

A Distributed DCEL implementation

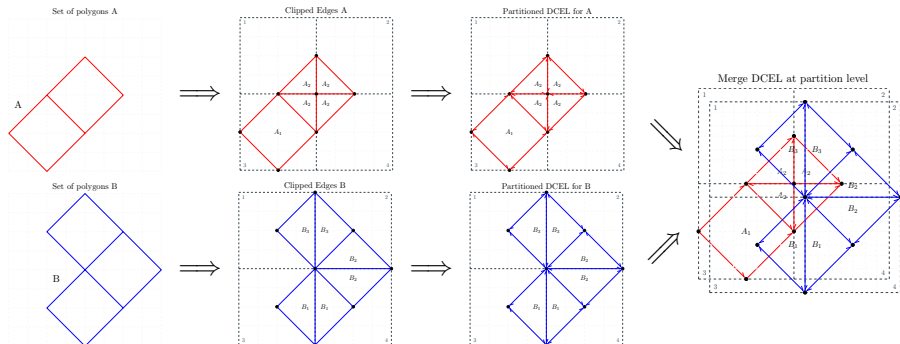
Andres Calderon

University of California, Riverside

April 17, 2020

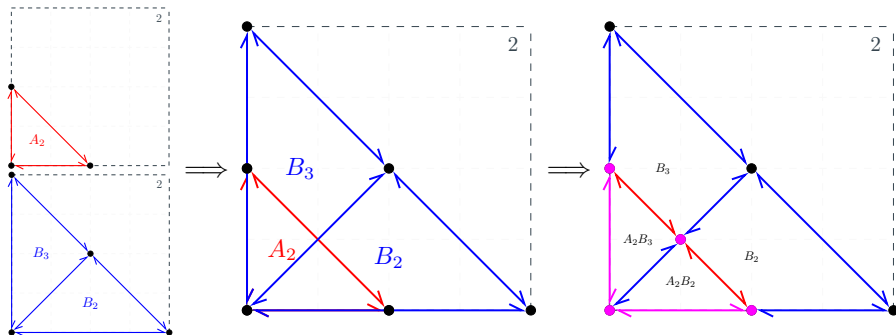
A Distributed DCEL...

Local DCELs



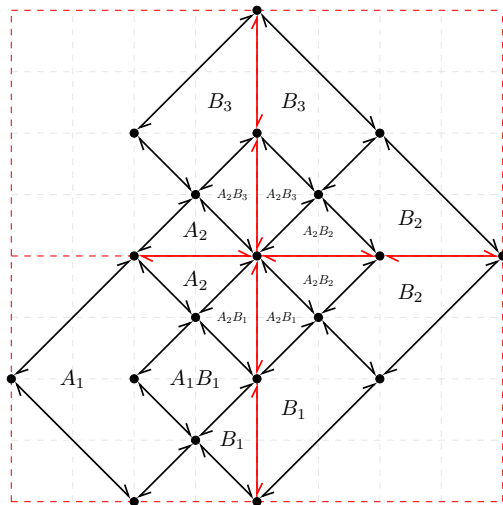
A Distributed DCEL...

Merged DCEL



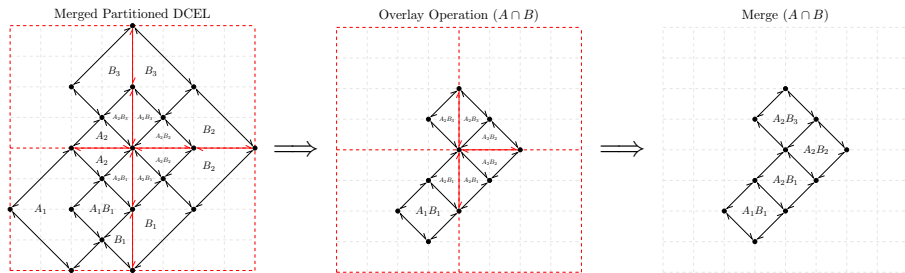
A Distributed DCEL...

Merged DCEL



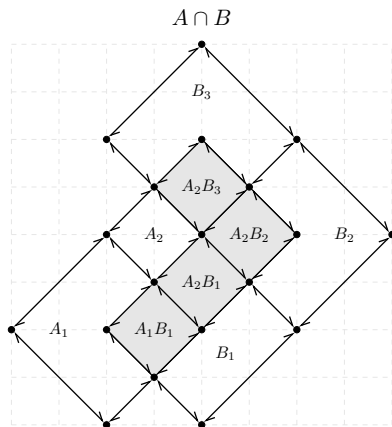
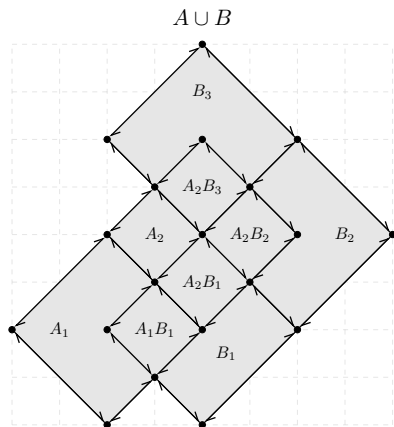
A Distributed DCEL...

Overlay Operations



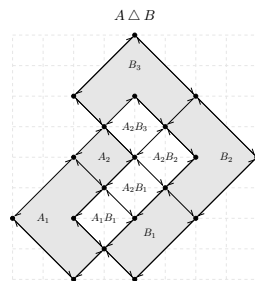
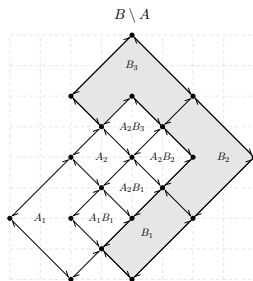
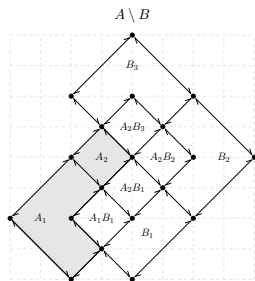
A Distributed DCEL...

Overlay Operations

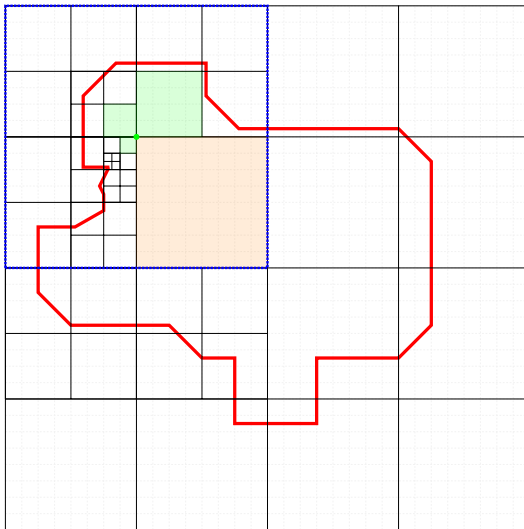


A Distributed DCEL...

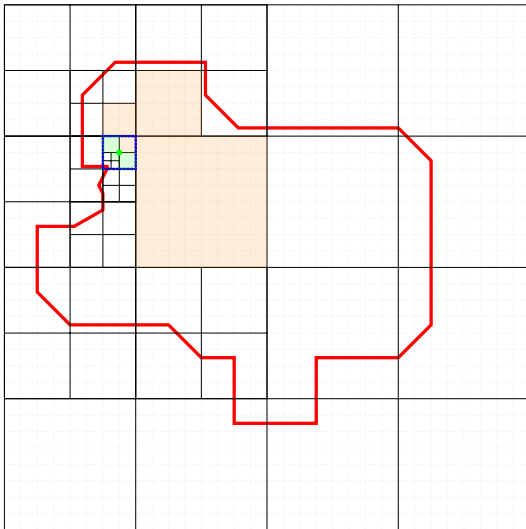
Overlay Operations



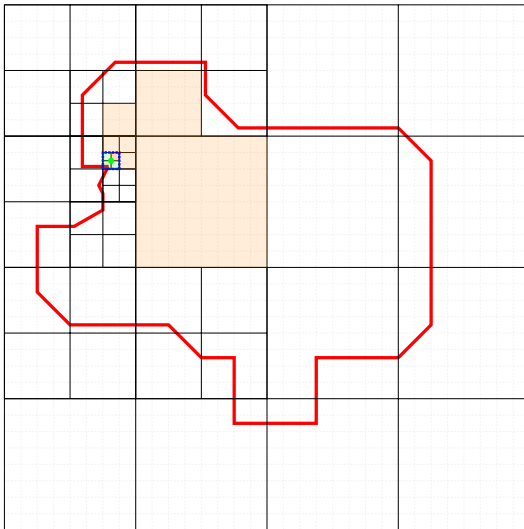
The Empty Cell problem...



The Empty Cell problem...



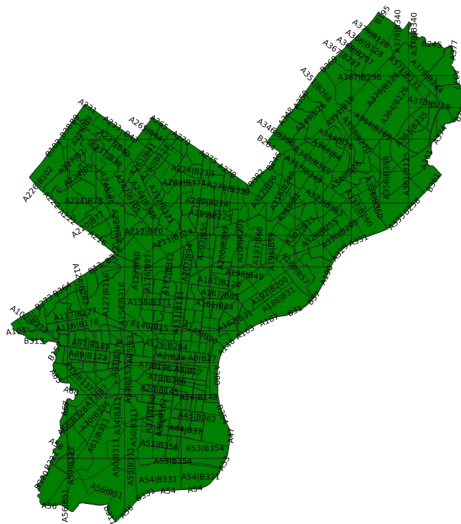
The Empty Cell problem...



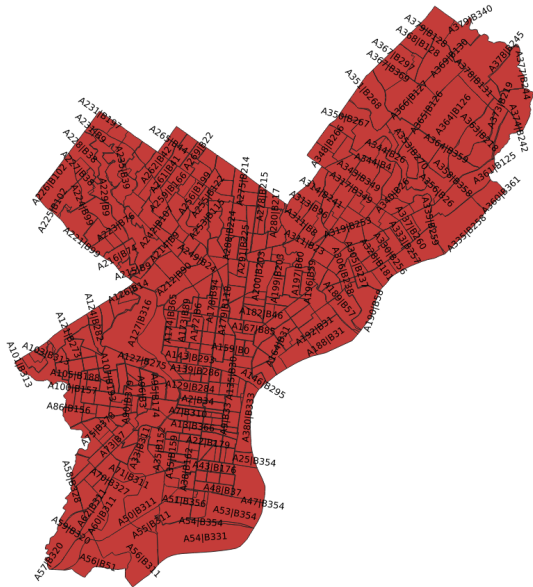
Correctness...

1. Run and extract polygons of the overlay operator from our implementation.
2. Run and extract polygons of the overlay operator using QGIS.
3. Run difference operator on the two outputs using QGIS.
4. If outputs are equal, difference operator must be empty.

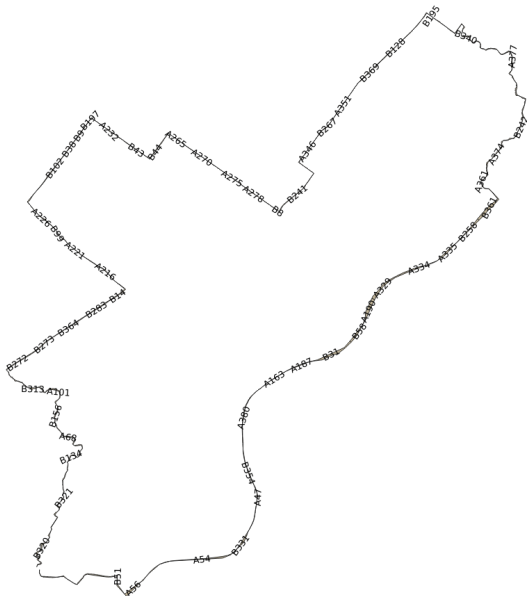
Philadelphia districts 2000 (381 polygons) and 2010 (384 polygons)



Intersections...

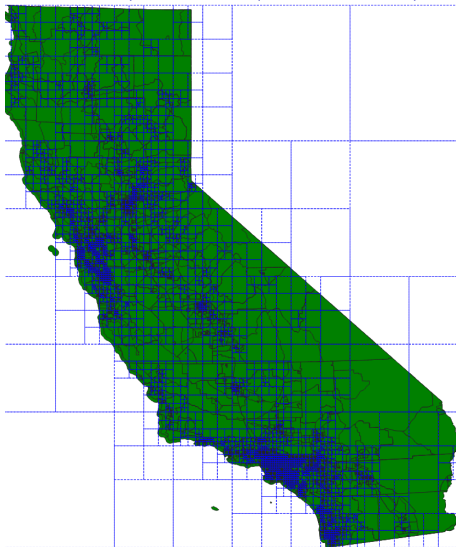


Symmetric difference...



Performance...

CA districts 2000 (7028 polygons) and 2010 (8047 polygons)



Performance...

Working on CGAL implementation

- ▶ Based on Arrangements in 2D in the CGAL library (Section 8. Extending the DCEL))¹.
- ▶ Theory and resources are discussed at “*CGAL Arrangements and Their Applications: A Step-by-Step Guide*” (Fogel et al, 2012)².
- ▶ Code available at repository³.

¹ https://doc.cgal.org/latest/Arrangement_on_surface_2/index.html#title51

² <https://www.springer.com/gp/book/9783642172823>

³ https://github.com/aocalderon/RIDIR/tree/master/Code/CGAL/dcel_code

Performance...

Preliminary experiments

DDCEL	Execution time [s]
Partitioning	10.22
Building single DCELs	4.02
Updating empty cells	7.82
Merging DCELs	9.62
Total	31.69

CGAL	Execution time [s]
Total	198934.76

Performance...

Some notes

- ▶ Most relevant reference about CGAL Arrangements performance found at Haran and Halperin (2009)⁴.
- ▶ It reports an execution time of 97.6 s for the construction of only one arrangement of uniform random segments with 1,366,364 edges.
- ▶ By comparisson, our arrangements have:

	Number of edges
CA 2000	999,808
CA 2010	2,901,802
Merged	4,455,399

⁴<https://dl.acm.org/doi/10.1145/1412228.1412237>