

Assignment-1 : Output files

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Description : This document contains the output of programs titled “quicksort_1903209.cpp” & “mergesort_1903209.cpp” submitted by author in order to fulfill requirement of Assignment-1 of CS222 course.

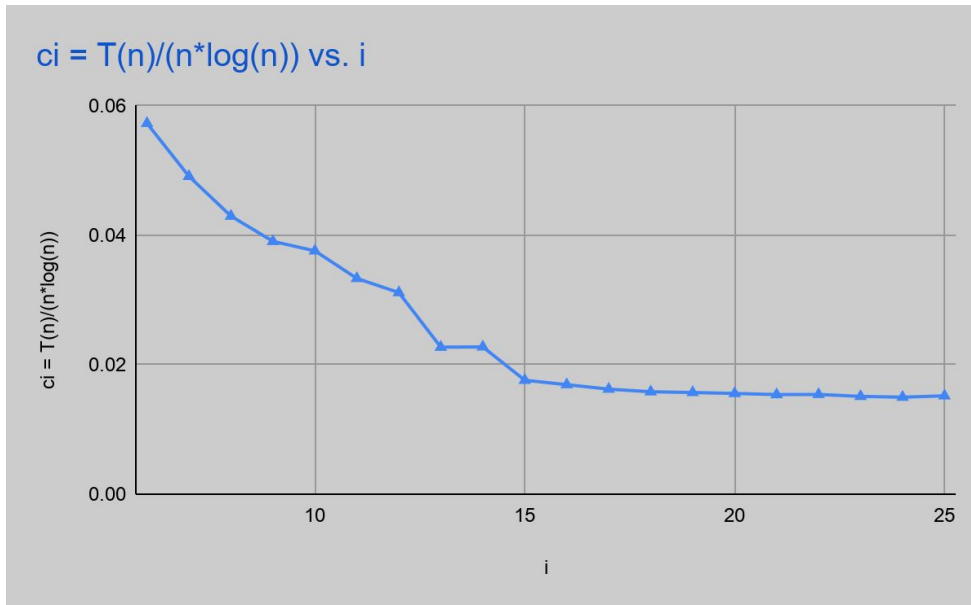
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❑ Formulas and values used in program :

- $K = 25$
- $i = \{6, 7, \dots, K\}$
- $n = 2^i$
- $T(n)$ = Time taken by program to sort the array (in microseconds)
- $C_i = T(n)/(n \cdot \log(n))$

Output of “quicksort_1903209.cpp”

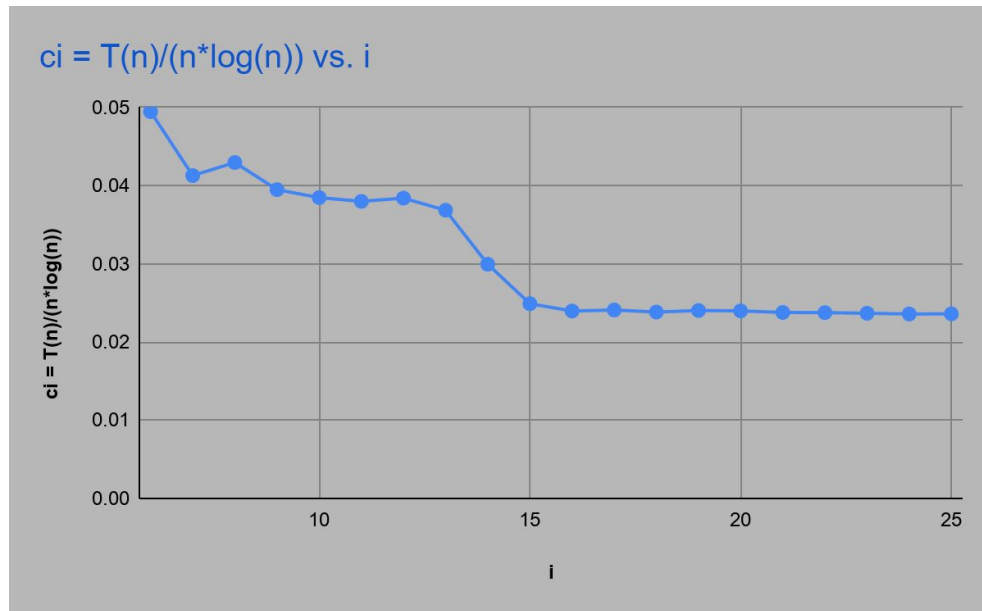


Graph 1.1

TABLE 1 : OUTPUT OF QUICKSORT ALGORITHM

| i | $n = 2^i$ | T(n) (in μs) | $n*\log(n) = i*(2^i)$ | $ci = T(n)/(n*\log(n))$ |
|----|-----------|--------------------|-----------------------|-------------------------|
| 6 | 64 | 22 | 384 | 0.0572917 |
| 7 | 128 | 44 | 896 | 0.0491071 |
| 8 | 256 | 88 | 2048 | 0.0429688 |
| 9 | 512 | 180 | 4608 | 0.0390625 |
| 10 | 1024 | 385 | 10240 | 0.0375977 |
| 11 | 2048 | 751 | 22528 | 0.0333363 |
| 12 | 4096 | 1531 | 49152 | 0.0311483 |
| 13 | 8192 | 2419 | 106496 | 0.0227145 |
| 14 | 16384 | 5220 | 229376 | 0.0227574 |
| 15 | 32768 | 8655 | 491520 | 0.0176086 |
| 16 | 65536 | 17742 | 1048576 | 0.0169201 |
| 17 | 131072 | 36169 | 2228224 | 0.0162322 |
| 18 | 262144 | 74665 | 4718592 | 0.0158236 |
| 19 | 524288 | 156482 | 9961472 | 0.0157087 |
| 20 | 1048576 | 326427 | 20971520 | 0.0155653 |
| 21 | 2097152 | 677821 | 44040192 | 0.015391 |
| 22 | 4194304 | 1422010 | 92274688 | 0.0154106 |
| 23 | 8388608 | 2915830 | 192937984 | 0.0151128 |
| 24 | 16777216 | 6034790 | 402653184 | 0.0149876 |
| 25 | 33554432 | 12748500 | 838860800 | 0.0151974 |

❑ Output of “mergesort_1903209.cpp”



Graph 1.2

TABLE 2 : OUTPUT OF MERGESORT ALGORITHM

| i | n = 2 ⁱ | T(n)(in μs) | n*log(n) = i*(2 ⁱ) | ci = T(n)/(n*log(n)) |
|----|--------------------|-------------|--------------------------------|----------------------|
| 6 | 64 | 19 | 384 | 0.0494792 |
| 7 | 128 | 37 | 896 | 0.0412946 |
| 8 | 256 | 88 | 2048 | 0.0429688 |
| 9 | 512 | 182 | 4608 | 0.0394965 |
| 10 | 1024 | 394 | 10240 | 0.0384766 |
| 11 | 2048 | 856 | 22528 | 0.0379972 |
| 12 | 4096 | 1888 | 49152 | 0.0384115 |
| 13 | 8192 | 3925 | 106496 | 0.0368558 |
| 14 | 16384 | 6871 | 229376 | 0.0299552 |
| 15 | 32768 | 12242 | 491520 | 0.0249064 |
| 16 | 65536 | 25135 | 1048576 | 0.0239706 |
| 17 | 131072 | 53701 | 2228224 | 0.0241004 |
| 18 | 262144 | 112472 | 4718592 | 0.0238359 |
| 19 | 524288 | 239451 | 9961472 | 0.0240377 |
| 20 | 1048576 | 502985 | 20971520 | 0.0239842 |
| 21 | 2097152 | 1047660 | 44040192 | 0.0237887 |
| 22 | 4194304 | 2192850 | 92274688 | 0.0237644 |
| 23 | 8388608 | 4569230 | 192937984 | 0.0236824 |
| 24 | 16777216 | 9499290 | 402653184 | 0.0235917 |
| 25 | 33554432 | 19800700 | 838860800 | 0.0236042 |

❑ **What can be said about Ci's?**

According to Graph 1.1 , C_i saturates for large n ($>2^{15}$), i.e. on random pivoting for large n , $T(n)$ is proportional to $n \cdot \log(n)$ or We can say Time Complexity, $T(n)$ of quicksort algorithm is of order $n \cdot \log(n)$ approximately.

Similar result is also observed in Graph 1.2 i.e. merge sort is of order $n \cdot \log(n)$ approximately too.