|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **n** | **Insertion Sort**  **(CPU Running Time | Number of steps)** | | **Merge Sort**  **(CPU Running Time | Number of Steps)** | |
| 100 | 2 microseconds | 596 steps | 64 microseconds | 7676 steps |
| 200 | 2 microseconds | 1196 steps | 63 microseconds | 17164 steps |
| 300 | 3 microseconds | 1796 steps | 94 microseconds | 27308 steps |
| 400 | 3 microseconds | 2396 steps | 79 microseconds | 37940 steps |
| 500 | 4 microseconds | 2996 steps | 301 microseconds | 48436 steps |
| 1000 | 6 microseconds | 5996 steps | 250 microseconds | 105884 steps |
| 4000 | 81 microseconds | 23996 steps | 889 microseconds | 495572 steps |
| 10000 | 58 microseconds | 59996 steps | 2195 microseconds | 1366932 steps |

Sorted Input

Reversely Sorted Input

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **n** | **Insertion Sort**  **(CPU Running Time | Number of steps)** | | **Merge Sort**  **(CPU Running Time | Number of Steps)** | |
| 100 | 24 microseconds | 20396 steps | 34 microseconds | 7596 steps |
| 200 | 97 microseconds | 80796 steps | 241 microseconds | 17004 steps |
| 300 | 203 microseconds | 181196 steps | 72 microseconds | 27052 steps |
| 400 | 268 microseconds | 321596 steps | 79 microseconds | 37620 steps |
| 500 | 414 microseconds | 501996 steps | 128 microseconds | 48324 steps |
| 1000 | 1626 microseconds | 2003996 steps | 240 microseconds | 105660 steps |
| 4000 | 26100 microseconds | 32015996 steps | 997 microseconds | 494676 steps |
| 10000 | 151165 microseconds | 200039996 steps | 2188 microseconds | 1358132 steps |

Random Permutation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **n** | **Insertion Sort**  **(CPU Running Time | Number of steps)** | | **Merge Sort**  **(CPU Running Time | Number of Steps)** | |
| 100 | 21 microseconds | 12996 steps | 27 microseconds | 8042 steps |
| 200 | 61 microseconds | 51748 steps | 73 microseconds | 18024 steps |
| 300 | 108 microseconds | 109304 steps | 78 microseconds | 28812 steps |
| 400 | 192 microseconds | 188952 steps | 100 microseconds | 40182 steps |
| 500 | 242 microseconds | 292044 steps | 126 microseconds | 51592 steps |
| 1000 | 946 microseconds | 1118244 steps | 287 microseconds | 112958 steps |
| 4000 | 11078 microseconds | 13013756 steps | 986 microseconds | 529700 steps |
| 10000 | 64236 microseconds | 84415316 steps | 2329 microseconds | 1444832 steps |

50 instances of n random numbers generated in the range of [1..n]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **n** | **Insertion Sort**  **(CPU Running Time | Number of steps)**  **(Average)** | | **Merge Sort**  **(CPU Running Time | Number of Steps)**  **(Average)** | |
| 100 | 12.5 microseconds | 10328 steps | 25.12 microseconds | 8050 steps |
| 200 | 44.58 microseconds | 37092 steps | 61.3 microseconds | 18078 steps |
| 300 | 79.72 microseconds | 94496 steps | 64.1 microseconds | 28868 steps |
| 400 | 139.26 microseconds | 156344 steps | 97.6 microseconds | 40250 steps |
| 500 | 222.16 microseconds | 243448 steps | 122.06 microseconds | 51594 steps |
| 1000 | 826.42 microseconds | 968080 steps | 260.18 microseconds | 113252 steps |
| 4000 | 12837.5 microseconds | 1.60323e+07 steps | 1119.68 microseconds | 532932 steps |
| 10000 | 77212.5 microseconds | 1.40149e+07 steps | 2828.26 microseconds | 1.46991e+06 steps |

**Approximation of constant C**

**Insertion sort**: C = num steps / n2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **n** | **Reversely Sorted** | | **Random Permutation** | | **50 instances of n random numbers** | |
| **Steps** | **C** | **Steps** | **C** | **Steps** | **C** |
| 100 | 20396 | 2.0396 | 12996 | 1.2996 | 10328 | 1.0328 |
| 200 | 80796 | 2.0199 | 51748 | 1.2937 | 37092 | 0.9273 |
| 300 | 181196 | 2.013288889 | 109304 | 1.214488889 | 94496 | 1.049955556 |
| 400 | 321596 | 2.009975 | 188952 | 1.18095 | 156344 | 0.97715 |
| 500 | 501996 | 2.007984 | 292044 | 1.168176 | 243448 | 0.973792 |
| 1000 | 2003996 | 2.003996 | 1118244 | 1.118244 | 968080 | 0.96808 |
| 4000 | 32015996 | 2.00099975 | 13013756 | 0.81335975 | 1.60323e+07 | 1.00201875 |
| 10000 | 200039996 | 2.00039996 | 84415316 | 0.84415316 | 1.40149e+07 | 0.38096448 |

\*Sorted input is excluded because it’s O(n) in insertion sort

Average C for insertion sort = (sum of c) / (8\*3) = 32.341 / 24 **Average C = 1.348**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **Sorted** | | **Reversely Sorted** | | **Random Permutation** | | **50 instances of n random numbers** | |
| **Steps** | **C** | **Steps** | **C** | **Steps** | **C** | **Steps** | **C** |
| 100 | 7676 | 38.38 | 7596 | 37.98 | 8042 | 40.21 | 8050 | 40.25 |
| 200 | 17164 | 37.29634127 | 17004 | 36.94867088 | 18024 | 39.16506963 | 18078 | 39.28240839 |
| 300 | 27308 | 36.74695637 | 27052 | 36.40247047 | 28812 | 38.770811 | 28868 | 38.84616729 |
| 400 | 37940 | 36.45188824 | 37620 | 36.14443953 | 40182 | 38.6059508 | 40250 | 38.67128365 |
| 500 | 48436 | 35.89221067 | 48324 | 35.80921605 | 51592 | 38.23088061 | 51594 | 38.23236265 |
| 1000 | 105884 | 35.29466667 | 105660 | 35.22 | 112958 | 37.65266667 | 113252 | 37.75066667 |
| 4000 | 495572 | 34.3950407 | 494676 | 34.33285406 | 529700 | 36.76368531 | 532932 | 36.9880014 |
| 10000 | 1366932 | 34.1733 | 1358132 | 33.9533 | 1444832 | 36.1208 | 1.46991e+06 | 36.74775 |

**Merge sort**: C = num steps / nlog(n)

Average C for merge sort = (sum of c) / (8\*4) = 1187.70985898 / 32

**Average C = 37.116**