A Scalable DCEL implementation

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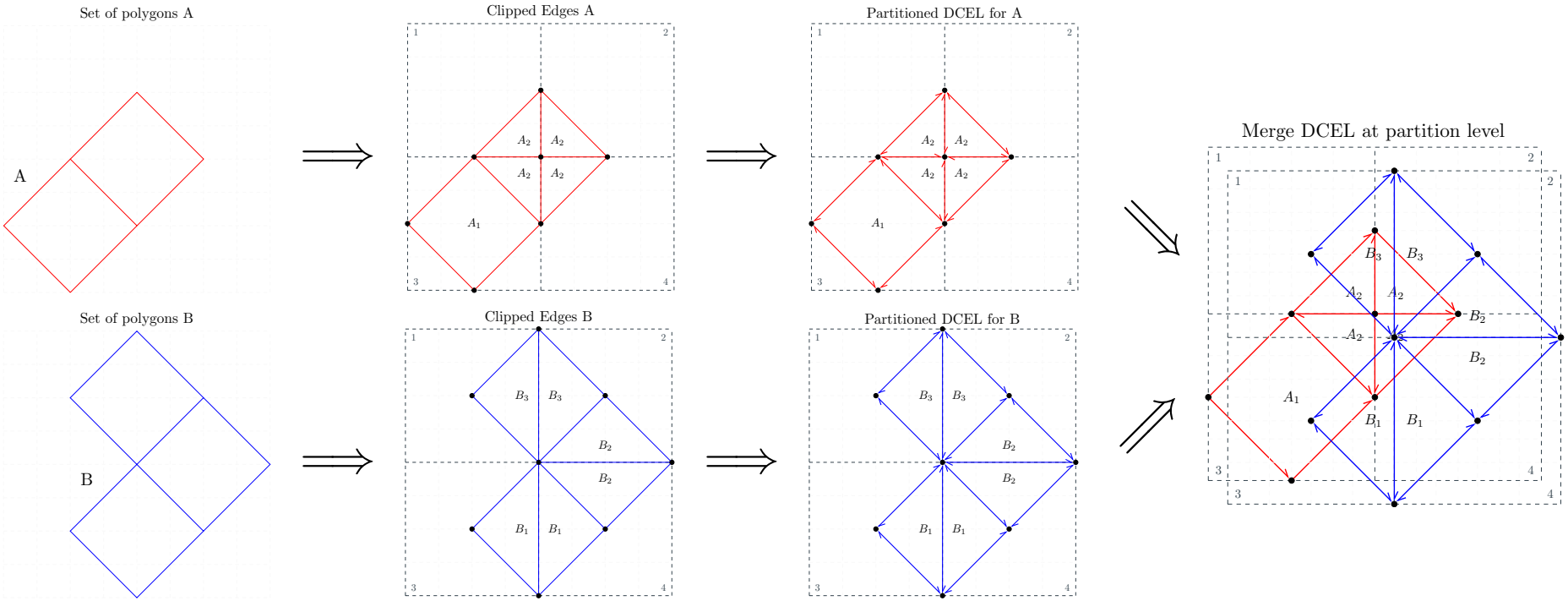
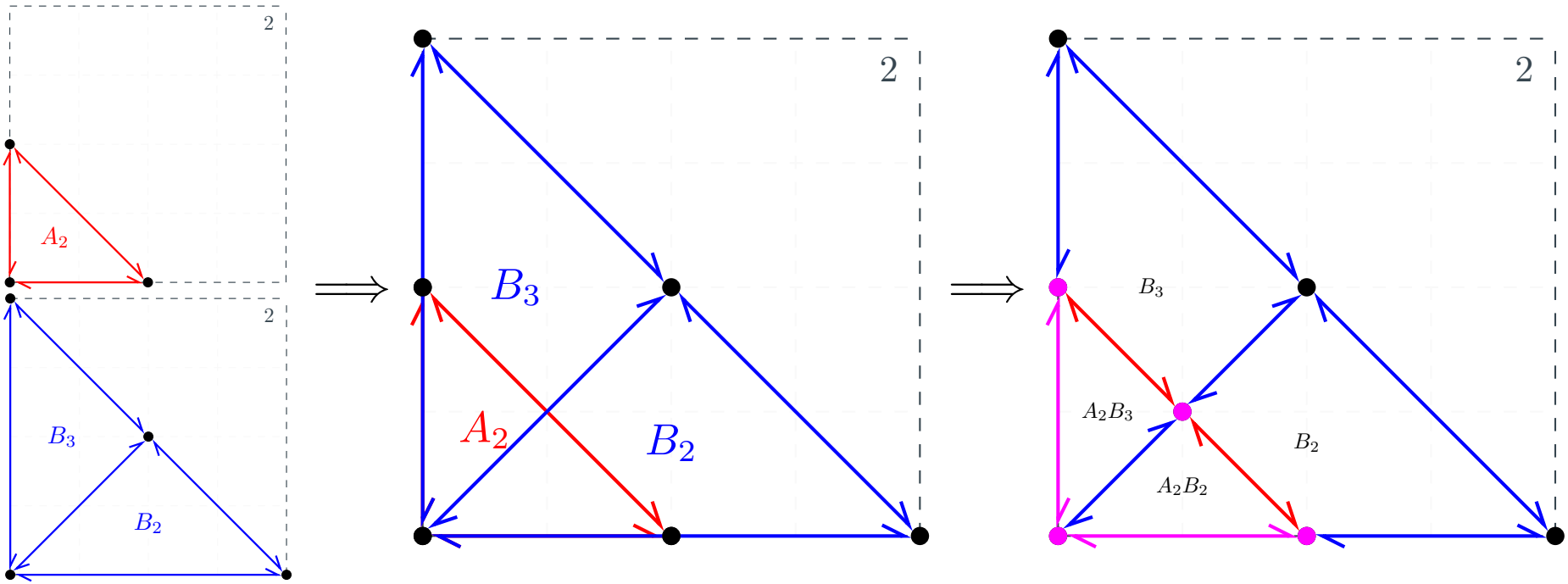
A Scalable DCEL...

Local DCELs



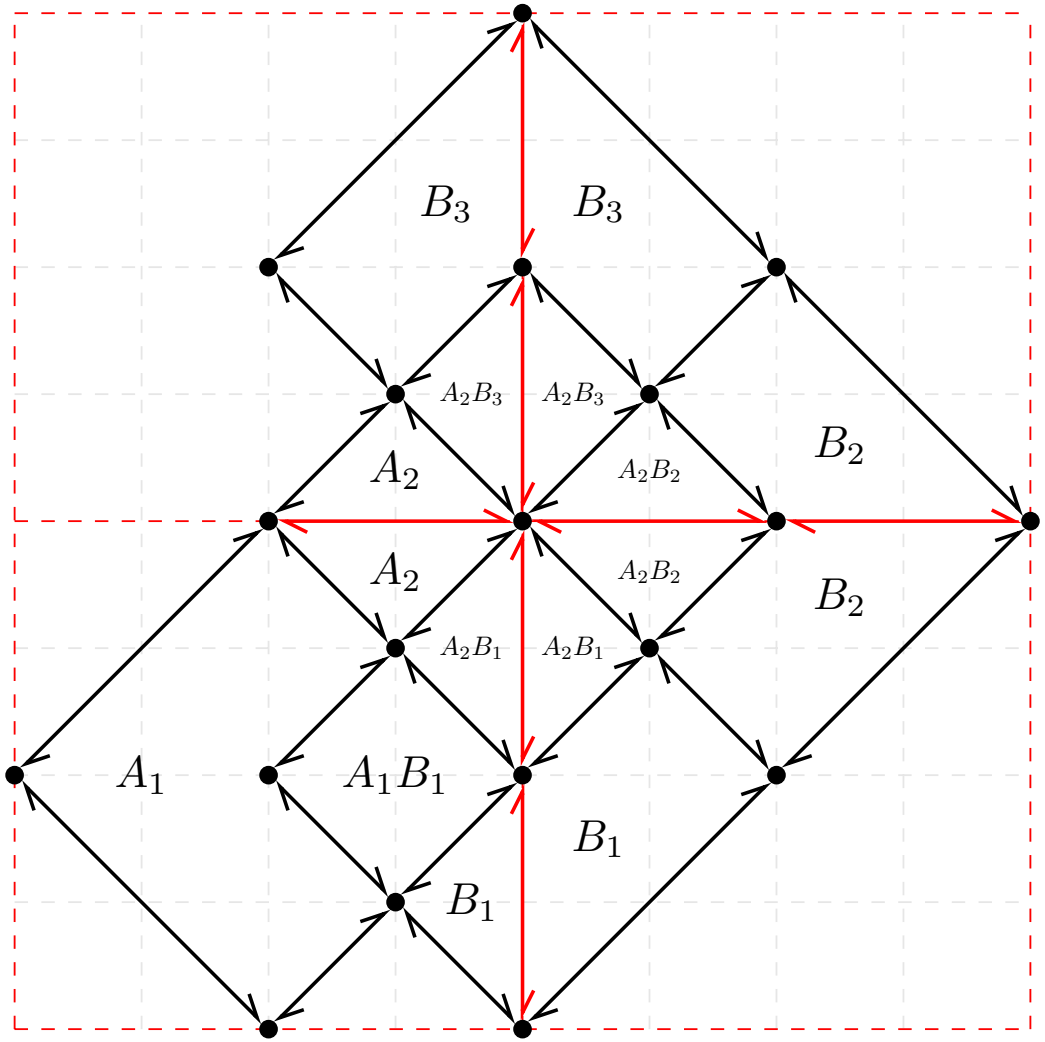
A Scalable DCEL...

Merged DCEL



A Scalable DCEL...

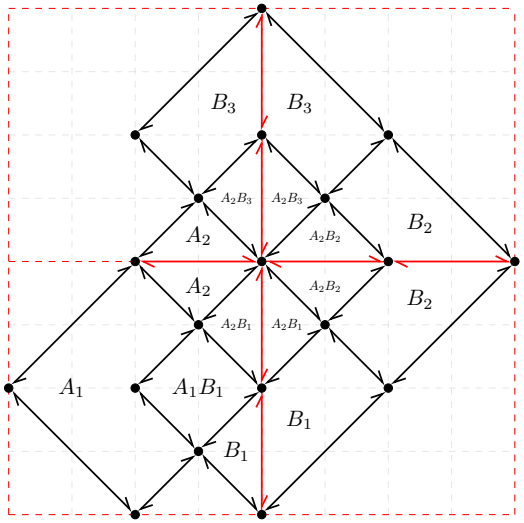
Merged DCEL



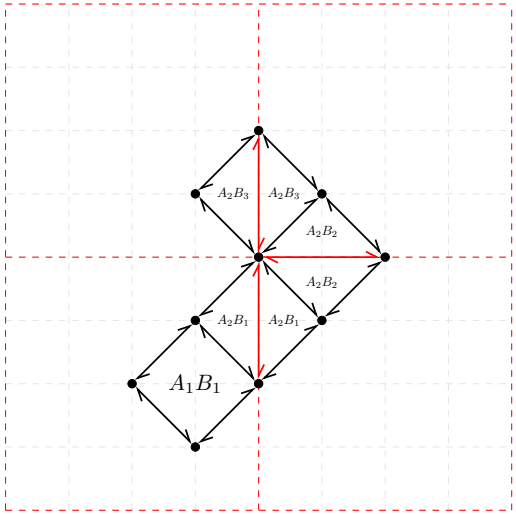
A Scalable DCEL...

Overlay Operations

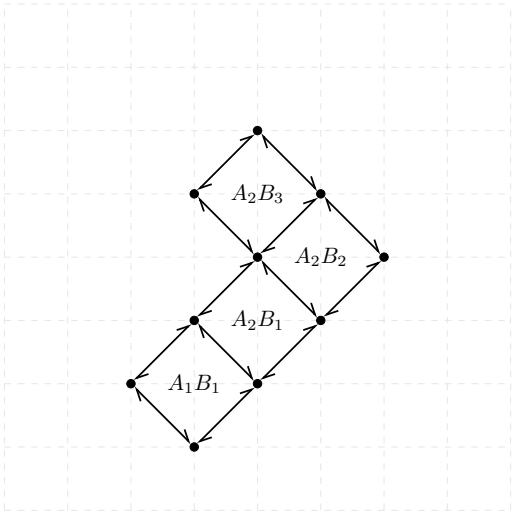
Merged Partitioned DCEL



Overlay Operation ($A \cap B$)



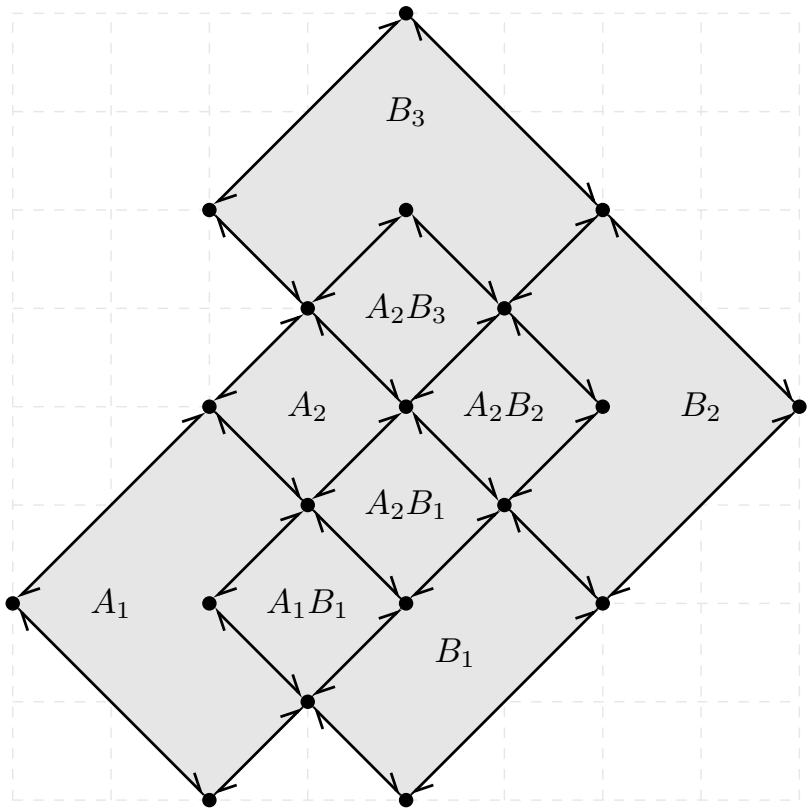
Merge ($A \cap B$)



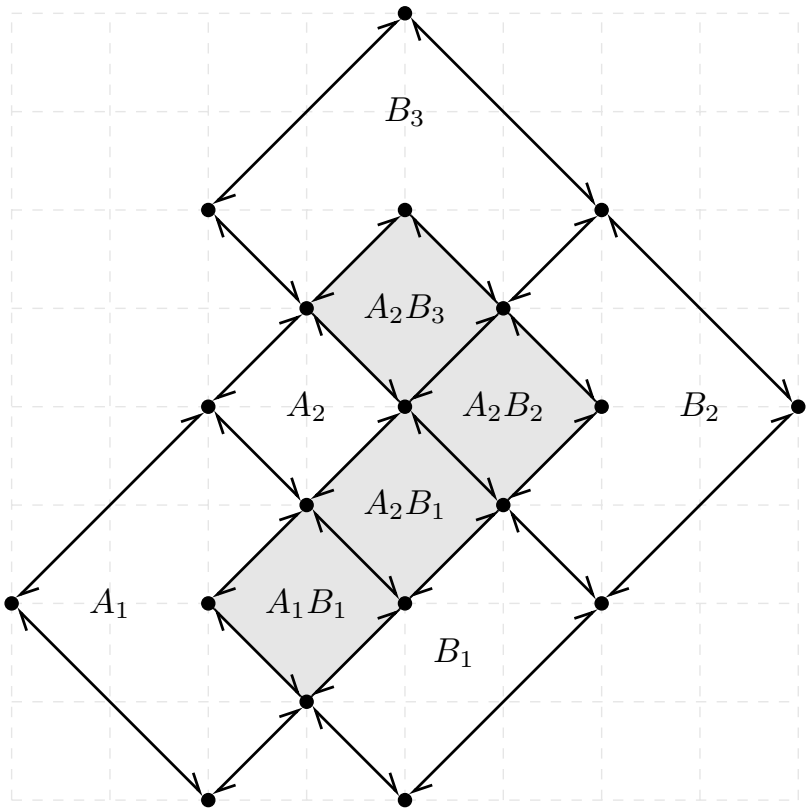
A Scalable DCEL...

Overlay Operations

$A \cup B$



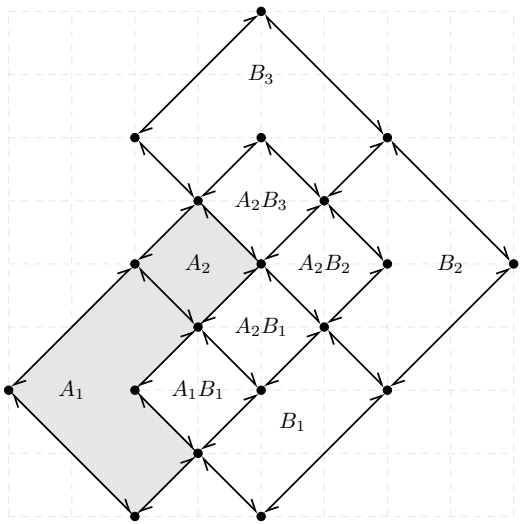
$A \cap B$



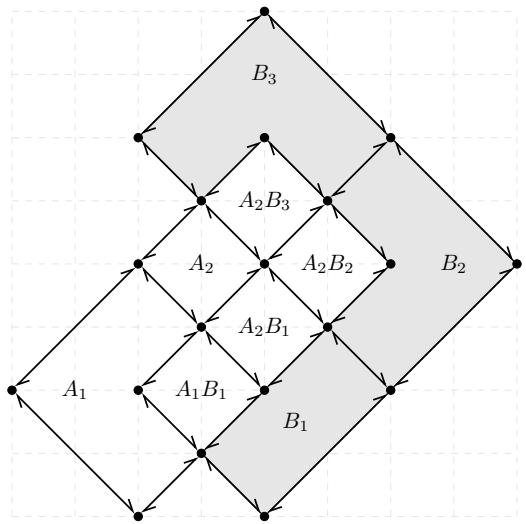
A Scalable DCEL...

Overlay Operations

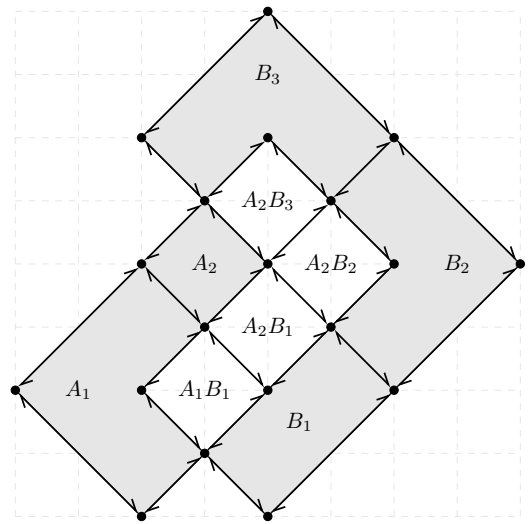
$A \setminus B$



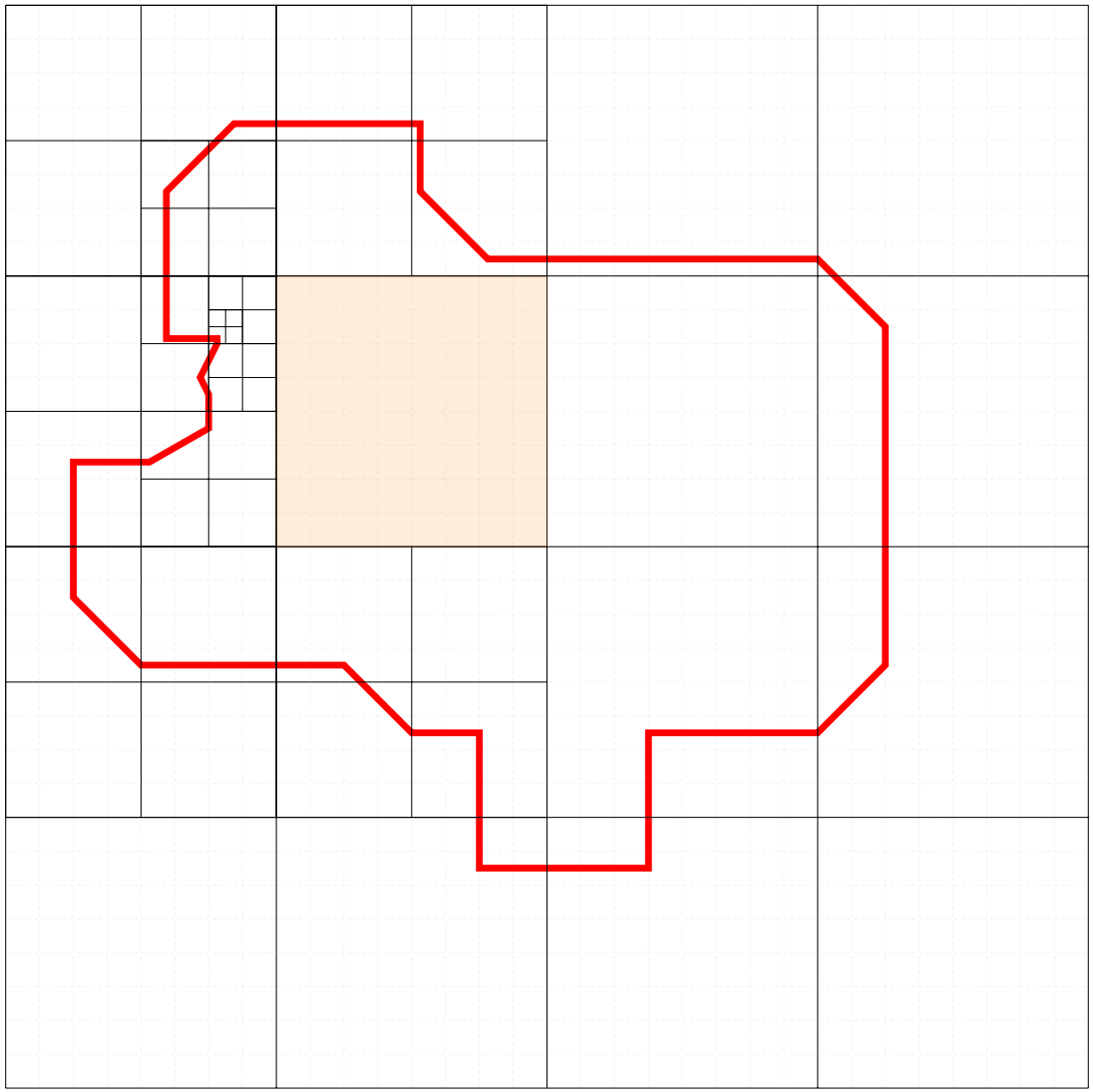
$B \setminus A$



$A \triangle B$



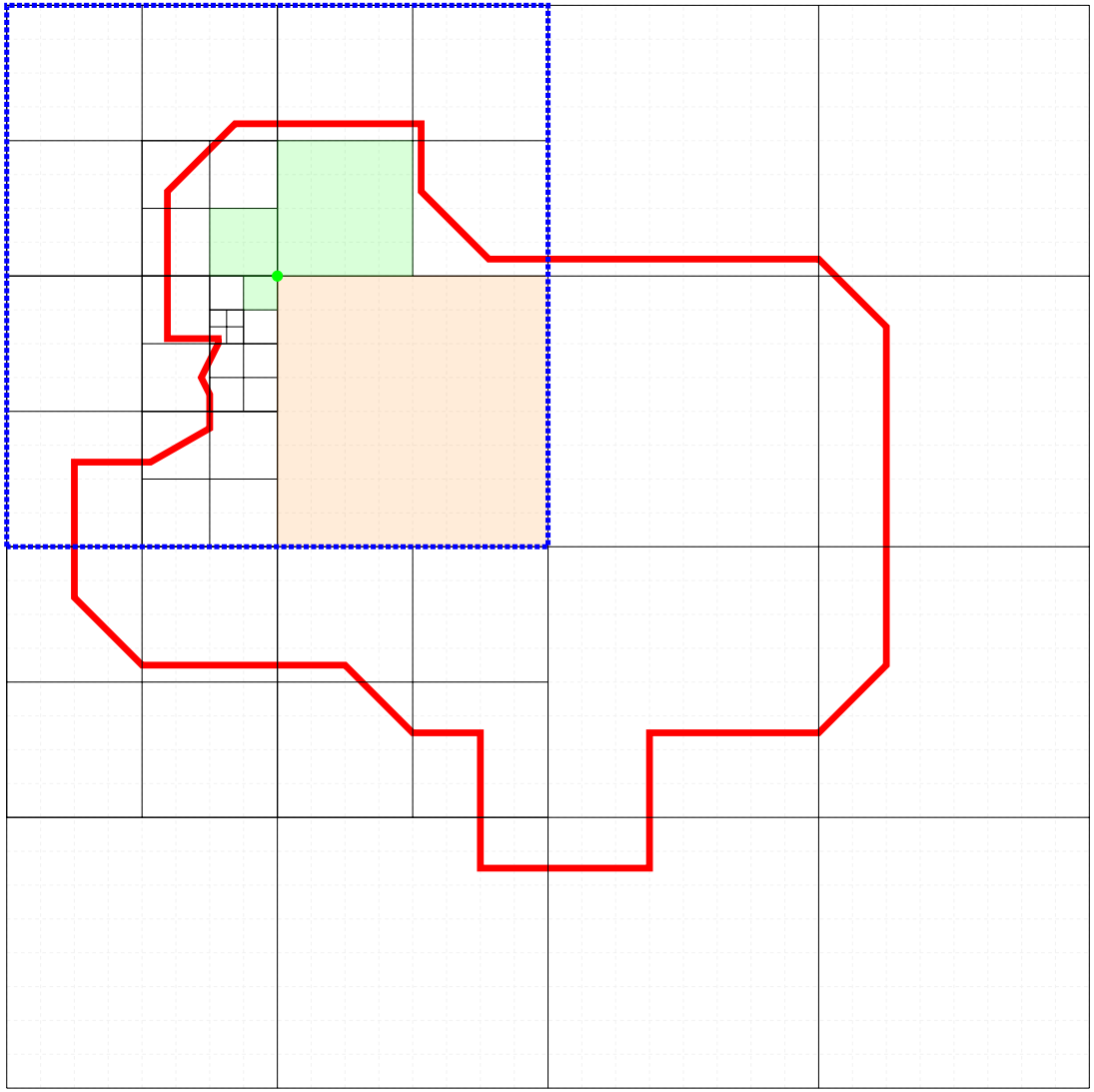
The Empty Cell problem...



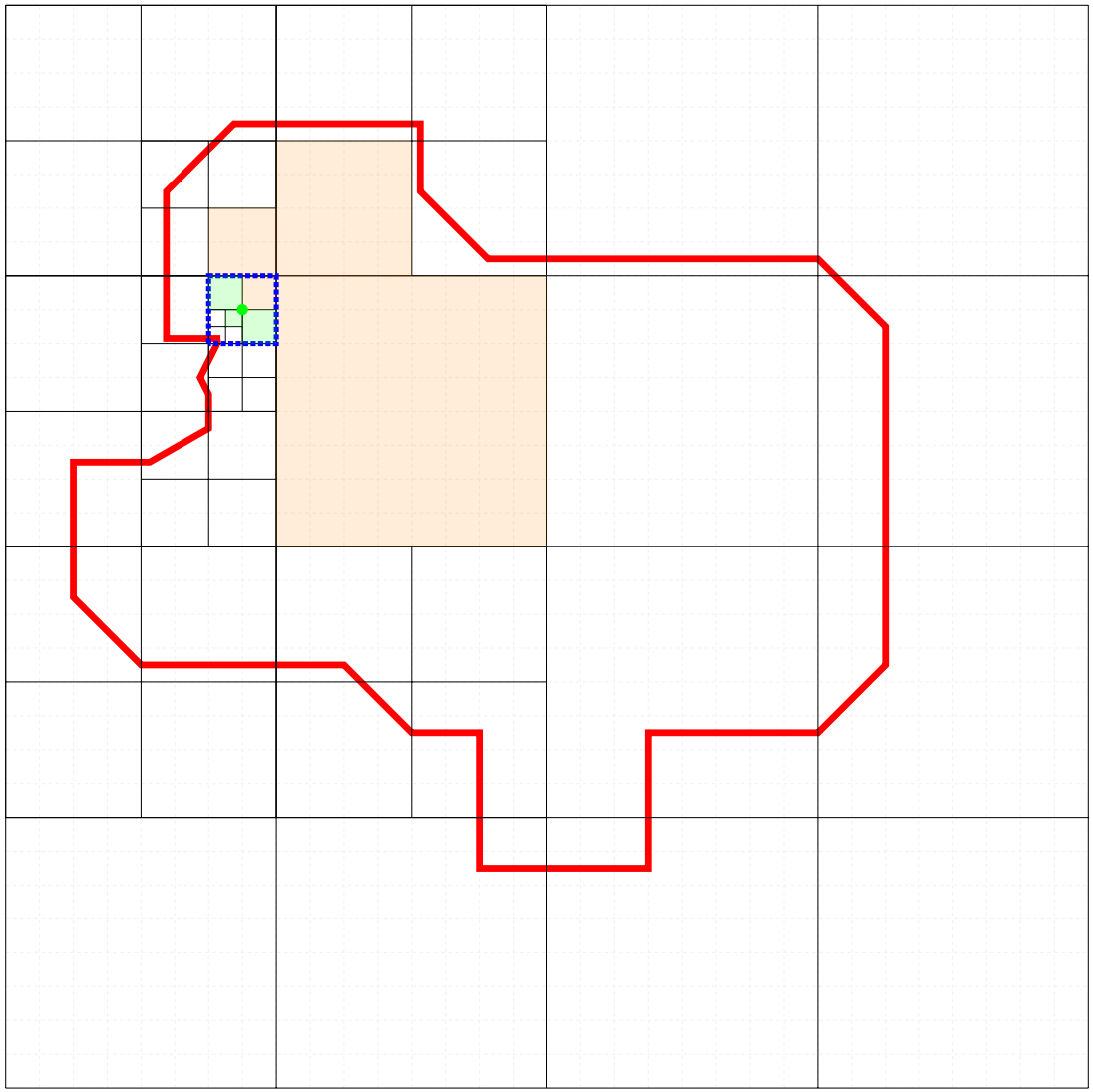
The Empty Cell problem...

1. Identify the quadrant father Q of the current empty cell.
2. Find the other 3 cells whose touch the center of Q.
3. If one of them has edges: You are done.
4. If not: choose one of them and repeate.

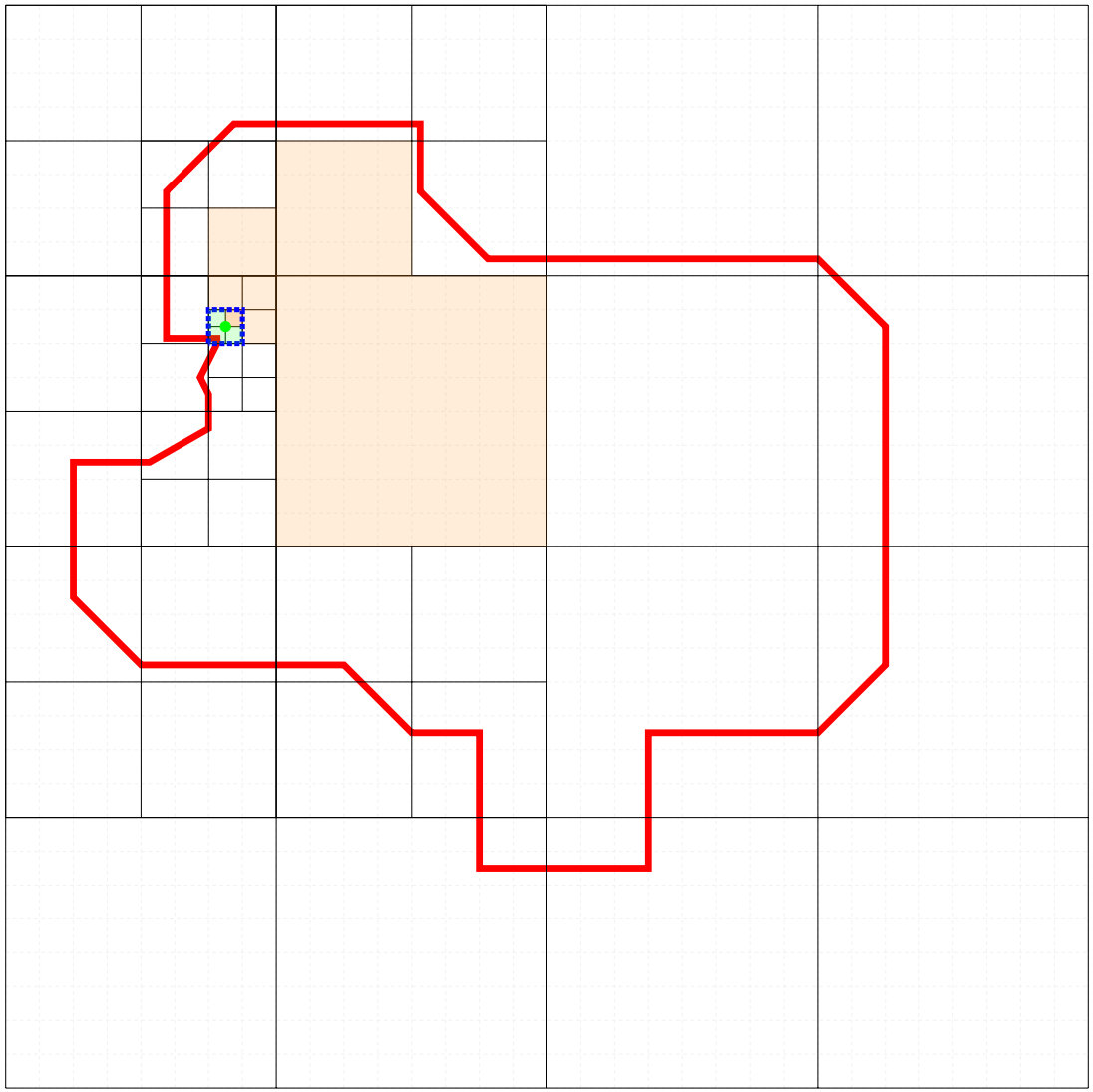
The Empty Cell problem...



The Empty Cell problem...



The Empty Cell problem...

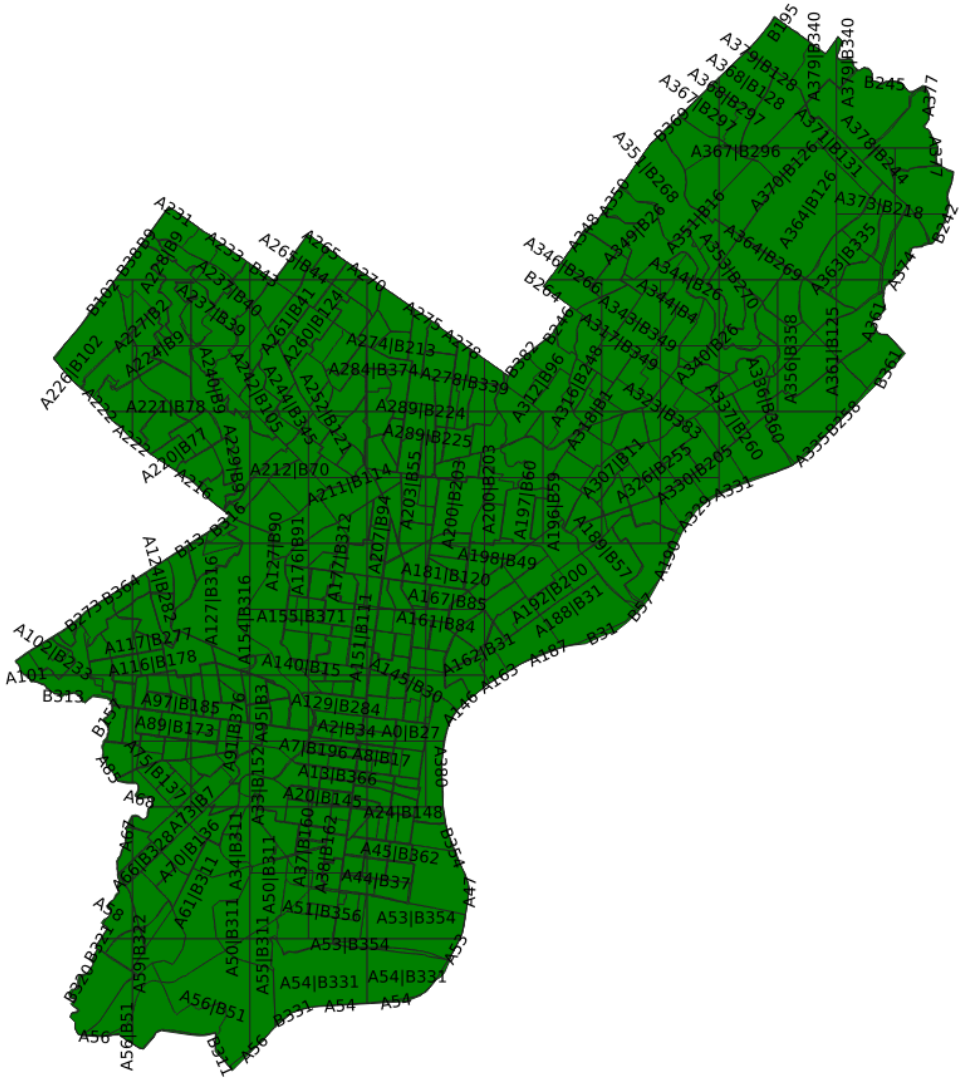


Correctness experiments...

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.

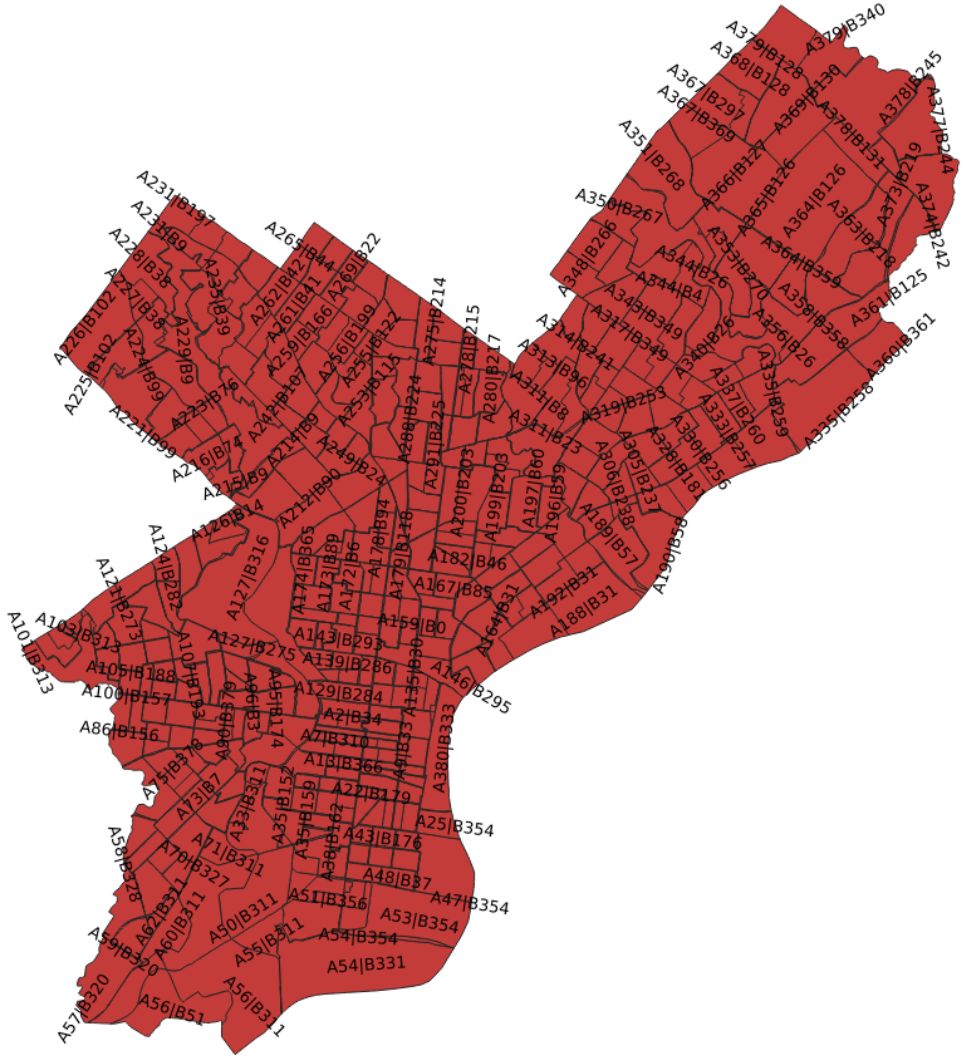
Correctness experiments...

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



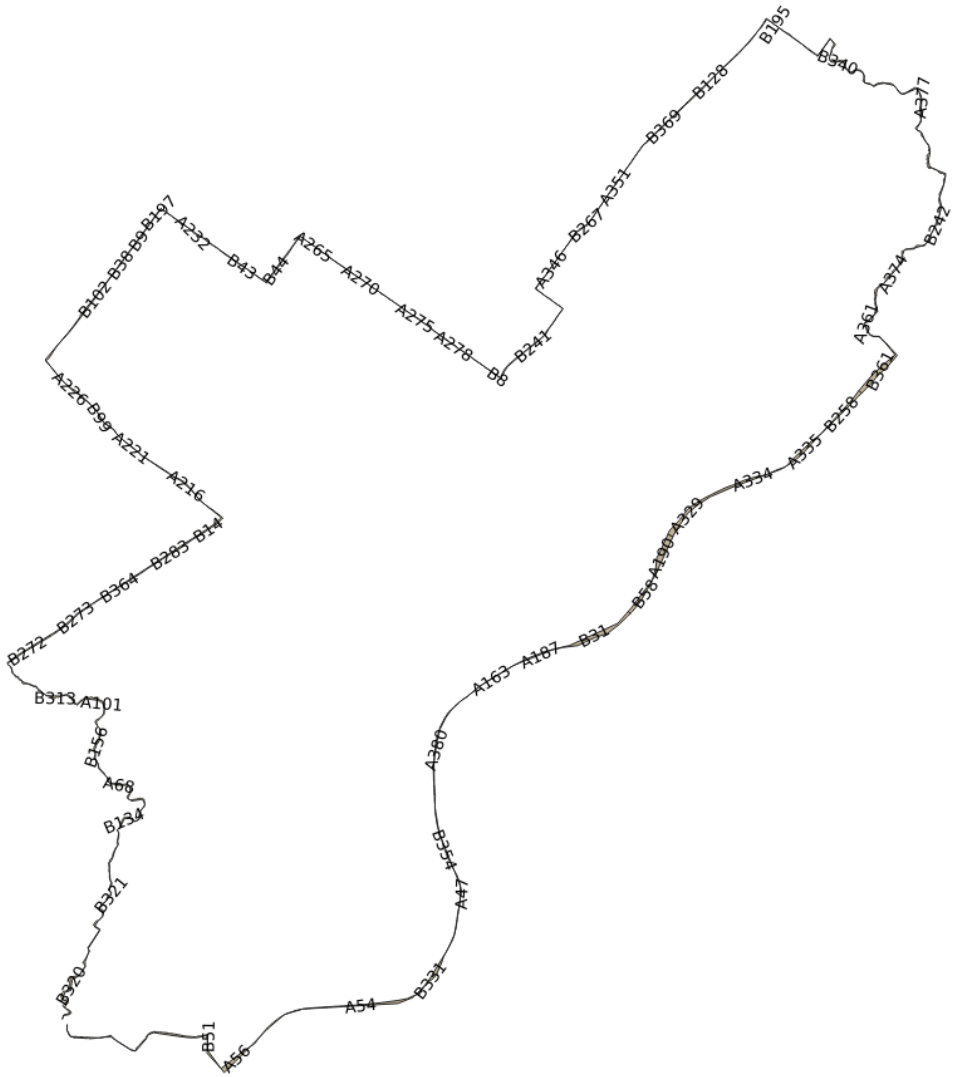
Correctness experiments...

Intersections...



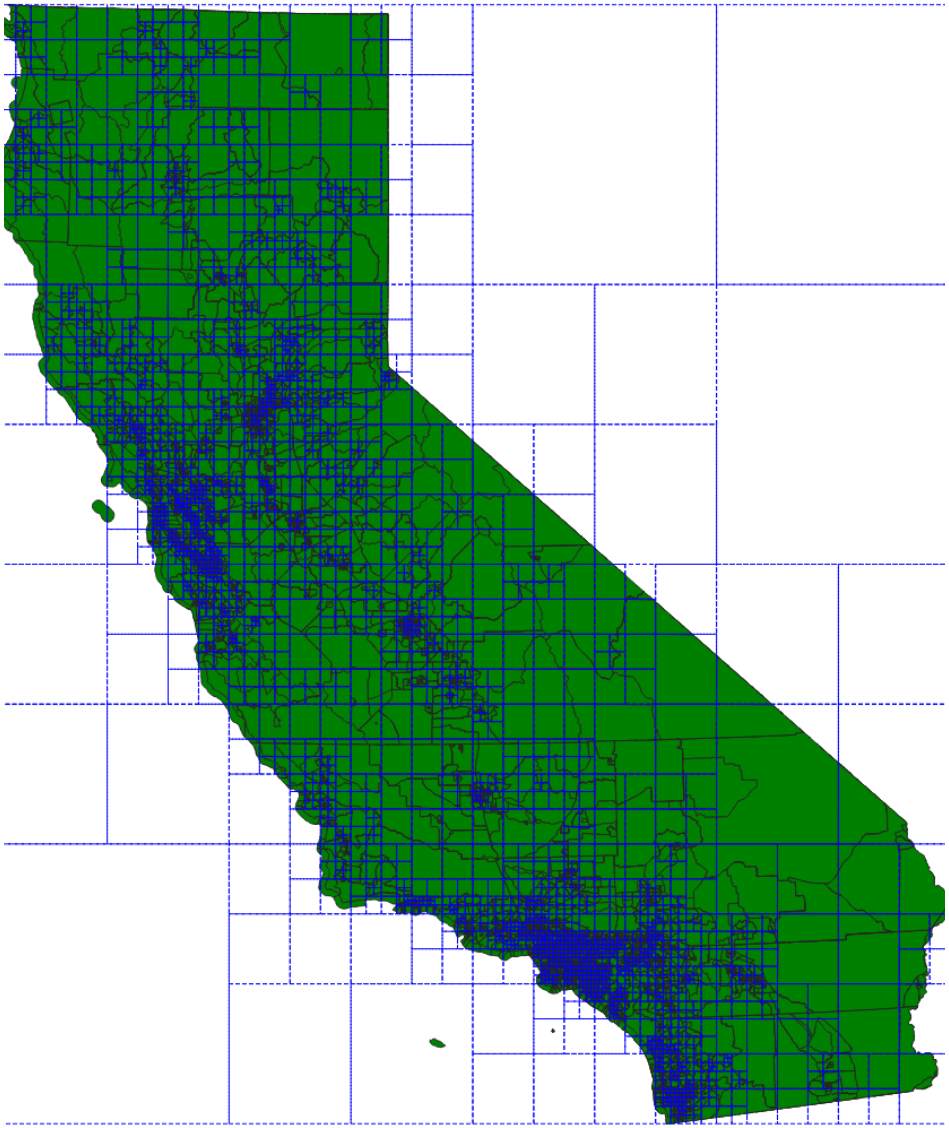
Correctness experiments...

Symmetric difference...



Performance experiments...

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



Performance experiments...

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 repository[3].
- Performance is similar to previous work (Haran and Halperin, 2009[4]) and discussed with their authors.

[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

[4] https://dl.acm.org/doi/10.1145/1412228.1412237

Performance experiments...

SDCEL	**Execution time [s]**
Partitioning	10.22
Building single DCELs	4.02
Updating empy cells	7.82
Merging DCELs	9.62
Total	**31.69**

CGAL	**Execution time [s]**
Building single DCELs	594.01
Merging DCELs	14.64
Total	**608.66**

What's next?

- Currently working on Scale up and Speed up experiment tests.
- Exploring further case uses or expermients.