarray [0:1] ---

Initial Pivot: Index=1. Value=2. Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=0, value=1, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=1, value=2, cost=2,0000 | Best: idx=1, value=2, cost=2,0000 Iteration 40 | Temp: 0.244 | Current: idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 60 | Temp: 0.164 | Current; idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=0, value=1, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 90 | Temp: 0.110 | Current: idx=1, value=2, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=0, value=1, cost=2.0000 | Best: idx=1, value=2, cost=2.0000 Selected Pivot: Index=1, Value=2, Cost=2.0000

--- Simulated Annealing for Subarray [5:9] ---

Initial Pivot: Index=9. Value=6. Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=8, value=7, cost=6.0000 | Best: idx=8, value=7, cost=6.0000 Iteration 10 | Temp: 0.909 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 20 | Temp: 0.476 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 30 | Temp: 0.323 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 40 | Temp: 0.244 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 50 | Temp: 0.196 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 70 | Temp: 0 141 | Current: idx=7 value=8 cost=4 0000 | Best: idx=7 value=8 cost=4 0000 Iteration 80 | Temp: 0.123 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=7, value=8, cost=4.0000 | Best: idx=7, value=8, cost=4.0000 Selected Pivot: Index=7, Value=8, Cost=4.0000

--- Simulated Annealing for Subarray [5:6] ---

Initial Pivot: Index=6, Value=7, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=6, value=7, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=5, value=6, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=5, value=6, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=6. value=7. cost=2.0000 | Best: idx=6. value=7. cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=6, value=7, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=5, value=6, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 60 | Temp: 0.164 | Current: idx=5, value=6, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=5, value=6, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=6, value=7, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 90 | Temp: 0.110 | Current: idx=6, value=7, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=5, value=6, cost=2.0000 | Best: idx=6, value=7, cost=2.0000 Selected Pivot: Index=6. Value=7. Cost=2.0000

Simulated Annealing for Subarray [8:9] --

Initial Pivot: Index=9. Value=10. Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=8, value=9, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=9, value=10, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=8, value=9, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=8, value=9, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=9, value=10, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=8, value=9, cost=2,0000 | Best: idx=9, value=10, cost=2,0000 Iteration 60 | Temp: 0.164 | Current: idx=9, value=10, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=8, value=9, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=8, value=9, cost=2,0000 | Best: idx=9, value=10, cost=2,0000

Iteration 90 | Temp: 0.110 | Current: idx=9, value=10, cost=2.0000 | Best: idx=9, value=10, cost=2.0000

Iteration 99 | Temp: 0.100 | Current: idx=8, value=9, cost=2.0000 | Best: idx=9, value=10, cost=2.0000 Selected Pivot: Index=9, Value=10, Cost=2.0000

Sorted Array: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]

Total Swaps: 13

Total Pivot Selection Cost: 24 0000

4. Nearly Sorted Array

--- Simulated Annealing for Subarray [0:8] ---

Initial Pivot: Index=1, Value=12, Cost=10.0000

0 | Temp: 10.000 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 10 | Temp: 0.909 | Current: idx=8, value=19, cost=12.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 20 | Temp: 0.476 | Current: idx=8, value=19, cost=12.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 30 | Temp: 0.323 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 40 | Temp: 0.244 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 50 | Temp: 0.196 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 60 | Temp: 0.164 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 70 | Temp: 0.141 | Current: idx=2, value=13, cost=8,0000 | Best: idx=2, value=13, cost=8,0000 Iteration 80 | Temp: 0.123 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 90 | Temp: 0.110 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000 Iteration 99 | Temp: 0.100 | Current: idx=2, value=13, cost=8.0000 | Best: idx=2, value=13, cost=8.0000

--- Simulated Annealing for Subarray [0:3] ---

Initial Pivot: Index=1, Value=12, Cost=6.0000

Iteration 0 | Temp: 10.000 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 10 | Temp: 0.909 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 20 | Temp: 0.476 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 30 | Temp: 0.323 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 40 | Temp: 0.244 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 50 | Temp: 0.196 | Current: idx=2, value=2, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=2, value=2, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 70 | Temp: 0.141 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 80 | Temp: 0.123 | Current: idx=2, value=2, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 90 | Temp: 0.110 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=0, value=11, cost=4.0000 | Best: idx=0, value=11, cost=4.0000 Selected Pivot: Index=0 Value=11 Cost=4 0000

- Simulated Annealing for Subarray [0:1] ---

Initial Pivot: Index=0. Value=1. Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=0, value=1, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=1, value=2, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=1, value=2, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=1, value=2, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=0, value=1, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=1, value=2, cost=2,0000 | Best: idx=0, value=1, cost=2,0000 Iteration 60 | Temp: 0.164 | Current: idx=1, value=2, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=0, value=1, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=0, value=1, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 90 | Temp: 0.110 | Current: idx=0, value=1, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=1, value=2, cost=2.0000 | Best: idx=0, value=1, cost=2.0000 Selected Pivot: Index=0. Value=1. Cost=2.0000

--- Simulated Annealing for Subarray [5:8] ---

Initial Pivot: Index=5 Value=14 Cost=6 0000

Iteration 0 | Temp: 10.000 | Current: idx=5, value=14, cost=6.0000 | Best: idx=5, value=14, cost=6.0000 | Iteration 10 | Temp: 0.909 | Current: idx=7, value=30, cost=6.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=6, value=20, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=6, value=20, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 40 | Temp: 0.244 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 60 | Temp: 0.164 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 70 | Temp: 0.123 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=8, value=19, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=20, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=20, cost=4.0000 | Best: idx=6, value=20, cost=4.0000 | Selected Pivot: Index=6, Value=20, Cost=4.0000 | Selected Pivot: Index=6, Value=20, Cost=4.0000

--- Simulated Annealing for Subarray [5:6] ---

Initial Pivot: Index=5, Value=14, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=5, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 10 | Temp: 0.909 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 20 | Temp: 0.476 | Current: idx=6, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 30 | Temp: 0.323 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 40 | Temp: 0.244 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 50 | Temp: 0.196 | Current: idx=5, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 60 | Temp: 0.164 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 70 | Temp: 0.114 | Current: idx=5, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=5, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.110 | Current: idx=5, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.110 | Current: idx=5, value=14, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=19, cost=2.0000 | Best: idx=5, value=14, cost=2.0000 | Iteration 90 | Temp: 0.100 | Cur

Sorted Array: [1, 2, 11, 12, 13, 14, 19, 20, 30]

Total Swaps: 13 Total Comparisons: 16

Total Pivot Selection Cost: 20.0000

5. Duplicate Values Test 1

--- Simulated Annealing for Subarray [0:30] ---

Initial Pivot: Index=12, Value=1, Cost=60.0000

| Retation | 0 | Temp: 10.000 | Current: idx=11, value=1, cost=60.0000 | Best: idx=12, value=1, cost=60.0000

--- Simulated Annealing for Subarray [1:30] ---

Initial Pivot: Index=16, Value=1, Cost=58.0000

Iteration 0 | Temp: 10.000 | Current: idx=17, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 10 | Temp: 0.909 | Current: idx=20, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 20 | Temp: 0.476 | Current: idx=18, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 30 | Temp: 0.323 | Current: idx=18, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 40 | Temp: 0.244 | Current: idx=11, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 50 | Temp: 0.196 | Current: idx=15, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 60 | Temp: 0.164 | Current: idx=1, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 70 | Temp: 0.114 | Current: idx=24, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 80 | Temp: 0.123 | Current: idx=20, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Iteration 90 | Temp: 0.110 | Current: idx=10, value=1, cost=58.0000 | Best: idx=16, value=1, cost=58.0000 | Set: idx=16, value=1, cost=58.0000 | Set:

--- Simulated Annealing for Subarray [2:30] ---

Initial Pivot: Index=10. Value=1. Cost=56.0000

Iteration 0 | Temp: 10.000 | Current: idx=21, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 10 | Temp: 0.909 | Current: idx=9, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 20 | Temp: 0.476 | Current: idx=15, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 30 | Temp: 0.323 | Current: idx=23, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 40 | Temp: 0.244 | Current: idx=21, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 50 | Temp: 0.196 | Current: idx=14, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 60 | Temp: 0.164 | Current: idx=14, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 70 | Temp: 0.141 | Current: idx=15, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 80 | Temp: 0.123 | Current: idx=15, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 80 | Temp: 0.123 | Current: idx=19, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 80 | Temp: 0.123 | Current: idx=19, value=1, cost=56.0000 | Temp: 0.123 | Current: idx=19, value=1, cost=56.0000 | Temp: 0.124 | Current: idx=19, value=1, cost=56.0000 | Temp: 0.124 | Current: idx=19, value=1, cost=56.0000 | Temp: 0.124 | Current: idx=10, value=1, cost=56.0000 | Temp: 0.125 | Current: idx=19, value=1, cost=56.0000 | Temp: 0.125 | Current: idx=19, value=1, cost=56.0000 | Temp: 0.125 | Current: idx=10, value=1, cost=56.0000 | Temp: 0.125 | Cur

Iteration 90 | Temp: 0.110 | Current: idx=8, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Iteration 99 | Temp: 0.100 | Current: idx=13, value=1, cost=56.0000 | Best: idx=10, value=1, cost=56.0000 | Selected Pivot: Index=10, Value=1, Cost=56.0000 | Selected Pivot: Index=10, Value=1, Cost=56.0000

--- Simulated Annealing for Subarray [3:30] ---

Initial Pivot: Index=21, Value=1, Cost=54.0000

Iteration 0 | Temp: 10.000 | Current: idx=22, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 10 | Temp: 0.909 | Current: idx=30, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 20 | Temp: 0.476 | Current: idx=6, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 30 | Temp: 0.323 | Current: idx=6, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 40 | Temp: 0.244 | Current: idx=11, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 50 | Temp: 0.196 | Current: idx=19, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 60 | Temp: 0.164 | Current: idx=16, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 70 | Temp: 0.141 | Current: idx=16, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 90 | Temp: 0.123 | Current: idx=27, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 90 | Temp: 0.110 | Current: idx=30, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Best: idx=21, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Iteration 99 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Iteration 90 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Iteration 90 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Iteration 90 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Iteration 90 | Temp: 0.100 | Current: idx=17, value=1, cost=54.0000 | Iteratio

--- Simulated Annealing for Subarray [4:30] ---

Initial Pivot: Index=12, Value=1, Cost=52.0000

Iteration 0 | Temp: 10.000 | Current: idx=18, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 10 | Temp: 0.909 | Current: idx=23, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 20 | Temp: 0.476 | Current: idx=30, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 30 | Temp: 0.323 | Current: idx=30, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 40 | Temp: 0.244 | Current: idx=27, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 50 | Temp: 0.196 | Current: idx=7, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 60 | Temp: 0.164 | Current: idx=25, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 70 | Temp: 0.141 | Current: idx=18, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 80 | Temp: 0.123 | Current: idx=18, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 90 | Temp: 0.110 | Current: idx=27, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 90 | Temp: 0.110 | Current: idx=27, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=52.0000 | Best: idx=12, value=1, cost=52.0000 | Selected Pivot: Index=12, Value=1, Cost=52.0000

--- Simulated Annealing for Subarray [5:30] ---

Initial Pivot: Index=20, Value=1, Cost=50.0000

Iteration 0 | Temp: 10.000 | Current: idx=19, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 10 | Temp: 0.909 | Current: idx=25, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 20 | Temp: 0.476 | Current: idx=26, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 30 | Temp: 0.323 | Current: idx=28, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 40 | Temp: 0.244 | Current: idx=29, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 50 | Temp: 0.196 | Current: idx=29, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 60 | Temp: 0.164 | Current: idx=15, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 70 | Temp: 0.141 | Current: idx=16, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 80 | Temp: 0.123 | Current: idx=18, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.110 | Current: idx=28, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.110 | Current: idx=28, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=50.0000 | Best: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=50.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=50.0000 | Iterat

--- Simulated Annealing for Subarray [6:30] ---

Initial Pivot: Index=26, Value=1, Cost=48.0000

 Iteration 40 | Temp: 0.244 | Current: idx=12, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 50 | Temp: 0.196 | Current: idx=13, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 60 | Temp: 0.164 | Current: idx=6, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 70 | Temp: 0.141 | Current: idx=29, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 80 | Temp: 0.123 | Current: idx=25, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 90 | Temp: 0.110 | Current: idx=22, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 99 | Temp: 0.100 | Current: idx=9, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Iteration 99 | Temp: 0.100 | Current: idx=9, value=1, cost=48.0000 | Best: idx=26, value=1, cost=48.0000 | Selected Pivot: Index=26, Value=1, Cost=48.0000

--- Simulated Annealing for Subarray [7:30] ---

Initial Pivot: Index=14, Value=1, Cost=46.0000

Iteration 0 | Temp: 10.000 | Current: idx=13, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 10 | Temp: 0.909 | Current: idx=20, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 20 | Temp: 0.476 | Current: idx=16, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 30 | Temp: 0.323 | Current: idx=29, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 40 | Temp: 0.244 | Current: idx=13, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 50 | Temp: 0.196 | Current: idx=15, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 60 | Temp: 0.164 | Current: idx=24, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 70 | Temp: 0.141 | Current: idx=29, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 80 | Temp: 0.123 | Current: idx=8, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.110 | Current: idx=22, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.110 | Current: idx=22, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=15, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=15, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=15, value=1, cost=46.0000 | Best: idx=14, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=15, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=15, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=15, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=16, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=16, value=1, cost=46.0000 | Iteration 90 | Temp: 0.100 | Current: idx=16, value=1, cost=46.0000 | Iterati

--- Simulated Annealing for Subarray [8:30] ---

Initial Pivot: Index=19, Value=1, Cost=44.0000

Iteration 0 | Temp: 10.000 | Current: idx=18, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 10 | Temp: 0.909 | Current: idx=18, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 20 | Temp: 0.476 | Current: idx=15, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 30 | Temp: 0.323 | Current: idx=28, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 40 | Temp: 0.244 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 50 | Temp: 0.196 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 60 | Temp: 0.164 | Current: idx=27, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 70 | Temp: 0.141 | Current: idx=12, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 80 | Temp: 0.123 | Current: idx=20, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.110 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.110 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=44.0000 | Best: idx=19, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=30, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=30, cost=44.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=30, cost=44.0000 | Iteration 90 | Temp: 0.100 | Curren

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--- Simulated Annealing for Subarray [9:30] ---

Initial Pivot: Index=16, Value=1, Cost=42.0000

Iteration 0 | Temp: 10.000 | Current: idx=17, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 10 | Temp: 0.909 | Current: idx=18, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 20 | Temp: 0.476 | Current: idx=17, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 30 | Temp: 0.323 | Current: idx=9, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 40 | Temp: 0.244 | Current: idx=27, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 50 | Temp: 0.196 | Current: idx=23, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 70 | Temp: 0.141 | Current: idx=23, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 70 | Temp: 0.123 | Current: idx=13, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.123 | Current: idx=16, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.110 | Current: idx=28, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Best: idx=16, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=42.0000 | Iterati

--- Simulated Annealing for Subarray [10:30] ---

Initial Pivot: Index=27. Value=1. Cost=40.0000

Iteration 0 | Temp: 10.000 | Current: idx=28, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 10 | Temp: 0.909 | Current: idx=22, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 20 | Temp: 0.476 | Current: idx=12, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 30 | Temp: 0.323 | Current: idx=15, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 40 | Temp: 0.244 | Current: idx=12, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 50 | Temp: 0.196 | Current: idx=24, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 60 | Temp: 0.164 | Current: idx=24, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 70 | Temp: 0.141 | Current: idx=24, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 80 | Temp: 0.123 | Current: idx=13, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 90 | Temp: 0.110 | Current: idx=12, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=12, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Best: idx=27, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=1, cost=40.0000 | Iteration 99 | Temp: 0.100 | Cur

Selected Pivot: Index=27. Value=1. Cost=40.0000

--- Simulated Annealing for Subarray [11:30] ---

Initial Pivot: Index=24, Value=1, Cost=38.0000

Iteration 0 | Temp: 10.000 | Current: idx=23, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 10 | Temp: 0.909 | Current: idx=12, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 20 | Temp: 0.476 | Current: idx=26, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 30 | Temp: 0.323 | Current: idx=17, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 40 | Temp: 0.244 | Current: idx=13, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 50 | Temp: 0.196 | Current: idx=20, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 60 | Temp: 0.164 | Current: idx=15, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 70 | Temp: 0.141 | Current: idx=29, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 80 | Temp: 0.123 | Current: idx=20, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.110 | Current: idx=24, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.110 | Current: idx=24, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Best: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=38.0000 | Iterat

--- Simulated Annealing for Subarray [12:30] ---

Initial Pivot: Index=25, Value=1, Cost=36.0000

Iteration 0 | Temp: 10.000 | Current: idx=22, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 10 | Temp: 0.909 | Current: idx=17, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 20 | Temp: 0.476 | Current: idx=16, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 30 | Temp: 0.323 | Current: idx=20, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 40 | Temp: 0.244 | Current: idx=30, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 50 | Temp: 0.196 | Current: idx=12, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 60 | Temp: 0.164 | Current: idx=17, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 70 | Temp: 0.141 | Current: idx=21, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 80 | Temp: 0.123 | Current: idx=21, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 90 | Temp: 0.110 | Current: idx=21, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Iteration 90 | Temp: 0.110 | Current: idx=21, value=1, cost=36.0000 | Best: idx=25, value=1, cost=36.0000 | Selected Pivot Index=25, value=1, cost=36.0000 | Selected Pivot Index=25,

--- Simulated Annealing for Subarray [13:30] ---

Initial Pivot: Index=24, Value=1, Cost=34.0000

Iteration 0 | Temp: 10.000 | Current: idx=23, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 10 | Temp: 0.909 | Current: idx=21, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 20 | Temp: 0.476 | Current: idx=26, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 30 | Temp: 0.323 | Current: idx=21, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 40 | Temp: 0.244 | Current: idx=26, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 50 | Temp: 0.196 | Current: idx=23, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 60 | Temp: 0.164 | Current: idx=28, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 70 | Temp: 0.141 | Current: idx=15, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 80 | Temp: 0.123 | Current: idx=25, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 90 | Temp: 0.110 | Current: idx=25, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 99 | Temp: 0.100 | Current: idx=25, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 99 | Temp: 0.100 | Current: idx=15, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Iteration 99 | Temp: 0.100 | Current: idx=15, value=1, cost=34.0000 | Best: idx=24, value=1, cost=34.0000 | Selected Pivot: Index=24, Value=1, Cost=34.0000

--- Simulated Annealing for Subarray [14:30] ---

Initial Pivot: Index=18, Value=1, Cost=32.0000

| Retation 0 | Temp: 10.000 | Current: idx=22, value=1, cost=32.0000 | Best: idx=18, value=1, cost=32.0000 | Rest: idx=18, value=1, cost=32.0000 |

--- Simulated Annealing for Subarray [15:30] ---

Initial Pivot: Index=25, Value=1, Cost=30.0000

Iteration 0 | Temp: 10.000 | Current: idx=28, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 10 | Temp: 0.909 | Current: idx=30, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 20 | Temp: 0.476 | Current: idx=18, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000

Iteration 30 | Temp: 0.323 | Current: idx=23, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 40 | Temp: 0.244 | Current: idx=15, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 50 | Temp: 0.196 | Current: idx=19, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 60 | Temp: 0.164 | Current: idx=25, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 70 | Temp: 0.141 | Current: idx=17, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 90 | Temp: 0.110 | Current: idx=26, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Iteration 99 | Temp: 0.100 | Current: idx=27, value=1, cost=30.0000 | Best: idx=25, value=1, cost=30.0000 | Selected Pivot: Index=25, value=1, Cost=30.0000

--- Simulated Annealing for Subarray [16:30] ---

Initial Pivot: Index=27. Value=1. Cost=28.0000

Iteration 0 | Temp: 10.000 | Current: idx=26, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 10 | Temp: 0.909 | Current: idx=20, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 20 | Temp: 0.476 | Current: idx=21, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 30 | Temp: 0.323 | Current: idx=29, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 40 | Temp: 0.244 | Current: idx=24, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 50 | Temp: 0.196 | Current: idx=18, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 60 | Temp: 0.164 | Current: idx=18, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 70 | Temp: 0.141 | Current: idx=17, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 80 | Temp: 0.123 | Current: idx=20, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 90 | Temp: 0.110 | Current: idx=18, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 99 | Temp: 0.100 | Current: idx=18, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=28.0000 | Best: idx=27, value=1, cost=28.0000 | Selected Pivot: Index=27, Value=1, cost=28.0000

--- Simulated Annealing for Subarray [17:30] ---

Initial Pivot: Index=17, Value=1, Cost=26.0000

Iteration 0 | Temp: 0.000 | Current: idx=21, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 10 | Temp: 0.909 | Current: idx=21, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 20 | Temp: 0.476 | Current: idx=20, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 30 | Temp: 0.323 | Current: idx=17, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 40 | Temp: 0.244 | Current: idx=19, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 50 | Temp: 0.196 | Current: idx=19, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 50 | Temp: 0.164 | Current: idx=25, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 70 | Temp: 0.141 | Current: idx=25, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 80 | Temp: 0.123 | Current: idx=18, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 90 | Temp: 0.110 | Current: idx=18, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Iteration 90 | Temp: 0.110 | Current: idx=18, value=1, cost=26.0000 | Best: idx=17, value=1, cost=26.0000 | Selected Pivot: Index=17, Value=1, Cost=26.0000 | Selected Pivot: Index=17, Value=1, Cost=26.0000 | Selected Pivot: Index=17, Value=1, Cost=26.0000

--- Simulated Annealing for Subarray [18:30] ---

Initial Pivot: Index=27, Value=1, Cost=24.0000

 $Iteration 0 \mid Temp: 10.000 \mid Current: idx=26, value=1, cost=24.0000 \mid Best: idx=27, value=1, cost=24.0000$

--- Simulated Annealing for Subarray [19:30] ---

Initial Pivot: Index=29, Value=1, Cost=22.0000

Iteration 0 | Temp: 10.000 | Current: idx=30, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 10 | Temp: 0.909 | Current: idx=20, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 20 | Temp: 0.476 | Current: idx=19, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 30 | Temp: 0.323 | Current: idx=20, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 40 | Temp: 0.244 | Current: idx=25, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 50 | Temp: 0.196 | Current: idx=24, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 70 | Temp: 0.164 | Current: idx=29, value=1, cost=22.0000 | Best: idx=29, value=1, cost=20.0000 | Iteration 70 | Temp: 0.123 | Current: idx=21, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.123 | Current: idx=29, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=29, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=20, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=20, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=20, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=20, value=1, cost=22.0000 | Iteration 80 | Temp: 0.110 | Current: idx=20, valu

Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=22.0000 | Best: idx=29, value=1, cost=22.0000 | Selected Pivot: Index=29, Value=1, Cost=22.0000

--- Simulated Annealing for Subarray [20:30] ---

Initial Pivot: Index=21, Value=1, Cost=20.0000

Iteration 0 | Temp: 10.000 | Current: idx=27, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 10 | Temp: 0.909 | Current: idx=23, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 20 | Temp: 0.476 | Current: idx=29, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 30 | Temp: 0.323 | Current: idx=23, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 40 | Temp: 0.244 | Current: idx=22, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 50 | Temp: 0.196 | Current: idx=27, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 60 | Temp: 0.164 | Current: idx=21, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 70 | Temp: 0.141 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 80 | Temp: 0.123 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 90 | Temp: 0.110 | Current: idx=25, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Best: idx=21, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Iteration 99 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Iteration 90 | Temp: 0.100 | Current: idx=30, value=1, cost=20.0000 | Iteration 90 | Temp: 0.100 | Current:

--- Simulated Annealing for Subarray [21:30] ---

Initial Pivot: Index=27, Value=1, Cost=18.0000

Iteration 0 | Temp: 10.000 | Current: idx=28, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 10 | Temp: 0.909 | Current: idx=26, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 20 | Temp: 0.476 | Current: idx=27, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 30 | Temp: 0.323 | Current: idx=27, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 40 | Temp: 0.244 | Current: idx=30, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 50 | Temp: 0.196 | Current: idx=28, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 60 | Temp: 0.164 | Current: idx=29, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 70 | Temp: 0.141 | Current: idx=22, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.110 | Current: idx=27, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.110 | Current: idx=27, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=27, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=27, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=23, value=1, cost=18.0000 | Best: idx=27, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current: idx=20, value=1, cost=18.0000 | Iteration 90 | Temp: 0.100 | Current:

--- Simulated Annealing for Subarray [22:30] ---

Initial Pivot: Index=23, Value=1, Cost=16.0000

Iteration 0 | Temp: 10.000 | Current: idx=22, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 10 | Temp: 0.909 | Current: idx=23, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 20 | Temp: 0.476 | Current: idx=27, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 30 | Temp: 0.323 | Current: idx=23, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 40 | Temp: 0.244 | Current: idx=23, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 50 | Temp: 0.196 | Current: idx=22, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 60 | Temp: 0.164 | Current: idx=22, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 70 | Temp: 0.141 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 80 | Temp: 0.123 | Current: idx=27, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=25, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Best: idx=23, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current: idx=24, value=1, cost=16.0000 | Iteration 90 | Temp: 0.100 | Current:

--- Simulated Annealing for Subarray [23:30] ---

Initial Pivot: Index=28, Value=1, Cost=14.0000

Iteration 0 | Temp: 10.000 | Current: idx=27, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 10 | Temp: 0.909 | Current: idx=24, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 20 | Temp: 0.476 | Current: idx=24, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 30 | Temp: 0.323 | Current: idx=30, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 40 | Temp: 0.244 | Current: idx=24, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 50 | Temp: 0.196 | Current: idx=23, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 60 | Temp: 0.164 | Current: idx=26, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 70 | Temp: 0.123 | Current: idx=24, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 80 | Temp: 0.123 | Current: idx=26, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 90 | Temp: 0.110 | Current: idx=24, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 90 | Temp: 0.110 | Current: idx=24, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 90 | Temp: 0.110 | Current: idx=29, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Iteration 90 | Temp: 0.100 | Current: idx=29, value=1, cost=14.0000 | Best: idx=28, value=1, cost=14.0000 | Selected Pivot: index=28, value=1, cost=14

--- Simulated Annealing for Subarray [24:30] ---

Initial Pivot: Index=24, Value=1, Cost=12.0000

 $10 \ | \ Temp: 10.000 \ | \ Current: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ | \ Best: \ idx=24, \ value=1, \ cost=12.0000 \ |$

| Retration | 20 | Temp: | 0.476 | Current: idx=24, value=1, cost=12.0000 | Best: idx=24, value=1, cost=12.0000 | Rest: idx=24, value=1, cost=12.0

--- Simulated Annealing for Subarray [25:30] ---

Initial Pivot: Index=26. Value=1. Cost=10.0000

Iteration 0 | Temp: 10.000 | Current: idx=25, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 10 | Temp: 0.909 | Current: idx=29, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 20 | Temp: 0.476 | Current: idx=25, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 30 | Temp: 0.323 | Current: idx=28, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 40 | Temp: 0.244 | Current: idx=25, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 50 | Temp: 0.196 | Current: idx=27, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 60 | Temp: 0.164 | Current: idx=27, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 70 | Temp: 0.141 | Current: idx=30, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 90 | Temp: 0.110 | Current: idx=28, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Iteration 99 | Temp: 0.100 | Current: idx=29, value=1, cost=10.0000 | Best: idx=26, value=1, cost=10.0000 | Selected Pivot: Index=26, Value=1, Cost=10.0000

--- Simulated Annealing for Subarray [26:30] ---

Initial Pivot: Index=30, Value=1, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=30, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 10 | Temp: 0.909 | Current: idx=28, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 20 | Temp: 0.476 | Current: idx=29, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 30 | Temp: 0.323 | Current: idx=28, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 40 | Temp: 0.244 | Current: idx=30, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 50 | Temp: 0.196 | Current: idx=27, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 60 | Temp: 0.164 | Current: idx=26, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 70 | Temp: 0.141 | Current: idx=29, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 80 | Temp: 0.123 | Current: idx=29, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 90 | Temp: 0.110 | Current: idx=30, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Iteration 90 | Temp: 0.110 | Current: idx=29, value=1, cost=8.0000 | Best: idx=30, value=1, cost=8.0000 | Selected Pivot Index=30, value=1, cost=8.0000 | Selected Pivot Index=30, value=1, cost=8.0000

--- Simulated Annealing for Subarray [27:30] ---

Initial Pivot: Index=28, Value=1, Cost=6.0000

Iteration 0 | Temp: 10.000 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 10 | Temp: 0.909 | Current: idx=28, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 20 | Temp: 0.476 | Current: idx=28, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 30 | Temp: 0.323 | Current: idx=28, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 40 | Temp: 0.244 | Current: idx=28, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 50 | Temp: 0.196 | Current: idx=29, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 60 | Temp: 0.164 | Current: idx=29, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 70 | Temp: 0.121 | Current: idx=29, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 90 | Temp: 0.110 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 90 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 90 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Best: idx=28, value=1, cost=6.0000 | Iteration 90 | Temp: 0.100 | Current: idx=27, value=1, cost=6.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=6.0000 | Iteration 90 | Temp: 0.100 | Current: idx=28, value=1, cost=6.0000 | Iteration 90 | Temp: 0.100 | Current:

--- Simulated Annealing for Subarray [28:30] ---

Initial Pivot: Index=30, Value=1, Cost=4.0000

Iteration 0 | Temp: 10.000 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 10 | Temp: 0.909 | Current: idx=29, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 40 | Temp: 0.244 | Current: idx=29, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 60 | Temp: 0.164 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 70 | Temp: 0.141 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=30, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=28, value=1, cost=4.0000 | Iteration 80 |

Iteration 90 | Temp: 0.110 | Current: idx=28, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=28, value=1, cost=4.0000 | Best: idx=30, value=1, cost=4.0000 | Selected Pivot: Index=30, Value=1, Cost=4.0000

--- Simulated Annealing for Subarray [29:30] ---

Initial Pivot: Index=29, Value=1, Cost=2.0000

| Retation 0 | Temp: 10.000 | Current: idx=30, value=1, cost=2.0000 | Best: idx=29, value=1, cost=2.0000 | Rest: idx=29, v

Total Swaps: 58

Total Comparisons: 465

Total Pivot Selection Cost: 930.0000

6. Duplicate Values Test 2

--- Simulated Annealing for Subarray [0:26] ---

Initial Pivot: Index=14. Value=90. Cost=34.0000

Iteration 10 | Temp: 0.909 | Current: idx=8, value=90, cost=34.0000 | Best: idx=14, value=90, cost=34.0000

Iteration 20 | Temp: 0.476 | Current: idx=8, value=90, cost=34.0000 | Best: idx=14, value=90, cost=34.0000

Iteration 30 | Temp: 0.323 | Current: idx=8, value=90, cost=34.0000 | Best: idx=14, value=90,

cost=34.0000

Iteration 40 | Temp: 0.244 | Current: idx=8, value=90, cost=34.0000 | Best: idx=14, value=90,

 $\begin{tabular}{ll} Iteration & 70 & | & Temp: & 0.141 & | & Current: idx=14, value=90, cost=34.0000 & | & Best: idx=14, value=90, cost=34.0000 & | & B$

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Iteration 90 | Temp: 0.110 | Current: idx=17, value=90, cost=34.0000 | Best: idx=14, value=90, cost=34.0000

Iteration 99 | Temp: 0.100 | Current: idx=17, value=90, cost=34.0000 | Best: idx=14, value=90, cost=34.0000

Selected Pivot: Index=14, Value=90, Cost=34.0000

--- Simulated Annealing for Subarray [0:8] ---

Initial Pivot: Index=5, Value=49, Cost=16.0000

Iteration 0 | Temp: 10.000 | Current: idx=6, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 10 | Temp: 0.909 | Current: idx=8, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 20 | Temp: 0.476 | Current: idx=8, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 30 | Temp: 0.323 | Current: idx=3, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 40 | Temp: 0.244 | Current: idx=3, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 50 | Temp: 0.196 | Current: idx=6, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 50 | Temp: 0.164 | Current: idx=6, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 70 | Temp: 0.141 | Current: idx=1, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 80 | Temp: 0.123 | Current: idx=0, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 90 | Temp: 0.110 | Current: idx=1, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Iteration 99 | Temp: 0.100 | Current: idx=8, value=49, cost=16.0000 | Best: idx=5, value=49, cost=16.0000 | Selected Pivot: Index=5, Value=49, Cost=16.0000 | Selected Pivot: Index=5, Value=49, Cost=16.0000

--- Simulated Annealing for Subarray [1:8] ---

Initial Pivot: Index=7, Value=49, Cost=14.0000

 $Iteration \\ \ \ 0 \ | \ Temp: 10.000 \ | \ Current: idx=8, \\ value=49, \\ cost=14.0000 \ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=7, \\ value=49, \\ cost=14.0000 \\ | \ Best: idx=8, \\ cost=14.000$

| Reration | 10 | Temp: 0.909 | Current: idx=8, value=49, cost=14.0000 | Best: idx=7, value=49, cost=14.0000 | Rest: idx=7, value=49, cost=14.0000

--- Simulated Annealing for Subarray [2:8] ---

Initial Pivot: Index=6. Value=49. Cost=12.0000

Iteration 0 | Temp: 10.000 | Current: idx=7, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 10 | Temp: 0.909 | Current: idx=7, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 20 | Temp: 0.476 | Current: idx=2, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 30 | Temp: 0.323 | Current: idx=5, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 30 | Temp: 0.323 | Current: idx=5, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 40 | Temp: 0.244 | Current: idx=4, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 50 | Temp: 0.196 | Current: idx=5, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 70 | Temp: 0.141 | Current: idx=2, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 80 | Temp: 0.123 | Current: idx=3, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.110 | Current: idx=3, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.110 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0000 | Iteration 90 | Temp: 0.100 | Current: idx=6, value=49, cost=12.0000 | Best: idx=6, value=49, cost=12.0

--- Simulated Annealing for Subarray [3:8] ---

Selected Pivot: Index=6, Value=49, Cost=12.0000

Initial Pivot: Index=7. Value=49. Cost=10.0000

Initial Pivot: Index=8, Value=49, Cost=8.0000

| Retation | 0 | Temp: 10.000 | Current: idx=7, value=49, cost=8.0000 | Best: idx=8, value=49, cost=8.0000 | Rest: idx=8,

--- Simulated Annealing for Subarray [5:8] ---

Initial Pivot: Index=7, Value=49, Cost=6.0000

Iteration 0 | Temp: 10.000 | Current: idx=6, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 10 | Temp: 0.909 | Current: idx=6, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 20 | Temp: 0.476 | Current: idx=7, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 30 | Temp: 0.323 | Current: idx=7, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 40 | Temp: 0.244 | Current: idx=7, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 50 | Temp: 0.196 | Current: idx=6, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 60 | Temp: 0.164 | Current: idx=7, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=6, value=49, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=6, value=49, cost=6.0000 |

Iteration 80 | Temp: 0.123 | Current: idx=8, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 90 | Temp: 0.110 | Current: idx=6, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=7, value=49, cost=6.0000 | Best: idx=7, value=49, cost=6.0000 | Selected Pivot: Index=7, Value=49, Cost=6.0000

--- Simulated Annealing for Subarray [6:8] ---

Initial Pivot: Index=8, Value=49, Cost=4.0000

Iteration 0 | Temp: 10.000 | Current: idx=8, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 10 | Temp: 0.909 | Current: idx=8, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=8, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=8, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 40 | Temp: 0.244 | Current: idx=6, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 60 | Temp: 0.164 | Current: idx=8, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 70 | Temp: 0.121 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=8, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Best: idx=8, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=7, value=49, cost=4.0000 | Itera

--- Simulated Annealing for Subarray [7:8] ---

Initial Pivot: Index=8, Value=49, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=8, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 10 | Temp: 0.909 | Current: idx=7, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 20 | Temp: 0.476 | Current: idx=7, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 30 | Temp: 0.323 | Current: idx=7, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 40 | Temp: 0.244 | Current: idx=8, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 50 | Temp: 0.196 | Current: idx=8, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 60 | Temp: 0.164 | Current: idx=7, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 70 | Temp: 0.141 | Current: idx=7, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=8, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Iteration 90 | Temp: 0.110 | Current: idx=7, value=49, cost=2.0000 | Best: idx=8, value=49, cost=2.0000 | Set: idx=8, value=49, cost=2.0000 | Best: idx=8, value=49, co

--- Simulated Annealing for Subarray [10:26] ---

Initial Pivot: Index=14, Value=90, Cost=32.0000

| Reration | 0 | Temp: | 10.000 | Current: | idx=23, value=90, cost=32.0000 | Best: | idx=14, value=90, cost=32.0000 | Best: | idx=14, value=90, cost=32.0000 | Best: | idx=14, value=100, cost=16.0000 | Best: | idx=19, value=100, cost=16.000

| Rteration | 70 | Temp: | 0.141 | Current: | idx=10, value=100, cost=16.0000 | Best: | idx=19, value=100, cost=16.0000 | Rteration | 80 | Temp: | 0.123 | Current: | idx=10, value=100, cost=16.0000 | Best: | idx=19, value=100, cost=16.0000

Selected Pivot: Index=19, Value=100, Cost=16.0000

--- Simulated Annealing for Subarray [10:17] ---

Initial Pivot: Index=13, Value=90, Cost=14.0000

 $\label{eq:lemma:equation:cost} Iteration \qquad 0 \mid Temp: 10.000 \mid Current: idx=12, \ value=90, \ cost=14.0000 \mid Best: \ idx=13, \ cost=14.0000 \mid Best: \ idx=14.0000 \mid Best: \ idx=14.$

40 | Temp: 0.244 | Current: idx=10, value=90, cost=14,0000 | Best: idx=13, value=90, Iteration cost=14.0000 Iteration 50 | Temp: 0.196 | Current: idx=10. value=90. cost=14.0000 | Best: idx=13. value=90. Iteration 60 | Temp: 0.164 | Current: idx=11, value=90, cost=14.0000 | Best: idx=13, value=90, cost=14 0000 Iteration 70 | Temp: 0.141 | Current: idx=10, value=90, cost=14.0000 | Best: idx=13, value=90, cost=14.0000 Iteration 80 | Temp: 0.123 | Current: idx=16, value=90, cost=14.0000 | Best: idx=13, value=90, cost=14.0000 Iteration 90 | Temp: 0.110 | Current: idx=13, value=90, cost=14.0000 | Best: idx=13, value=90, cost=14.0000 Iteration 99 | Temp: 0.100 | Current: idx=12, value=90, cost=14.0000 | Best: idx=13, value=90, cost=14.0000 Selected Pivot: Index=13, Value=90, Cost=14.0000 --- Simulated Annealing for Subarray [11:17] ---Initial Pivot: Index=15, Value=90, Cost=12.0000 Iteration 0 | Temp: 10.000 | Current: idx=16, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 10 | Temp: 0.909 | Current: idx=13, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 $Iteration - 20 \mid Temp: - 0.476 \mid Current: idx = 13, \ value = 90, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 15, \ cost = 12.0000 \mid Best: \ idx = 12.00000 \mid Best: \ idx = 12.00000 \mid Best: \ idx = 12.00000000000000000000$ cost=12.0000 Iteration 30 | Temp: 0.323 | Current: idx=11, value=90, cost=12.0000 | Best: idx=15, value=90. Iteration 40 | Temp: 0.244 | Current: idx=17, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 50 | Temp: 0.196 | Current: idx=14, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 60 | Temp: 0.164 | Current: idx=14, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 70 | Temp: 0.141 | Current: idx=14, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 80 | Temp: 0.123 | Current: idx=12, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 90 | Temp: 0.110 | Current: idx=11, value=90, cost=12.0000 | Best: idx=15, value=90, cost=12.0000 Iteration 99 | Temp: 0.100 | Current: idx=11, value=90, cost=12.0000 | Best: idx=15, value=90. cost=12.0000 Selected Pivot: Index=15, Value=90, Cost=12,0000 --- Simulated Annealing for Subarray [12:17] ---Initial Pivot: Index=17 Value=90 Cost=10 0000 0 | Temp: 10.000 | Current: idx=16, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Iteration 10 | Temp: 0.909 | Current: idx=12, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Iteration 20 | Temp: 0.476 | Current: idx=12, value=90, cost=10.0000 | Best: idx=17, value=90, Iteration 30 | Temp: 0.323 | Current: idx=15, value=90, cost=10.0000 | Best: idx=17, value=90, Iteration 40 | Temp: 0.244 | Current: idx=12, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10 0000 Iteration 50 | Temp: 0.196 | Current: idx=13, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Iteration 60 | Temp: 0.164 | Current: idx=16, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Iteration 70 | Temp: 0.141 | Current: idx=13, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Iteration 80 | Temp: 0.123 | Current: idx=15, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Iteration 90 | Temp: 0.110 | Current: idx=14, value=90, cost=10.0000 | Best: idx=17, value=90. Iteration 99 | Temp: 0.100 | Current: idx=14, value=90, cost=10.0000 | Best: idx=17, value=90, cost=10.0000 Selected Pivot: Index=17, Value=90, Cost=10.0000

--- Simulated Annealing for Subarray [13:17] ---

Initial Pivot: Index=14, Value=90, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=14, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000 Iteration 10 | Temp: 0.909 | Current: idx=16, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000 Iteration 20 | Temp: 0.476 | Current: idx=17. value=90. cost=8.0000 | Best: idx=14. value=90. cost=8.0000 Iteration 30 | Temp: 0.323 | Current: idx=15, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000 Iteration 50 | Temp: 0.196 | Current: idx=13, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000

Iteration 60 | Temp: 0.164 | Current: idx=15. value=90. cost=8.0000 | Best: idx=14. value=90. cost=8.0000 Iteration 70 | Temp: 0.141 | Current: idx=15, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000 Iteration 80 | Temp: 0.123 | Current: idx=16. value=90. cost=8.0000 | Best: idx=14. value=90. cost=8.0000 Iteration 90 | Temp: 0.110 | Current: idx=13, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000 Iteration 99 | Temp: 0.100 | Current: idx=15, value=90, cost=8.0000 | Best: idx=14, value=90, cost=8.0000 Selected Pivot: Index=14, Value=90, Cost=8.0000

--- Simulated Annealing for Subarray [14:17] ---

Initial Pivot: Index=17. Value=90. Cost=6.0000

Iteration 0 | Temp: 10.000 | Current: idx=17, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 10 | Temp: 0.909 | Current: idx=16, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 20 | Temp: 0.476 | Current: idx=16, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 30 | Temp: 0.323 | Current: idx=17. value=90. cost=6.0000 | Best: idx=17. value=90. cost=6.0000 Iteration 40 | Temp: 0.244 | Current: idx=17, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 50 | Temp: 0.196 | Current: idx=17, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 60 | Temp: 0.164 | Current: idx=17, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 70 | Temp: 0.141 | Current: idx=16, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 80 | Temp: 0.123 | Current: idx=14, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 90 | Temp: 0.110 | Current: idx=14, value=90, cost=6.0000 | Best: idx=17, value=90, cost=6.0000 Iteration 99 | Temp: 0.100 | Current: idx=16 value=90 cost=6.000 | Best: idx=17 value=90 cost=6.0000 Selected Pivot: Index=17, Value=90, Cost=6.0000

--- Simulated Annealing for Subarray [15:17] ---

Initial Pivot: Index=16. Value=90. Cost=4.0000

Iteration 0 | Temp: 10.000 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 10 | Temp: 0.909 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 20 | Temp: 0.476 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 30 | Temp: 0.323 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 40 | Temp: 0.244 | Current: idx=17. value=90. cost=4.0000 | Best: idx=16. value=90. cost=4.0000 Iteration 50 | Temp: 0.196 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 70 | Temp: 0.141 | Current: idx=17, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 80 | Temp: 0.123 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 90 | Temp: 0.110 | Current: idx=17, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=15, value=90, cost=4.0000 | Best: idx=16, value=90, cost=4.0000 Selected Pivot: Index=16. Value=90. Cost=4.0000

--- Simulated Annealing for Subarray [16:17] ---

Initial Pivot: Index=16. Value=90. Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=16. value=90. cost=2.0000 | Best: idx=16. value=90. cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 20 | Temp: 0.476 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 30 | Temp: 0.323 | Current: idx=16, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 60 | Temp: 0.164 | Current: idx=16, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 70 | Temp: 0.141 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 80 | Temp: 0.123 | Current: idx=16 value=90 cost=2.0000 | Best: idx=16 value=90 cost=2.0000 Iteration 90 | Temp: 0.110 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Iteration 99 | Temp: 0.100 | Current: idx=17, value=90, cost=2.0000 | Best: idx=16, value=90, cost=2.0000 Selected Pivot: Index=16. Value=90. Cost=2.0000

--- Simulated Annealing for Subarray [19:26] ---

Initial Pivot: Index=19, Value=100, Cost=14.0000

0 | Temp: 10.000 | Current: idx=19, value=100, cost=14.0000 | Best: idx=19, value=100, cost=14.0000 Iteration 10 | Temp: 0.909 | Current: idx=20, value=100, cost=14.0000 | Best: idx=19, value=100, cost=14 0000 Iteration 20 | Temp: 0.476 | Current: idx=26, value=100, cost=14.0000 | Best: idx=19, value=100,

cost=14.0000 Iteration 30 | Temp: 0.323 | Current: idx=23, value=100, cost=14,0000 | Best: idx=19, value=100,

cost=14.0000 Iteration 40 | Temp: 0.244 | Current: idx=21, value=100, cost=14.0000 | Best: idx=19, value=100, cost=14.0000

Iteration 50 | Temp: 0.196 | Current: idx=22, value=100, cost=14.0000 | Best: idx=19, value=100, cost=14.0000

Iteration 60 | Temp: 0.164 | Current: idx=25, value=100, cost=14.0000 | Best: idx=19, value=100, cost=14.0000

Iteration 70 | Temp: 0.141 | Current: idx=25, value=100, cost=14.0000 | Best: idx=19, value=100, cost=14 0000

Iteration 80 Temp: cost=14.0000	0.123 Current:	idx=22,	value=100, cost=14.0000 Best: idx=19, value=100,
Iteration 90 Temp: cost=14.0000	0.110 Current:	idx=21,	value=100, cost=14.0000 Best: idx=19, value=100,
Iteration 99 Temp: cost=14.0000	0.100 Current:	idx=23,	value=100, cost=14.0000 Best: idx=19, value=100,
Selected Pivot: Index=19, Value=100, Cost=14.0000			
Simulated Annealing for Subarray [20:26]			
Initial Pivot: Index=24, Value=100, Cost=12.0000			
			value=100, cost=12.0000 Best: idx=24, value=100,
	0.909 Current:	idx=24,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 20 Temp: cost=12.0000	0.476 Current:	idx=23,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 30 Temp: cost=12.0000	0.323 Current:	idx=21,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 40 Temp: cost=12.0000	0.244 Current:	idx=22,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 50 Temp: cost=12.0000	0.196 Current:	idx=22,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 60 Temp: cost=12.0000	0.164 Current:	idx=25,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 70 Temp: cost=12.0000	0.141 Current:	idx=23,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 80 Temp: cost=12.0000	0.123 Current:	idx=26,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 90 Temp: cost=12.0000	0.110 Current:	idx=23,	value=100, cost=12.0000 Best: idx=24, value=100,
Iteration 99 Temp: cost=12.0000	0.100 Current:	idx=23,	value=100, cost=12.0000 Best: idx=24, value=100,
Selected Pivot: Index=24, Value=100, Cost=12.0000			
Simulated Annealing			
Initial Pivot: Index=21,			
Iteration 0 Temp: cost=10.0000	10.000 Current:	idx=22,	value=100, cost=10.0000 Best: idx=21, value=100,
	0.909 Current:	idx=26,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 20 Temp: cost=10.0000	0.476 Current:	idx=24,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 30 Temp: cost=10.0000	0.323 Current:	idx=26,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 40 Temp: cost=10.0000	0.244 Current:	idx=25,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 50 Temp: cost=10.0000	0.196 Current:	idx=23,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 60 Temp: cost=10.0000	0.164 Current:	idx=22,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 70 Temp: cost=10.0000	0.141 Current:	idx=22,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 80 Temp: cost=10.0000	0.123 Current:	idx=23,	value=100, cost=10.0000 Best: idx=21, value=100,
Iteration 90 Temp: cost=10.0000	0.110 Current:	idx=22,	value=100, cost=10.0000 Best: idx=21, value=100,
cost=10.0000			value=100, cost=10.0000 Best: idx=21, value=100,
Selected Pivot: Index=21, Value=100, Cost=10.0000			
Simulated Annealing	for Subarray [22:26	6]	
Initial Pivot: Index=23,	Value=100, Cost=8.	0000	
Iteration 0 Temp: cost=8.0000	10.000 Current:	idx=22,	value=100, cost=8.0000 Best: idx=23, value=100,
Iteration 10 Temp: cost=8.0000	0.909 Current:	idx=24,	value=100, cost=8.0000 Best: idx=23, value=100,
Iteration 20 Temp: cost=8.0000			value=100, cost=8.0000 Best: idx=23, value=100,
Iteration 30 Temp: cost=8.0000			value=100, cost=8.0000 Best: idx=23, value=100,
cost=8.0000			value=100, cost=8.0000 Best: idx=23, value=100,
Iteration 50 Temp: cost=8.0000			value=100, cost=8.0000 Best: idx=23, value=100,
Iteration 60 Temp: cost=8.0000	0.164 Current:	ıdx=23,	value=100, cost=8.0000 Best: idx=23, value=100,

 $Iteration \quad 70 \mid Temp: \quad 0.141 \mid Current: \ idx=26, \ value=100, \ cost=8.0000 \mid Best: \ idx=23, \ value=100, \ cost=8.0000 \mid Best: \ idx=23, \ value=100, \ cost=8.0000 \mid Best: \ idx=24, \ cost=8.00000 \mid Best: \ idx=24, \ cost=8.00000 \mid Best: \ idx=24, \ cost=8.00000 \mid Best: \ idx$

cost=8.0000

Iteration 90 | Temp: 0.110 | Current: idx=22, value=100, cost=8.0000 | Best: idx=23, value=100, $Iteration \ \ 99 \ | \ Temp: \ \ 0.100 \ | \ Current: \ idx=22, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ value=100, \ cost=8.0000 \ | \ Best: \ idx=23, \ cost=8.00000 \ | \ Best: \ idx=23, \ cost=8.0000 \ | \ Best: \ idx=23, \ cost=8.0000 \ |$ cost=8.0000 Selected Pivot: Index=23, Value=100, Cost=8.0000 --- Simulated Annealing for Subarray [23:26] ---Initial Pivot: Index=26 Value=100 Cost=6 0000 Iteration 0 | Temp: 10.000 | Current: idx=25, value=100, cost=6.0000 | Best: idx=26, value=100, cost=6.0000 Iteration 10 | Temp: 0.909 | Current: idx=25, value=100, cost=6.0000 | Best: idx=26, value=100, $Iteration \ \ 20 \ | \ Temp: \ \ 0.476 \ | \ Current: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.00000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost$ cost=6.0000 $Iteration \quad 30 \mid Temp: \quad 0.323 \mid Current: \ idx=25, \ value=100, \ cost=6.0000 \mid Best: \ idx=26, \ value=100, \ cost=6.0000$ $Iteration \quad 50 \ | \ Temp: \quad 0.196 \ | \ Current: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ cost=6.00000 \ | \ Best: \ idx=26, \ cost=6.0000 \$ cost=6.0000 Iteration 60 | Temp: 0.164 | Current: idx=24, value=100, cost=6.0000 | Best: idx=26, value=100, cost=6.0000 Iteration 70 | Temp: 0.141 | Current: idx=23, value=100, cost=6.0000 | Best: idx=26, value=100, Iteration 80 | Temp: 0.123 | Current: idx=24, value=100, cost=6.0000 | Best: idx=26, value=100, cost=6.0000 $Iteration \ \ 90 \ | \ Temp: \ \ 0.110 \ | \ Current: \ idx=24, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.00000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ value=100, \ cost=6.0000 \ | \ Best: \ idx=26, \ cost=6.0000 \ | \ B$ cost=6.0000 Iteration 99 | Temp: 0.100 | Current: idx=24, value=100, cost=6.0000 | Best: idx=26, value=100, cost=6.0000 Selected Pivot: Index=26, Value=100, Cost=6.0000 --- Simulated Annealing for Subarray [24:26] ---Initial Pivot: Index=26, Value=100, Cost=4.0000 Iteration 0 | Temp: 10.000 | Current: idx=25, value=100, cost=4.0000 | Best: idx=26, value=100, $Iteration \quad 10 \ | \ Temp: \quad 0.909 \ | \ Current: \ idx=24, \ value=100, \ cost=4.0000 \ | \ Best: \ idx=26, \ value=100, \ value=100$ cost=4.0000 Iteration 20 | Temp: 0.476 | Current: idx=25, value=100, cost=4.0000 | Best: idx=26, value=100, cost=4.0000 $Iteration \quad 30 \mid Temp: \quad 0.323 \mid Current: \ idx=25, \ value=100, \ cost=4.0000 \mid Best: \ idx=26, \ cost=4.0000 \mid B$ cost=4 0000 Iteration 40 | Temp: 0.244 | Current: idx=25, value=100, cost=4.0000 | Best: idx=26, value=100, cost=4.0000 Iteration 50 | Temp: 0.196 | Current: idx=26. value=100. cost=4.0000 | Best: idx=26. value=100. cost=4.0000 Iteration 60 | Temp: 0.164 | Current: idx=24, value=100, cost=4.0000 | Best: idx=26, value=100, cost=4.0000 Iteration 70 | Temp: 0.141 | Current: idx=24, value=100, cost=4.0000 | Best: idx=26, value=100, cost=4.0000 Iteration 99 | Temp: 0.100 | Current: idx=25, value=100, cost=4.0000 | Best: idx=26, value=100, cost=4.0000 Selected Pivot: Index=26, Value=100, Cost=4.0000 --- Simulated Annealing for Subarray [25:26] ---Initial Pivot: Index=25, Value=100, Cost=2,0000 Iteration 0 | Temp: 10.000 | Current: idx=25, value=100, cost=2.0000 | Best: idx=25, value=100, cost=2.0000 Iteration 10 | Temp: 0.909 | Current: idx=25, value=100, cost=2.0000 | Best: idx=25, value=100, cost=2.0000 $Iteration \ \ 20 \ | \ Temp: \ \ 0.476 \ | \ \ Current: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.00000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ value=100, \ cost=2.0000 \ | \ Best: \ idx=25, \ cost=2.0000 \ | \ Best: \ idx=25, \ cost=2.0000 \ | \ Best: \ id$ cost=2.0000 $Iteration \quad 30 \mid Temp: \quad 0.323 \mid Current: \ idx=25, \ value=100, \ cost=2.0000 \mid Best: \ idx=25, \ cost=2.0000 \mid Best: \$ cost=2.0000 Iteration 40 | Temp: 0.244 | Current: idx=26, value=100, cost=2.0000 | Best: idx=25, value=100, cost=2.0000 Iteration 50 | Temp: 0.196 | Current: idx=25, value=100, cost=2.0000 | Best: idx=25, value=100, Iteration 60 | Temp: 0.164 | Current: idx=26, value=100, cost=2.0000 | Best: idx=25, value=100, Iteration 70 | Temp: 0.141 | Current: idx=26, value=100, cost=2.0000 | Best: idx=25, value=100, cost=2.0000

Iteration 80 | Temp: 0.123 | Current: idx=24, value=100, cost=8.0000 | Best: idx=23, value=100,

cost=8.0000

Iteration 90 | Temp: 0.110 | Current: idx=25, value=100, cost=2.0000 | Best: idx=25, value=100, cost=2.0000

Iteration 99 | Temp: 0.100 | Current: idx=25, value=100, cost=2.0000 | Best: idx=25, value=100, cost=2.0000

Selected Pivot: Index=25, Value=100, Cost=2.0000

Total Swaps: 58

Total Pivot Selection Cost: 234.0000

7. Duplicate Values Test 3

--- Simulated Annealing for Subarray [0:11] ---

Initial Pivot: Index=3, Value=4, Cost=22.0000

Iteration 0 | Temp: 10.000 | Current: idx=2, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 10 | Temp: 0.909 | Current: idx=4, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 20 | Temp: 0.476 | Current: idx=4, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 30 | Temp: 0.323 | Current: idx=4, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 40 | Temp: 0.244 | Current: idx=6, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 50 | Temp: 0.196 | Current: idx=6, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 60 | Temp: 0.164 | Current: idx=4, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 70 | Temp: 0.141 | Current: idx=0, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Best

Iteration 90 | Temp: 0.110 | Current: idx=6, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Iteration 99 | Temp: 0.100 | Current: idx=2, value=10, cost=12.0000 | Best: idx=2, value=10, cost=12.0000 | Selected Pivot: Index=2, Value=10, Cost=12.0000

--- Simulated Annealing for Subarray [0:5] ---

Initial Pivot: Index=5, Value=4, Cost=10.0000

Iteration 0 | Temp: 10.000 | Current: idx=5, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 10 | Temp: 0.909 | Current: idx=2, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 20 | Temp: 0.476 | Current: idx=1, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 30 | Temp: 0.323 | Current: idx=2, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 40 | Temp: 0.244 | Current: idx=1, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 50 | Temp: 0.196 | Current: idx=1, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 60 | Temp: 0.164 | Current: idx=1, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 70 | Temp: 0.141 | Current: idx=1, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 80 | Temp: 0.123 | Current: idx=3, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 90 | Temp: 0.110 | Current: idx=2, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Iteration 90 | Temp: 0.110 | Current: idx=2, value=4, cost=10.0000 | Best: idx=5, value=4, cost=10.0000 | Selected Pivot: Index=5, Value=4, Cost=10.0000 | Selected Pivot: Index=5, Value=4, Cost=10.0000

--- Simulated Annealing for Subarray [1:5] ---

Initial Pivot: Index=3, Value=4, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=3, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 10 | Temp: 0.909 | Current: idx=4, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 20 | Temp: 0.476 | Current: idx=5, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 30 | Temp: 0.323 | Current: idx=1, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 40 | Temp: 0.244 | Current: idx=3, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 50 | Temp: 0.196 | Current: idx=3, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 60 | Temp: 0.164 | Current: idx=1, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 70 | Temp: 0.141 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.123 | Current: idx=4, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 90 | Temp: 0.110 | Current: idx=3, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 90 | Temp: 0.110 | Current: idx=3, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | Best: idx=3, value=4, cost=8.0000 | Iteration 80 | Temp: 0.100 | Current: idx=2, value=4, cost=8.0000 | It

--- Simulated Annealing for Subarray [2:5] ---

Initial Pivot: Index=2, Value=4, Cost=6.0000

Iteration 0 | Temp: 10.000 | Current: idx=2, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 10 | Temp: 0.909 | Current: idx=4, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 20 | Temp: 0.476 | Current: idx=2, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 30 | Temp: 0.323 | Current: idx=3, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 30 | Temp: 0.323 | Current: idx=3, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 30 | Temp: 0.323 | Current: idx=3, value=4, cost=6.0000 | Iteration 30 | Temp: 0.323 | Current: idx=3, value=4, cost=6.0000 | Iteration 30 | Iteration

Iteration 40 | Temp: 0.244 | Current: idx=4, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 50 | Temp: 0.196 | Current: idx=5, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 60 | Temp: 0.164 | Current: idx=3, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 70 | Temp: 0.141 | Current: idx=5, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 80 | Temp: 0.123 | Current: idx=5, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 90 | Temp: 0.110 | Current: idx=2, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Iteration 99 | Temp: 0.100 | Current: idx=3, value=4, cost=6.0000 | Best: idx=2, value=4, cost=6.0000 | Selected Pivot: Index=2, Value=4, Cost=6.0000 | Selected Pivot: Index=

--- Simulated Annealing for Subarray [3:5] ---

Initial Pivot: Index=4, Value=4, Cost=4.0000

Iteration 0 | Temp: 10.000 | Current: idx=3, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 10 | Temp: 0.909 | Current: idx=3, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=5, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=3, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 40 | Temp: 0.244 | Current: idx=3, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=3, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 60 | Temp: 0.164 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 70 | Temp: 0.114 | Current: idx=5, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=5, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Best: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=4, value=4, cost=4.0000 | Iteration 90 | Temp: 0.100 | Current: idx=

--- Simulated Annealing for Subarray [4:5] ---

Initial Pivot: Index=5, Value=4, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 10 | Temp: 0.909 | Current: idx=5, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 20 | Temp: 0.476 | Current: idx=5, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 30 | Temp: 0.323 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 40 | Temp: 0.244 | Current: idx=5, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 50 | Temp: 0.196 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 60 | Temp: 0.164 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 70 | Temp: 0.141 | Current: idx=5, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 80 | Temp: 0.123 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 90 | Temp: 0.110 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Iteration 99 | Temp: 0.100 | Current: idx=4, value=4, cost=2.0000 | Best: idx=5, value=4, cost=2.0000 |
Selected Pivot: Index=5, Value=4, Cost=2.0000 |

--- Simulated Annealing for Subarray [7:11] ---

Initial Pivot: Index=11, Value=10, Cost=8.0000

Iteration 0 | Temp: 10.000 | Current: idx=11, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 10 | Temp: 0.909 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 20 | Temp: 0.476 | Current: idx=10, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 30 | Temp: 0.323 | Current: idx=9, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 40 | Temp: 0.244 | Current: idx=10, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 50 | Temp: 0.196 | Current: idx=11, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 60 | Temp: 0.164 | Current: idx=9, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 70 | Temp: 0.124 | Current: idx=9, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 80 | Temp: 0.123 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.110 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=8, value=10, cost=8.0000 | Best: idx=11, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=8.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10,

--- Simulated Annealing for Subarray [8:11] ---

Initial Pivot: Index=11, Value=10, Cost=6.0000

| Iteration | 0 | Temp: 10.000 | Current: idx=10, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 10 | Temp: 0.909 | Current: idx=8, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 20 | Temp: 0.476 | Current: idx=8, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 30 | Temp: 0.323 | Current: idx=8, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 40 | Temp: 0.244 | Current: idx=10, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 50 | Temp: 0.196 | Current: idx=9, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 70 | Temp: 0.141 | Current: idx=9, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 80 | Temp: 0.123 | Current: idx=9, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.121 | Current: idx=11, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.110 | Current: idx=11, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.100 | Current: idx=11, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.100 | Current: idx=10, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.100 | Current: idx=10, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.100 | Current: idx=9, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.100 | Current: idx=10, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Iteration | 90 | Temp: 0.100 | Current: idx=10, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Best: idx=11, value=10, cost=6.0000 | Best: idx=10, value=10, c

--- Simulated Annealing for Subarray [9:11] ---

Initial Pivot: Index=11, Value=10, Cost=4.0000

Iteration 0 | Temp: 10.000 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 10 | Temp: 0.909 | Current: idx=11, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 20 | Temp: 0.476 | Current: idx=9, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 30 | Temp: 0.323 | Current: idx=9, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 40 | Temp: 0.244 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 50 | Temp: 0.196 | Current: idx=9, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 50 | Temp: 0.141 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 70 | Temp: 0.141 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 80 | Temp: 0.123 | Current: idx=9, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 90 | Temp: 0.110 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 99 | Temp: 0.110 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 99 | Temp: 0.110 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Best: idx=11, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=10, value=10, cost=4.0000 | Iteration 99 | Temp: 0.100 | Current: idx=

--- Simulated Annealing for Subarray [10:11] ---

Initial Pivot: Index=11, Value=10, Cost=2.0000

Iteration 0 | Temp: 10.000 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 10 | Temp: 0.909 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 20 | Temp: 0.476 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 30 | Temp: 0.323 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 40 | Temp: 0.244 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 50 | Temp: 0.196 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 50 | Temp: 0.164 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 70 | Temp: 0.141 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 80 | Temp: 0.123 | Current: idx=11, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.110 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Best: idx=11, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Iteration 90 | Temp: 0.100 | Current: idx=10, value=10, cost=2.0000 | Iterat

Sorted Array: [4, 4, 4, 4, 4, 4, 10, 10, 10, 10, 10, 10]

Total Swaps: 20 Total Comparisons: 36

Total Pivot Selection Cost: 62.0000