Parallel Connected Components

Intermediate report

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MPI implementations removed from scope

- Graphs always fit in the Memory
- Plenty of algorithms and options to explore using OpenMP
- However, Boost's parallel connected components implementation actually uses MPI

Algorithm implementation status

Algorithm	Status	Observation	Runtime*
Serial BFS	OK		~5.4s
Parallel BFS with Atomics	In progress	Half of the time spent merging. Verifying if can optimize.	~5.2s
Parallel BFS lock-free	In progress	Half of the time spent merging. Verifying if can optimize.	~5.2s
Serial Union Find	OK		~1.8s
Parallel Minimum Spanning Tree	OK		~1.7s
Serial Randomized Contraction	OK		~23.2s
Parallel Randomized Contraction	In progress	One important section is still serial. Need to invest more time improve parallelism.	~15.7s
Serial Boost Implementation	OK		~16.5s
Parallel Boost Implementation	In progress	Usage of the parallel boost implementation is more difficult than expected. Was not yet able to run benchmar.	n/a

* Graph with 10 components, 2.75m vertices and ~20m Edges, Intel Quad-Core i7-2675QM CPU @ 2.20GHz

Comparison between algorithms

- We noticed that it took a long time to prepare input before actually running algorithm
- We decided that we will compare algorithms' runtime when using its most convenient input format
- For example:
  - BFS algorithms: Adjacency list
  - Contract and union find algorithms: List of edges
  - Boost algorithms: Boost adjacency list

Graphs used for benchmarking

- Connected components is commonly used as a sanity check, making sure there is only 1 components
  - Graphs from Matrix Market and Florida Sparse Matrix Collection can be used
- 3D models in computer graphics naturally have many components.
  - Graphs from free 3D models available in sites like turbosquid.com

Next steps

- Finish algorithm implementation and validation
- Run implementations on Xeon Phi
- Benchmark algorithms with real world graphs
- Plot results and write report