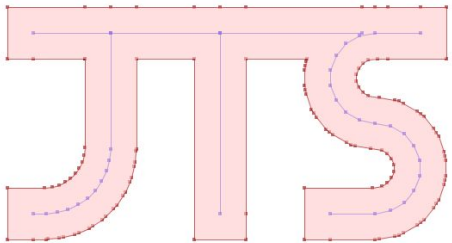


State of JTS

Presented by:
James, Jody, Rob, (Martin)

LocationTech

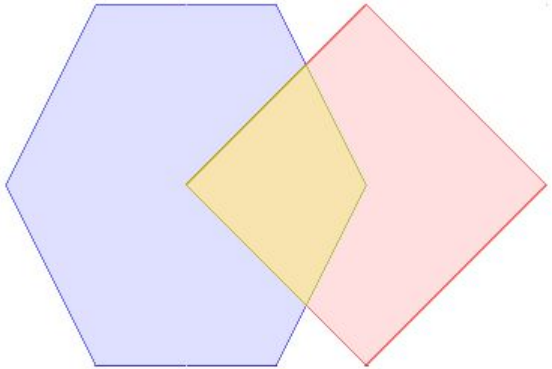
Welcome

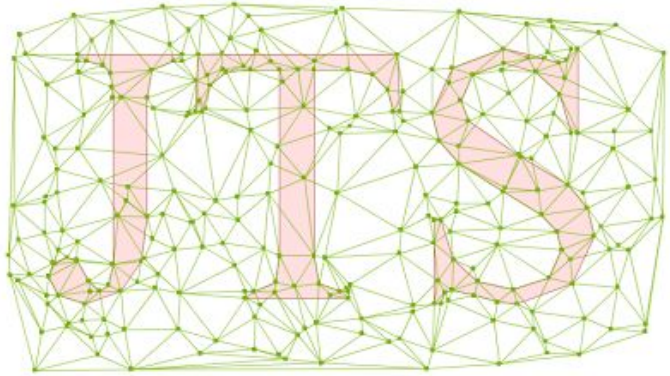
Martin Davis	James Hughes	Jody Garnett	Rob Emanuele
Vivid Solutions	CCRi	Boundless	Azavea

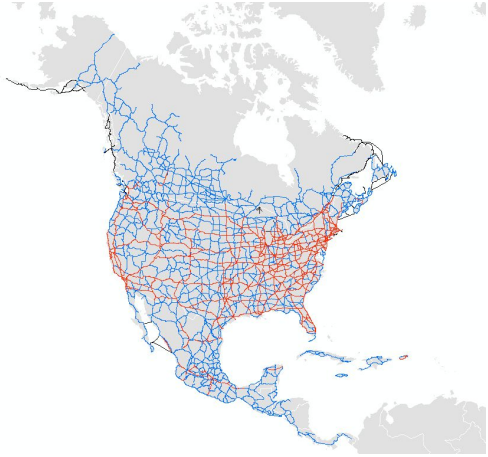
Introducing
JTS Topology Suite

What is JTS Topology Suite?

Java API for working with **2D Geometries**



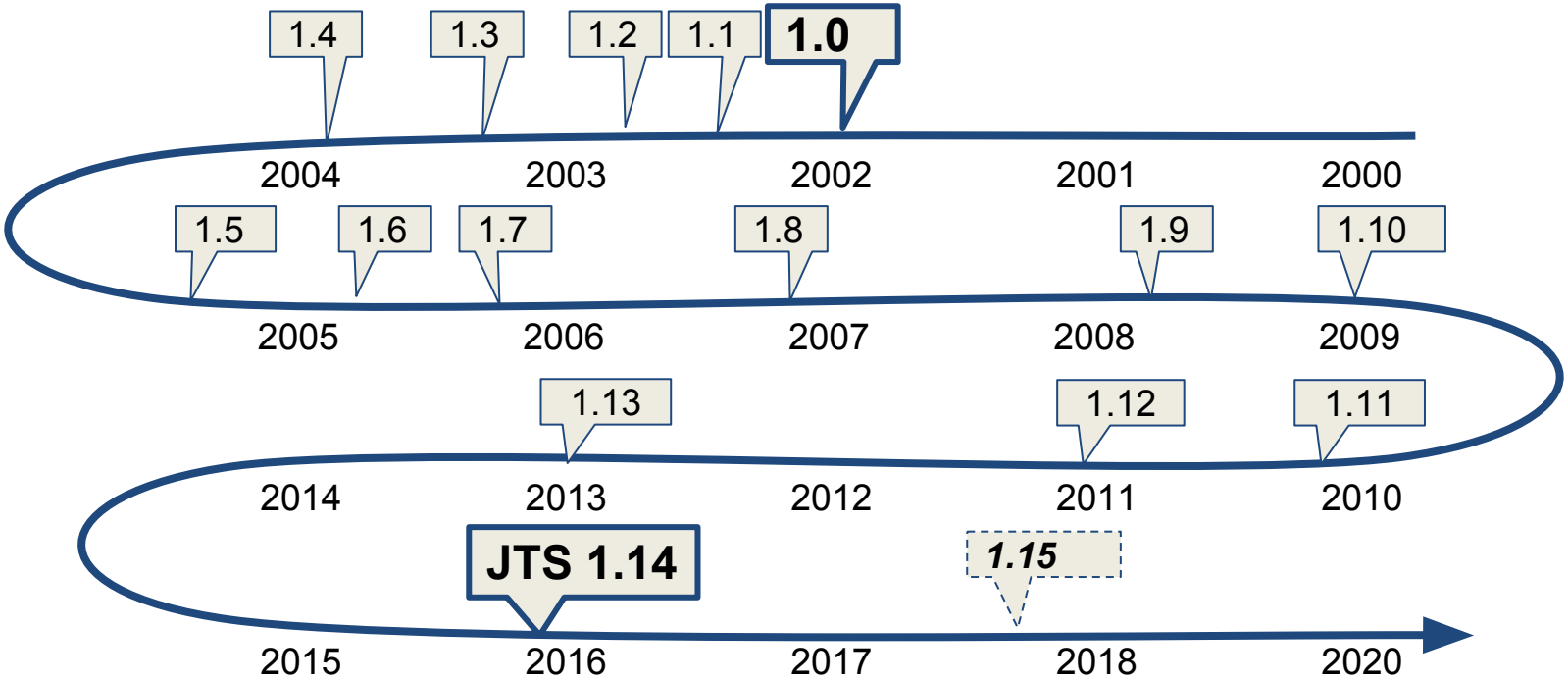




JTS is EVERYWHERE

Net Topology Suite

JTS Project History



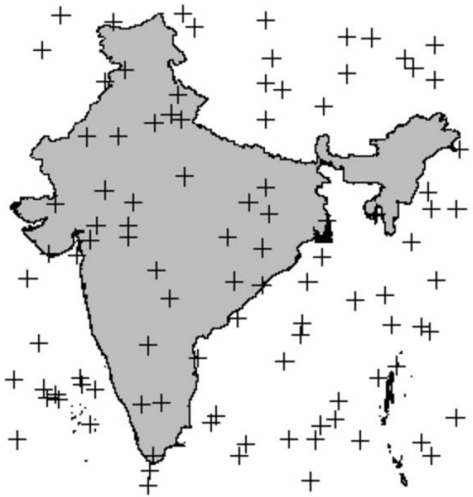
LocationTech

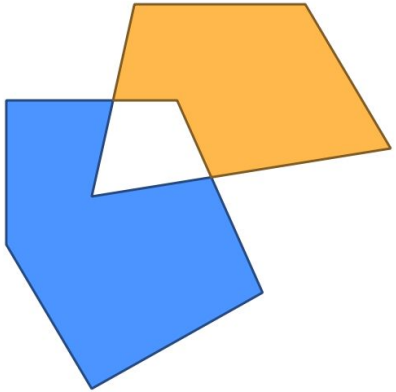
JTS Topology Suite

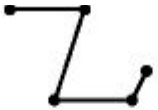
Reprentations:

OGC Simple Features

- Point
- LineString
- LinearRing
- Polygon
- MultiPoint
- MultiLineString
- MultiPolygon
- GeometryCollection





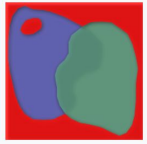


OGC®
Making location count.

JTS Topology Suite

Predicates (DE-9IM)

- Equals
- Disjoin
- Intersects
- Touches
- Crosses
- Within
- Contains
- Overlaps
- Covers
- CoveredBy

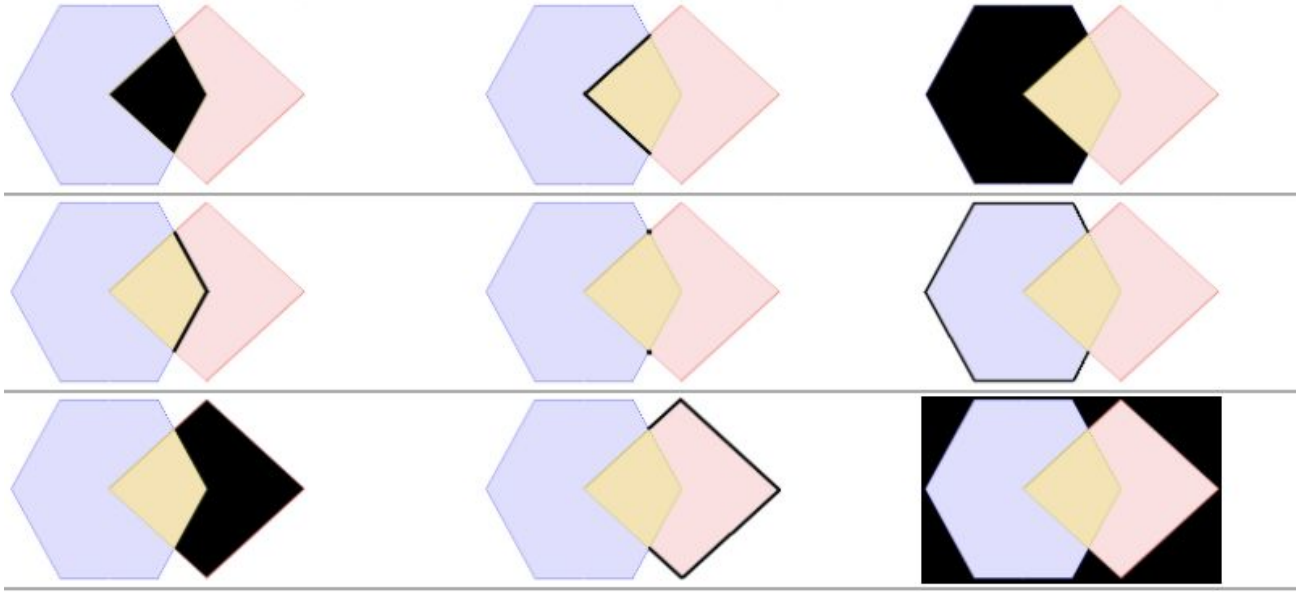
	Interior	Boundary	Exterior
Interior	 $\dim[I(a) \cap I(b)] = 2$	 $\dim[I(a) \cap B(b)] = 1$	 $\dim[I(a) \cap E(b)] = 2$
Boundary	 $\dim[B(a) \cap I(b)] = 1$	 $\dim[B(a) \cap B(b)] = 0$	 $\dim[B(a) \cap E(b)] = 1$
Exterior	 $\dim[E(a) \cap I(b)] = 2$	 $\dim[E(a) \cap B(b)] = 1$	 $\dim[E(a) \cap E(b)] = 2$

LocationTech

JTS Topology Suite

Overlays

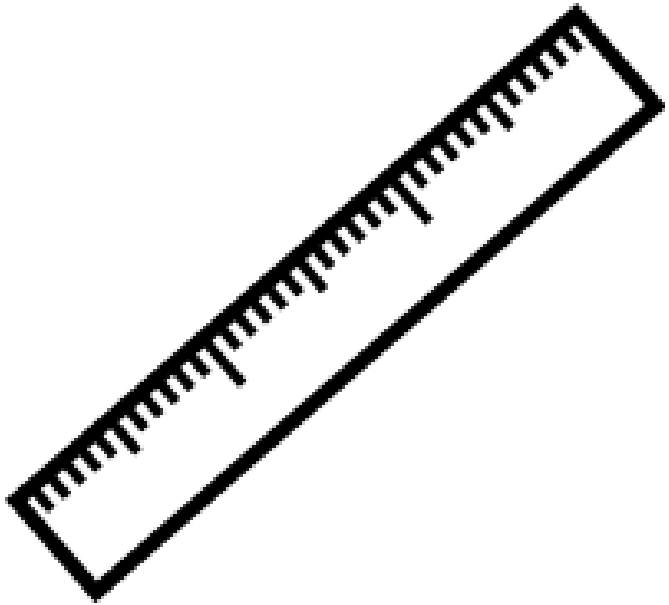
- Intersection
- Union
- Difference
- SymDifference



JTS Topology Suite

Measurements

- Length
- Area
- Distance



JTS Topology Suite

IO:

- WKT
- WKB
- GeoJSON
- KML

```
wkt_geom
Polygon ((-105.03792611059080286
39.780147822254917 86, -105.04818400099962616
39.75856265597848704, -105.02284438556741009
39.75418720873850731, -105.01231287864754904
39.76789982851657612, -105.01364722199988933
39.78389171288461768, -105.03792611059080286
39.780147822254917 86))
```

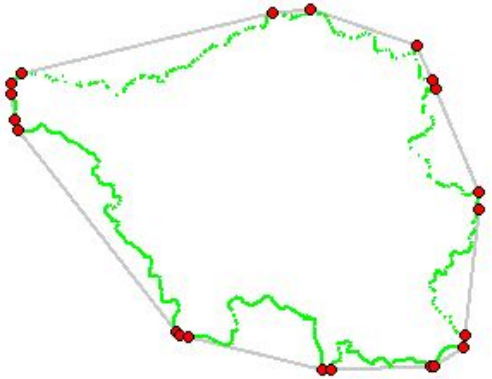
```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
    <Placemark>
        <name>Study site</name>
        <description>Forest inventory study</descript
        <Polygon>
            <outerBoundaryIs>
                <LinearRing>
                    <coordinates>
                        -94.765829,31.505884,0
                        -94.762480,31.506556,0
                        -94.763288,31.509076,0
                        -94.766736,31.508471,0
                        -94.765829,31.505884,0
                    </coordinates>
                </LinearRing>
            </outerBoundaryIs>
        </Polygon>
    </Placemark>
</kml>
```

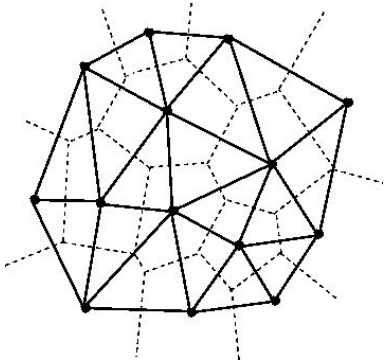
```
{
  "type": "Feature",
  "geometry": {
    "type": "Point",
    "coordinates": [
      -122.65335738658904,
      45.512083676585156
    ]
  },
  "properties": {
    "name": "Hungry Heart Cupcakes",
    "address": "1212 SE Hawthorne Boulevard",
    "website": "http://www.hungryheartcupcakes.com",
    "gluten free": "no"
  }
}
```

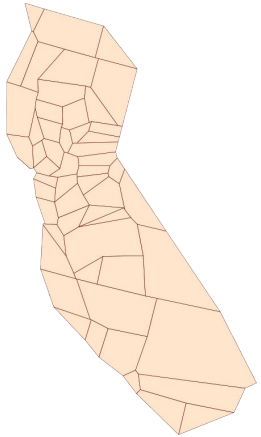
JTS Topology Suite

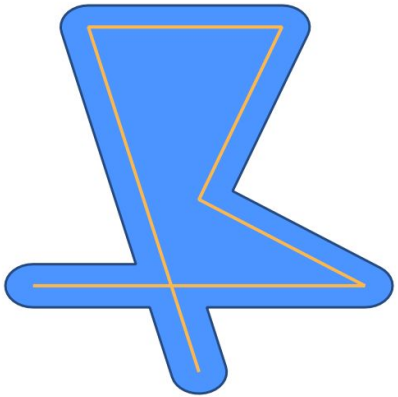
Algorithms

- Convex Hull
- Buffer
- Validation
- Dissolve
- Polygonization
- Simplification
- Triangulation
- Voronoi
- Linear Referencing
- and more...





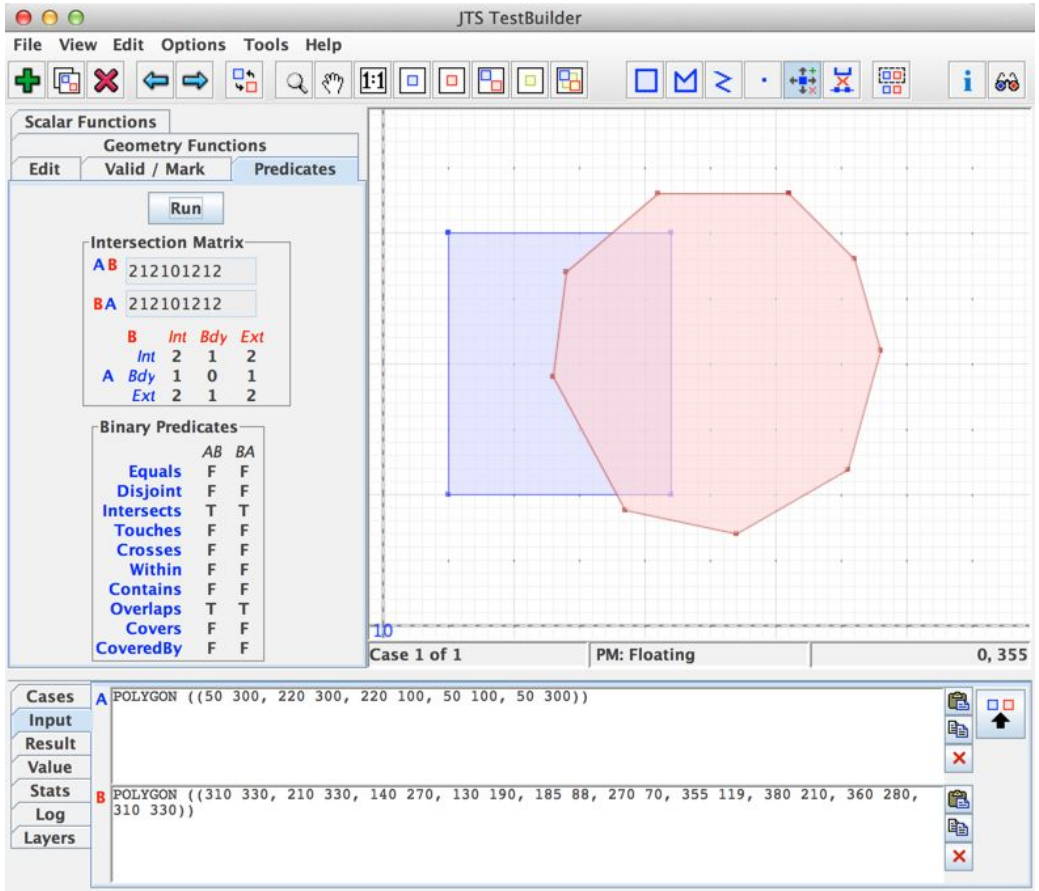




JTS Topology Suite

Applications

- TestBuilder
- TestRunner

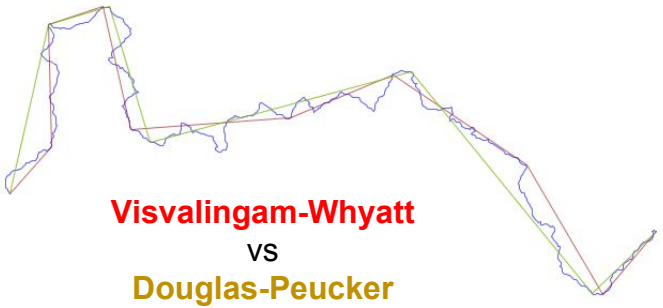


JTS 1.14

JTS 1.14 Released

January 2016

- LineDissolver
- edgegraph package
- Visvalingam-Whyatt simplification



Visvalingam-Whyatt
vs
Douglas-Peucker

Improvements:

- Improved thread-safety
- Fixed Java 7 compatibility
- Added Spatialite WKB
- CoordinateSequence
- many bug fixes and performance improvements

JTS I/O

- KML Writer
- GeoJsonReader/Writer
- Oracle SDO Performance

JTS 1.14 with Maven

JTS 1.14

```
<dependency>
    <groupId>com.vividsolutions</groupId>
    <artifactId>jts-core</artifactId>
    <version>1.14.0</version>
</dependency>
```

Published

Official release on SF

- Install into local repo

On Maven Central

- We do not know who did this!

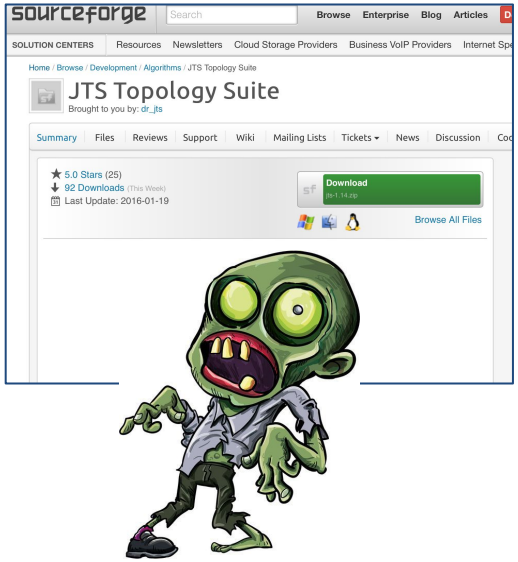
JTS 1.15

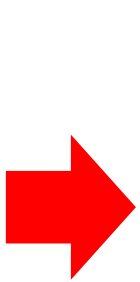
JTS 1.15

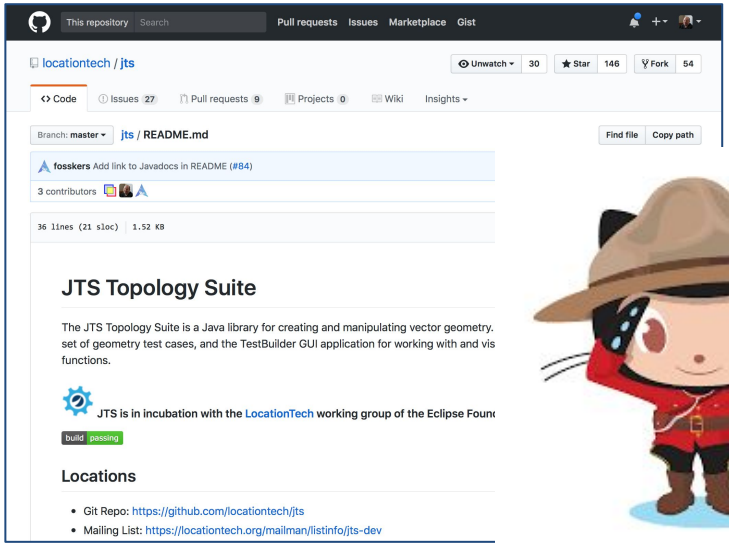
- Focus on codebase
  - organization and packaging
- Some functionality improvements
  - K Nearest Neighbor search for STR-Tree
  - Improve handling of Quadtree queries with null Envelope
  - Intersects now supports GeometryCollection
  - JTSTestRunnerCmd command-line app

Sourceforge → GitHub

- Moving from SVN to GIT
- https://github.com/locationtech/jts





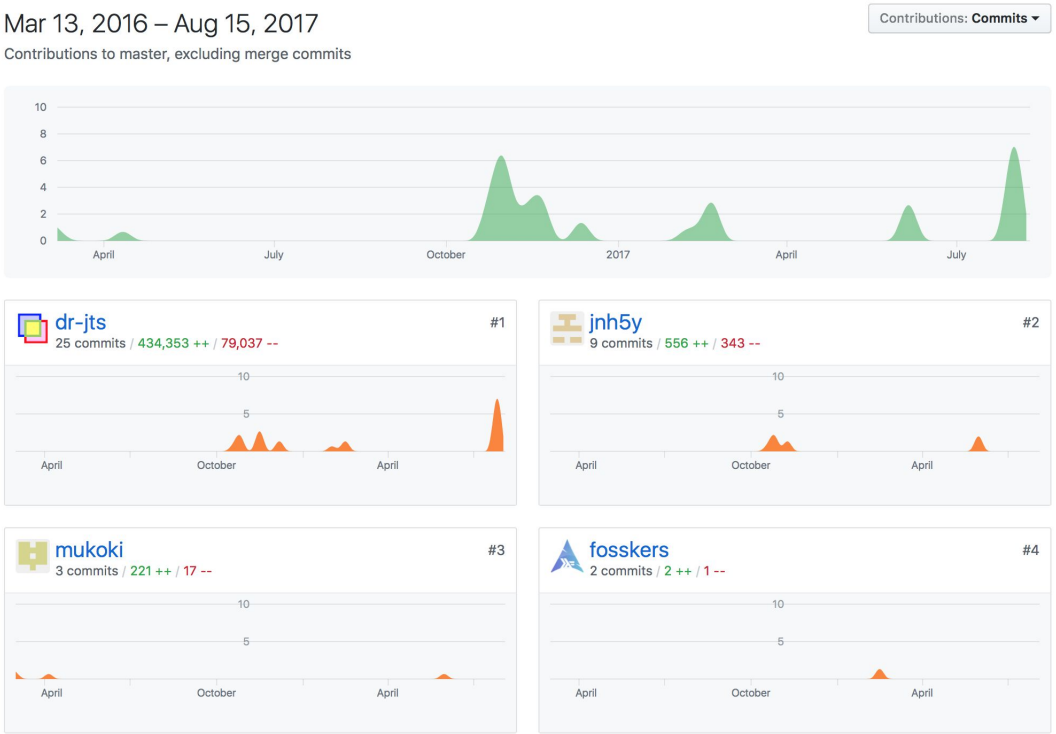


Why choose GitHub?

- High Visibility
- Great tools
  - Git tools
  - Issue tracking
  - Pull Requests
  - Continuous Integration
  - Website
- Easier for contributions
- Where the action is!

GitHub: JTS Project Activity

- Pull Requests
  - 76 accepted, 8 open
- Issues
  - 7 closed, 25 open



Mavenization

- Build chain now uses Maven instead of Ant
  - Easier to build and use
  - Easy Eclipse IDE configuration
- Unit tests run by Maven build
  - including XML tests
- Better release story
  - Code artifacts will be hosted on Maven Central
  - Apps built as fat-jars (TestBuilder, TestRunner)
- To Do
  - Work on packaging a distro with source, scripts, etc...

Modular Codebase

- Codebase organized into modules
  - **jts-core** - geometry implementation for use
  - **jts-tests** - extensive testing for correctness and stability
  - **jts-io** - read and write geometry
  - **jts-example** - examples of using the jts api
  - **jts-lab** - experimental playground use at your own risk
  - **jts-app** - test builder application for defining tests
- better clarity of internal dependencies

JTS Joins LocationTech

- LocationTech offers
  - project infrastructure
  - project visibility
  - stability, governance
- Immediate benefits
  - More team members
  - Synergy with other LocationTech projects
  - In-depth legal review for IP (Intellectual Property) cleanliness
- Initial Work
  - Project Application
  - License Change
  - LocationTech Incubation
- Long term hopes
  - Additional Contributors
  - Funding for JTS 2.0
  - Build Infrastructure
  - Official Maven Deployment

LocationTech Incubation

A new License

- Eclipse Public License
- Eclipse Distribution License (BSD-3 Clause License)

Challenges:

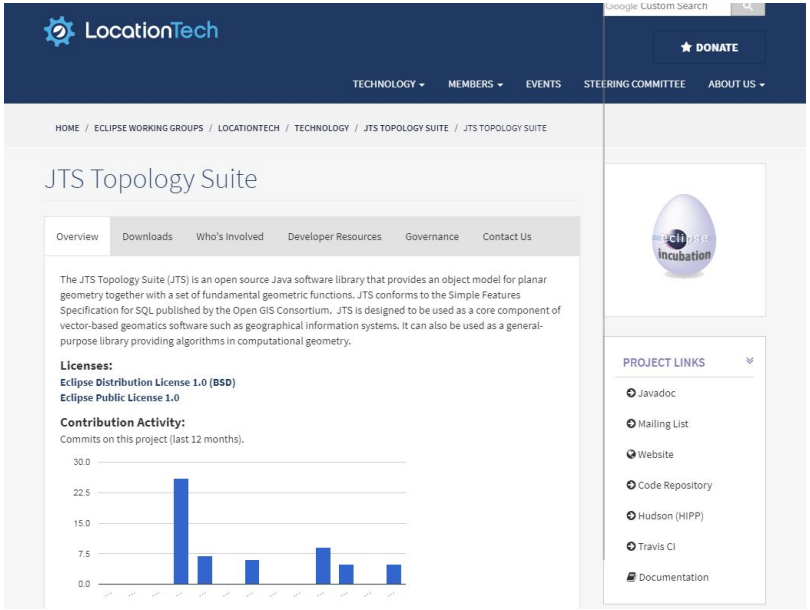
- Contact assorted contributors (because we did not have a CLA)
- changing package names
- Opportunity to work together
- Maintaining codebase history

A new home:

- Project Website
- Mailing List
- Build Server
- GitHub repo

LocationTech Project Site

- **`www.locationtech.org/projects/technology.jts`**



JTS 1.15-SNAPSHOT

- Packaging
  - `org.locationtech.jts`
- GitHub repo
  - https://github.com/locationtech/jts
- Snapshots Available via LT Nexus
  - https://repo.locationtech.org/

Using JTS 1.15 with Maven

JTS 1.14

```
<dependency>
    <groupId>com.vividsolutions</groupId>
    <artifactId>jts-core</artifactId>
    <version>1.14.0</version>
</dependency>
```

JTS 1.15.0-SNAPSHOT

```
<dependency>
    <groupId>org.locationtech.jts</groupId>
    <artifactId>jts-core</artifactId>
    <version>1.15.0-SNAPSHOT</version>
</dependency>
....
 <repositories>
    <repository>
        <id>locationtech-snapshots</id>
        <url>https://repo.locationtech.org/content/groups/snapshots</url>
        <snapshots>
            <enabled>true</enabled>
        </snapshots>
    </repository>
 </repositories>
```

Migration to JTS 1.15

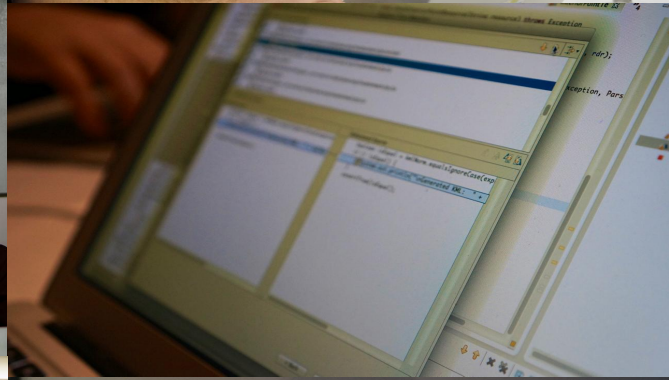
- New module structure
  - `jts-core`
  - `jts-io-common` - GeoJSON
  - `jts-io-ora` - Oracle support
  - `jts-io-sde` - SDE support
  - `jts-tests` - XML Tests & TestRunner
- Change package names
  - `org.locationtech.jts.*`
- Change Maven reference
  - *To be determined…*

Team Code Sprints

- Dates
  - January 25-27, 2016
  - November 3-4, 2016
- Achievements
  - Sourceforge → GitHub
  - Mavenization
  - New Committers
  - Addressed IP review questions






JTS 1.15 Coming Soon!

- Coming soon to a repo near you!
  - Incubation is nearly complete
- LocationTech Release process
  - Final IP issues being resolved
    (checking in new icons for the test builder application)
  - Two week release review
- Deploy to Maven Central (and LocationTech repo)

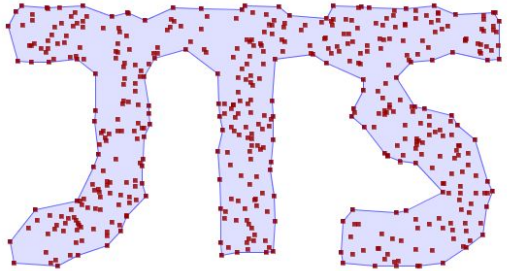
Roadmap / Wishlist

Algorithm Improvements

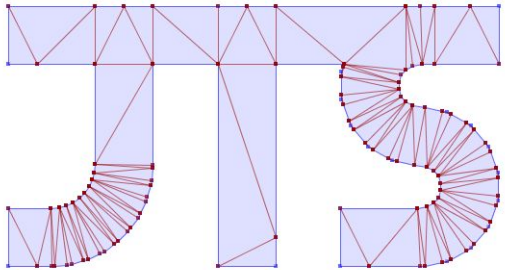
- Goal: improve some key JTS algorithms
  - Overlay
    - Snap-rounding (no more TopologyExceptions!)
    - Support PreparedGeometry for caching
    - Fast & robust Clip to Rectangle
  - Spatial Predicate improvements
    - Streaming / Lazy evaluation with short-circuiting
    - User-defined precision model
    - Less sensitive to valid geometry (e.g. Intersects)
  - Distance
    - Support cached PreparedGeometry

New Algorithms

- Concave Hull
- Polygon Triangulation
- Polygon Cleaning (“MakeValid”)
- Split Geometry by Line
- Polygon Coverage Simplification



Concave Hull



Polygon Triangulation

New API - JTS 2.0

- Concept for a redesign of JTS
- Key Goals
  - Interface-based Geometry access
  - Immutable Geometry objects
  - Geodetic (WGS84) support, with some basic algorithms
  - Pluggable/discoverable Geometry operation framework
  - Coordinate extensions (XY, XY+M)
- Non-goals
  - Backwards compatibility
  - Improving geometry algorithms

Join JTS Topology Suite

Shape the Future

Contributing to JTS

- Register as a Contributor
  - Sign the Eclipse Contributor Agreement
  - https://www.eclipse.org/legal/ECA.php
- Develop a patch, making sure to include
  - Javadoc
  - Unit Tests - JUnit and/or JTS XML tests
- Make a Pull Request on GitHub
  - Acknowledge code is IP clean by signing-off each Git commit
  - Make sure the Travis CI validation tests pass

See also https://github.com/locationtech/jts/blob/master/CONTRIBUTING.md

Questions?

Project Resources

- Source Code repo
  - https://github.com/locationtech/jts
- Issue Tracker
  - https://github.com/locationtech/jts/issues
- Mailing List
  - https://dev.locationtech.org/mailman/listinfo/jts-dev
- Project website
  - https://locationtech.github.io/jts
- Javadoc
  - https://locationtech.github.io/jts/javadoc

Thank you from the JTS Team

What is JTS Topology Suite

- Java API for **2D Geometry**
  - linear vector geometry
  - representing and processing
- Featuring:
  - Validation, Polygonization, Simplification, Linear Referencing, etc.
- Apps
  - TestRunner
  - TestBuilder

- **OGC Simple Features for SQL**
  - full geometry specification:
- **Geometry:**
  - Points, Linestring, Polygons
  - Collections
- **Metrics:**
  - Length, Area, Distance
- **Predicates:**
  - intersects, contains, etc.; relate for DE-9IM
- **Overlay:**
  - intersection, union, difference, symDifference
- **Algorithms:**
  - Convex Hull, Buffer

JTS in LT projects (and others)

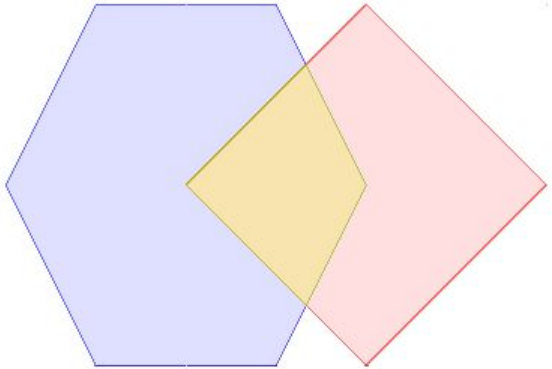
- LocationTech projects using JTS
  - GeoMesa - geoanalytics for big data
  - GeoTrellis - geoprocessing for big data
  - Spatial4J - geodetic geometry API

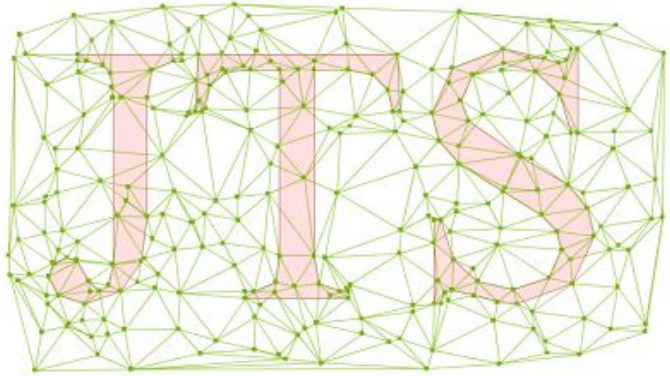
- Also by some interesting research projects
  - GeoSpark (https://github.com/DataSystemsLab/GeoSpark)
  - Simba - Spatial In-Memory Big data Analytics (https://github.com/InitialDLab/Simba)

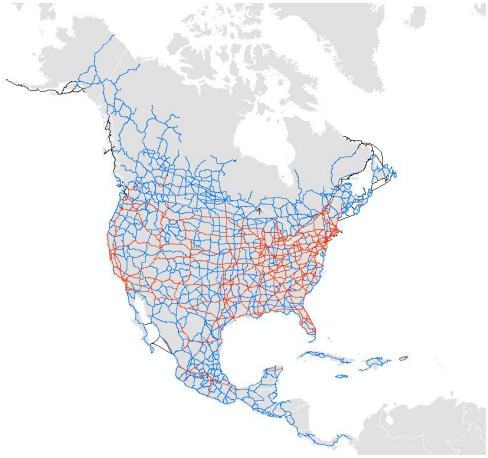
GeoSpark

What is JTS Topology Suite?

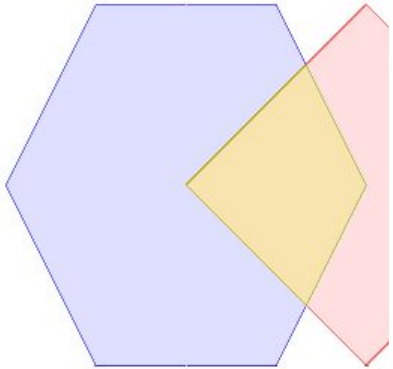
Java API for **2D Geometries**

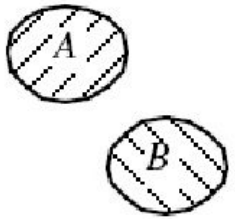
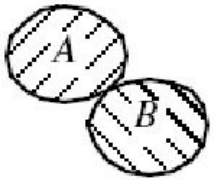
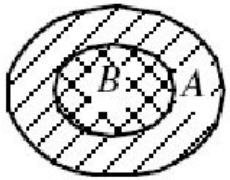
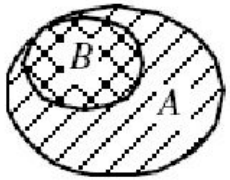
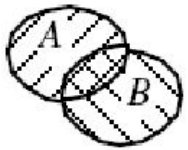
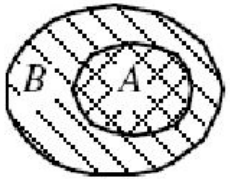
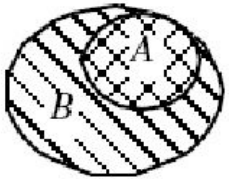


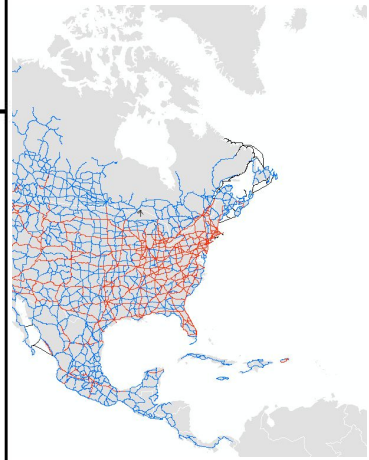




Wha…iite?



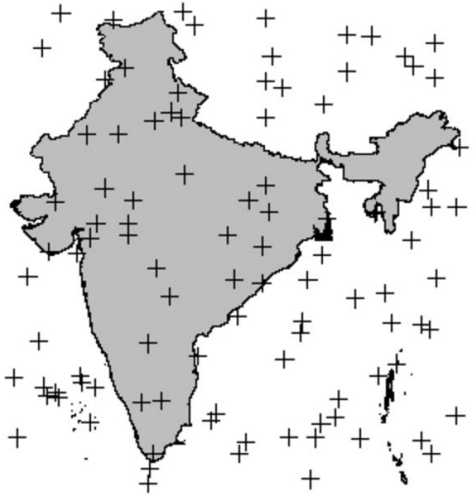
			
$\begin{matrix} & \partial B & B^\circ \\ \partial A & \varnothing & \varnothing \\ A^\circ & \varnothing & \varnothing \end{matrix}$	$\begin{matrix} & \partial B & B^\circ \\ \partial A & \neg\varnothing & \varnothing \\ A^\circ & \varnothing & \varnothing \end{matrix}$	$\begin{matrix} & \partial B & B^\circ \\ \partial A & \varnothing & \varnothing \\ A^\circ & \neg\varnothing & \neg\varnothing \end{matrix}$	$\begin{matrix} & \partial B & B^\circ \\ \partial A & \neg\varnothing & \varnothing \\ A^\circ & \neg\varnothing & \neg\varnothing \end{matrix}$
disjoint	*meet*	*contains*	*covers*
			
$\begin{matrix} & \partial B & B^\circ \\ \partial A & \neg\varnothing & \varnothing \\ A^\circ & \varnothing & \neg\varnothing \end{matrix}$	$\begin{matrix} & \partial B & B^\circ \\ \partial A & \neg\varnothing & \neg\varnothing \\ A^\circ & \neg\varnothing & \neg\varnothing \end{matrix}$	$\begin{matrix} & \partial B & B^\circ \\ \partial A & \varnothing & \neg\varnothing \\ A^\circ & \varnothing & \neg\varnothing \end{matrix}$	$\begin{matrix} & \partial B & B^\circ \\ \partial A & \neg\varnothing & \neg\varnothing \\ A^\circ & \varnothing & \neg\varnothing \end{matrix}$
equal	*overlap*	*inside*	*coveredBy*

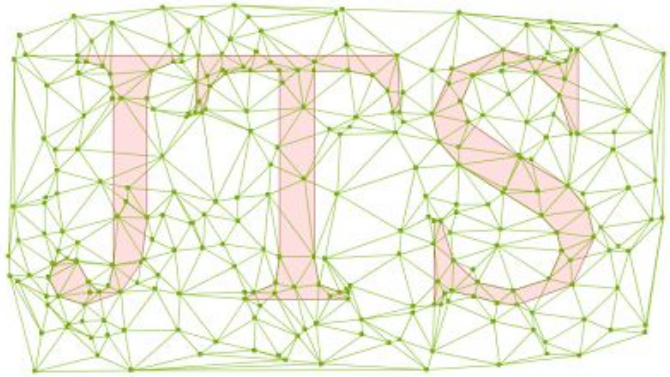


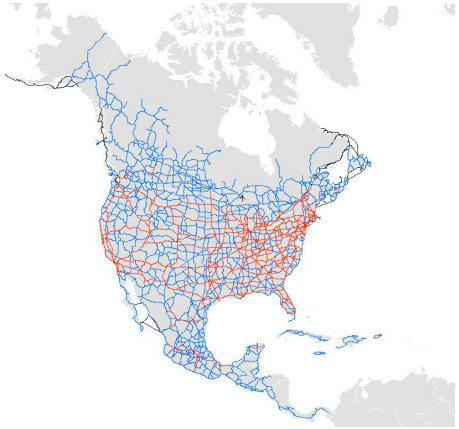
Location

What is JTS Topology Suite?

Java API for **2D Geometries**







What is JTS Topology Suite

- Java API for **2D Geometry**
  - linear vector geometry
  - representing and processing
- Featuring:
  - Validation, Polygonization, Simplification, Linear Referencing, etc.
- Apps
  - TestRunner
  - TestBuilder

- **OGC Simple Features for SQL**
  - full geometry specification:
- **Geometry:**
  - Points, Linestring, Polygons
  - Collections
- **Metrics:**
  - Length, Area, Distance
- **Predicates:**
  - intersects, contains, etc.; relate for DE-9IM
- **Overlay:**
  - intersection, union, difference, symDifference
- **Algorithms:**
  - Convex Hull, Buffer