

## Abstract

We investigate distributed memory parallel sorting algorithms that scale to the largest available machines and are robust with respect to input size, duplicate keys, and distribution of the input elements. The main outcome is that four sorting algorithms cover the entire range of possible input sizes. For three algorithms we devise new low overhead mechanisms to make them robust with respect to duplicate keys and skewed input distributions. One of these, designed for medium sized inputs, is a new variant of quicksort with fast high-quality pivot selection. At the same time asymptotic analysis provides performance guarantees and guides the selection and configuration of the algorithms. We validate these hypotheses using extensive experiments on 7 algorithms, 10 input distributions, up to 262 144 cores, and varying input sizes over 9 orders of magnitude. For “difficult” input distributions, our algorithms are the only ones that work at all. For all but the largest input sizes, we are the first to perform experiments on such large machines at all and our algorithms significantly outperform the ones one would conventionally have considered.