(b)

**before sorting**

[8, 1, 9, 9, 3, 2, 6, 1, 5, 5]

**after sorting**

[1, 1, 2, 3, 5, 5, 6, 8, 9, 9]

(c)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input size | Input range | Counting sort running time | Merge sort running time | Heap sort running time |
| 10 | 0-9 | 1800 | 316500 | 11500 |
| 100 | 0-99 | 10500 | 96400 | 110200 |
| 1000 | 0-999 | 99600 | 687400 | 207800 |
| 10000 | 0-9999 | 801700 | 2661900 | 1284600 |
| 100000 | 0-99999 | 5190800 | 17246900 | 14172700 |
| 1000000 | 0-999999 | 39753500 | 158142600 | 170397200 |
| 10000000 | 0-9999999 | 523775700 | 1564534200 | 2741932200 |
| 100000000 | 0-99999999 | 13432175500 | 16437785300 | 38642256600 |

Which algorithm performs best at which input size?

*🡪 If the running time is less than the others, we can say that the algorithm performs better. I highlighted the better algorithm for each input size. From the highlights, we can conclude that counting sort performs better.*

(d) Now set the input range to 0-9999999 and fill the table below by repeating the analysis you made in part (c).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input size | Input range | Counting sort running time | Merge sort running time | Heap sort running time |
| 10 | 0-9999999 | 30008700 | 277800 | 16100 |
| 100 | 0-9999999 | 22481300 | 87300 | 79000 |
| 1000 | 0-9999999 | 26580200 | 641700 | 169300 |
| 10000 | 0-9999999 | 19696300 | 1234500 | 1268900 |
| 100000 | 0-9999999 | 22514100 | 12159700 | 16639000 |

Which algorithm performs best at which input size?

*🡪 If the running time is less than the others, we can say that the algorithm performs better. I highlighted the better algorithm for each input size. From the highlights, we can conclude that heap sort is better input size is smaller however when input size is large enough merge sort seems to be working better.*

(e)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Input size | Input range | Counting sort RAM | Merge sort RAM | Heap sort RAM |
| 100000000 | 0-9999999 | 1707 | 1972 | 1670 |

*🡪 We can see that merge sort uses more memory since algorithm needs to copy arrays into subarrays.*