**Program Structure and Algorithms**

**Assignment - 4 Parallel Sort**

**Name:** Prathamesh Mahesh Sahasrabuddhe

**NUID:** 002117703

**TASK:**

1. A cutoff (defaults to, say, 1000) which you will update according to the first argument in the command line when running. It's your job to experiment and come up with a good value for this cutoff. If there are fewer elements to sort than the cutoff, then you should use the system sort instead.
2. Recursion depth or the number of available threads. Using this determination, you might decide on an ideal number (*t*) of separate threads (stick to powers of 2) and arrange for that number of partitions to be parallelized (by preventing recursion after the depth of *lg t* is reached).
3. An appropriate combination of these.

**CONCLUSION:**

We can easily say that four threads would be a good choice and using any thread beyond them would be useless and wastage of resources.

For number of threads(T) and recursion depth(d), we can easily deduce that:

T = 2d

Or the maximum recursion depth would be

lg(size of array/cutoff)

At any moment, the depth will not be more than maximum depth as array reaches the cutoff.

**EVIDENCE:**

Array Size = 20000

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Threads |  |  |  |
| **cutoff** | **2** | **4** | **8** | **16** | **32** | **64** |
| **10000** | 68 | 9 | 8 | 9 | 7 | 7 |
| **20000** | 19 | 8 | 7 | 8 | 7 | 7 |
| **30000** | 13 | 9 | 10 | 9 | 10 | 9 |
| **40000** | 14 | 10 | 9 | 9 | 9 | 9 |
| **50000** | 11 | 9 | 10 | 9 | 10 | 9 |
| **60000** | 10 | 10 | 9 | 9 | 9 | 10 |
| **70000** | 13 | 9 | 9 | 9 | 9 | 9 |
| **80000** | 14 | 10 | 10 | 9 | 10 | 8 |
| **90000** | 13 | 9 | 9 | 9 | 9 | 9 |
| **100000** | 9 | 9 | 9 | 8 | 9 | 10 |
| **110000** | 10 | 10 | 9 | 9 | 9 | 9 |
| **120000** | 9 | 9 | 9 | 10 | 9 | 9 |
| **130000** | 9 | 9 | 9 | 9 | 9 | 8 |
| **140000** | 9 | 9 | 9 | 8 | 9 | 9 |
| **150000** | 10 | 10 | 9 | 10 | 9 | 9 |

A screenshot of a computer

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

Array Size = 40000

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Threads |  |  |  |
| **cutoff** | **2** | **4** | **8** | **16** | **32** | **64** |
| **10000** | 108 | 14 | 15 | 12 | 13 | 13 |
| **20000** | 15 | 12 | 11 | 11 | 13 | 11 |
| **30000** | 16 | 16 | 14 | 15 | 15 | 15 |
| **40000** | 15 | 15 | 14 | 14 | 15 | 15 |
| **50000** | 20 | 20 | 20 | 20 | 20 | 20 |
| **60000** | 21 | 21 | 19 | 19 | 19 | 20 |
| **70000** | 20 | 20 | 19 | 19 | 18 | 19 |
| **80000** | 19 | 19 | 19 | 19 | 19 | 19 |
| **90000** | 21 | 19 | 20 | 18 | 20 | 19 |
| **100000** | 23 | 19 | 18 | 18 | 19 | 19 |
| **110000** | 24 | 19 | 19 | 19 | 19 | 19 |
| **120000** | 23 | 19 | 19 | 19 | 19 | 19 |
| **130000** | 29 | 18 | 19 | 20 | 19 | 20 |
| **140000** | 26 | 19 | 20 | 19 | 18 | 18 |
| **150000** | 23 | 20 | 19 | 18 | 19 | 20 |

A screenshot of a computer

Description automatically generated with medium confidence

A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated with medium confidence

A screenshot of a computer

Description automatically generated with medium confidence

A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

Array Size = 80000

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Threads |  |  |  |
| **cutoff** | **2** | **4** | **8** | **16** | **32** | **64** |
| **10000** | 158 | 26 | 24 | 21 | 22 | 23 |
| **20000** | 24 | 25 | 20 | 22 | 21 | 21 |
| **30000** | 27 | 28 | 23 | 25 | 22 | 23 |
| **40000** | 42 | 26 | 22 | 22 | 24 | 23 |
| **50000** | 59 | 32 | 28 | 29 | 29 | 28 |
| **60000** | 28 | 32 | 29 | 29 | 29 | 31 |
| **70000** | 29 | 32 | 29 | 28 | 30 | 29 |
| **80000** | 31 | 32 | 29 | 29 | 31 | 28 |
| **90000** | 48 | 43 | 40 | 40 | 40 | 40 |
| **100000** | 43 | 41 | 41 | 41 | 41 | 41 |
| **110000** | 43 | 42 | 42 | 42 | 40 | 39 |
| **120000** | 43 | 39 | 40 | 40 | 41 | 41 |
| **130000** | 41 | 40 | 44 | 40 | 40 | 40 |
| **140000** | 40 | 40 | 41 | 40 | 41 | 41 |
| **150000** | 43 | 41 | 40 | 42 | 41 | 40 |

Graphical user interface, text

Description automatically generated

A screenshot of a computer

Description automatically generated with medium confidence

A screenshot of a computer

Description automatically generated with medium confidence

A screenshot of a computer

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence

A computer screen capture

Description automatically generated with medium confidence