# QUICKSORT USING OPENMP

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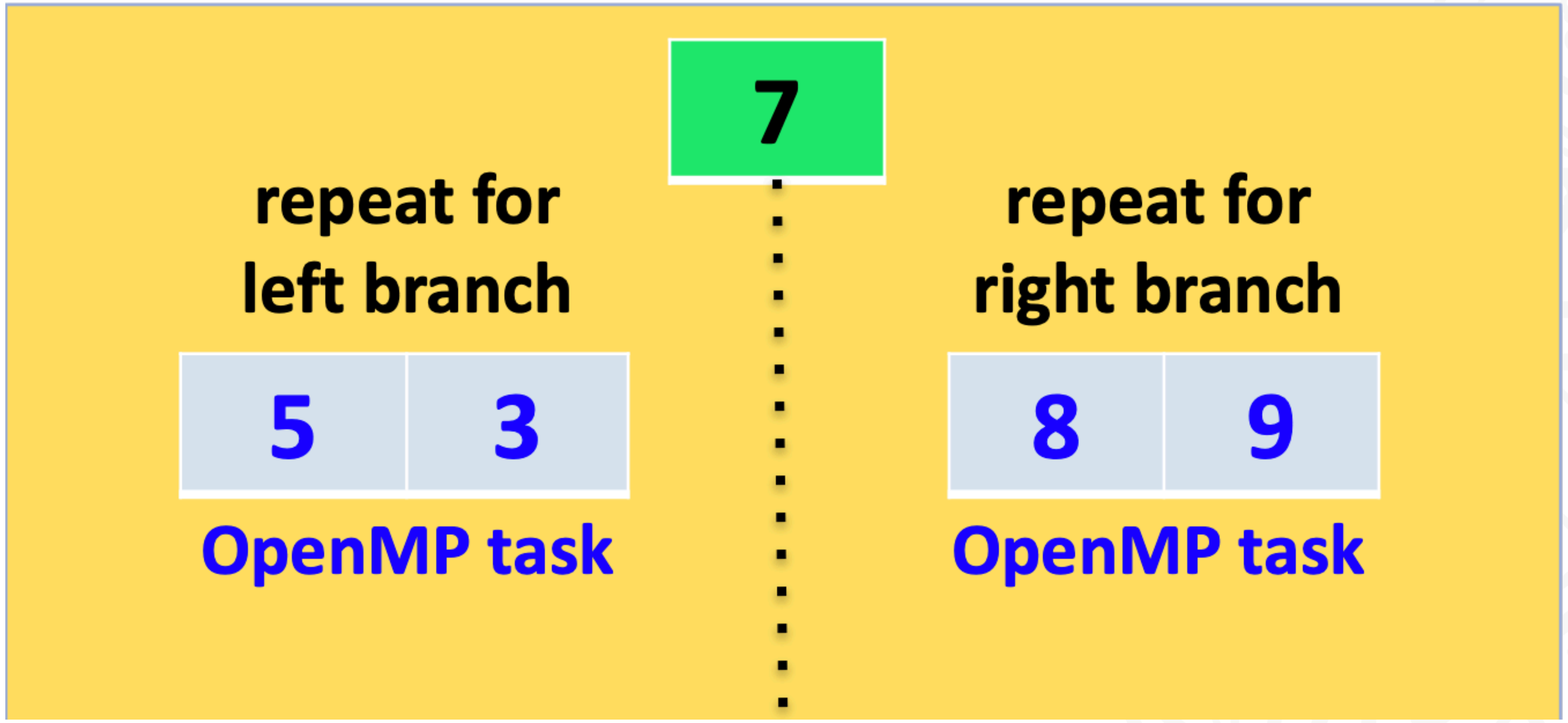
## Sequential Quicksort

- Select median as pivot from the sample data set picked from the actual data set.
- Divide the list into two sub lists: a “low list” containing numbers smaller than the pivot, and a “high list” containing numbers larger than the pivot
- The low list and high list recursively repeat the procedure to sort themselves.
- The final sorted result is the concatenation of the sorted low list, the pivot, and the sorted high list.

| | | | | |
|---|---|---|---|---|
| 8 | 5 | 7 | 3 | 9 |
| 8 | 5 | 7 | 3 | 9 |
| 8 | 5 | 7 | 3 | 9 |
| 8 | 5 | 9 | 3 | 7 |
| 8 | 5 | 9 | 3 | 7 |
| 5 | 8 | 9 | 3 | 7 |
| 5 | 3 | 9 | 8 | 7 |
| 5 | 3 | 9 | 8 | 7 |
| 5 | 3 | 7 | 8 | 9 |

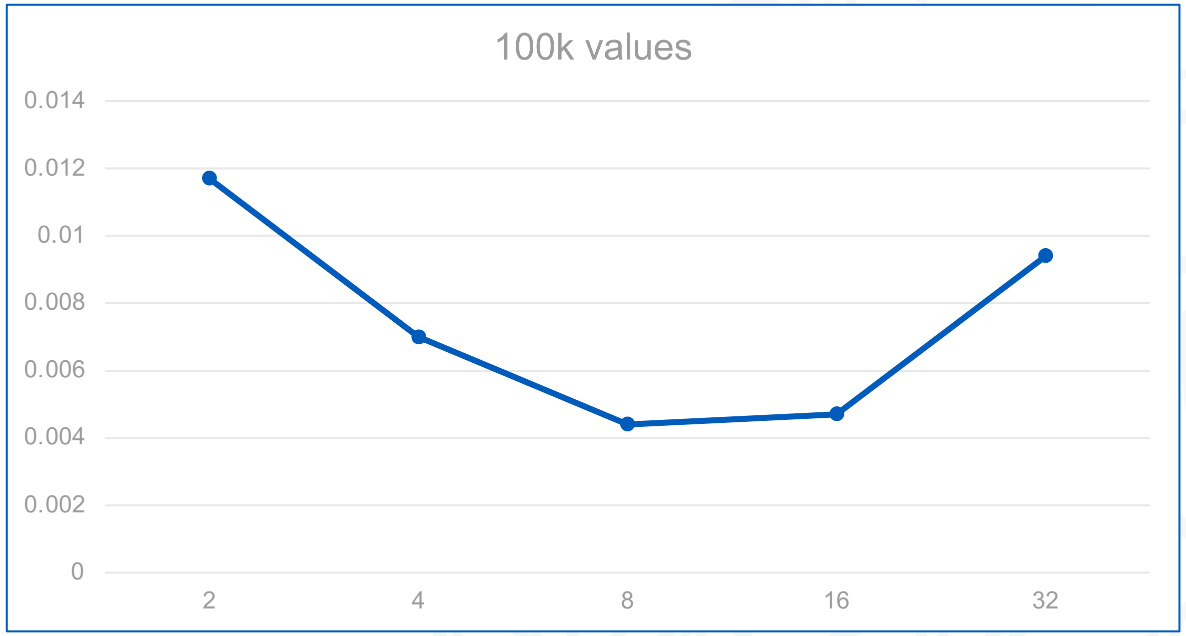
- Divide and Conquer – Parallelism can be introduced
- Each worker thread is spawned whenever a task construct is seen. (#pragma omp task)


7
repeat for left branch
5
3
OpenMP task
repeat for right branch
8
9
OpenMP task

## Results

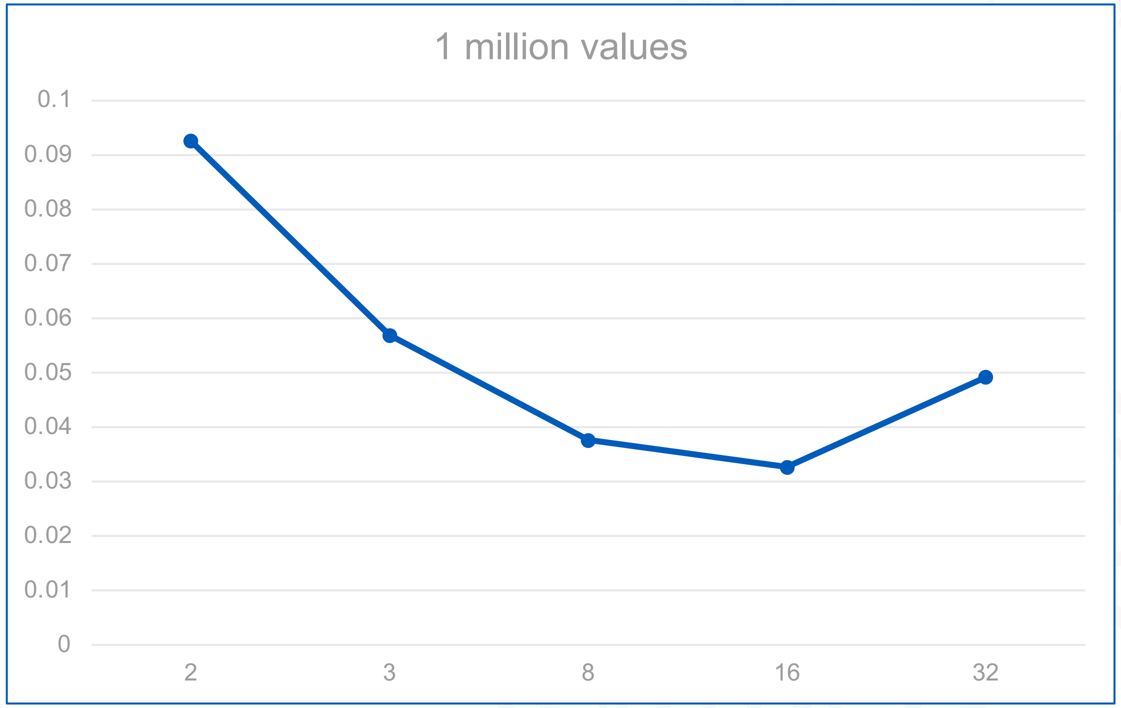
## 100k values

| Threads | Time |
|---|---|
| 2 | 0.0117 |
| 4 | 0.0070 |
| 8 | 0.0044 |
| 16 | 0.0047 |
| 32 | 0.0094 |



## 1 million values

| Threads | Time |
|---|---|
| 2 | 0.0926 |
| 4 | 0.0564 |
| 8 | 0.0376 |
| 16 | 0.0327 |
| 32 | 0.0492 |



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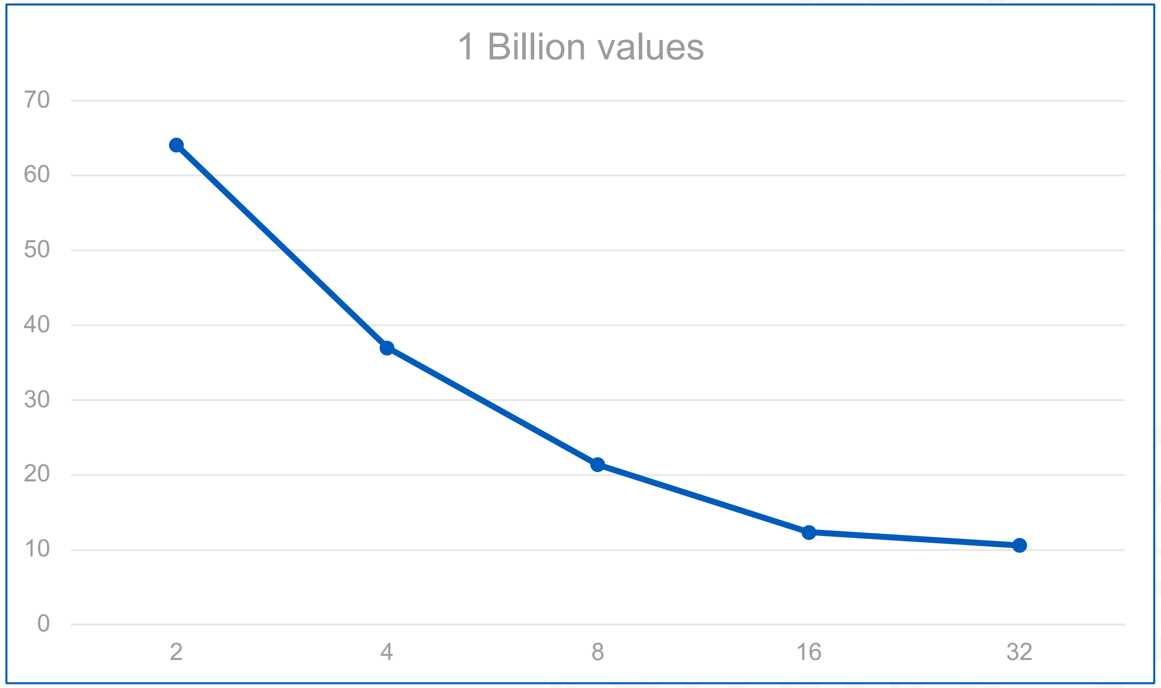
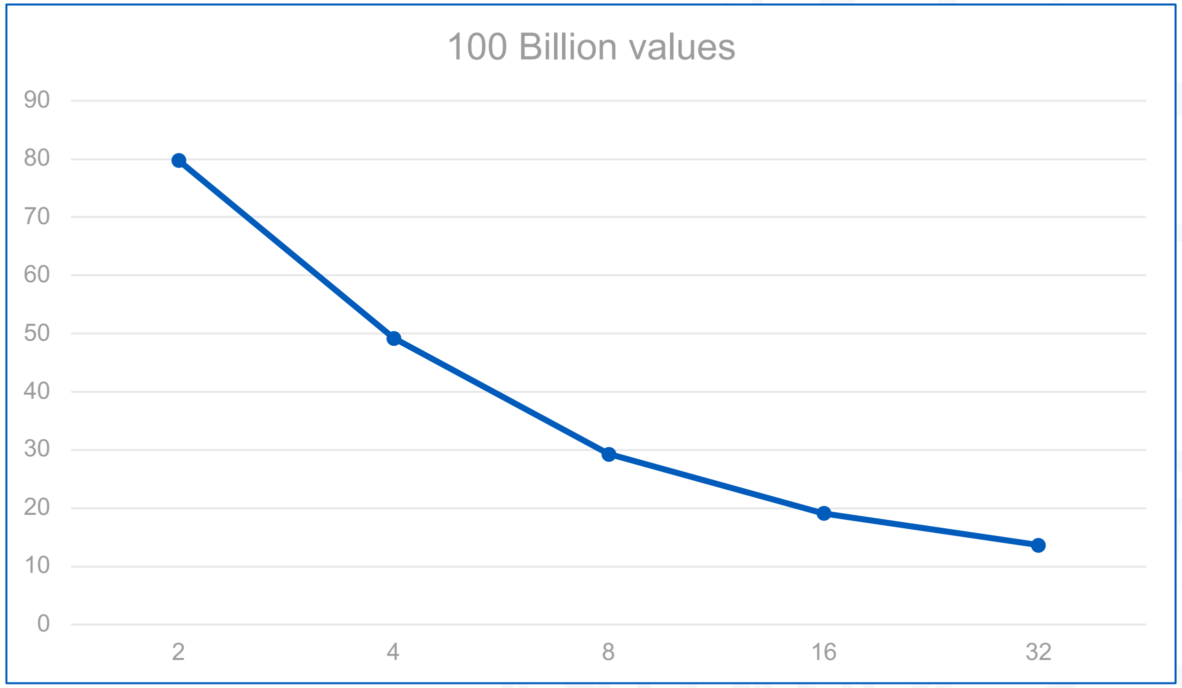
## 1 Billion values

| Threads | Time (in s) |
|---|---|
| 2 | 64.1 |
| 4 | 37.0 |
| 8 | 21.39 |
| 16 | 12.35 |
| 32 | 10.57 |



## 100 Billion values

| Threads | Time (in s) |
|---|---|
| 2 | 79.75 |
| 4 | 49.21 |
| 8 | 29.32 |
| 16 | 19.12 |
| 32 | 13.66 |



## Inferences

- Performance degrades when using large number of threads when the size of the data is relatively small.
- Makes sense to increase the number of threads as the size of the data increases.
- Possible reason for performance degradation – overhead due to thread creation, thread scheduling.

## References

- https://cse.buffalo.edu/faculty/miller/teaching.shtml
- https://www.openmp.org/
- https://www.openmp.org/wp-content/uploads/sc16-openmp-booth-tasking-ruud.pdf
- https://stackoverflow.com/questions/16007640/openmp-parallel-quicksort