



State of JTS

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

The letters 'JTS' are rendered in a light pink, rounded font. Each letter is outlined with a dashed line, suggesting a path or trajectory. The 'J' has a curved path at the bottom, the 'T' is a straight vertical line, and the 'S' is a continuous curved path.

LocationTech

Welcome

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

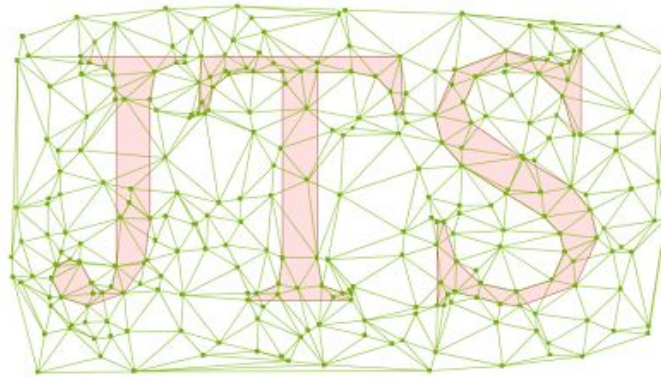
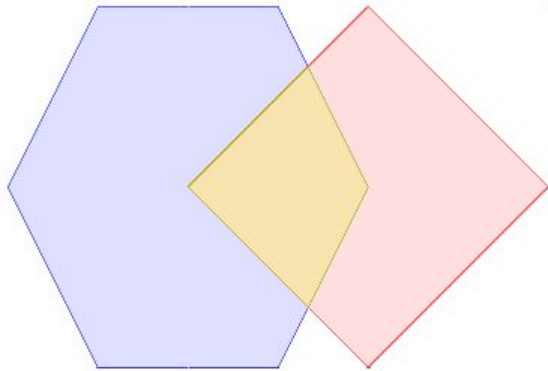




Introducing JTS Topology Suite

What is JTS Topology Suite?

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



JTS is EVERYWHERE

Net Topology Suite

JTS

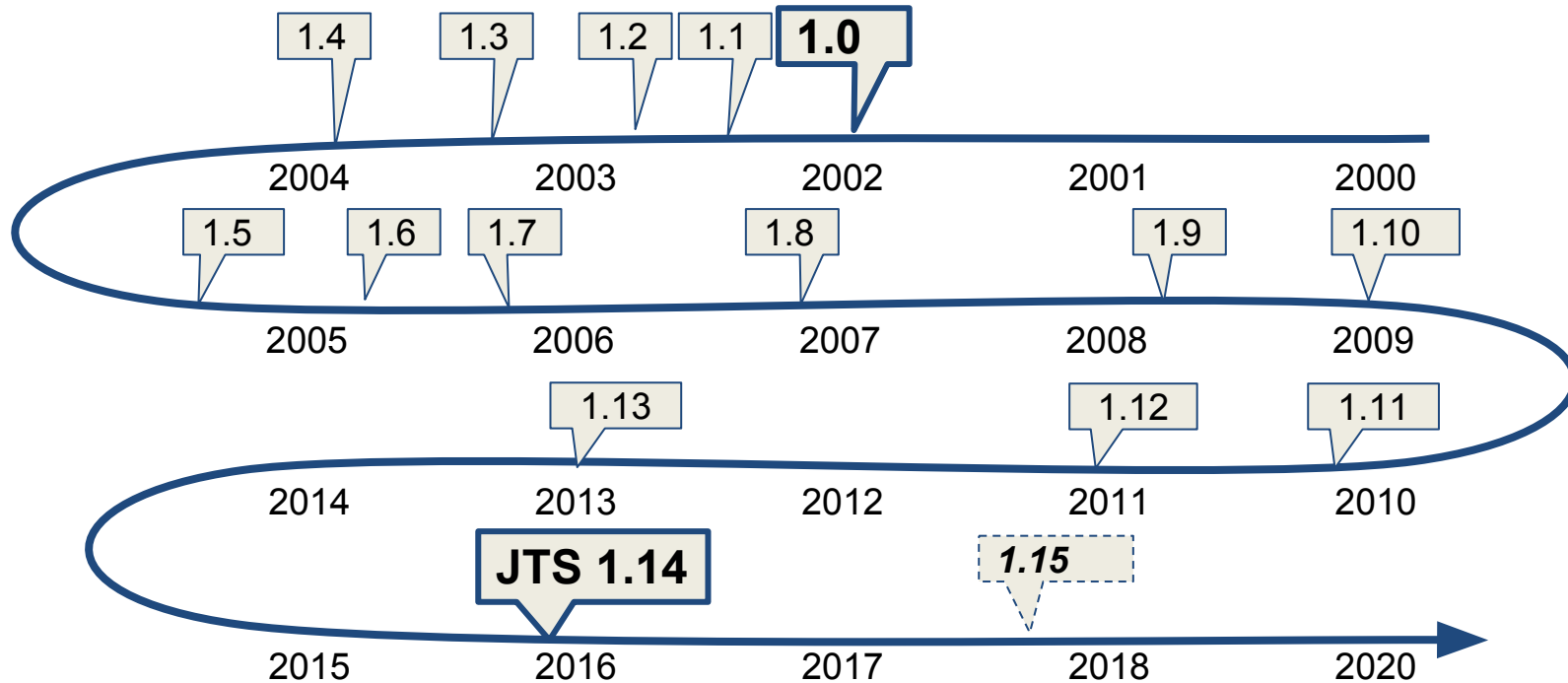


GEOS

JTS



JTS Project History

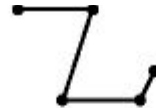
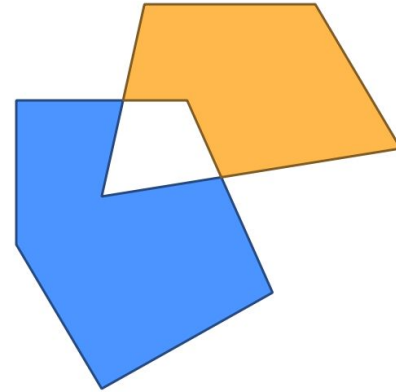
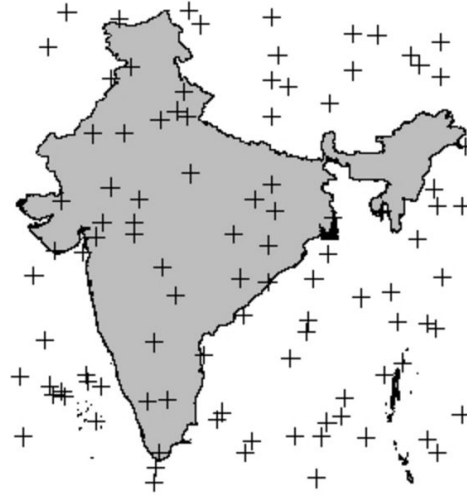


JTS Topology Suite

Representations:

OGC Simple Features

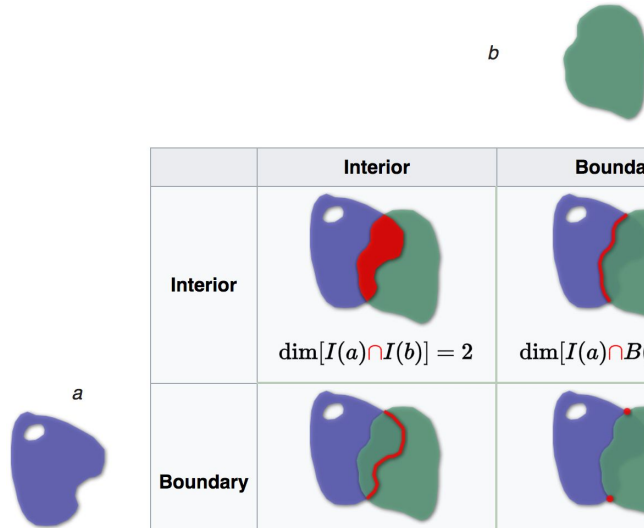
- Point
- LineString
- LinearRing
- Polygon
- MultiPoint
- MultiLineString
- MultiPolygon
- GeometryCollection



JTS Topology Suite

Predicates (DE-9IM)

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

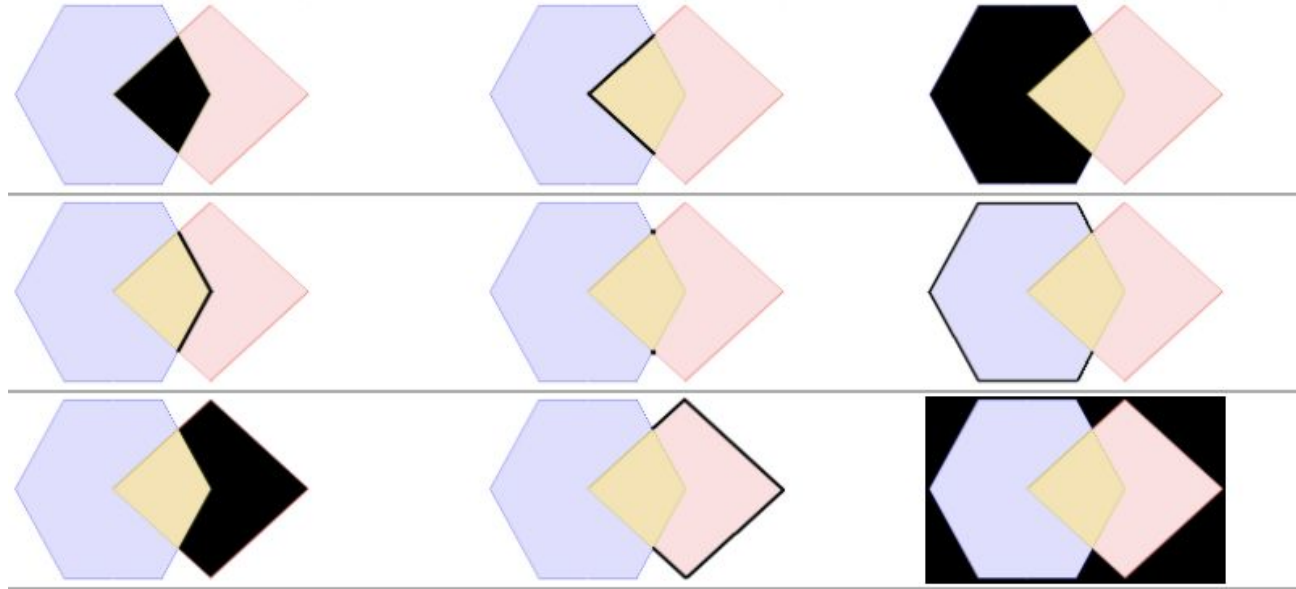


	Interior	Boundary	Exterior
Interior	 $\dim[I(a) \cap I(b)] = 2$	 $\dim[I(a) \cap B(b)] = 1$	 $\dim[I(a) \cap E(b)] = 2$
Boundary	 $\dim[B(a) \cap I(b)] = 1$	 $\dim[B(a) \cap B(b)] = 0$	 $\dim[B(a) \cap E(b)] = 1$
Exterior	 $\dim[E(a) \cap I(b)] = 2$	 $\dim[E(a) \cap B(b)] = 1$	 $\dim[E(a) \cap E(b)]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

JTS Topology Suite

Overlays

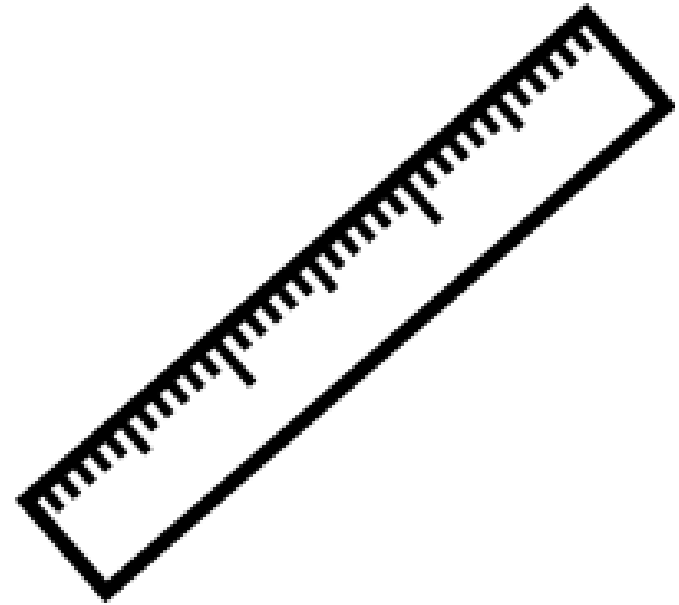
- Intersection
- Union
- Difference
- SymDifference



JTS Topology Suite

Measurements

- Length
- Area
- Distance



JTS Topology Suite

IO:

- WKT
- WKB
- GeoJSON
- KML

```
wkt_geom
Polygon ((-105.03792611059080286
39.78014782225491786, -105.04818400099962616
39.75856265597848704, -105.02284438556741009
39.75418720873850731, -105.01231287864754904
39.76789982851657612, -105.01364722199988933
39.78389171288461768, -105.03792611059080286
39.78014782225491786))
```

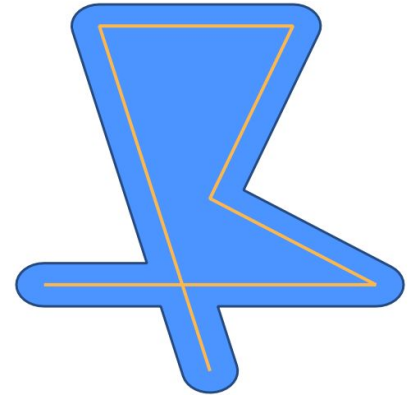
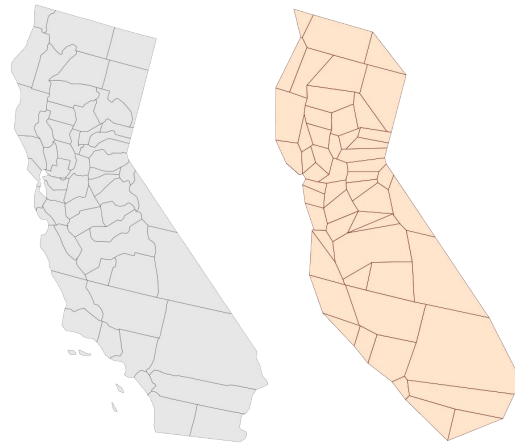
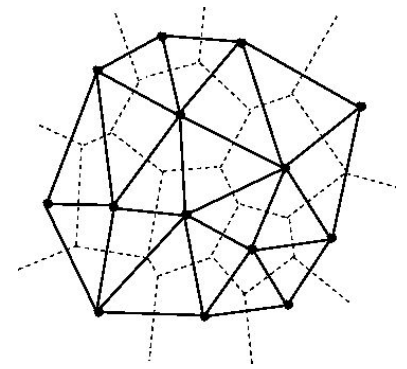
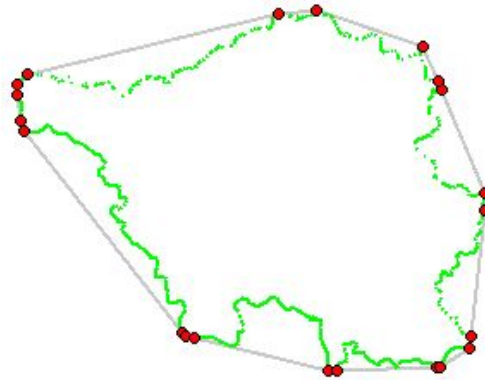
```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
  <Placemark>
    <name>Study site</name>
    <description>Forest inventory study</descript
    <Polygon>
      <outerBoundaryIs>
        <LinearRing>
          <coordinates>
            -94.765829,31.505884,0
  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

The screenshot shows the JTS TestBuilder application interface. The main window displays a grid with a blue square and a red polygon. The polygon overlaps the square. The interface includes a menu bar (File, View, Edit, Options, Tools, Help), a toolbar with various icons, and a left-hand panel with tabs for Scalar Functions, Geometry Functions, and Predicates. The Predicates tab is active, showing an Intersection Matrix and a table of Binary Predicates. The bottom status bar indicates 'Case 1 of 1' and 'PM: Floating'.

Scalar Functions

Geometry Functions

Edit Valid / Mark Predicates

Run

Intersection Matrix

A B	2	1	2	1	2
B A	2	1	2	1	2
B	Int	Bdy	Ext		
Int	2	1	2		
A	Bdy	1	0	1	
Ext	2	1	2		

Binary Predicates

	AB	BA
Equals	F	F
Disjoint	F	F
Intersects	T	T
Touches	F	F
Crosses	F	F
Within	F	F
Contains	F	F
Overlaps	T	T
Covers	F	F
CoveredBy	F	F

Case 1 of 1 PM: Floating 0, 355

Cases

Input A POLYGON ((50 300, 220 300, 220 100, 50 100, 50 300))

Result

Value

Stats B POLYGON ((310 330, 210 330, 140 270, 130 190, 185 88, 270 70, 355 119, 380 210, 360 280, 310 330))

Log

Layers



JTS 1.14

JTS 1.14 Released

January 2016

- LineDissolver
- edgegraph package
- Visvalingam-Whyatt simplification



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

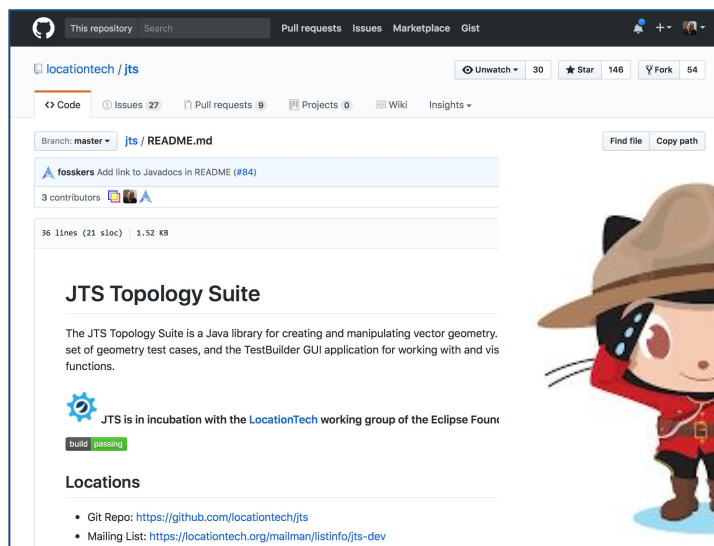
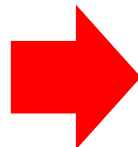
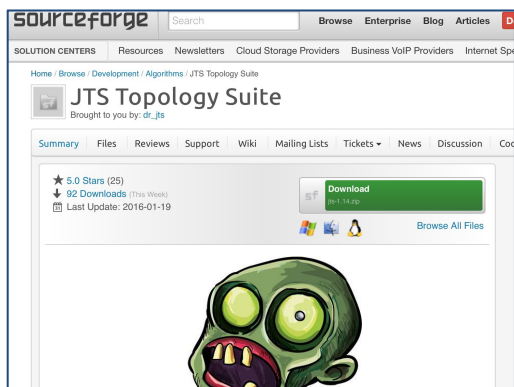
JTS 1.15

- 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!



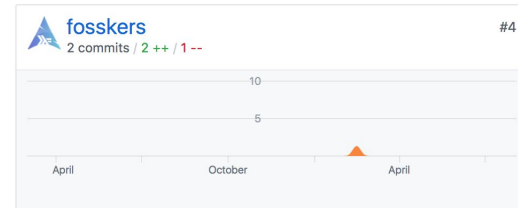
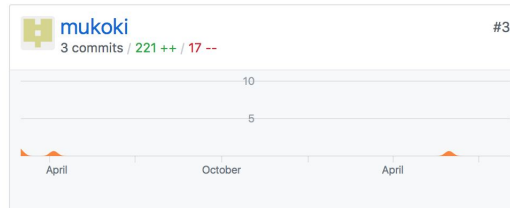
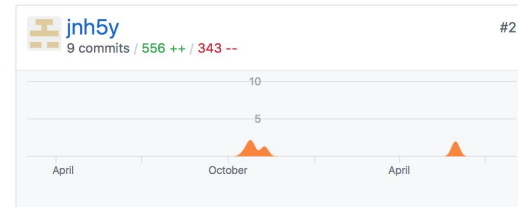
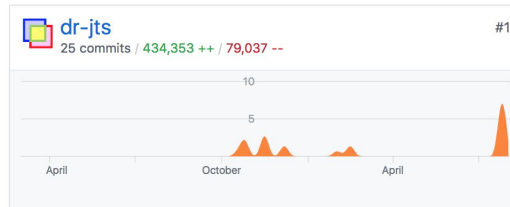
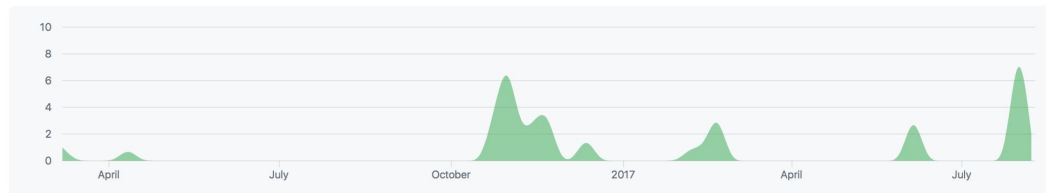
GitHub: JTS Project Activity

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

Mar 13, 2016 – Aug 15, 2017

Contributions: **Commits** ▾

Contributions to master, excluding merge commits



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

The screenshot shows the LocationTech website interface. The top navigation bar includes the LocationTech logo, a search bar, and a 'DONATE' button. The main navigation menu contains links for TECHNOLOGY, MEMBERS, EVENTS, STEERING COMMITTEE, and ABOUT US. The breadcrumb trail reads: HOME / ECLIPSE WORKING GROUPS / LOCATIONTECH / TECHNOLOGY / JTS TOPOLOGY SUITE / JTS TOPOLOGY SUITE. The page title is 'JTS Topology Suite'. Below the title is a sub-navigation menu with tabs for Overview, Downloads, Who's Involved, Developer Resources, Governance, and Contact Us. The main content area features a description of the JTS Topology Suite as an open source Java software library. It lists the licenses: Eclipse Distribution License 1.0 (BSD) and Eclipse Public License 1.0. A 'Contribution Activity' section includes a bar chart showing commits over time. The right sidebar contains an 'Eclipse Incubation' logo and a 'PROJECT LINKS' section with links to Javadoc, Mailing List, Website, Code Repository, Hudson (HIPP), Travis CI, and Documentation.

LocationTech

TECHNOLOGY ▾ MEMBERS ▾ EVENTS STEERING COMMITTEE ABOUT US ▾

HOME / ECLIPSE WORKING GROUPS / LOCATIONTECH / TECHNOLOGY / JTS TOPOLOGY SUITE / JTS TOPOLOGY SUITE

JTS Topology Suite

Overview Downloads Who's Involved Developer Resources Governance Contact Us

The JTS Topology Suite (JTS) is an open source Java software library that provides an object model for planar geometry together with a set of fundamental geometric functions. JTS conforms to the Simple Features Specification for SQL published by the Open GIS Consortium. JTS is designed to be used as a core component of vector-based geomatics software such as geographical information systems. It can also be used as a general-purpose library providing algorithms in computational geometry.

Licenses:
Eclipse Distribution License 1.0 (BSD)
Eclipse Public License 1.0

Contribution Activity:
Commits on this project (last 12 months).

Month	Commits
12/15	0
11/15	0
10/15	0
09/15	28
08/15	6
07/15	5
06/15	0
05/15	10
04/15	4
03/15	0
02/15	5

PROJECT LINKS ▾

- Javadoc
- Mailing List
- Website
- Code Repository
- Hudson (HIPP)
- Travis CI
- Documentation

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

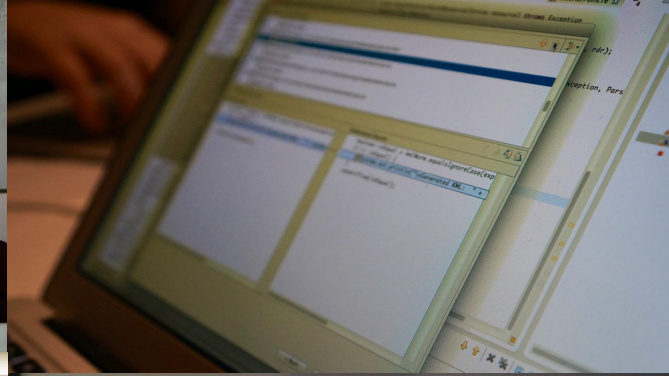
- New module structure
 - `jts-core`
 - `jts-io-common` - GeoJSON
 - `jts-io-ora` - Oracle support
 - `jts-io-sde` - SDE support
 - `jts-tests` - XML Tests & TestRunner
- Change package names
 - `org.locationtech.jts.*`
- Change Maven reference
 - *To be determined...*



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)





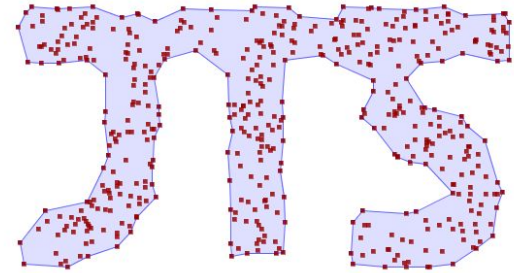
Roadmap / Wishlist

Algorithm Improvements

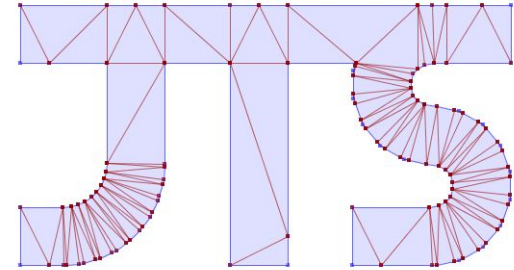
- Goal: improve some key JTS algorithms
 - Overlay
 - Snap-rounding (no more TopologyExceptions!)
 - Support PreparedGeometry for caching
 - Fast & robust Clip to Rectangle
 - Spatial Predicate improvements
 - Streaming / Lazy evaluation with short-circuiting
 - User-defined precision model
 - Less sensitive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

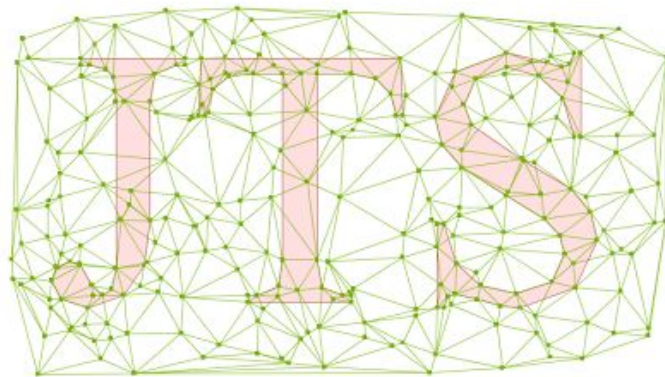
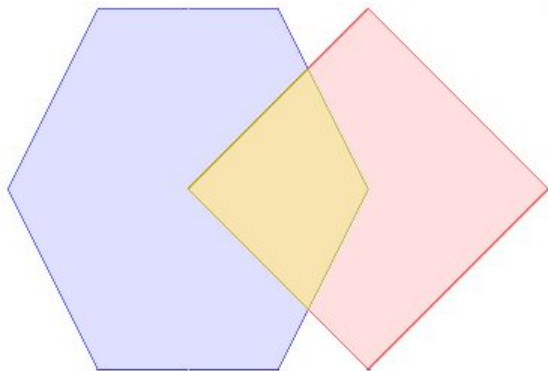
- LocationTech projects using JTS
 - GeoMesa - geanalytics for big data
 - GeoTrellis - geoprocessing for big data
 - Spatial4J - geodetic geometry API
- Also by some interesting research projects
 - GeoSpark (<https://github.com/DataSystemsLab/GeoSpark>)
 - Simba - Spatial In-Memory Big data Analytics (<https://github.com/InitialDLab/Simba>)



GeoSpark

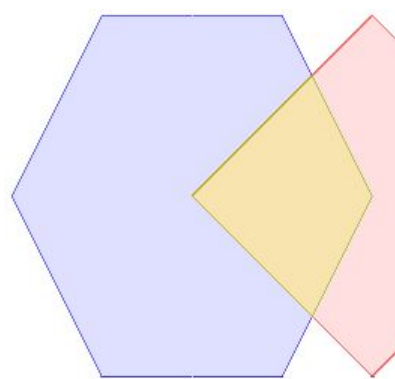
What is JTS Topology Suite?

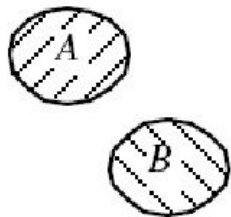
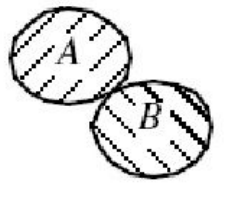
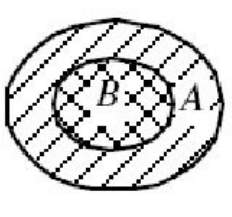
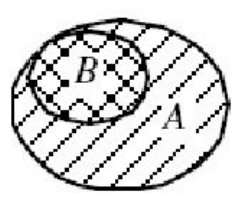
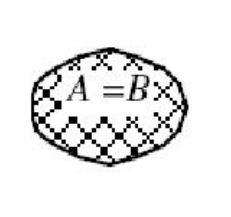
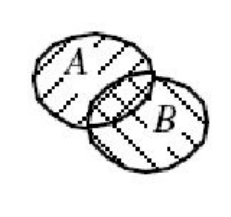
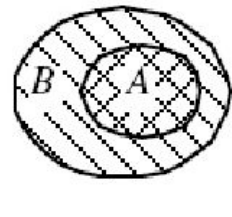

Java API for **2D Geometries**

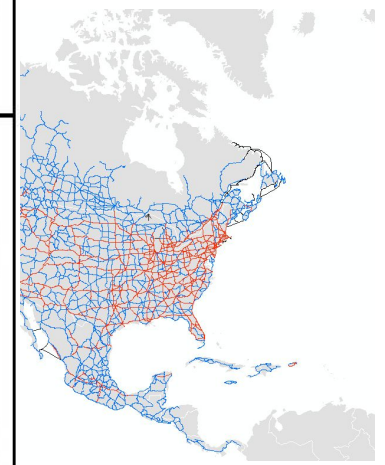


What

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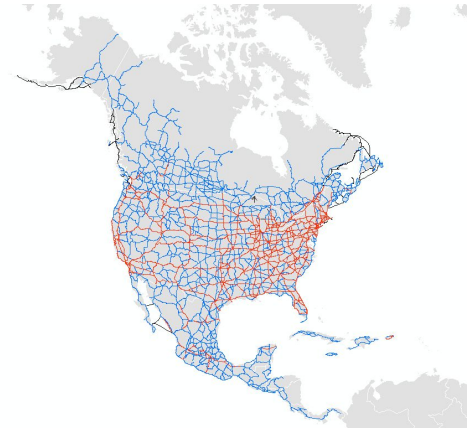
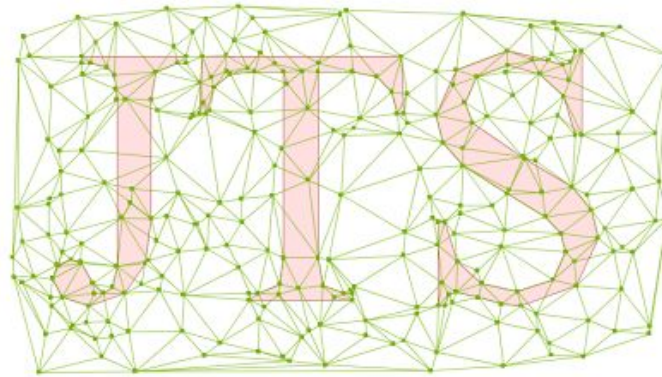
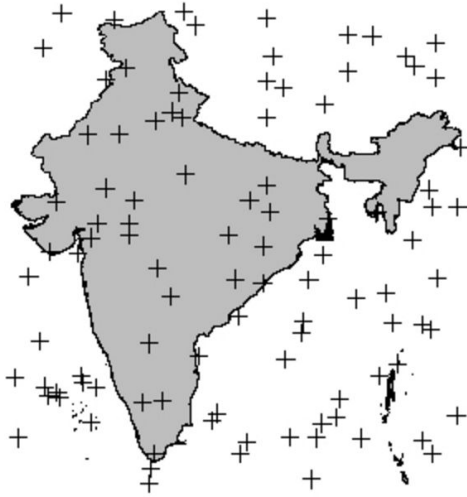


 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ \emptyset & \emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} \emptyset & \emptyset \\ \emptyset & \emptyset \end{pmatrix} \end{matrix}$ <p><i>disjoint</i></p>	 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ -\emptyset & \emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} \emptyset & \emptyset \\ \emptyset & \emptyset \end{pmatrix} \end{matrix}$ <p><i>meet</i></p>	 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ \emptyset & \emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} -\emptyset & -\emptyset \\ -\emptyset & -\emptyset \end{pmatrix} \end{matrix}$ <p><i>contains</i></p>	 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ -\emptyset & \emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} -\emptyset & -\emptyset \\ -\emptyset & -\emptyset \end{pmatrix} \end{matrix}$ <p><i>covers</i></p>
 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ -\emptyset & \emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} \emptyset & -\emptyset \\ \emptyset & -\emptyset \end{pmatrix} \end{matrix}$ <p><i>equal</i></p>	 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ -\emptyset & -\emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} -\emptyset & -\emptyset \\ -\emptyset & -\emptyset \end{pmatrix} \end{matrix}$ <p><i>overlap</i></p>	 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ \emptyset & -\emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} \emptyset & -\emptyset \\ \emptyset & -\emptyset \end{pmatrix} \end{matrix}$ <p><i>inside</i></p>	 $\begin{matrix} \partial A & \begin{pmatrix} \partial B & B^\circ \\ -\emptyset & -\emptyset \end{pmatrix} \\ A^\circ & \begin{pmatrix} \emptyset & -\emptyset \\ \emptyset & -\emptyset \end{pmatrix} \end{matrix}$ <p><i>coveredBy</i></p>



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