Lab 6: Runtime Comparisons of different Sorting Algorithms

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I. SUMMARY OF RESULTS

A. Tables

Note that NAN indicates an excessive runtime (> 10 minutes).

Sorting	Array Size (in thousands)						
	1	**2**	**4**	**8**	**16**	**32**	**1000**
Java Default	0	1	0	1	0	5	36
Bubble Sort	3	6	18	30	123	497	NAN
Selection Sort	2	6	18	21	145	383	NAN
Insertion Sort	1	2	4	5	13	32	28338
Mergesort	1	1	1	1	2	4	101
Quicksort	0	0	1	1	2	4	46

TABLE I: List a

Sorting	Array Size (in thousands)						
	1	**2**	**4**	**8**	**16**	**32**	**1000**
Java Default	0	0	0	0	0	1	3
Bubble Sort	0	2	6	23	86	344	NAN
Selection Sort	2	6	10	21	113	382	NAN
Insertion Sort	0	0	0	0	0	0	1
Mergesort	0	0	0	1	1	4	71
Quicksort	0	0	0	0	0	0	11

TABLE II: List b

	Array Size (in thousands)						
Sorting	1	2	4	8	16	32	1000
Java Default	0	0	1	1	1	19	3
Bubble Sort	1	1	6	16	60	239	NAN
Selection Sort	0	2	8	13	86	193	NAN
Insertion Sort	1	8	36	24	67	257	244656
Mergesort	0	0	1	1	1	2	53
Quicksort	0	1	1	0	0	0	13

TABLE III: List c

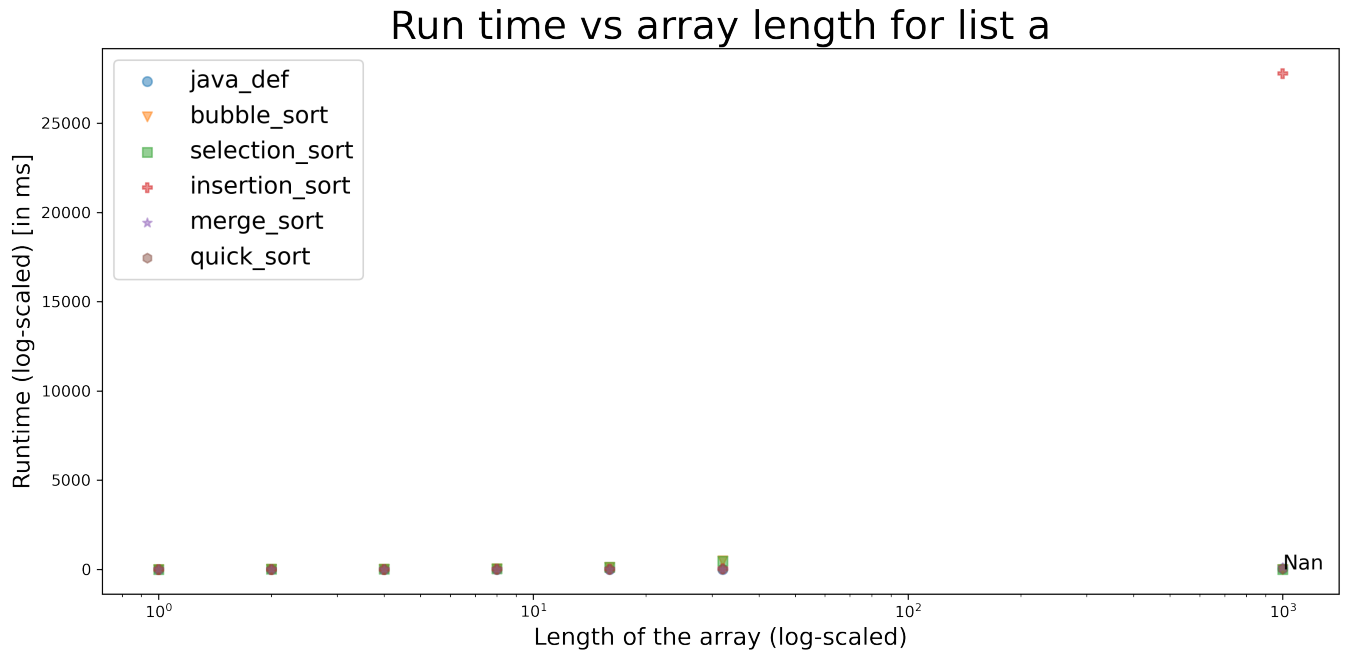|	Array Size (in thousands)						
Sorting	1	2	4	8	16	32	1000
Java Default	0	0	0	0	0	1	2
Bubble Sort	0	1	2	22	87	241	NAN
Selection Sort	0	1	9	20	95	376	NAN
Insertion Sort	0	0	0	0	0	0	1
Mergesort	0	0	1	1	0	2	55
Quicksort	0	0	0	0	0	0	11

TABLE IV: List d

B. Plots

FIG. 1: Plot summarizing the comparison of run times for different sorting algorithms for List a (indicated in the legend) for array of different sizes
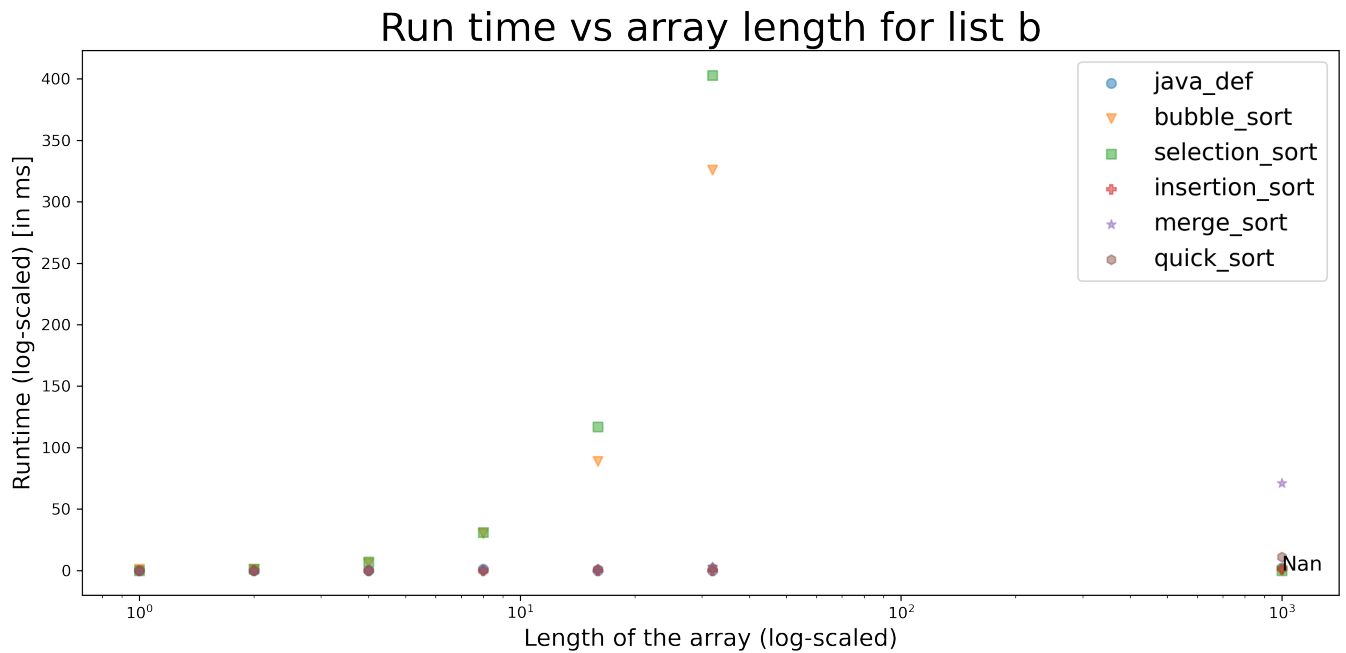

FIG. 2: Plot summarizing the comparison of run times for different sorting algorithms for List b (indicated in the legend) for array of different sizes
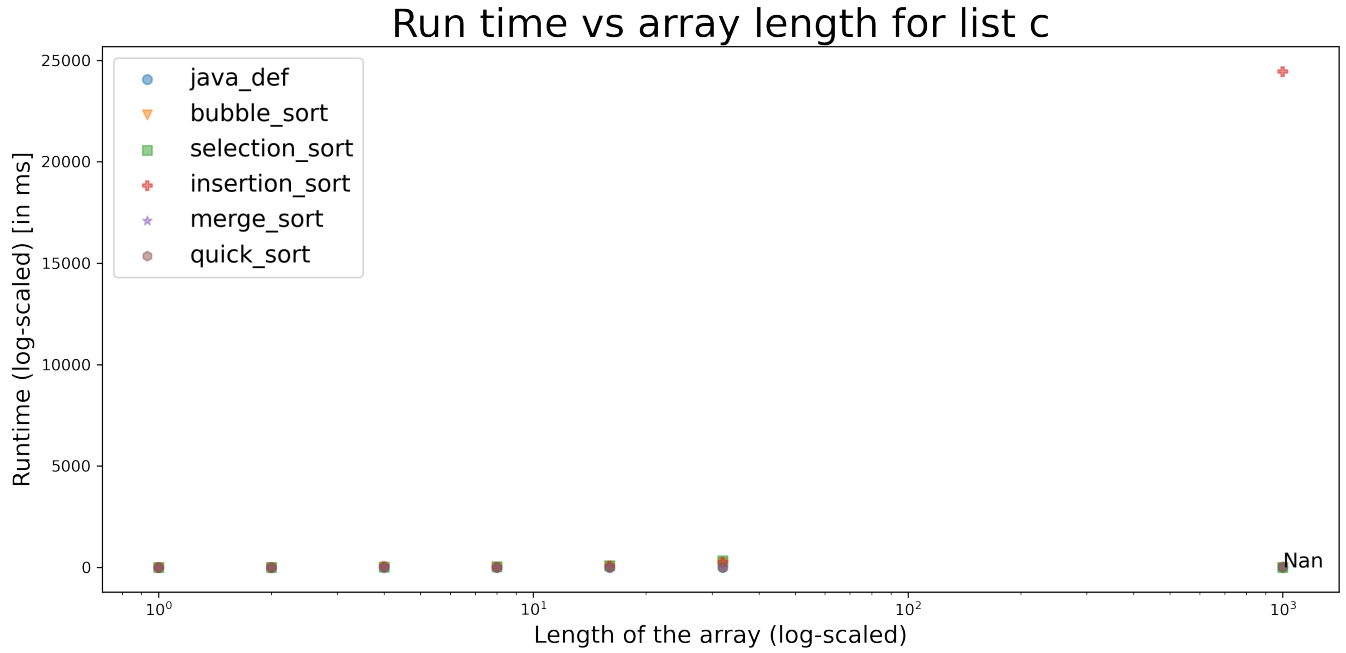
FIG. 3: Plot summarizing the comparison of run times for different sorting algorithms for List c (indicated in the legend) for array of different sizes
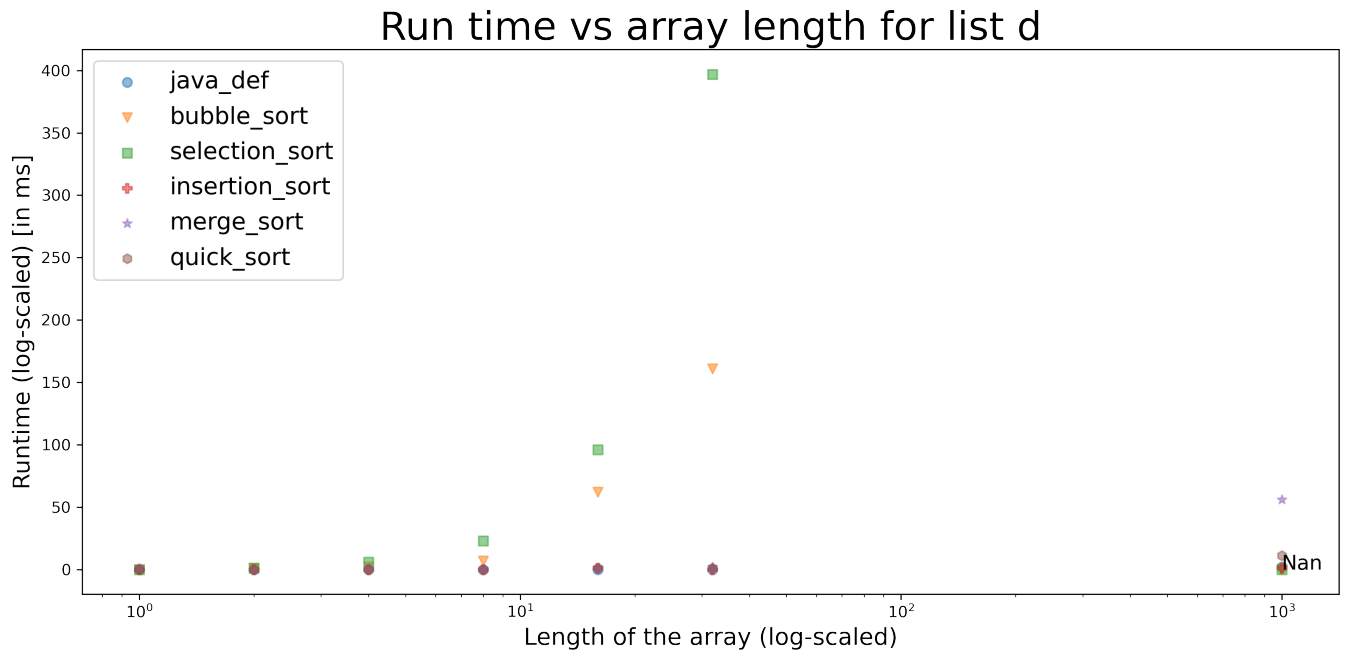

FIG. 4: Plot summarizing the comparison of run times for different sorting algorithms for List d (indicated in the legend) for array of different sizes

II.   SCREENSHOTS FROM THE CODE

```
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 1Kints.txt 0
defaultSort() a      0.0    20220410_145712   lbetti   1Kints.txt
defaultSort() b      0.0    20220410_145712   lbetti   1Kints.txt
defaultSort() c      0.0    20220410_145712   lbetti   1Kints.txt
defaultSort() d      0.0    20220410_145712   lbetti   1Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 1Kints.txt 1
Bubble Sort a      3.0    20220410_145721   lbetti   1Kints.txt
Bubble Sort b      0.0    20220410_145721   lbetti   1Kints.txt
Bubble Sort c      1.0    20220410_145721   lbetti   1Kints.txt
Bubble Sort d      0.0    20220410_145721   lbetti   1Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 1Kints.txt 2
Selection Sort a      2.0    20220410_145726   lbetti   1Kints.txt
Selection Sort b      0.0    20220410_145726   lbetti   1Kints.txt
Selection Sort c      0.0    20220410_145726   lbetti   1Kints.txt
Selection Sort d      0.0    20220410_145726   lbetti   1Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 1Kints.txt 3
Insertion Sort a      1.0    20220410_145733   lbetti   1Kints.txt
Insertion Sort b      0.0    20220410_145733   lbetti   1Kints.txt
Insertion Sort c      1.0    20220410_145733   lbetti   1Kints.txt
Insertion Sort d      0.0    20220410_145733   lbetti   1Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 1Kints.txt 4
Merge Sort a    1.0    20220410_145746   lbetti   1Kints.txt
Merge Sort b    0.0    20220410_145746   lbetti   1Kints.txt
Merge Sort c    0.0    20220410_145746   lbetti   1Kints.txt
Merge Sort d    0.0    20220410_145746   lbetti   1Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 1Kints.txt 5
Quick Sort a    0.0    20220410_145749   lbetti   1Kints.txt
Quick Sort b    0.0    20220410_145749   lbetti   1Kints.txt
Quick Sort c    1.0    20220410_145749   lbetti   1Kints.txt
Quick Sort d    0.0    20220410_145749   lbetti   1Kints.txt
```

FIG. 5: 1k

```
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 2Kints.txt 0
defaultSort() a       1.0    20220410_150243   lbetti   2Kints.txt
defaultSort() b       0.0    20220410_150243   lbetti   2Kints.txt
defaultSort() c       0.0    20220410_150243   lbetti   2Kints.txt
defaultSort() d       0.0    20220410_150243   lbetti   2Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 2Kints.txt 1
Bubble Sort a        6.0    20220410_150246   lbetti   2Kints.txt
Bubble Sort b        2.0    20220410_150246   lbetti   2Kints.txt
Bubble Sort c        1.0    20220410_150246   lbetti   2Kints.txt
Bubble Sort d        1.0    20220410_150246   lbetti   2Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 2Kints.txt 2
Selection Sort a        6.0    20220410_150248   lbetti   2Kints.txt
Selection Sort b        1.0    20220410_150248   lbetti   2Kints.txt
Selection Sort c        2.0    20220410_150248   lbetti   2Kints.txt
Selection Sort d        1.0    20220410_150248   lbetti   2Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 2Kints.txt 3
Insertion Sort a        2.0    20220410_150255   lbetti   2Kints.txt
Insertion Sort b        0.0    20220410_150255   lbetti   2Kints.txt
Insertion Sort c        8.0    20220410_150255   lbetti   2Kints.txt
Insertion Sort d        0.0    20220410_150255   lbetti   2Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 2Kints.txt 4
Merge Sort a       1.0    20220410_150257   lbetti   2Kints.txt
Merge Sort b       0.0    20220410_150257   lbetti   2Kints.txt
Merge Sort c       0.0    20220410_150257   lbetti   2Kints.txt
Merge Sort d       0.0    20220410_150257   lbetti   2Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 2Kints.txt 5
Quick Sort a       0.0    20220410_150300   lbetti   2Kints.txt
Quick Sort b       0.0    20220410_150300   lbetti   2Kints.txt
Quick Sort c       0.0    20220410_150300   lbetti   2Kints.txt
Quick Sort d       0.0    20220410_150300   lbetti   2Kints.txt
```

FIG. 6: 2k

```
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 4Kints.txt 0
defaultSort() a        0.0    20220410_150451   lbetti   4Kints.txt
defaultSort() b        0.0    20220410_150451   lbetti   4Kints.txt
defaultSort() c        1.0    20220410_150451   lbetti   4Kints.txt
defaultSort() d        0.0    20220410_150451   lbetti   4Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 4Kints.txt 1
Bubble Sort a       18.0     20220410_150455   lbetti   4Kints.txt
Bubble Sort b        6.0     20220410_150455   lbetti   4Kints.txt
Bubble Sort c        6.0     20220410_150455   lbetti   4Kints.txt
Bubble Sort d        2.0     20220410_150455   lbetti   4Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 4Kints.txt 2
Selection Sort a     18.0     20220410_150457   lbetti   4Kints.txt
Selection Sort b     10.0     20220410_150457   lbetti   4Kints.txt
Selection Sort c      8.0     20220410_150457   lbetti   4Kints.txt
Selection Sort d      9.0     20220410_150457   lbetti   4Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 4Kints.txt 3
Insertion Sort a      4.0     20220410_150459   lbetti   4Kints.txt
Insertion Sort b      0.0     20220410_150459   lbetti   4Kints.txt
Insertion Sort c     36.0     20220410_150459   lbetti   4Kints.txt
Insertion Sort d      0.0     20220410_150459   lbetti   4Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 4Kints.txt 4
Merge Sort a       1.0    20220410_150500   lbetti   4Kints.txt
Merge Sort b       0.0    20220410_150500   lbetti   4Kints.txt
Merge Sort c       1.0    20220410_150500   lbetti   4Kints.txt
Merge Sort d       1.0    20220410_150500   lbetti   4Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 4Kints.txt 5
Quick Sort a       1.0    20220410_150503   lbetti   4Kints.txt
Quick Sort b       0.0    20220410_150503   lbetti   4Kints.txt
Quick Sort c       0.0    20220410_150503   lbetti   4Kints.txt
Quick Sort d       0.0    20220410_150503   lbetti   4Kints.txt
```

FIG. 7: 4k

```
vashisth@Vashisths—MacBook—Pro src_livia % java Sorting 8Kints.txt 0
defaultSort() a        1.0    20220410_150531   lbetti   8Kints.txt
defaultSort() b        0.0    20220410_150531   lbetti   8Kints.txt
defaultSort() c        0.0    20220410_150531   lbetti   8Kints.txt
defaultSort() d        0.0    20220410_150531   lbetti   8Kints.txt
vashisth@Vashisths—MacBook—Pro src_livia % java Sorting 8Kints.txt 1
Bubble Sort a      30.0    20220410_150533   lbetti   8Kints.txt
Bubble Sort b      23.0    20220410_150533   lbetti   8Kints.txt
Bubble Sort c      16.0    20220410_150533   lbetti   8Kints.txt
Bubble Sort d      22.0    20220410_150533   lbetti   8Kints.txt
vashisth@Vashisths—MacBook—Pro src_livia % java Sorting 8Kints.txt 2
Selection Sort a      21.0    20220410_150535   lbetti   8Kints.txt
Selection Sort b      21.0    20220410_150535   lbetti   8Kints.txt
Selection Sort c      13.0    20220410_150535   lbetti   8Kints.txt
Selection Sort d      20.0    20220410_150535   lbetti   8Kints.txt
vashisth@Vashisths—MacBook—Pro src_livia % java Sorting 8Kints.txt 3
Insertion Sort a       5.0    20220410_150537   lbetti   8Kints.txt
Insertion Sort b       0.0    20220410_150537   lbetti   8Kints.txt
Insertion Sort c      24.0    20220410_150537   lbetti   8Kints.txt
Insertion Sort d       0.0    20220410_150537   lbetti   8Kints.txt
vashisth@Vashisths—MacBook—Pro src_livia % java Sorting 8Kints.txt 4
Merge Sort a      1.0    20220410_150539   lbetti   8Kints.txt
Merge Sort b      1.0    20220410_150539   lbetti   8Kints.txt
Merge Sort c      1.0    20220410_150539   lbetti   8Kints.txt
Merge Sort d      1.0    20220410_150539   lbetti   8Kints.txt
vashisth@Vashisths—MacBook—Pro src_livia % java Sorting 8Kints.txt 5
Quick Sort a      1.0    20220410_150542   lbetti   8Kints.txt
Quick Sort b      0.0    20220410_150542   lbetti   8Kints.txt
Quick Sort c      0.0    20220410_150542   lbetti   8Kints.txt
Quick Sort d      0.0    20220410_150542   lbetti   8Kints.txt
```

FIG. 8: 8k

```
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 16Kints.txt 0
defaultSort() a       0.0    20220410_150609   lbetti   16Kints.txt
defaultSort() b       0.0    20220410_150609   lbetti   16Kints.txt
defaultSort() c       1.0    20220410_150609   lbetti   16Kints.txt
defaultSort() d       0.0    20220410_150609   lbetti   16Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 16Kints.txt 1
Bubble Sort a     123.0    20220410_150611   lbetti   16Kints.txt
Bubble Sort b      86.0    20220410_150611   lbetti   16Kints.txt
Bubble Sort c      60.0    20220410_150611   lbetti   16Kints.txt
Bubble Sort d      87.0    20220410_150611   lbetti   16Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 16Kints.txt 2
Selection Sort a    145.0    20220410_150613   lbetti   16Kints.txt
Selection Sort b    113.0    20220410_150613   lbetti   16Kints.txt
Selection Sort c     86.0    20220410_150614   lbetti   16Kints.txt
Selection Sort d     95.0    20220410_150614   lbetti   16Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 16Kints.txt 3
Insertion Sort a     13.0    20220410_150616   lbetti   16Kints.txt
Insertion Sort b      0.0    20220410_150616   lbetti   16Kints.txt
Insertion Sort c     67.0    20220410_150616   lbetti   16Kints.txt
Insertion Sort d      0.0    20220410_150616   lbetti   16Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 16Kints.txt 4
Merge Sort a      2.0    20220410_150618   lbetti   16Kints.txt
Merge Sort b      1.0    20220410_150618   lbetti   16Kints.txt
Merge Sort c      1.0    20220410_150618   lbetti   16Kints.txt
Merge Sort d      0.0    20220410_150618   lbetti   16Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 16Kints.txt 5
Quick Sort a      2.0    20220410_150620   lbetti   16Kints.txt
Quick Sort b      0.0    20220410_150620   lbetti   16Kints.txt
Quick Sort c      0.0    20220410_150620   lbetti   16Kints.txt
Quick Sort d      0.0    20220410_150620   lbetti   16Kints.txt
```

FIG. 9: 16k

```
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 32Kints.txt 0
defaultSort() a        5.0    20220410_150643   lbetti   32Kints.txt
defaultSort() b        1.0    20220410_150643   lbetti   32Kints.txt
defaultSort() c       19.0    20220410_150643   lbetti   32Kints.txt
defaultSort() d        1.0    20220410_150643   lbetti   32Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 32Kints.txt 1
Bubble Sort a     497.0    20220410_150645   lbetti   32Kints.txt
Bubble Sort b     344.0    20220410_150645   lbetti   32Kints.txt
Bubble Sort c     239.0    20220410_150645   lbetti   32Kints.txt
Bubble Sort d     241.0    20220410_150646   lbetti   32Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 32Kints.txt 2
Selection Sort a    383.0    20220410_150649   lbetti   32Kints.txt
Selection Sort b    382.0    20220410_150649   lbetti   32Kints.txt
Selection Sort c    193.0    20220410_150650   lbetti   32Kints.txt
Selection Sort d    376.0    20220410_150650   lbetti   32Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 32Kints.txt 3
Insertion Sort a     32.0    20220410_150652   lbetti   32Kints.txt
Insertion Sort b      0.0    20220410_150652   lbetti   32Kints.txt
Insertion Sort c    257.0    20220410_150653   lbetti   32Kints.txt
Insertion Sort d      0.0    20220410_150653   lbetti   32Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 32Kints.txt 4
Merge Sort a      4.0    20220410_150655   lbetti   32Kints.txt
Merge Sort b      4.0    20220410_150655   lbetti   32Kints.txt
Merge Sort c      2.0    20220410_150655   lbetti   32Kints.txt
Merge Sort d      2.0    20220410_150655   lbetti   32Kints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting 32Kints.txt 5
Quick Sort a      4.0    20220410_150659   lbetti   32Kints.txt
Quick Sort b      0.0    20220410_150659   lbetti   32Kints.txt
Quick Sort c      0.0    20220410_150659   lbetti   32Kints.txt
Quick Sort d      0.0    20220410_150659   lbetti   32Kints.txt
```

FIG. 10: 32k

```
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting  1Mints.txt 0
defaultSort() a      36.0    20220410_160800   lbetti   1Mints.txt
defaultSort() b       3.0    20220410_160800   lbetti   1Mints.txt
defaultSort() c       3.0    20220410_160801   lbetti   1Mints.txt
defaultSort() d       2.0    20220410_160801   lbetti   1Mints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting  1Mints.txt 1
^C%
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting  1Mints.txt 2
^C%
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting  1Mints.txt 3
Insertion Sort a  28338.0    20220410_160904   lbetti   1Mints.txt
Insertion Sort b      1.0    20220410_160904   lbetti   1Mints.txt
Insertion Sort c 244656.0    20220410_161309   lbetti   1Mints.txt
Insertion Sort d      1.0    20220410_161309   lbetti   1Mints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting  1Mints.txt 4
Merge Sort a     101.0    20220410_161508   lbetti   1Mints.txt
Merge Sort b      71.0    20220410_161508   lbetti   1Mints.txt
Merge Sort c      53.0    20220410_161509   lbetti   1Mints.txt
Merge Sort d      55.0    20220410_161509   lbetti   1Mints.txt
vashisth@Vashisths-MacBook-Pro src_livia % java Sorting  1Mints.txt 5
Quick Sort a      46.0    20220410_161511   lbetti   1Mints.txt
Quick Sort b      11.0    20220410_161511   lbetti   1Mints.txt
Quick Sort c      13.0    20220410_161511   lbetti   1Mints.txt
Quick Sort d      11.0    20220410_161511   lbetti   1Mints.txt
vashisth@Vashisths-MacBook-Pro src_livia % 
```

FIG. 11: 100k