```
1   Welcome to DrJava.  Working directory is C:\Users\Home\Work\CISC1115
2   > run Sorting
3   The Original Array
4   10 numbers in almost sorted order.
5   4 6 8 9 13 11 16 17 19 20
6   The Sorted Array with quick sort
7   4 6 8 9 11 13 16 17 19 20
8   Number of comparison = 41.  Number of Swaps = 48
9
10  The Original Array
11  10 numbers in almost sorted order.
12  4 6 8 9 13 11 16 17 19 20
13  The Sorted Array with heap sort
14  4 6 8 9 11 13 16 17 19 20
15  Number of comparison = 111.  Number of Swaps = 32
16
17  The Original Array
18  10 numbers in almost sorted order.
19  4 6 8 9 13 11 16 17 19 20
20  The Sorted Array with bubble sort
21  4 6 8 9 11 13 16 17 19 20
22  Number of comparison = 45.  Number of Swaps = 1
23  _____
24  The Quick Sort made the least comparisons = 41
25  The Heap Sort made the most comparisons = 111
26  The Bubble Sort made the middle comparisons = 45
27  _____
28  The Bubble Sort made the least Swaps = 1
29  The Quick Sort made the most Swaps = 48
30  The Heap Sort made the middle Swaps = 32
31  _____
32
33  The Original Array
34  10 numbers in reverse order.
35  28 25 23 21 18 15 14 13 11 10
36  The Sorted Array with quick sort
37  10 11 13 14 15 18 21 23 25 28
38  Number of comparison = 45.  Number of Swaps = 29
39
40  The Original Array
41  10 numbers in reverse order.
42  28 25 23 21 18 15 14 13 11 10
43  The Sorted Array with heap sort
44  10 11 13 14 15 18 21 23 25 28
45  Number of comparison = 81.  Number of Swaps = 22
46
47  The Original Array
48  10 numbers in reverse order.
49  28 25 23 21 18 15 14 13 11 10
50  The Sorted Array with bubble sort
51  10 11 13 14 15 18 21 23 25 28
52  Number of comparison = 45.  Number of Swaps = 45
53  _____
54  The Bubble Sort made the same Compares as Quick Sort 45
55  The Heap Sort made the most Compares = 81
56  _____
57  The Heap Sort made the least Swaps = 22
58  The Bubble Sort made the most Swaps = 45
59  The Quick Sort made the middle Swaps = 29
60  _____
61
62  The Original Array
63  10 numbers in random order.
64  4 2 9 6 8 12 17 11 13 10
65  The Sorted Array with quick sort
66  2 4 6 8 9 10 11 12 13 17
67  Number of comparison = 20.  Number of Swaps = 18
68
69  The Original Array
70  10 numbers in random order.
```

71 4 2 9 6 8 12 17 11 13 10
72 The Sorted Array with heap sort
73 2 4 6 8 9 10 11 12 13 17
74 Number of comparison = 102. Number of Swaps = 29
75
76 The Original Array
77 10 numbers in random order.
78 4 2 9 6 8 12 17 11 13 10
79 The Sorted Array with bubble sort
80 2 4 6 8 9 10 11 12 13 17
81 Number of comparison = 45. Number of Swaps = 10
82 _____
83 The Quick Sort made the least comparisons = 20
84 The Heap Sort made the most comparisons = 102
85 The Bubble Sort made the middle comparisons = 45
86 _____
87 The Bubble Sort made the least Swap = 10
88 The Heap Sort made the most Swaps = 29
89 The Quick Sort made the middle Swaps = 18
90 _____
91
92 The Original Array
93 50 numbers in almost sorted order.
94 3 5 7 9 11 13 17 15 19 25 21 23 27 28 29 31 34 37 39 38 42 45 47 49 50 51 53 54 56
    58 59 61 63 65 67 69 71 75 73 78 82 46 89 95 96 97 99 100 105 98
95 The Sorted Array with quick sort
96 3 5 7 9 11 13 15 17 19 21 23 25 27 28 29 31 34 37 38 39 42 45 46 47 49 50 51 53 54
    56 58 59 61 63 65 67 69 71 73 75 78 82 89 95 96 97 98 99 100 105
97 Number of comparison = 633. Number of Swaps = 480
98
99 The Original Array
100 50 numbers in almost sorted order.
101 3 5 7 9 11 13 17 15 19 25 21 23 27 28 29 31 34 37 39 38 42 45 47 49 50 51 53 54 56
    58 59 61 63 65 67 69 71 75 73 78 82 46 89 95 96 97 99 100 105 98
102 The Sorted Array with heap sort
103 3 5 7 9 11 13 15 17 19 21 23 25 27 28 29 31 34 37 38 39 42 45 46 47 49 50 51 53 54
    56 58 59 61 63 65 67 69 71 73 75 78 82 89 95 96 97 98 99 100 105
104 Number of comparison = 873. Number of Swaps = 266
105
106 The Original Array
107 50 numbers in almost sorted order.
108 3 5 7 9 11 13 17 15 19 25 21 23 27 28 29 31 34 37 39 38 42 45 47 49 50 51 53 54 56
    58 59 61 63 65 67 69 71 75 73 78 82 46 89 95 96 97 99 100 105 98
109 The Sorted Array with bubble sort
110 3 5 7 9 11 13 15 17 19 21 23 25 27 28 29 31 34 37 38 39 42 45 46 47 49 50 51 53 54
    56 58 59 61 63 65 67 69 71 73 75 78 82 89 95 96 97 98 99 100 105
111 Number of comparison = 1225. Number of Swaps = 27
112 _____
113 The Quick Sort made the least comparisons = 633
114 The Bubble Sort made the most comparisons = 1225
115 The Heap Sort made the middle comparisons = 873
116 _____
117 The Bubble Sort made the least Swaps = 27
118 The Quick Sort made the most Swaps = 480
119 The Heap Sort made the middle Swaps = 266
120 _____
121
122 The Original Array
123 50 numbers in reverse order.
124 995 986 972 964 950 943 935 925 917 907 896 885 874 855 864 843 833 827 816 807 796
    785 774 765 754 743 737 725 719 706 699 686 673 664 656 644 635 628 618 606 586 596
    574 562 552 535 542 521 511 500
125 The Sorted Array with quick sort
126 500 511 521 535 542 552 562 574 586 596 606 618 628 635 644 656 664 673 686 699 706
    719 725 737 743 754 765 774 785 796 807 816 827 833 843 855 864 874 885 896 907 917
    925 935 943 950 964 972 986 995
127 Number of comparison = 1060. Number of Swaps = 561
128
129 The Original Array
130 50 numbers in reverse order.

131 995 986 972 964 950 943 935 925 917 907 896 885 874 855 864 843 833 827 816 807 796
    785 774 765 754 743 737 725 719 706 699 686 673 664 656 644 635 628 618 606 586 596
    574 562 552 535 542 521 511 500
132 The Sorted Array with heap sort
133 500 511 521 535 542 552 562 574 586 596 606 618 628 635 644 656 664 673 686 699 706
    719 725 737 743 754 765 774 785 796 807 816 827 833 843 855 864 874 885 896 907 917
    925 935 943 950 964 972 986 995
134 Number of comparison = 702. Number of Swaps = 209
135
136 The Original Array
137 50 numbers in reverse order.
138 995 986 972 964 950 943 935 925 917 907 896 885 874 855 864 843 833 827 816 807 796
    785 774 765 754 743 737 725 719 706 699 686 673 664 656 644 635 628 618 606 586 596
    574 562 552 535 542 521 511 500
139 The Sorted Array with bubble sort
140 500 511 521 535 542 552 562 574 586 596 606 618 628 635 644 656 664 673 686 699 706
    719 725 737 743 754 765 774 785 796 807 816 827 833 843 855 864 874 885 896 907 917
    925 935 943 950 964 972 986 995
141 Number of comparison = 1225. Number of Swaps = 1222
142 _____
143 The Heap Sort made the least comparisons = 702
144 The Bubble Sort made the most comparisons = 1225
145 The Quick Sort made the middle comparisons = 1060
146 _____
147 The Heap Sort made the least Swaps = 209
148 The Bubble Sort made the most Swaps = 1222
149 The Quick Sort made the middle Swaps = 561
150 _____
151
152 The Original Array
153 50 numbers in random order.
154 80 55 56 57 75 95 85 25 35 45 65 75 121 145 165 100 52 57 59 66 44 22 24 26 29 98
    97 94 93 90 14 16 17 19 171 211 240 7 16 77 70 73 78 345 451 297 234 187 186 165
155 The Sorted Array with quick sort
156 7 14 16 16 17 19 22 24 25 26 29 35 44 45 52 55 56 57 57 59 65 66 70 73 75 75 77 78
    80 85 90 93 94 95 97 98 100 121 145 165 165 171 186 187 211 234 240 297 345 451
157 Number of comparison = 274. Number of Swaps = 202
158
159 The Original Array
160 50 numbers in random order.
161 80 55 56 57 75 95 85 25 35 45 65 75 121 145 165 100 52 57 59 66 44 22 24 26 29 98
    97 94 93 90 14 16 17 19 171 211 240 7 16 77 70 73 78 345 451 297 234 187 186 165
162 The Sorted Array with heap sort
163 7 14 16 16 17 19 22 24 25 26 29 35 44 45 52 55 56 57 57 59 65 66 70 73 75 75 77 78
    80 85 90 93 94 95 97 98 100 121 145 165 165 171 186 187 211 234 240 297 345 451
164 Number of comparison = 807. Number of Swaps = 244
165
166 The Original Array
167 50 numbers in random order.
168 80 55 56 57 75 95 85 25 35 45 65 75 121 145 165 100 52 57 59 66 44 22 24 26 29 98
    97 94 93 90 14 16 17 19 171 211 240 7 16 77 70 73 78 345 451 297 234 187 186 165
169 The Sorted Array with bubble sort
170 7 14 16 16 17 19 22 24 25 26 29 35 44 45 52 55 56 57 57 59 65 66 70 73 75 75 77 78
    80 85 90 93 94 95 97 98 100 121 145 165 165 171 186 187 211 234 240 297 345 451
171 Number of comparison = 1225. Number of Swaps = 497
172 _____
173 The Quick Sort made the least comparisons = 274
174 The Bubble Sort made the most comparisons = 1225
175 The Heap Sort made the middle comparisons = 807
176 _____
177 The Quick Sort made the least Swaps = 202
178 The Bubble Sort made the most Swaps = 497
179 The Heap Sort made the middle Swaps = 244
180 _____
181
182 The Original Array
183 100 numbers in almost sorted order.
184 3 7 9 13 17 15 19 25 21 23 27 28 29 31 34 37 39 38 42 45 47 49 50 51 53 54 56 58 59
    61 63 65 67 69 71 75 73 78 82 46 89 95 96 97 99 100 105 98 101 110 125 134 143 156
    165 175 185 196 205 210 220 230 245 255 265 278 285 296 301 312 325 334 342 352 368

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     375 381 398 400 410 420 430 440 455 460 470 485 496 500 512 522 532 542 552 565 578
     589 598 601 620
185 The Sorted Array with quick sort
186 3 7 9 13 15 17 19 21 23 25 27 28 29 31 34 37 38 39 42 45 46 47 49 50 51 53 54 56 58
     59 61 63 65 67 69 71 73 75 78 82 89 95 96 97 98 99 100 101 105 110 125 134 143 156
     165 175 185 196 205 210 220 230 245 255 265 278 285 296 301 312 325 334 342 352 368
     375 381 398 400 410 420 430 440 455 460 470 485 496 500 512 522 532 542 552 565 578
     589 598 601 620
187 Number of comparison = 4405.  Number of Swaps = 4303
188
189 The Original Array
190 100 numbers in almost sorted order.
191 3 7 9 13 17 15 19 25 21 23 27 28 29 31 34 37 39 38 42 45 47 49 50 51 53 54 56 58 59
     61 63 65 67 69 71 75 73 78 82 46 89 95 96 97 99 100 105 98 101 110 125 134 143 156
     165 175 185 196 205 210 220 230 245 255 265 278 285 296 301 312 325 334 342 352 368
     375 381 398 400 410 420 430 440 455 460 470 485 496 500 512 522 532 542 552 565 578
     589 598 601 620
192 The Sorted Array with heap sort
193 3 7 9 13 15 17 19 21 23 25 27 28 29 31 34 37 38 39 42 45 46 47 49 50 51 53 54 56 58
     59 61 63 65 67 69 71 73 75 78 82 89 95 96 97 98 99 100 101 105 110 125 134 143 156
     165 175 185 196 205 210 220 230 245 255 265 278 285 296 301 312 325 334 342 352 368
     375 381 398 400 410 420 430 440 455 460 470 485 496 500 512 522 532 542 552 565 578
     589 598 601 620
194 Number of comparison = 2061.  Number of Swaps = 637
195
196 The Original Array
197 100 numbers in almost sorted order.
198 3 7 9 13 17 15 19 25 21 23 27 28 29 31 34 37 39 38 42 45 47 49 50 51 53 54 56 58 59
     61 63 65 67 69 71 75 73 78 82 46 89 95 96 97 99 100 105 98 101 110 125 134 143 156
     165 175 185 196 205 210 220 230 245 255 265 278 285 296 301 312 325 334 342 352 368
     375 381 398 400 410 420 430 440 455 460 470 485 496 500 512 522 532 542 552 565 578
     589 598 601 620
199 The Sorted Array with bubble sort
200 3 7 9 13 15 17 19 21 23 25 27 28 29 31 34 37 38 39 42 45 46 47 49 50 51 53 54 56 58
     59 61 63 65 67 69 71 73 75 78 82 89 95 96 97 98 99 100 101 105 110 125 134 143 156
     165 175 185 196 205 210 220 230 245 255 265 278 285 296 301 312 325 334 342 352 368
     375 381 398 400 410 420 430 440 455 460 470 485 496 500 512 522 532 542 552 565 578
     589 598 601 620
201 Number of comparison = 4950.  Number of Swaps = 28
202 _____
203 The Heap Sort made the least comparisons = 2061
204 The Bubble Sort made the most comparisons = 4950
205 The Quick Sort made the middle comparisons = 4405
206 _____
207 The Bubble Sort made the least Swaps = 28
208 The Quick Sort made the most Swaps = 4303
209 The Heap Sort made the middle Swaps = 637
210 _____
211
212 The Original Array
213 100 numbers in Reverse order.
214 995 986 972 964 950 943 935 925 917 907 896 885 874 855 864 843 833 827 816 807 796
     785 774 765 754 743 737 725 719 706 699 686 673 664 656 644 635 628 618 606 586 596
     574 562 552 535 542 521 511 500 499 488 477 466 455 444 433 422 411 400 399 388 377
     366 355 344 333 322 311 300 299 288 277 266 255 244 233 222 211 200 199 188 177 165
     155 145 135 125 115 100 98 57 87 76 65 49 36 25 15 10
215 The Sorted Array with quick sort
216 10 15 25 36 49 57 65 76 87 98 100 115 125 135 145 155 165 177 188 199 200 211 222
     233 244 255 266 277 288 299 300 311 322 333 344 355 366 377 388 399 400 411 422 433
     444 455 466 477 488 499 500 511 521 535 542 552 562 574 586 596 606 618 628 635 644
     656 664 673 686 699 706 719 725 737 743 754 765 774 785 796 807 816 827 833 843 855
     864 874 885 896 907 917 925 935 943 950 964 972 986 995
217 Number of comparison = 4678.  Number of Swaps = 2406
218
219 The Original Array
220 100 numbers in Reverse order.
221 995 986 972 964 950 943 935 925 917 907 896 885 874 855 864 843 833 827 816 807 796
     785 774 765 754 743 737 725 719 706 699 686 673 664 656 644 635 628 618 606 586 596
     574 562 552 535 542 521 511 500 499 488 477 466 455 444 433 422 411 400 399 388 377
     366 355 344 333 322 311 300 299 288 277 266 255 244 233 222 211 200 199 188 177 165
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     155 145 135 125 115 100 98 57 87 76 65 49 36 25 15 10
222 The Sorted Array with heap sort
223 10 15 25 36 49 57 65 76 87 98 100 115 125 135 145 155 165 177 188 199 200 211 222
     233 244 255 266 277 288 299 300 311 322 333 344 355 366 377 388 399 400 411 422 433
     444 455 466 477 488 499 500 511 521 535 542 552 562 574 586 596 606 618 628 635 644
     656 664 673 686 699 706 719 725 737 743 754 765 774 785 796 807 816 827 833 843 855
     864 874 885 896 907 917 925 935 943 950 964 972 986 995
224 Number of comparison = 1701.  Number of Swaps = 517
225
226 The Original Array
227 100 numbers in Reverse order.
228 995 986 972 964 950 943 935 925 917 907 896 885 874 855 864 843 833 827 816 807 796
     785 774 765 754 743 737 725 719 706 699 686 673 664 656 644 635 628 618 606 586 596
     574 562 552 535 542 521 511 500 499 488 477 466 455 444 433 422 411 400 399 388 377
     366 355 344 333 322 311 300 299 288 277 266 255 244 233 222 211 200 199 188 177 165
     155 145 135 125 115 100 98 57 87 76 65 49 36 25 15 10
229 The Sorted Array with bubble sort
230 10 15 25 36 49 57 65 76 87 98 100 115 125 135 145 155 165 177 188 199 200 211 222
     233 244 255 266 277 288 299 300 311 322 333 344 355 366 377 388 399 400 411 422 433
     444 455 466 477 488 499 500 511 521 535 542 552 562 574 586 596 606 618 628 635 644
     656 664 673 686 699 706 719 725 737 743 754 765 774 785 796 807 816 827 833 843 855
     864 874 885 896 907 917 925 935 943 950 964 972 986 995
231 Number of comparison = 4950.  Number of Swaps = 4944
232 _____
233 The Heap Sort made the least comparisons = 1701
234 The Bubble Sort made the most comparisons = 4950
235 The Quick Sort made the middle comparisons = 4678
236 _____
237 The Heap Sort made the least Swaps = 517
238 The Bubble Sort made the most Swaps = 4944
239 The Quick Sort made the middle Swaps = 2406
240 _____
241
242 The Original Array
243 100 numbers in random order.
244 80 55 56 57 75 95 85 25 35 45 65 75 121 145 165 100 52 57 59 66 44 22 24 26 29 98
     97 94 93 90 14 16 17 19 171 211 240 7 16 77 70 73 78 345 451 297 234 187 186 165
     355 334 312 322 301 345 367 395 385 375 452 461 443 415 425 435 495 578 485 400 722
     712 705 735 765 754 749 795 666 664 333 344 322 311 300 355 377 366 388 399 977 999
     988 955 966 914 945 922 900 15
245 The Sorted Array with quick sort
246 7 14 15 16 16 17 19 22 24 25 26 29 35 44 45 52 55 56 57 57 59 65 66 70 73 75 75 77
     78 80 85 90 93 94 95 97 98 100 121 145 165 165 171 186 187 211 234 240 297 300 301
     311 312 322 322 333 334 344 345 345 355 355 366 367 375 377 385 388 395 399 400 415
     425 435 443 451 452 461 485 495 578 664 666 705 712 722 735 749 754 765 795 900 914
     922 945 955 966 977 988 999
247 Number of comparison = 927.  Number of Swaps = 324
248
249 The Original Array
250 100 numbers in random order.
251 80 55 56 57 75 95 85 25 35 45 65 75 121 145 165 100 52 57 59 66 44 22 24 26 29 98
     97 94 93 90 14 16 17 19 171 211 240 7 16 77 70 73 78 345 451 297 234 187 186 165
     355 334 312 322 301 345 367 395 385 375 452 461 443 415 425 435 495 578 485 400 722
     712 705 735 765 749 795 666 664 333 344 322 311 300 355 377 366 388 399 977 999
     988 955 966 914 945 922 900 15
252 The Sorted Array with heap sort
253 7 14 15 16 16 17 19 22 24 25 26 29 35 44 45 52 55 56 57 57 59 65 66 70 73 75 75 77
     78 80 85 90 93 94 95 97 98 100 121 145 165 165 171 186 187 211 234 240 297 300 301
     311 312 322 322 333 334 344 345 345 355 355 366 367 375 377 385 388 395 399 400 415
     425 435 443 451 452 461 485 495 578 664 666 705 712 722 735 749 754 765 795 900 914
     922 945 955 966 977 988 999
254 Number of comparison = 1995.  Number of Swaps = 615
255
256 The Original Array
257 100 numbers in random order.
258 80 55 56 57 75 95 85 25 35 45 65 75 121 145 165 100 52 57 59 66 44 22 24 26 29 98
     97 94 93 90 14 16 17 19 171 211 240 7 16 77 70 73 78 345 451 297 234 187 186 165
     355 334 312 322 301 345 367 395 385 375 452 461 443 415 425 435 495 578 485 400 722
     712 705 735 765 754 749 795 666 664 333 344 322 311 300 355 377 366 388 399 977 999
     988 955 966 914 945 922 900 15
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259 The Sorted Array with bubble sort
260 7 14 15 16 16 17 19 22 24 25 26 29 35 44 45 52 55 56 57 57 59 65 66 70 73 75 75 77
    78 80 85 90 93 94 95 97 98 100 121 145 165 165 171 186 187 211 234 240 297 300 301
    311 312 322 322 333 334 344 345 345 355 355 366 367 375 377 385 388 395 399 400 415
    425 435 443 451 452 461 485 495 578 664 666 705 712 722 735 749 754 765 795 900 914
    922 945 955 966 977 988 999
261 Number of comparison = 4950. Number of Swaps = 977
262 _____
263 The Quick Sort made the least comparisons = 927
264 The Bubble Sort made the most comparisons = 4950
265 The Heap Sort made the middle comparisons = 1995
266 _____
267 The Quick Sort made the least Swaps = 324
268 The Bubble Sort made the most Swaps = 977
269 The Heap Sort made the middle Swaps = 615
270 _____
271
272 >