1. Table

|  |  |  |
| --- | --- | --- |
|  | Best | Worst |
| Bubble Sort | O(n) (when already sorted) | O(n^2) |
| Selection Sort | O(n^2) (when already sorted) | O(n^2) |
| Insertion Sort | O(n) (when already sorted) | O(n^2) |
| Merge Sort | O(nlog(n)) | O(nlog(n)) |
| Quicksort | O(nlog(n)) | O(n^2) (when the pivot is the least element) |

1. Illustration:

Bubble Sort (non-recursive & recursive)

Phase 1: 10 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 98 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 98 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 98 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 98 | | 30 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 22 | | 77 | | 50 | | 98 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 22 | | 77 | | 98 | | 50 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 22 | | 98 | | 77 | | 50 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 2 | | 49 | | 98 | | 22 | | 77 | | 50 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 2 | | 98 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 77 | | 4 | |

Phase 2: 9 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 77 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 77 | | 30 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 50 | | 77 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 77 | | 50 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 22 | | 77 | | 77 | | 50 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 2 | | 49 | | 77 | | 22 | | 77 | | 50 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 2 | | 77 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 4 | |

Phase 3: 8 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 49 | | 22 | | 77 | | 50 | | 20 | | 30 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 49 | | 22 | | 77 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 49 | | 22 | | 77 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 49 | | 22 | | 77 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 49 | | 77 | | 22 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 2 | | 77 | | 49 | | 22 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 2 | | 49 | | 22 | | 50 | | 30 | | 20 | | 4 | |

Phase 4: 7 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 77 | | 2 | | 49 | | 22 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 2 | | 49 | | 22 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 2 | | 49 | | 22 | | 50 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 2 | | 49 | | 50 | | 22 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 2 | | 50 | | 49 | | 22 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 2 | | 49 | | 22 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 2 | | 49 | | 22 | | 30 | | 20 | | 4 | |

Phase 5: 6 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 77 | | 50 | | 2 | | 49 | | 22 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 2 | | 49 | | 22 | | 30 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 2 | | 49 | | 30 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 2 | | 49 | | 30 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 2 | | 30 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 2 | | 30 | | 22 | | 20 | | 4 | |

Phase 6: 5 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 2 | | 30 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 2 | | 30 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 2 | | 30 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 2 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 2 | | 22 | | 20 | | 4 | |

Phase 7: 4 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 2 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 2 | | 22 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 2 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 2 | | 20 | | 4 | |

Phase 8: 3 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 2 | | 20 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 20 | | 2 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 20 | | 2 | | 4 | |

Phase 9: 2 comparisons

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 20 | | 2 | | 4 | | |  | | --- | | 98 | | 77 | | 77 | | 50 | | 49 | | 30 | | 22 | | 20 | | 4 | | 2 | |

Insertion Sort

Green means sorted; Red means the element to insert

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | ↓ | 77 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 2 | | 2   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | 77 | ↓ | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 2 | |
| 3   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | ↓ | 77 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 2 | | 4   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | ↓ | 30 | 77 | 98 | 20 | 50 | 77 | 22 | 49 | 2 | |
| 5   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | 20 | 30 | ↓ | 77 | 98 | 50 | 77 | 22 | 49 | 2 | | 6   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | 20 | 30 | 50 | ↓ | 77 | 98 | 77 | 22 | 49 | 2 | |
| 7   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | 20 | ↓ | 30 | 50 | 77 | 77 | 98 | 22 | 49 | 2 | | 8   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | 20 | 22 | 30 | ↓ | 50 | 77 | 77 | 98 | 49 | 2 | |
| 9   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | ↓ | 4 | 20 | 22 | 30 | 50 | 77 | 77 | 98 | 49 | 2 | | 10   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 30 | 50 | 77 | 77 | 98 | 49 | |

Selection Sort

Green means the current looping element, red means the smallest element in the unsorted part

Blue means the sorted part

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | 77 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 2 | | 2   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 77 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 4 | |
| 3   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 | | 4   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 30 | 98 | 50 | 77 | 22 | 49 | 77 | |
| 5   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 98 | 50 | 77 | 30 | 49 | 77 | | 6   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 30 | 50 | 77 | 98 | 49 | 77 | |
| 7   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 30 | 49 | 77 | 98 | 50 | 77 | | 8   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 30 | 49 | 50 | 98 | 77 | 77 | |
| 9   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 30 | 49 | 50 | 77 | 98 | 77 | | 10   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 2 | 4 | 20 | 22 | 30 | 49 | 50 | 77 | 77 | 98 | |

Merge Sort & Quicksort:

Merge Sort:

Diagram

Description automatically generated

For merge sort, I am also printing out the critical steps in the algorithms (i.e., calculating the middle index and adding elements to the main array from the subarrays) just for your reference.

Quick Sort:

**Blue and bold** means the pivot; green means the left index; red means the right index; purple means when the left and right indices are overlapping

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 77 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 2 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **4** | 2 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **2** | 4 | 98 | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |
| --- |
| **2** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **98** | 30 | 20 | 50 | 77 | 22 | 49 | 77 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **77** | 30 | 20 | 50 | 77 | 22 | 49 | 98 |

I am not going to draw the rest of it and so I am printing out the critical steps (such as swapping elements and indicating the pivot & its position) in my algorithm just for your reference.