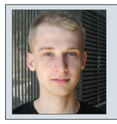
MADALGO
CENTER FOR MASSIVE DATA ALGORITHMICS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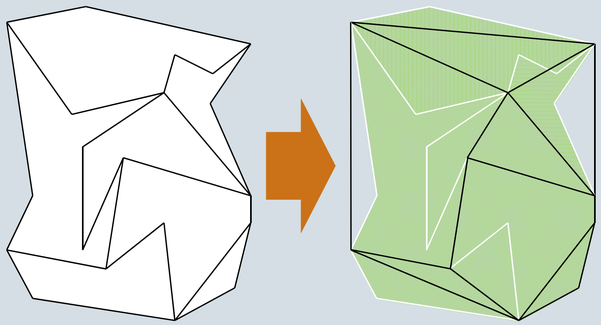
Simplification of Planar Decomposition

Problem

- Given a planar decomposition, simplify it preserving the following three properties.



Properties

- Planarity

- Homotopy Equivalence

- xy-constraints

Assumption

- Massive Dataset (*I/O model*).
- Any two adjacent faces fit in memory .i.e., all segments touching the faces are able to reside in main memory at the same time.

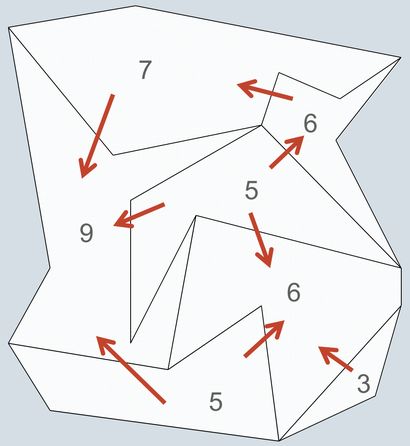
Motivation

- Simplification of vectorized terrain data such as contour map, watersheds and river networks is required since simplification reduces amount of storage needed, makes it easier to access for human viewer, and allows for faster computations involving the dataset.

Algorithm

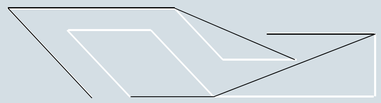
External memory algorithm

- Simplify line strings containing only nodes of degree two.
- The weight of a face is the number of segments on it.
- Line strings are simplified by the heaviest of the two faces containing it.
- Forward edges for faces to all heavier neighbours.
- Line strings are simplified by internal algorithm.



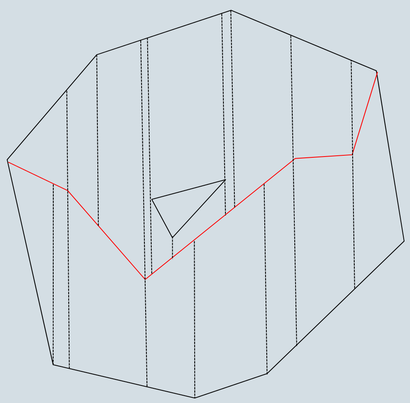
- The number of forwarded segments is at most 3n by duality of planar graph and arboricity [2, 3].
- This algorithm requires O(SORT(n)) I/Os.
- Highly efficient in practice.

- Two distinct simplifications do not intersect if each simplification does not intersect with any segments simplified to the other simplification.



Internal memory algorithm

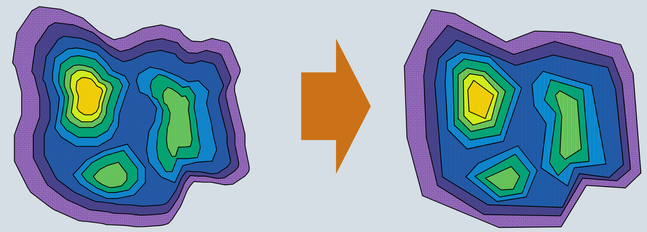
- Given all segments of two adjacent faces, simplify segments shared by the two faces.
- The simplification does not intersect with any segments of the two faces. (Preserving planarity)
- The simplification preserves homotopy of segments.
- The simplification does not violate xy-constraint.



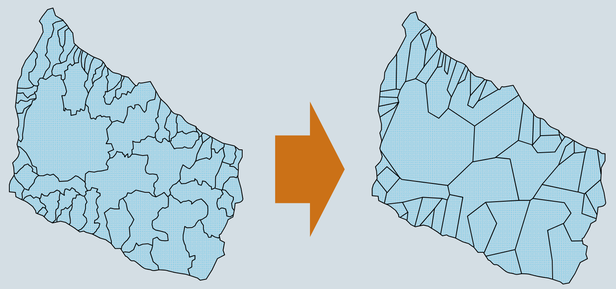
- Simplification is done using Douglas Peucker.
- Candidate segments are checked for intersection with boundary using a trapezoidal decomposition.
- Candidate segments are checked for self intersection using another trapezoidal decomposition.

Applications

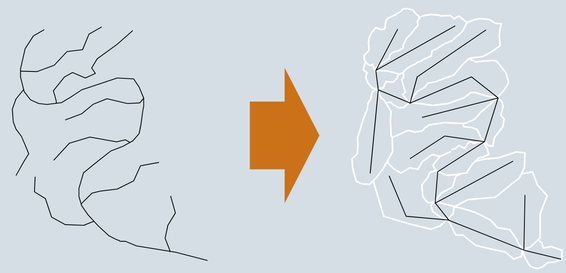
Contour simplification



Watershed simplification



River network simplification



References

[1] Arge, Deleuran, Mølhave, Revsbæk and Truelsen. *Simplifying massive contour maps*. ESA 2012.
[2] Nash-Williams. *Edge-disjoint spanning trees of finite graphs*. Journal of the London Mathematical Society, 1961.
[3] Nash-Williams. *Decomposition of finite graphs into forests*, Journal of the London Mathematical Society, 1964.