

Parallel Sort for Discrete Spatial Data

Project Characteristics

Modeling: ★★☆☆☆
Mathematics: ★★☆☆☆
Programming: ★★★★★

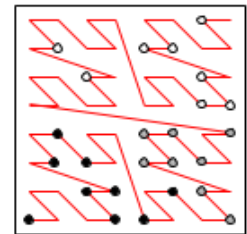
Setting:

- Space Filling Curves (SFC) are a powerful concept to organize discrete spatial data
 - e.g. Hilbert curve, Z-curve (Morton curve), etc.
- Some interesting applications:
 - Space partitioning in massive parallel settings
 - Cartesian mesh generation
 - Interpolation between grids, etc.
- Often, though, data is not yet in „SFC order“

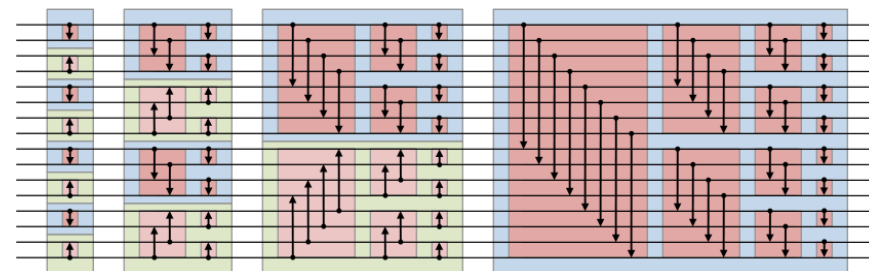
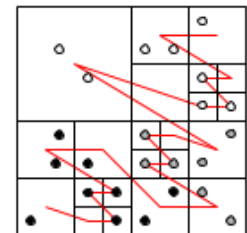
Your Tasks:

- **Implement** a distributed memory parallel sorting algorithm (e.g. bitonic sort) in C++ using MPI
- **Test** your implementation regarding CPU time and parallel scalability, potentially explore alternatives
- **Sample application:** Massive parallel interpolation
 - Simple Interpolator of scalar field from one distributed point cloud A onto another point cloud B

Point cloud in Morton order, SFC defines parallel partitioning (3 partitions)



Grouping points into adaptively sized cells (e.g. max. 2 points/cell) gives octree-like structure



Bitonic sorting network (from <https://en.wikipedia.org>)