Optimizing std::sort in libc++

Aditya Kumar
Divya Shanmughan
Issues with std::sort (libc++)

- Worst case
  - clang-libc++ $O(N^2)$ vs. gcc-libstdc++ $O(N\log N)$

* https://bugs.llvm.org/show_bug.cgi?id=20837
Sorting Algorithm in libc++

- Sorting algorithm currently implemented in libc++ uses quicksort
- Worst Case Complexity – $O(N^2)$
- Recursion Stack Space – $O(\log N)$
Modifications done

• Convert to introsort*
  – Sorting technique, which begins with quicksort and switches to heapsort after recursion reaches a threshold
  – Worst case complexity of $O(N\log N)$

• Eliminate recursion
  – Replaced memory Intensive recursive calls with stack
  – std::stack uses std::deque, which uses std::algorithm :

• Improved worst case time complexity by a factor of 10
  – https://reviews.llvm.org/D36423

https://en.wikipedia.org/wiki/Introsort
Sorting Results Plot (With std-benchmark)

* https://github.com/hiraditya/std-benchmark
Thank You