

**What's New
in the
JTS Topology Suite**

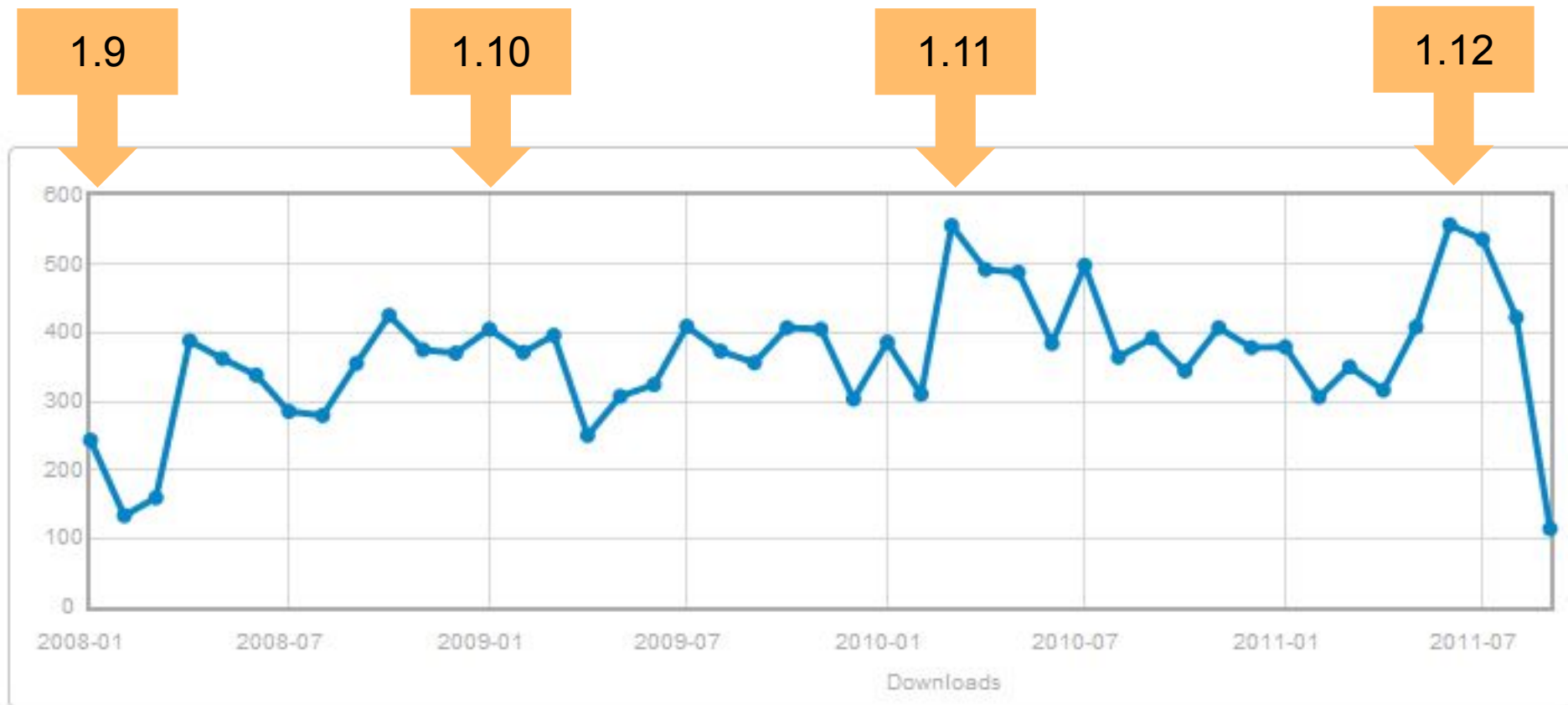
*Martin Davis
September 2011*

Project History

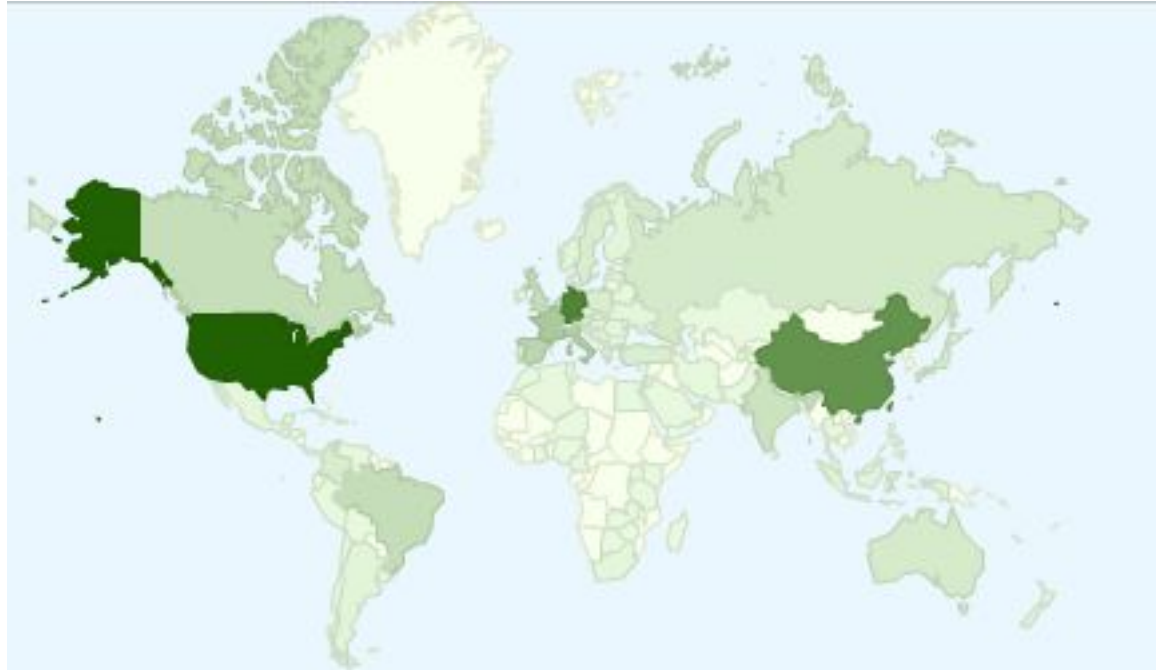
- **Version 1.0** - May 2001
- ...
- **Version 1.9** - January 2008
- **Version 1.10** - December 2008
- **Version 1.11** - March 2010
- **Version 1.12** - June 2011

Project Statistics - Downloads

Total downloads [Jan. 1, 2008 - Sept. 8 2011] : **16,405**



Project Statistics - Usage



Downloads [Jan. 1, 2008 - Sept. 8 2011]

1. United States -- 1,384
2. Germany -- 1,051
3. China -- 915
4. France -- 424
5. Italy -- 375

Are you using it?

JTS

Word cloud containing various GIS and geospatial software names, including: JTS, HatBox, JAI-Tools, SWECD, JUMP, GeoScript, MoxieMedia, SkyJUMP, OGC, Conflation, JASPA, GeoServer, Geomajas, HibernateSpatial, uDig, gvSIG, GeoKettle, RoadMatcher, deegree, Puzzle-GIS, JCSuite, OpenJUMP, GeoTools, JEQL, Kosmo, Sextante, GeoOxygene, Straightedge, Mapyrus, and IMF.

GEOS

Word cloud containing various GIS and geospatial software names, including: GEOS, OGR, Source, DjangoGIS, R-GEOS, MapServer, WebProcessingServer, MapWindow, MapGuide, PostGIS, Open, Spatialite, Quantum, RGeo, Shapely, and MonetDB.

Ports & Bindings to other languages

- **Ports**

- GEOS -> C++
- Net Topology Suite -> C#
- JSTS -> JavaScript

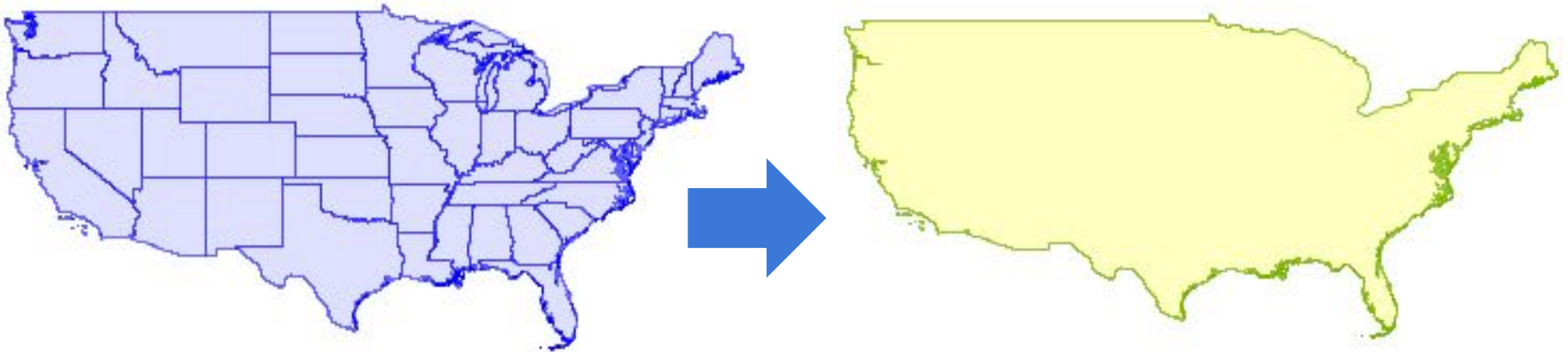
- **Bindings** (*via GEOS*)

- Shapely - Python
- RGeo - Ruby
- R-GEOS - R

What's New in **JTS**

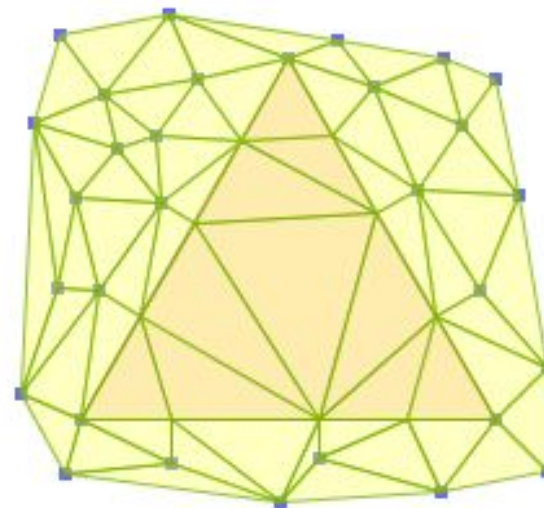
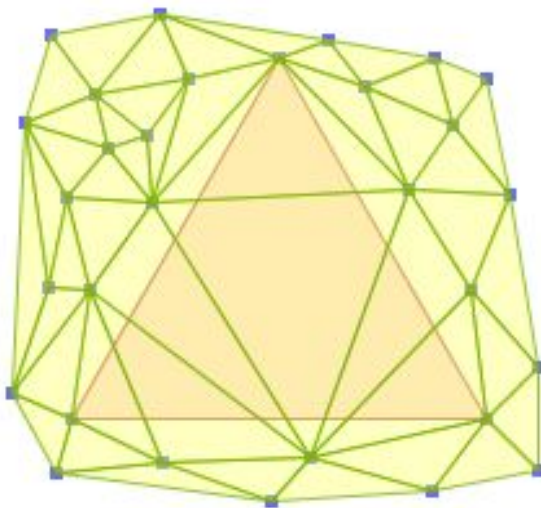
Unary Union

- `Geometry.union()`
 - High-performance union of geometry collections
 - Uses spatial index to optimize union
 - In most situations much more efficient than iterating `Geometry.union(Geometry)`
 - handles heterogeneous `GeometryCollections`



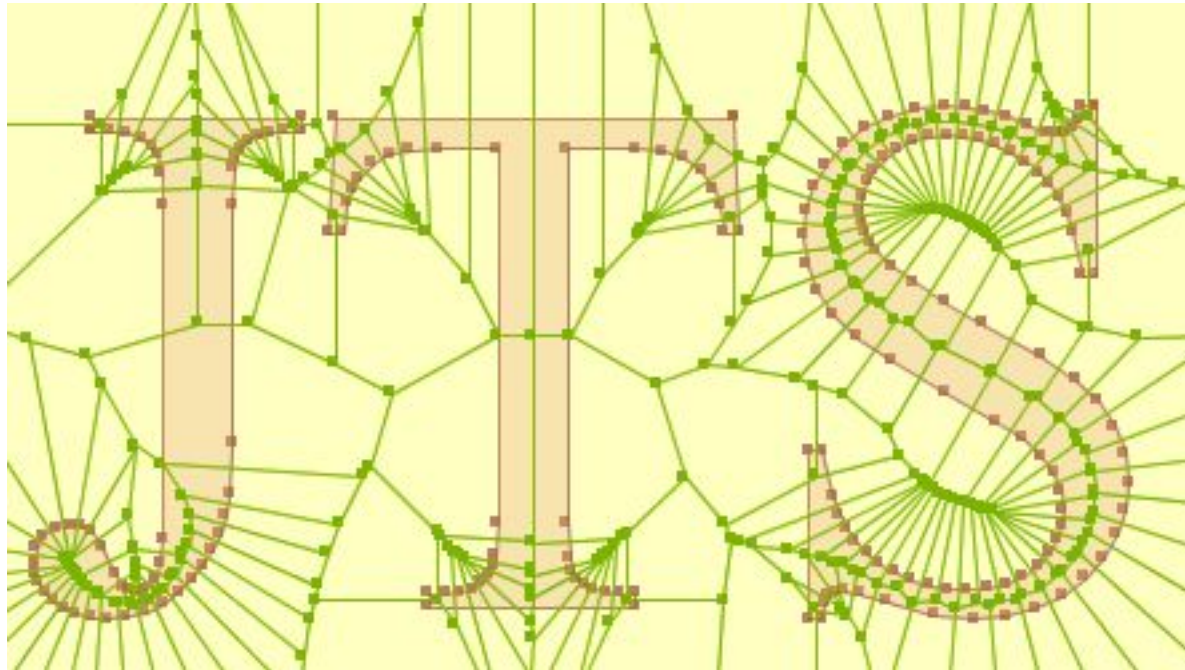
Delaunay Triangulation

- `DelaunayTriangulationBuilder`
 - Optimal triangulation of point sets
 - Efficient, robust algorithm
 - **Uses** `QuadEdge` data structure
- `ConformingDelaunayTriangulationBuilder`
 - Delaunay triangulation with linear constraints
 - approximates constraints by adding vertices along segments



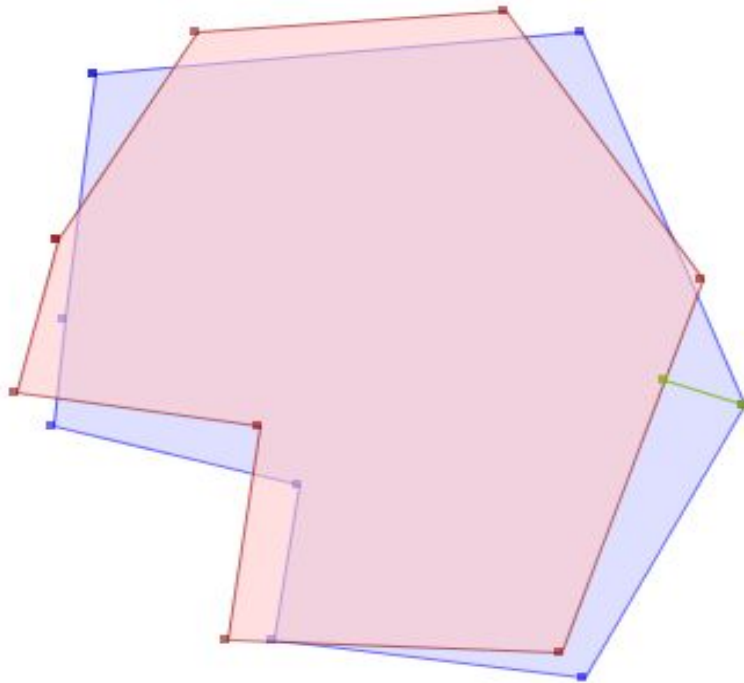
Voronoi Diagram

- Dual of Delaunay Triangulation
- Both scale well to millions of points



Hausdorff Distance

- DiscreteHausdorffDistance distance metric
 - "How far apart" are two geometries
 - useful for QA/comparison of geometry
 - true Hausdorff distance difficult & slow to compute, so provide faster discrete version

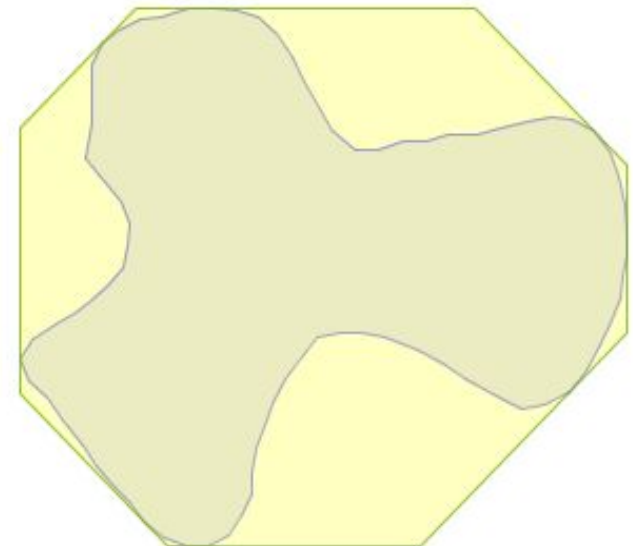
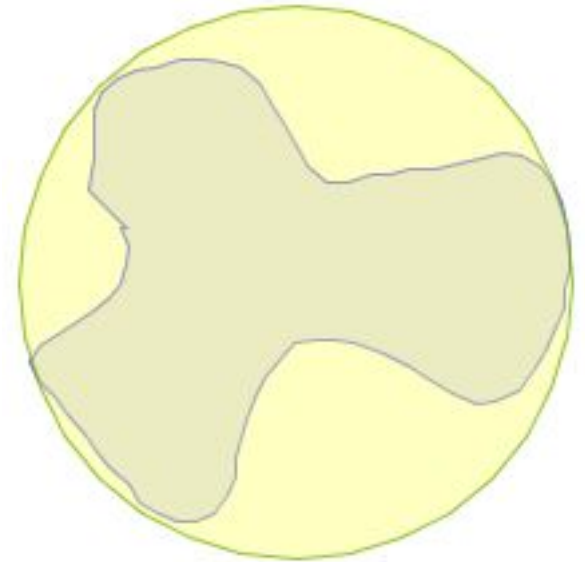
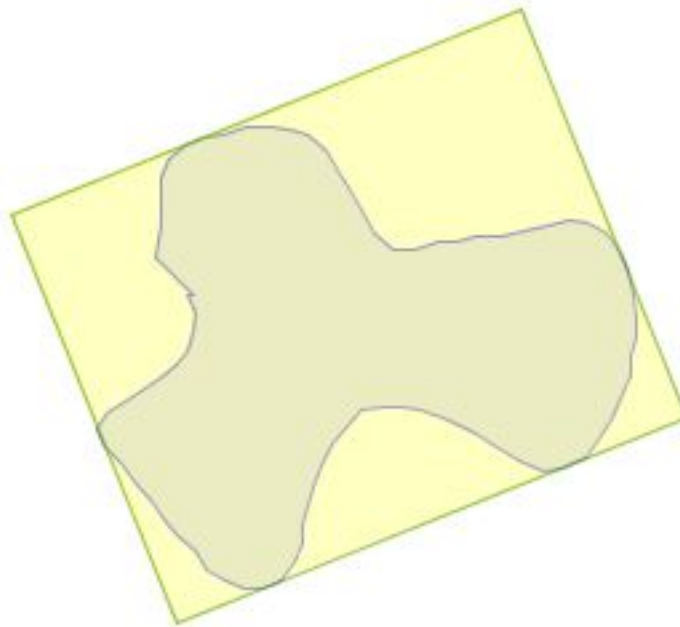
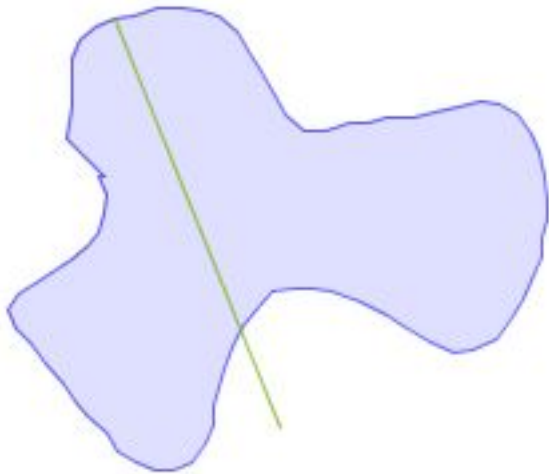


Euclidean distance = 0

Hausdorff distance = 18.23

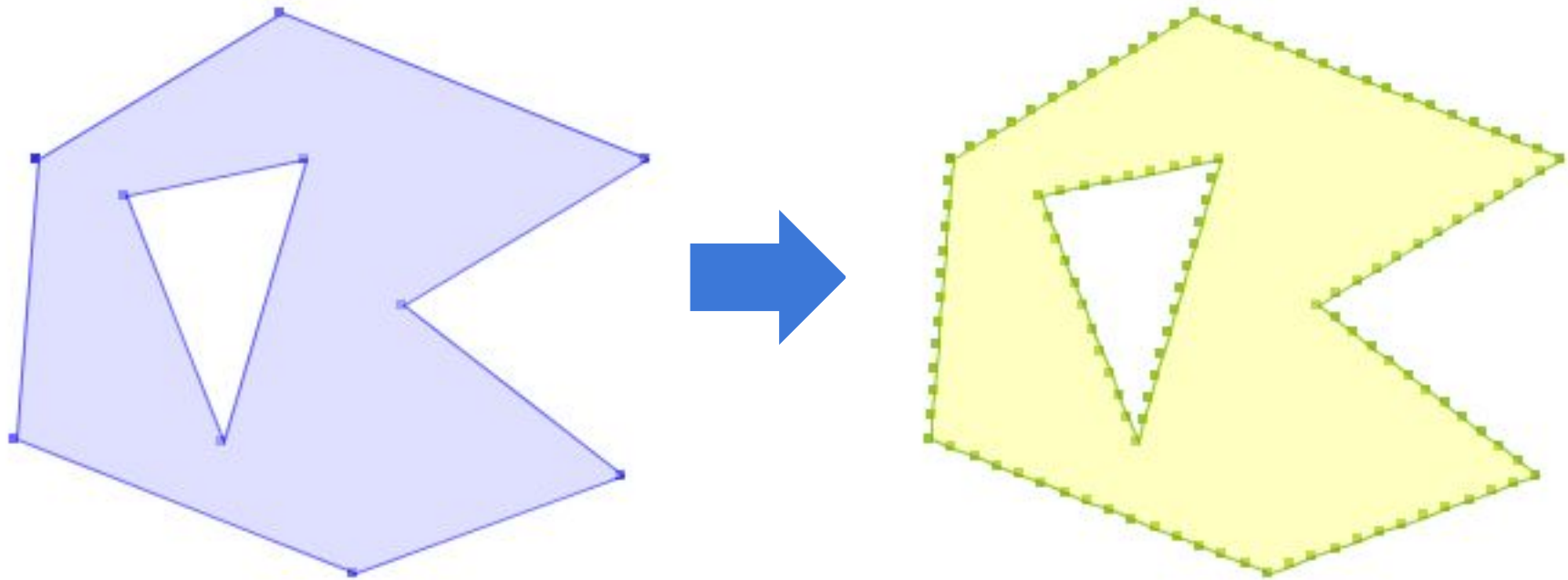
Bounding Containers

- `MinimumBoundingCircle`
- `MinimumDiameter`
 - **also Minimum Rectangle**
- `OctagonalEnvelope`



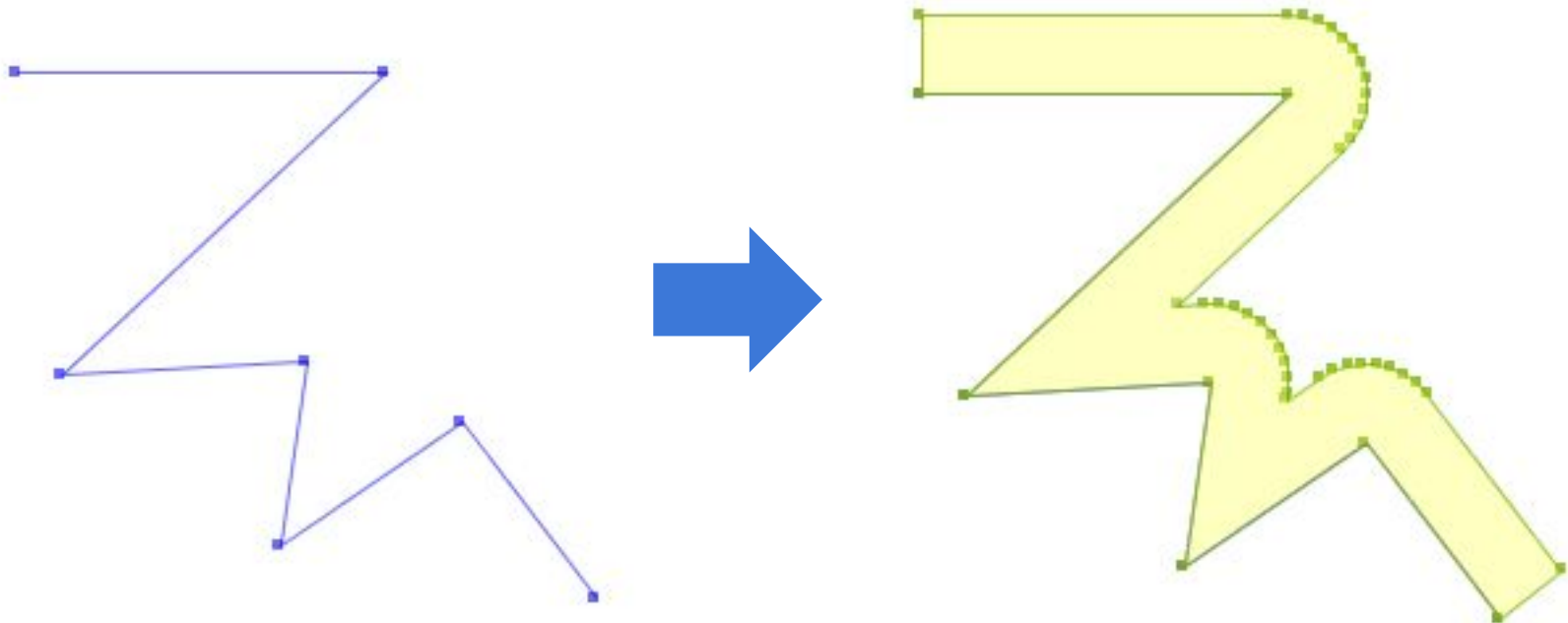
Densification

- Densifier
 - specify max length of segments
 - ensures valid topology of result



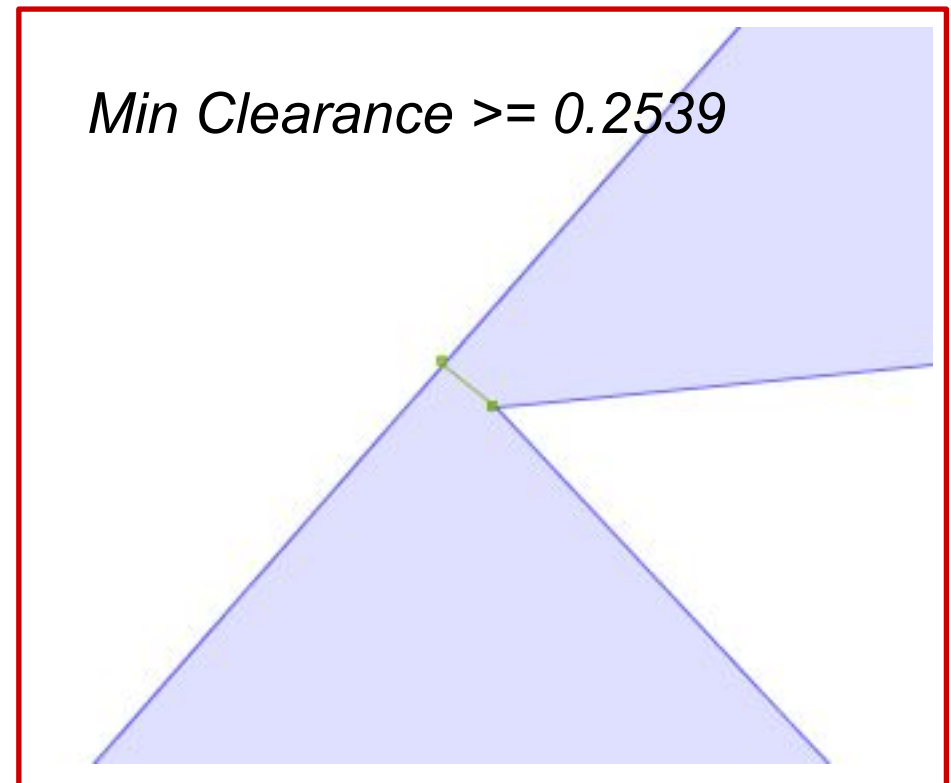
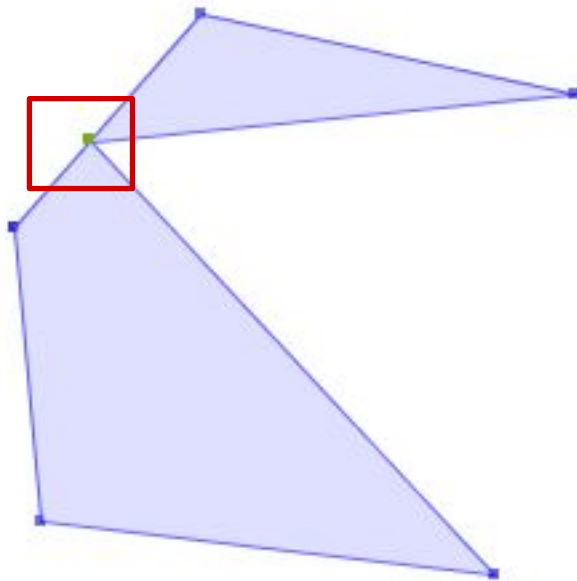
Single-Sided Buffers

- Invoke by `BufferParameters.setSingleSided()`
 - Sign of distance determines side
- *Some warnings apply!*



Minimum Clearance

- Determines if Precision Reduction might produce invalid result
- Uses `STRtree` Nearest Neighbour for efficient computation

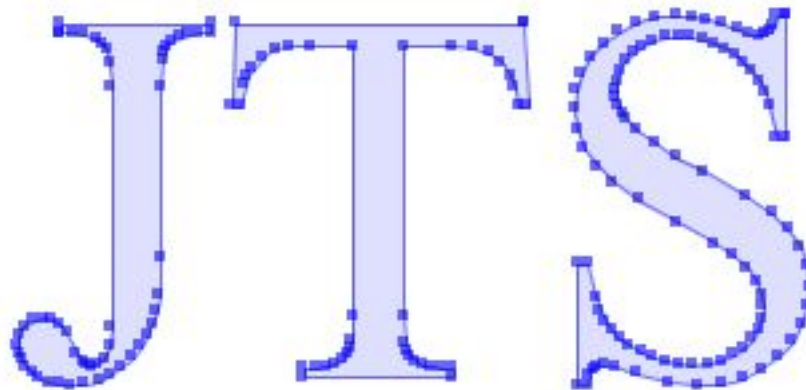


Nearest Neighbour

- **Nearest Neighbour**
 - between an object and a set
 - within a set
 - between two sets
- **implemented via** `STRtree` **index**
 - efficient search
 - user-definable distance metric
- **Uses**
 - MinimumClearance
 - Fast distance calculation

Java2D utilities

- ShapeReader
 - **converts** `java.awt.Shape` **to** `Geometry`
- ShapeWriter
 - **converts** `Geometry` **to** `java.awt.Shape`
 - **provides** `PointTransformation` **to** map coordinates
 - **uses** custom `PolygonShape` **to** support holes
- FontGlyphReader
 - **converts** `Font` **text to a** `Polygon` **geometry**

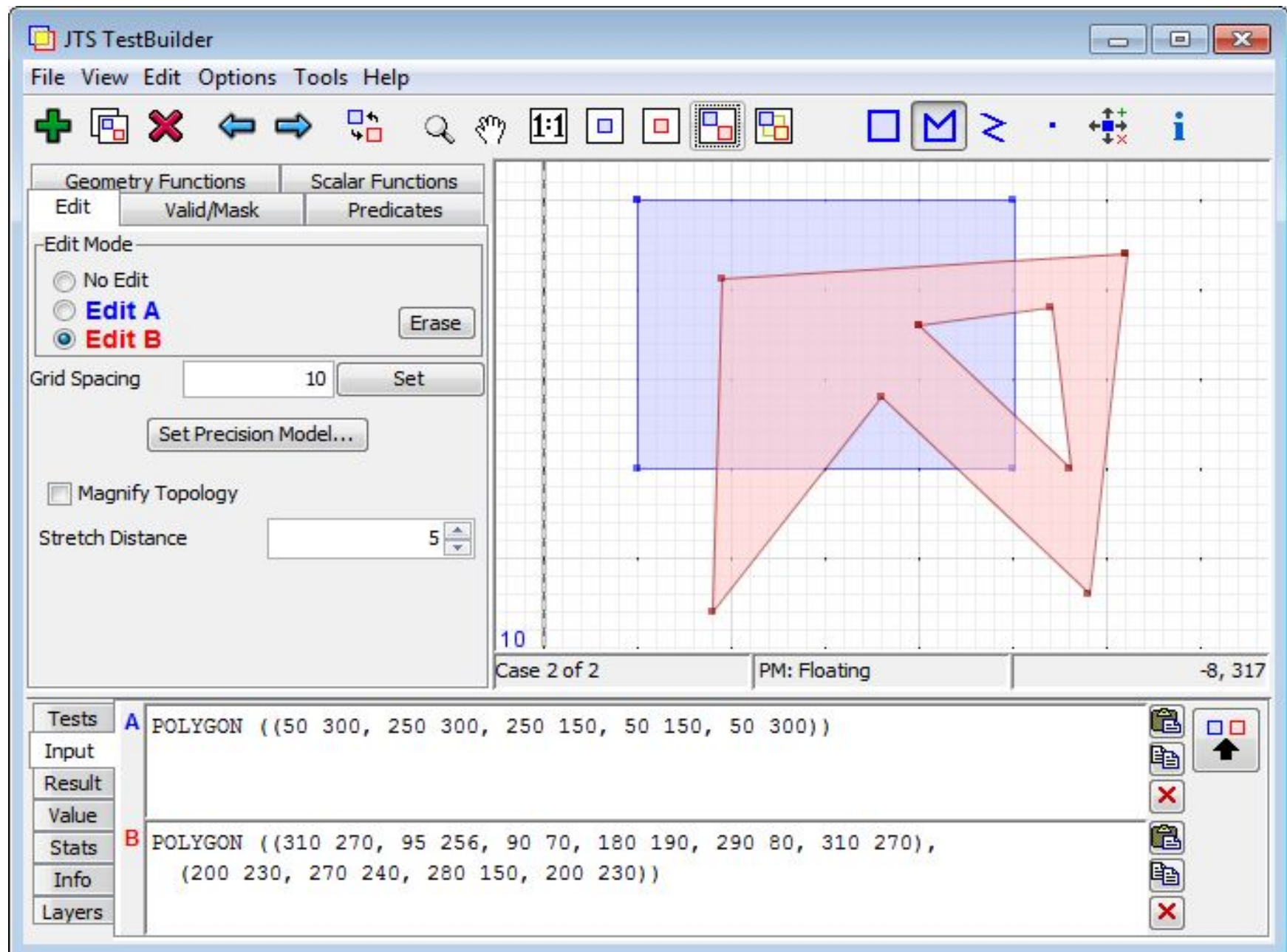


Mathematics utilities

- Vector2D
 - vector structure & operations
- DD - DoubleDouble
 - higher-precision floating-point arithmetic
 - 106 bits of precision
 - used to provide robust computation
 - inCircle test for Delaunay triangulation
 - triangle area & orientation

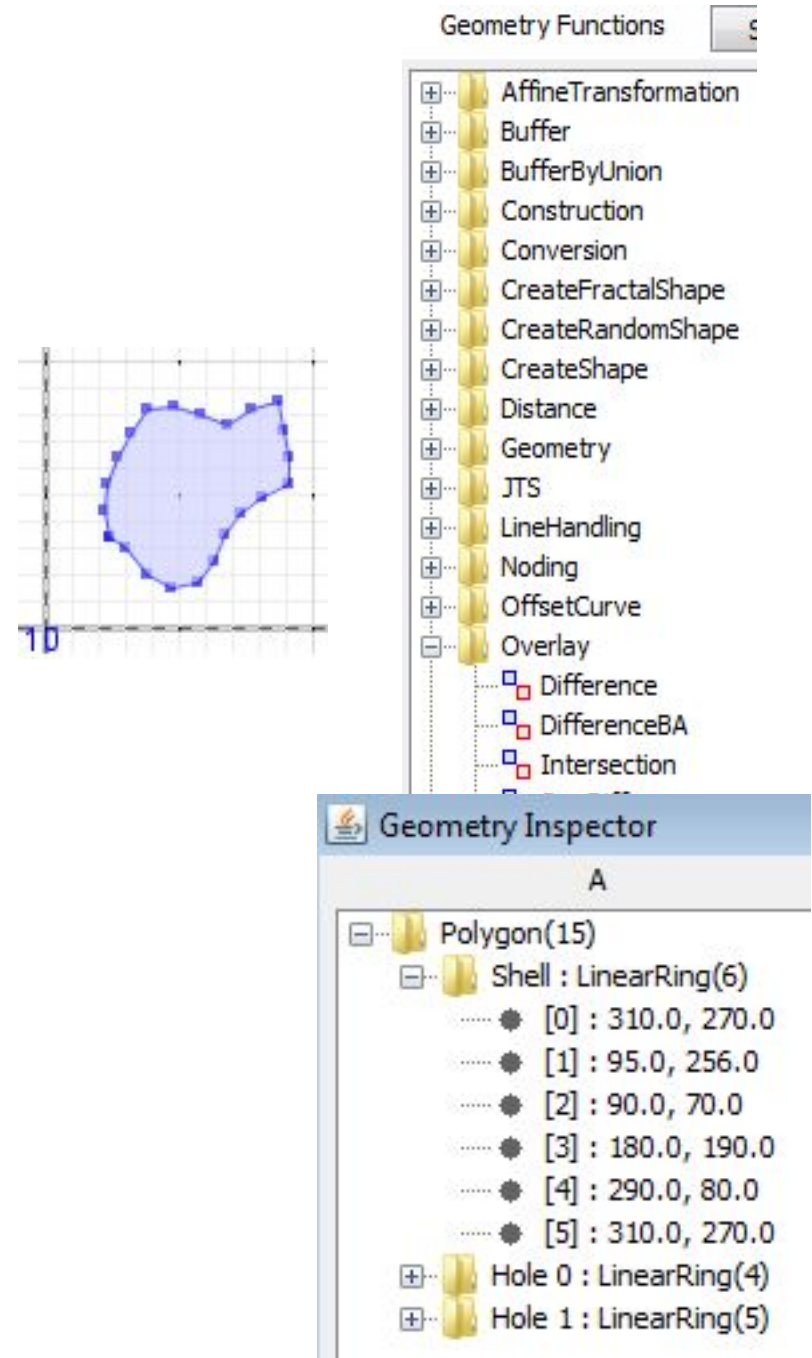
```
public static DD triAreaDDFast(  
    Coordinate a, Coordinate b, Coordinate c) {  
    DD t1 = DD.valueOf(b.x).selfSubtract(a.x)  
        .selfMultiply(DD.valueOf(c.y).selfSubtract(a.y));  
    DD t2 = DD.valueOf(b.y).selfSubtract(a.y)  
        .selfMultiply(DD.valueOf(c.x).selfSubtract(a.x));  
    return t1.selfSubtract(t2);  
}
```

What's New in TestBuilder



What's New in TestBuilder

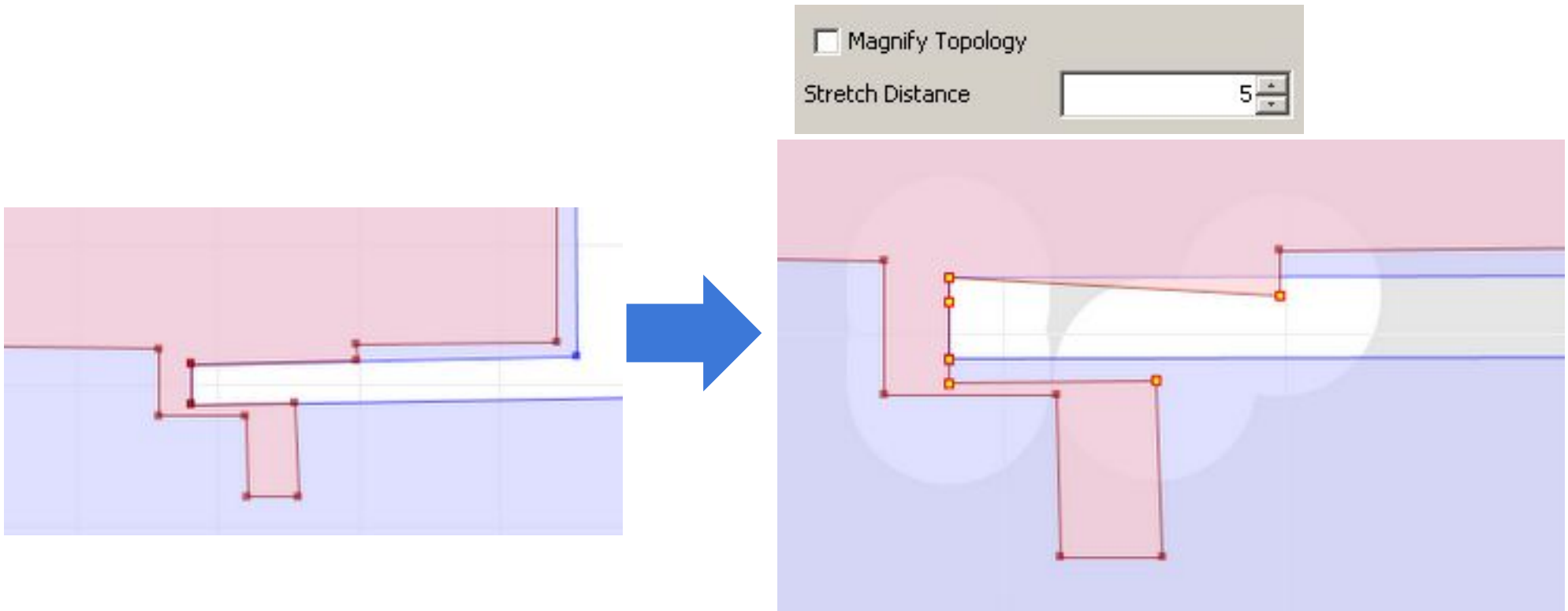
- **User-Defined Functions**
 - Java `public static` methods
- **Many new functions**
- **Dynamic digitizing grid**
- **Stream digitizing**
- **Drag-and-drop data load**
 - WKT, XML tests, Shapefile
- **Threading**
 - Function execution
 - Rendering
- **Display function run time**
- **Geometry Inspector**



What's New in TestBuilder

- **Magnify Topology**

- Visualize very small geometry discrepancies



What's New in TestRunner

- **Custom operations**

- Implement as Java code, configure in test file/cmd line
- Uses
 - Experiment with different algorithms
 - Re-use test corpus with different operations
 - Compare JTS results with external code

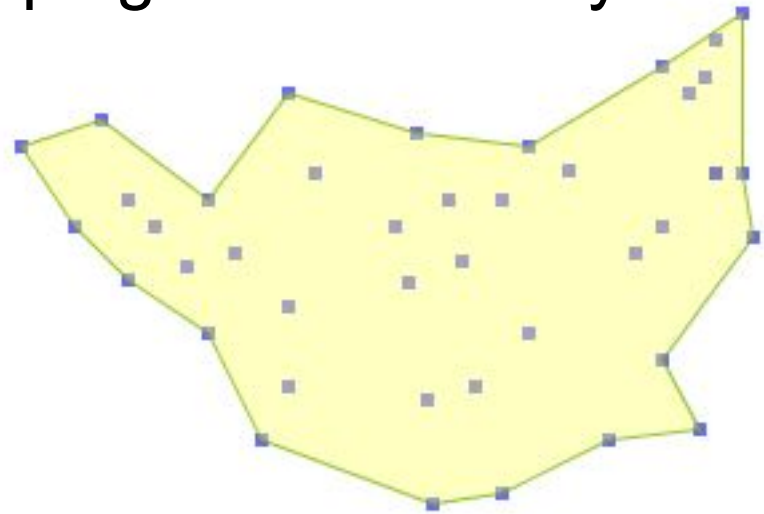
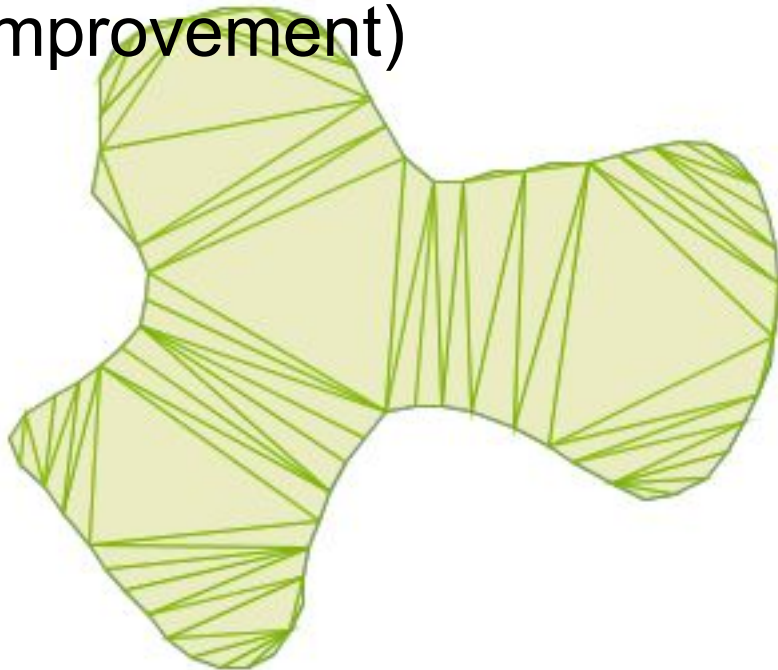
- **Custom Result Matching strategies**

- use for operations which produce approximate results
- e.g. `buffer()`

- **Ability to run single Test Case out of a set**

In the Lab

- **Buffer performance improvements (again!)**
- **New algorithms**
 - Concave Hull
 - Fast Distance computation
 - Clustering
 - Inner and Outer simplification
 - Polygon Triangulation (Ear Clipping with Delaunay improvement)



Future Plans

- **Computation in Geodetic coordinate systems**
 - Area, Distance first
 - Other operations ...somehow
- **Improve performance, robustness**
 - Constant quest...
- **Split packaging into Core and Algorithms**
- **Refactor Geometry classes to use interfaces**
 - allows alternate geometry representations
 - *JTS 2.0 !*

Distribution & Support

- **JTS available from SourceForge**

<http://sourceforge.net/projects/jts-topo-suite/>

- **Mailing List**

<https://lists.sourceforge.net/lists/listinfo/jts-topo-suite-user>

- **Other JTS resources**

- Javadoc
- References
- FAQ
- more to come...

<http://tsusiatsoftware.net/jts/main.html>