

JUMP & JTS

A foundation for spatial processing

<http://www.jump-project.org>

Open-source licensing (LGPL & GPL)

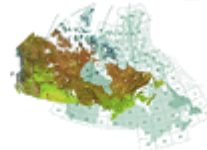
 BRITISH COLUMBIA
Ministry of Sustainable
Resource Management



 Ontario
Ministry of
Natural Resources



Centre for Topographic Information
Centre d'information topographique



Vivid Solutions

Refractions Research

The Jump Project

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The foundation of The JUMP-Project is a suite of free, open-source applications that provide an extensible API and graphic user interface (GUI) for viewing and manipulating spatial data-sets. Currently, the major projects of the JUMP Project suite include:

- **The JUMP Unified Mapping Platform (JUMP)** provides both the main UI and an API to a highly extensible framework for developing and running custom spatial data processing applications.
- **The JTS Topology Suite (JTS)** provides an API of 2D spatial predicates and functions for fundamental geometric operations in an OGC-compliant spatial object model.
- **The JCS Conflation Suite (JCS)** is an API and a set of interactive tools which perform conflation on spatial datasets.

[JUMP Plug-Ins](#) optimize the JUMP component tools and functions into environments specific to the needs of a given project or application. For example, the Government of British Columbia's (BC) Ministry of Sustainable Resource Management (MSRM) has developed and used various custom JUMP plug-ins for the preparation and integration of data into their Corporate Watershed Base (CWB) project.

The JUMP-Project is a collaborative effort between research and development teams in both the public and private sectors - Learn more about the [Development Teams and Project Sponsors](#).

JUMP PROJECTS provide the JUMP with the major components needed to perform its geoprocessing functions. Click one of of the links below for more information:

[JUMP Unified Mapping Platform \(JUMP\)](#)

[JCS Conflation Suite \(JCS\)](#)

[JTS Topology Suite \(JTS\)](#)

JUMP PLUG-INS work within the JUMP framework to accomplish specific tasks. Click one of of the links below for more information:

[RoadMatcher Extension \(RM\)](#)

[Stream Feature Matching Application \(SM\)](#)

[Water Body Feature Matching Application \(WBM\)](#)

Recent JUMP News ..

[RoadMatcher Version 1.0](#)

[Release Scheduled](#)

[2004/02/19] The RoadMatcher extension for JUMP is currently under development as part of the JCS Conflation Suite. RoadMatcher supports automated and manual matching of road networks as well as merging both geometry and attributes into a single integrated result. Version 1.0 of RoadMatcher is scheduled for release by March 31, 2004. [\[more \]](#)


[JCS 1.0.1 Compatibility](#)

[Release](#)

[2003/11/04] This release is not much different from JCS 1.0.0, the main difference being compatibility with the new JUMP 1.1. [\[more \]](#)

[\[View all News Briefs \]](#)

JUMP-Project Whitepapers

[Case for Open Source Geospatial](#) 

[JUMP Project and Direction](#)

JUMP History

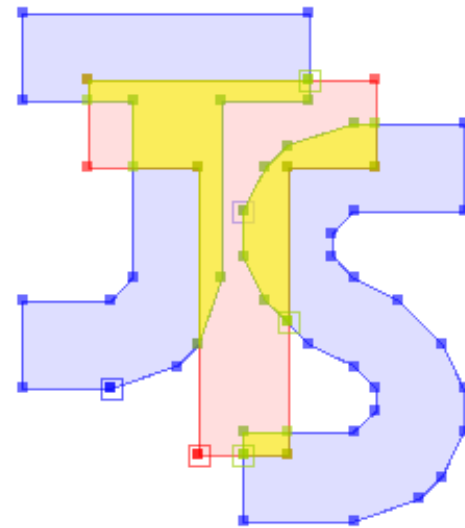
- GeoBase as a critical GeoConnections objective
 - Unified, single versions of DEM, roads & hydrography
 - All other data to be referenced to the GeoBase
- 2000: recognition of deficiencies of commercial s/w
 - Opportunity to develop efficient conflation tools
 - Topologic & geometric foundation to be developed first
- 2001: GeoConnections approval for JTS construction
 - Based on OGC simple feature specification
 - Versions 1.0, 1.1, 1.2, 1.3 and now 1.4; by Vivid
- 2002: GeoConnections approval for JCS construction
 - Initial effort led to requirement for JUMP by Vivid
 - Further efforts undertaken by both Refractions and Vivid
- 2003 & 2004: operational products emerging
 - In support of stream & road conflation and data management
 - In support of data submission and validation

Overview

- **JTS Topology Suite**
 - Open-Source API for representing and manipulating **Geometry**
- **JUMP Unified Mapping Platform**
 - Open-Source platform for representing, visualizing and manipulating **Geo-spatial Features**
- **Together: a foundation for spatial processing**
 - Algorithm Development
 - Data Visualization
 - Spatial Analysis
 - Application Deployment

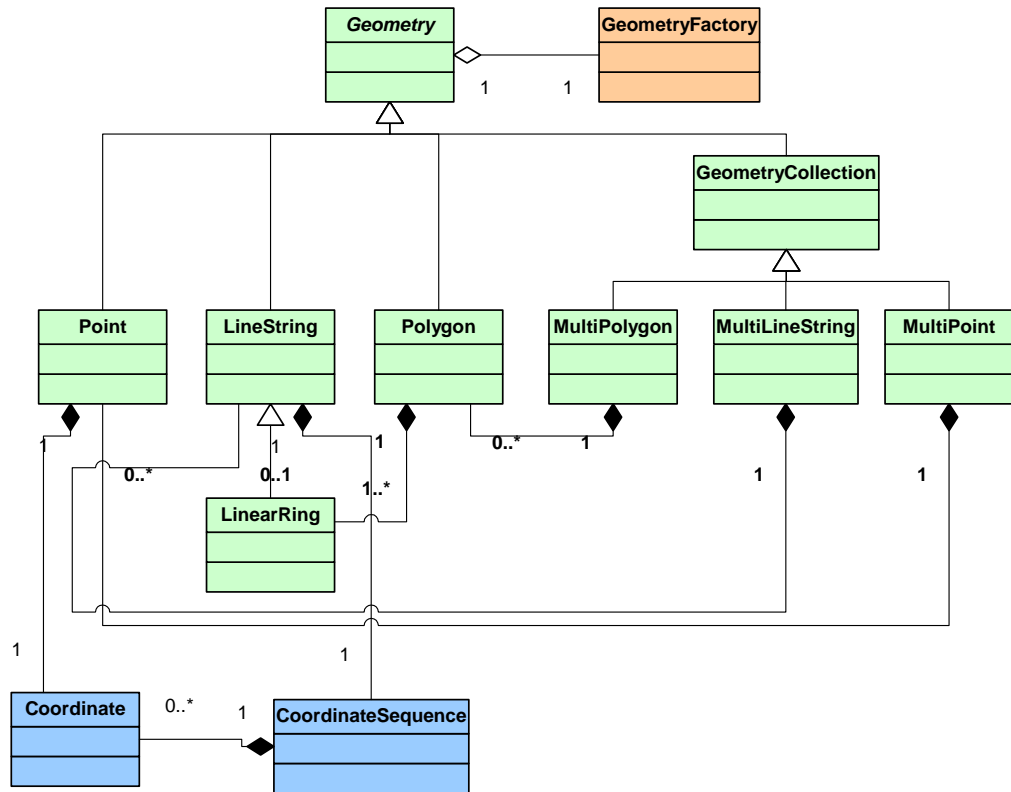
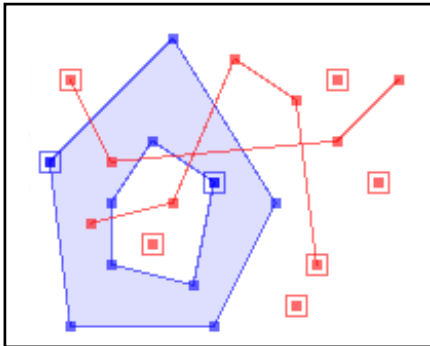
JTS Topology Suite

- **Core API for processing Geometry**
- **Implementation of *OpenGIS Consortium Simple Features Specification***
- **Open Source, 100% Java**
- **Design Features:**
 - Fast, production quality
 - Robust
 - Explicit precision model
 - All basic geometry operations
- **History:**
 - JTS 1.0 released Feb 2002
 - JTS 1.4 released Nov 2003



JTS - Geometry Model

- **Complete model for 2-D linear geometric objects**
 - Point
 - LineString, LinearRing
 - Polygon
 - MultiPoint, MultiLineString, MultiPolygon
 - GeometryCollection
- **Follows OGC SFS model**

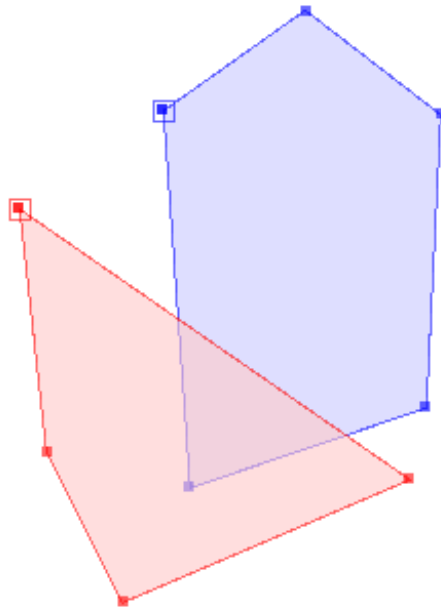


JTS – Spatial Predicates

- Spatial predicates determine how Geometries interact
- JTS implements the full *Dimensionally Extended 9-Intersection Model*
 - Relate
 - Equals, Disjoint, Intersects, Touches, Crosses, Within, Contains, Overlaps

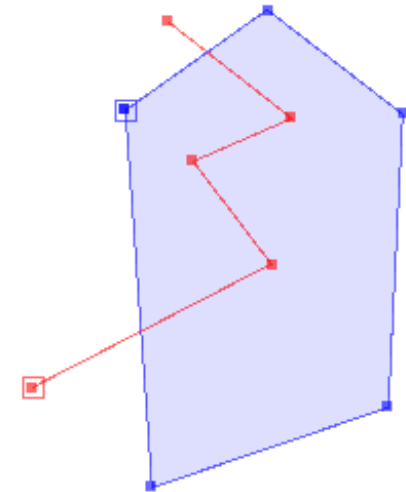
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	<i>Int</i>	2	1	2
A	<i>Bdy</i>	1	0	1
	<i>Ext</i>	2	1	2

Binary Predicates		
	<i>AB</i>	<i>BA</i>
Equals	F	F
Disjoint	F	F
Intersects	T	T
Touches	F	F
Crosses	F	F
Within	F	F
Contains	F	F
Overlaps	T	T



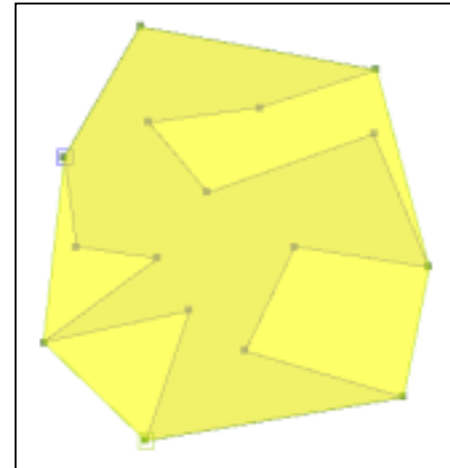
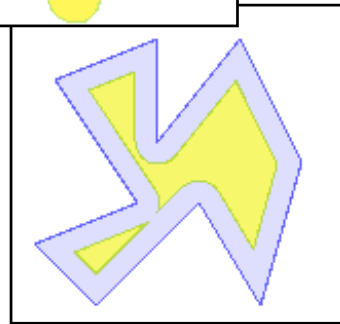
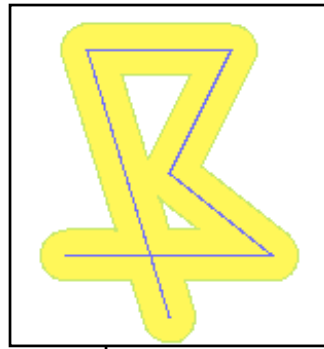
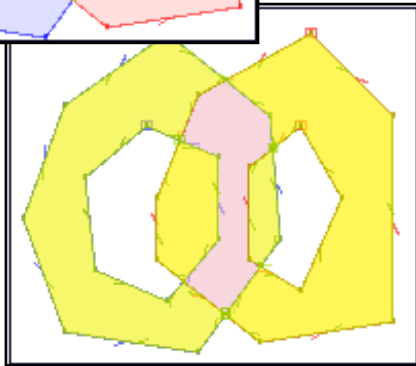
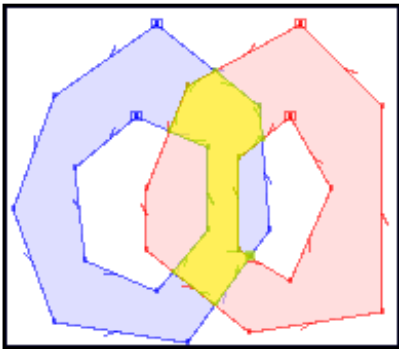
		B		
		<i>Int</i>	<i>Bdy</i>	<i>Ext</i>
	<i>Int</i>	1	F	2
A	<i>Bdy</i>	0	F	1
	<i>Ext</i>	1	0	2

Binary Predicates		
	<i>AB</i>	<i>BA</i>
Equals	F	F
Disjoint	F	F
Intersects	T	T
Touches	F	F
Crosses	T	T
Within	F	F
Contains	F	F
Overlaps	F	F



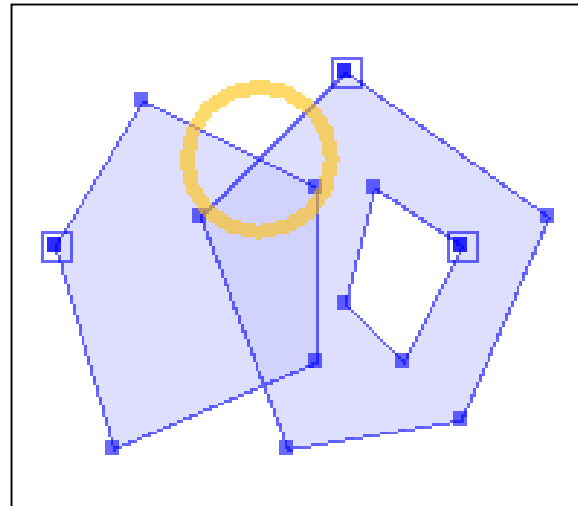
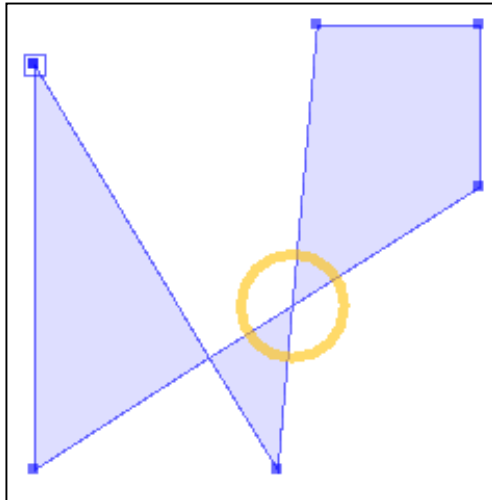
JTS – Geometry Methods

- **Overlay operations**
 - Intersection, Union, Difference, Symmetric Difference
- **Buffer**
 - Positive & negative
- **Convex Hull**
- **Distance, Centroid, InteriorPoint**, etc.



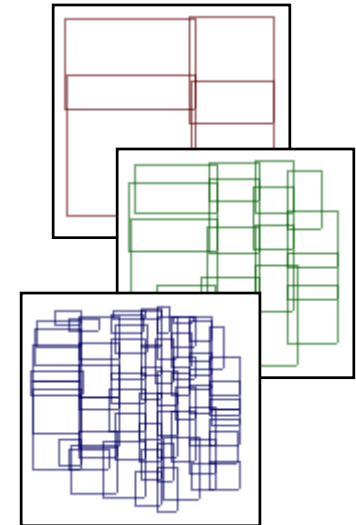
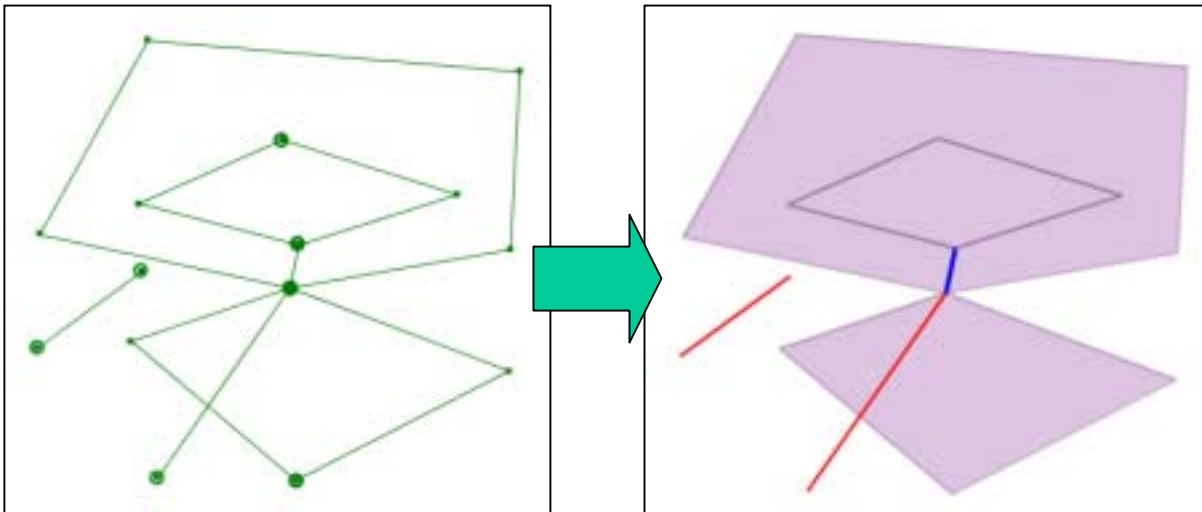
JTS - Geometry Validation

- **Validation of Geometry topology essential to ensure correct spatial processing**
- **JTS provides full Validation of Topology**
 - with location-based error reporting



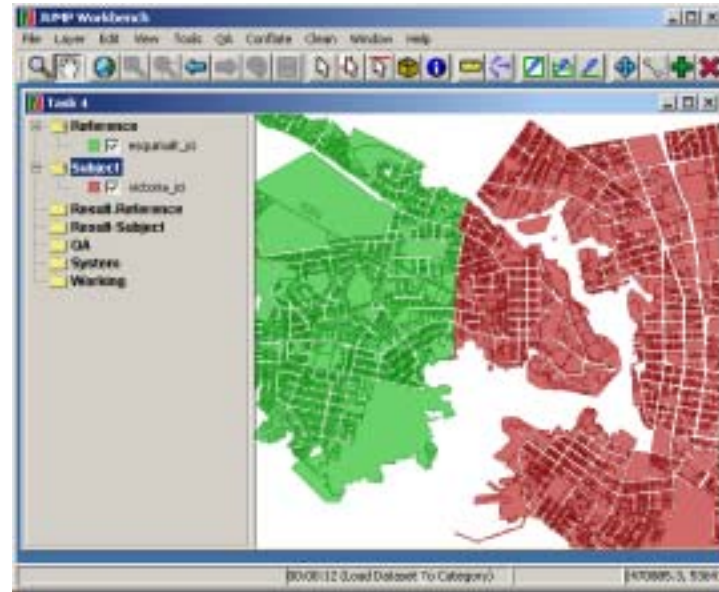
JTS – Spatial Algorithms

- **Numerous basic Computational Geometry algorithms**
 - Line segment intersection, ring/orientation, point-line distance, etc
- **Spatial Indexes**
 - Quadtree, STRtree, Bintree, MonotoneChains, SweepLine
- **Line segment Noding**
- **Planar Graph framework**
- **Precision Model Reduction**
- **Polygonization**
- **Line Merging**



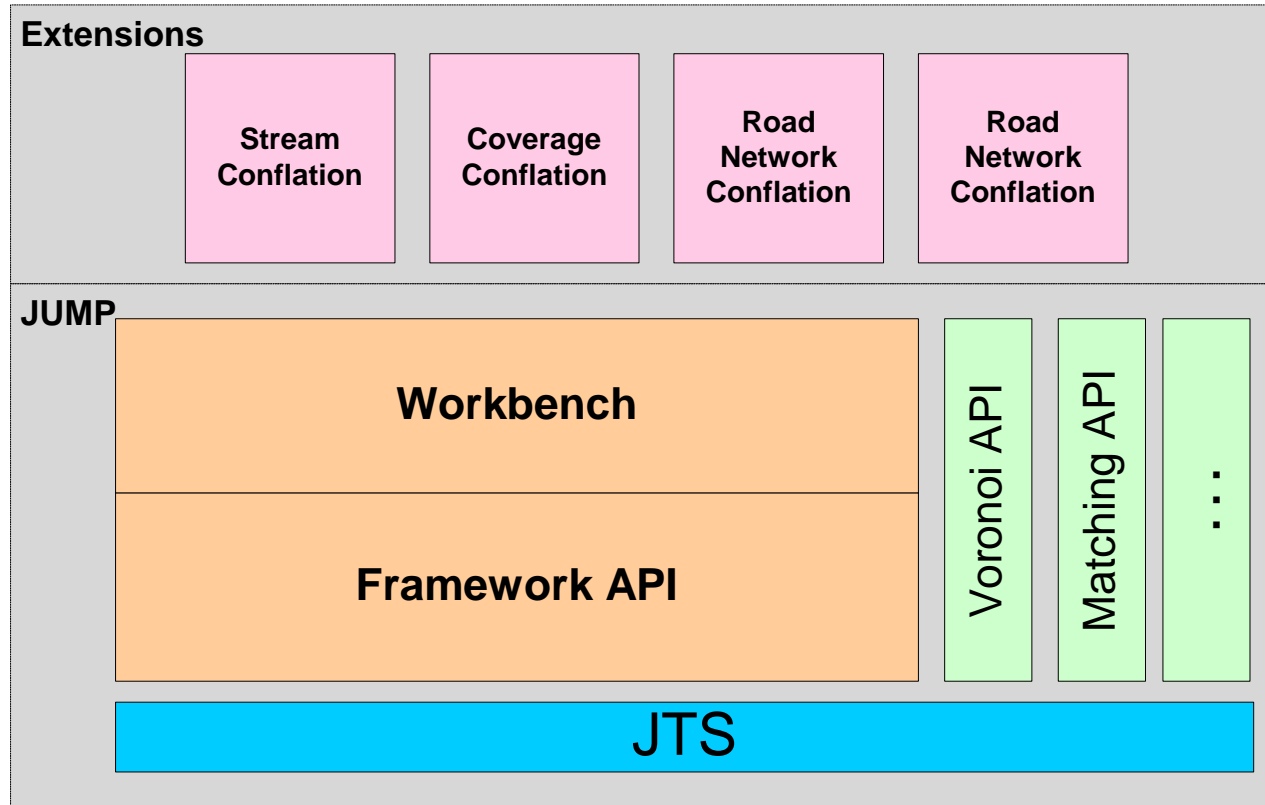
JUMP Unified Mapping Platform

- 100% pure Java
- Open Source (*GPL license*)
- Framework API (*for developers*)
- Workbench GUI (*for users*)



- Design Features:
 - Rich GUI environment for developing spatial algorithms, visualizing data and output
 - Interactive environment for supporting human-assisted spatial processing
 - Leverage all capabilities of Java platform
 - Highly extensible / reusable

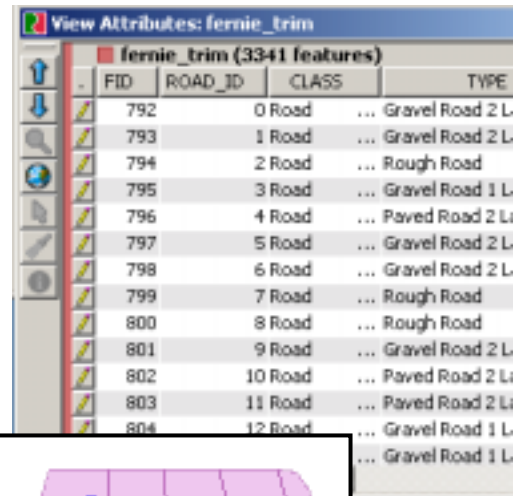
JUMP & JTS - Architecture



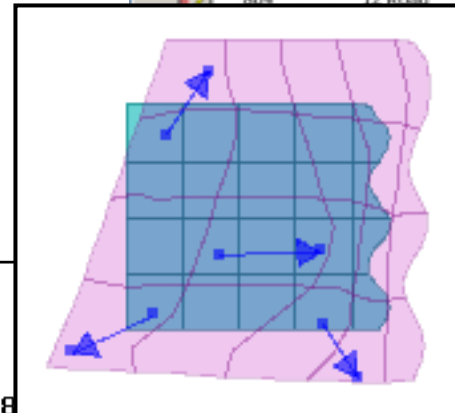
- JUMP core is APIs and GUI Framework
- Applications (such as Conflation) are packaged as JUMP Extensions

JUMP – Framework API

- Features with attributes and geometry
- Feature Collections
 - With optional spatial index
- DataSources
 - **File** - Well Known Text, GML, ESRI Shapefile
 - **Spatial DB** - Oracle, PostGIS, ESRI SDE
 - Easy to add new DataSources
- Warping
 - Affine Transform
 - Bilateral Interpolated Triangulation



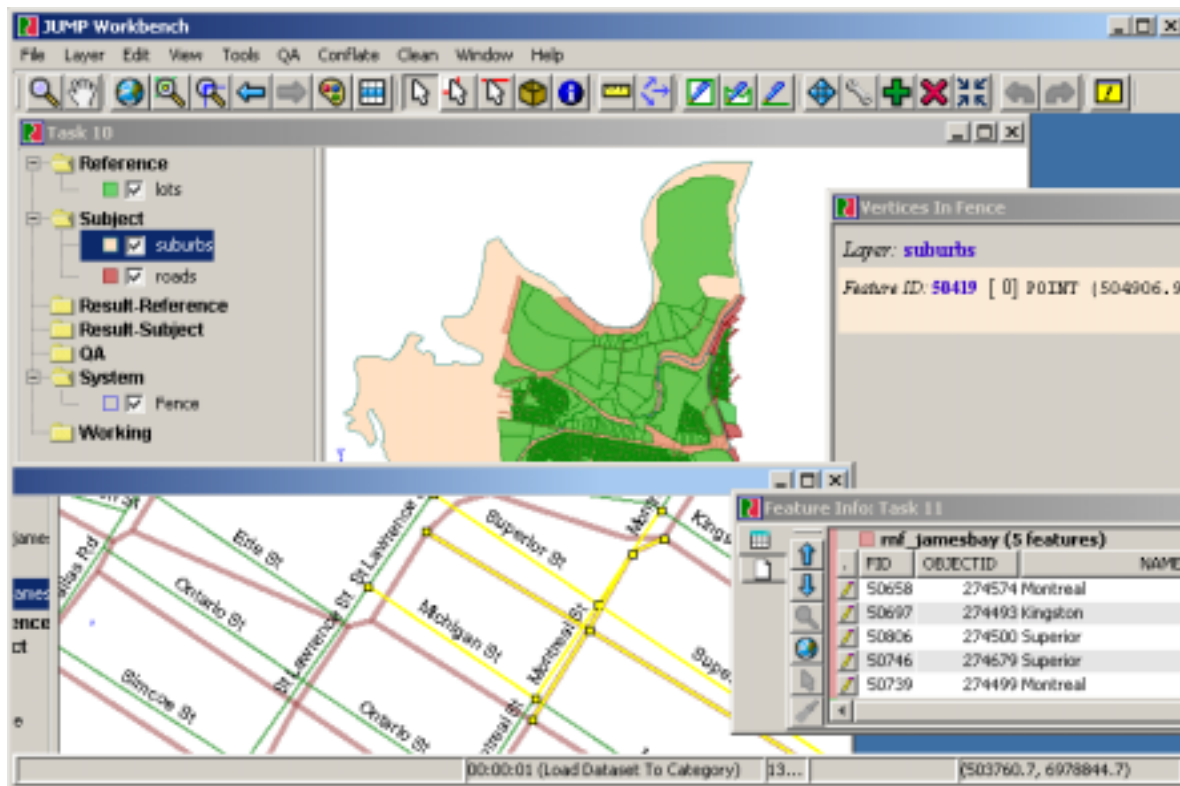
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793	1 Road	...	Gravel Road 2 L
794	2 Road	...	Rough Road
795	3 Road	...	Gravel Road 1 L
796	4 Road	...	Paved Road 2 L
797	5 Road	...	Gravel Road 2 L
798	6 Road	...	Gravel Road 2 L
799	7 Road	...	Rough Road
800	8 Road	...	Rough Road
801	9 Road	...	Gravel Road 2 L
802	10 Road	...	Paved Road 2 L
803	11 Road	...	Paved Road 2 L
804	12 Road	...	Gravel Road 1 L



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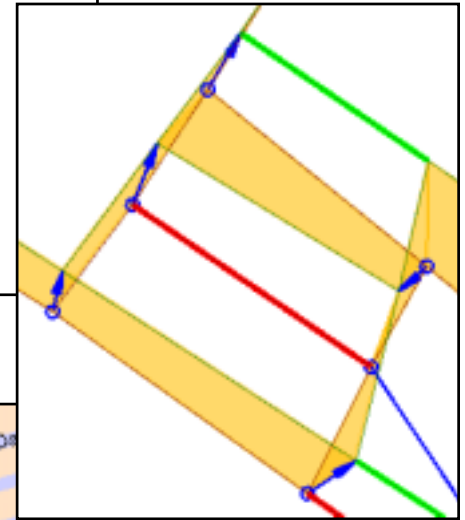
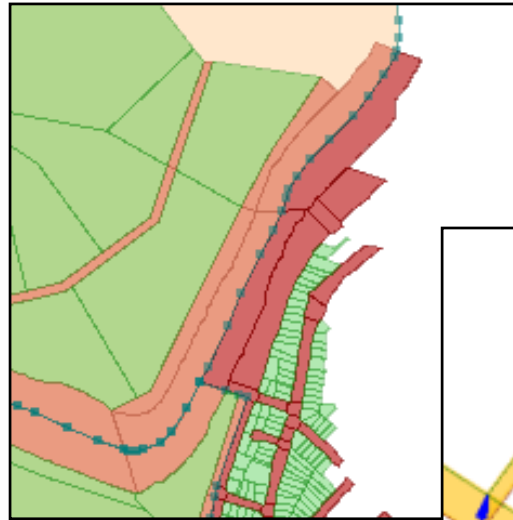
JUMP Workbench

- Multi-Window GUI
- Supports multiple layers of spatial data; rich styling options
- Provides GUI for JUMP API functions
- Geometry & Attribute editing
- Easily extensible via Plugin framework
- Highly modular for easy reusability



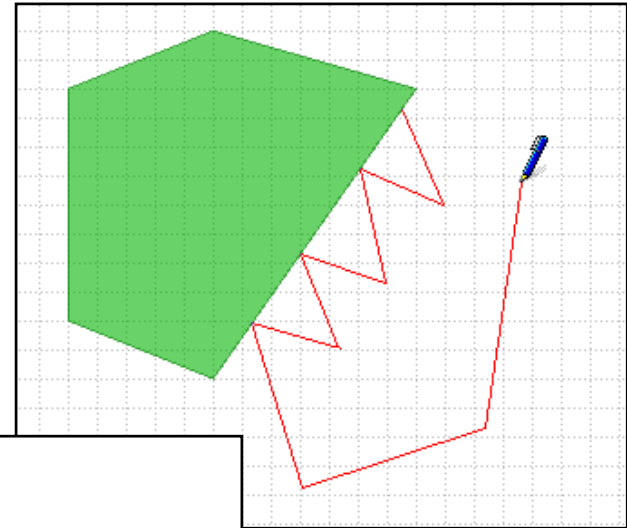
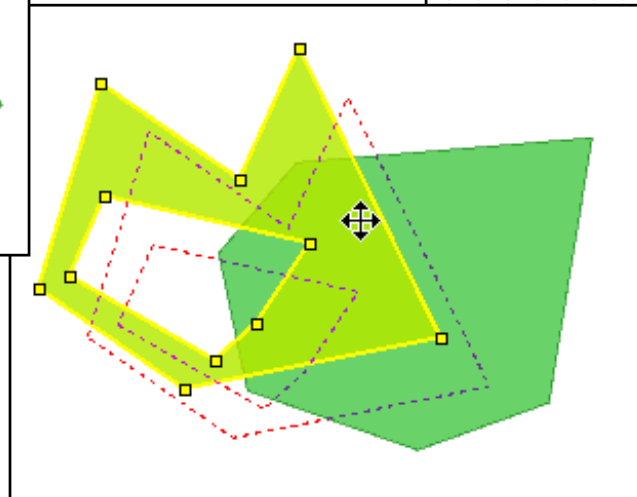
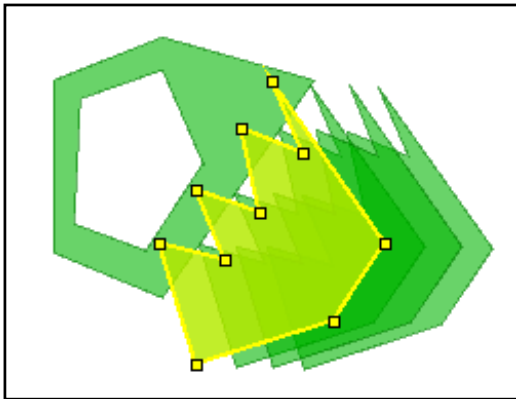
JUMP - Visualization

- Colour theming
 - Fill / Line colour, size, style
 - Theme by attribute
- Line Styles & Decorations
 - e.g. Dashes, Arrowheads
- Transparency
- Labeling
 - Rotation, scale defined by attribute
 - Scaled / absolute size
 - Collision detection
- Fully customizable via Renderer API



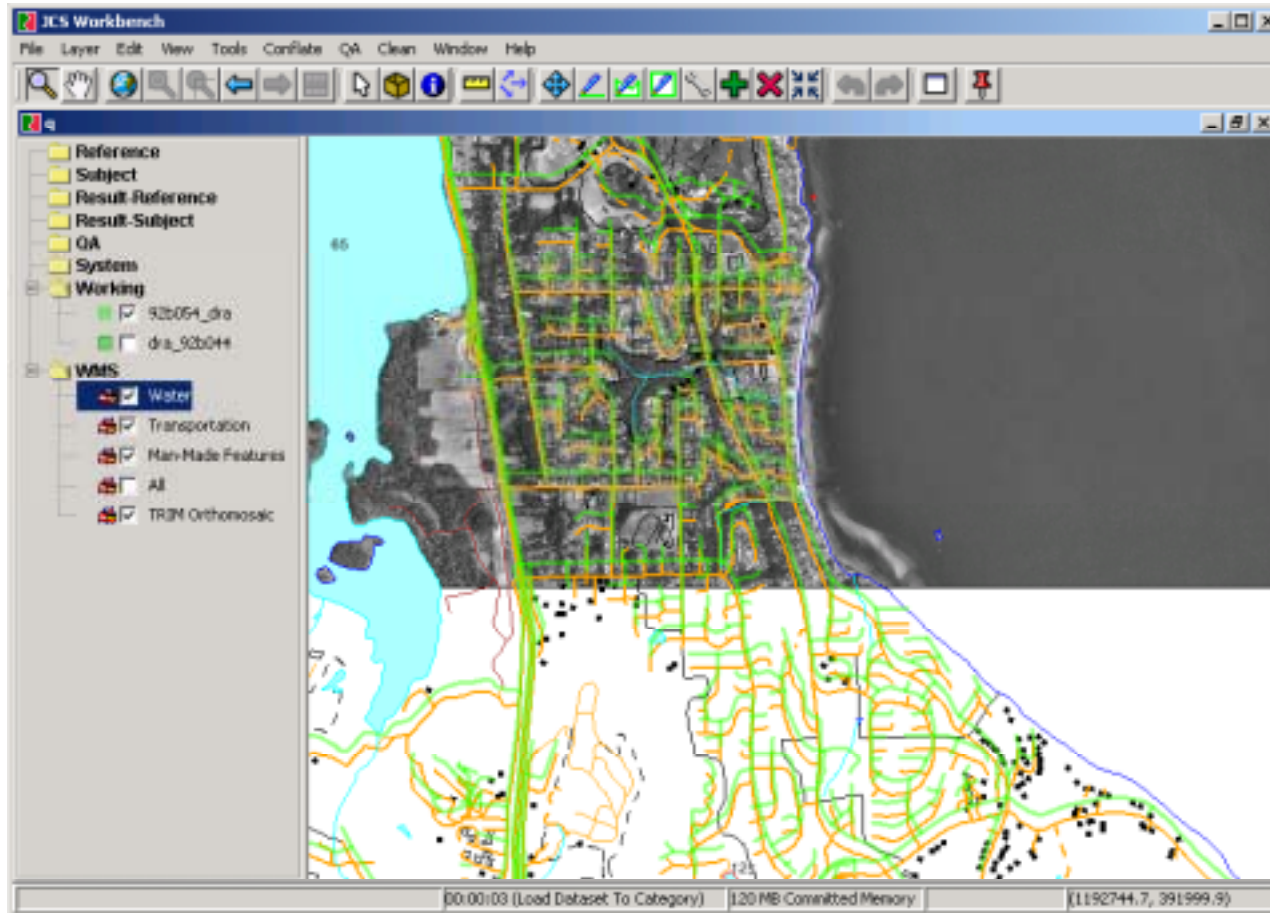
JUMP – Editing

- Create / Move / Delete Points, Lines, Polygons, Holes
- Combine / Explode to create Geometry Collections
- Snap To Vertex / Line / Grid
- Geometry Validation on Edit
- Multi-Level undo
- Cut / Copy / Paste



JUMP – Web Map Server Client

- Display images obtained from OGC-compliant Web Map Servers
- Multiple images / servers
- Transparency
- Also exposed as standalone API

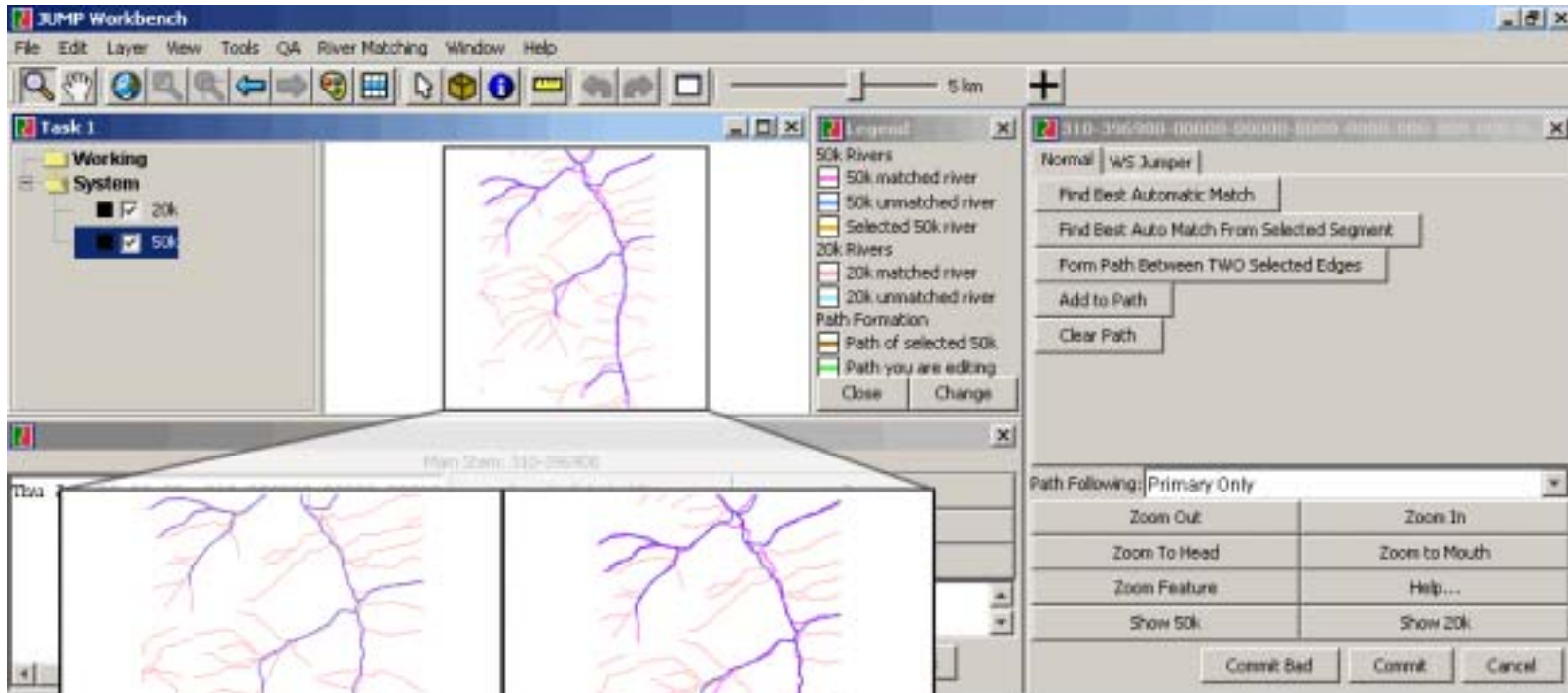


JUMP – Future Work

- **Coordinate Reference System support**
 - Prototype developed; need to improve API
- **Database Connectivity**
 - Live data access (“On-the-fly querying”)
 - Better UI and model for managing database connections
- **Display of geo-referenced imagery**
- **Improved editing tools**
 - Quite a few suggestions for richer linework editing tools
- **Harmonization with GeoTools codebase**
 - Start with Coordinate Transformations and DataSources
- **Improve WMS Client**
- **WFS Client**
- **Better Developer documentation**
- **Better cross-platform support, installs**
- ***Important to maintain clear, consistent design of UI and codebase!***

Some JUMP Applications

1:20k – 1:50k stream conflation



The dark blue (50k) data is layered on top of the red (20k) data.

The matching process correlates the 20k river segments to the corresponding 50k rivers. The matched 20k segments are shown in purple.

roads conflation (part way through process)

The screenshot shows the JUMP Workbench interface during a road conflation process. The main map area displays two overlapping road networks: Source A (blue) and Source B (red). The map shows a grid of roads with several nodes highlighted in pink circles, indicating areas of conflict or inconsistency. The 'Road-Matcher ToolBox' on the right provides a summary of the conflation results.

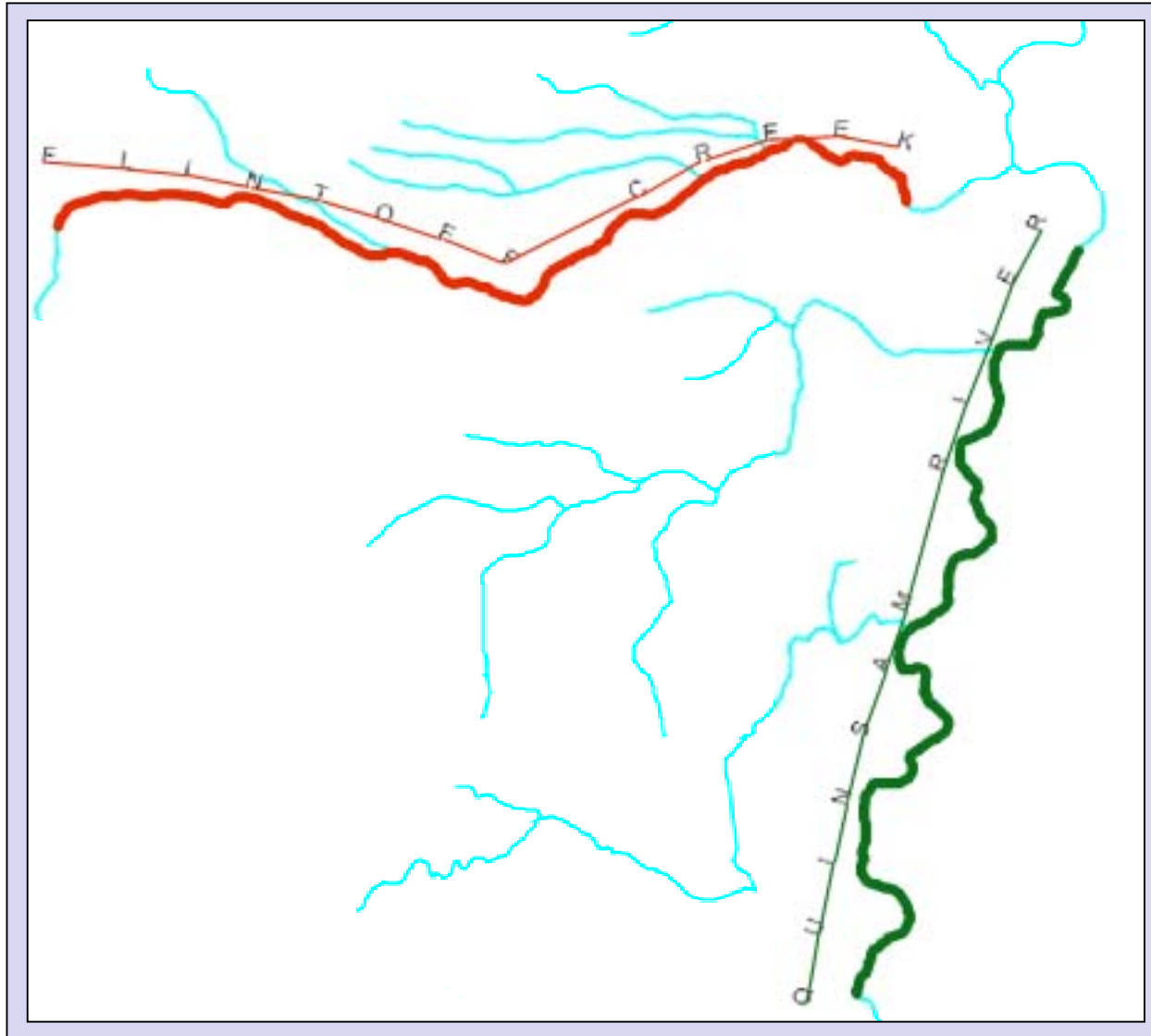
Road-Matcher ToolBox Summary:

Number of Road Segments		
B	A	Total
1331	3432	Total
96	386	Unknown
22	1833	Standalone*
1213	0	Matched (Ref)*
0	1213	Matched (Non-Ref)
0	0	Retired

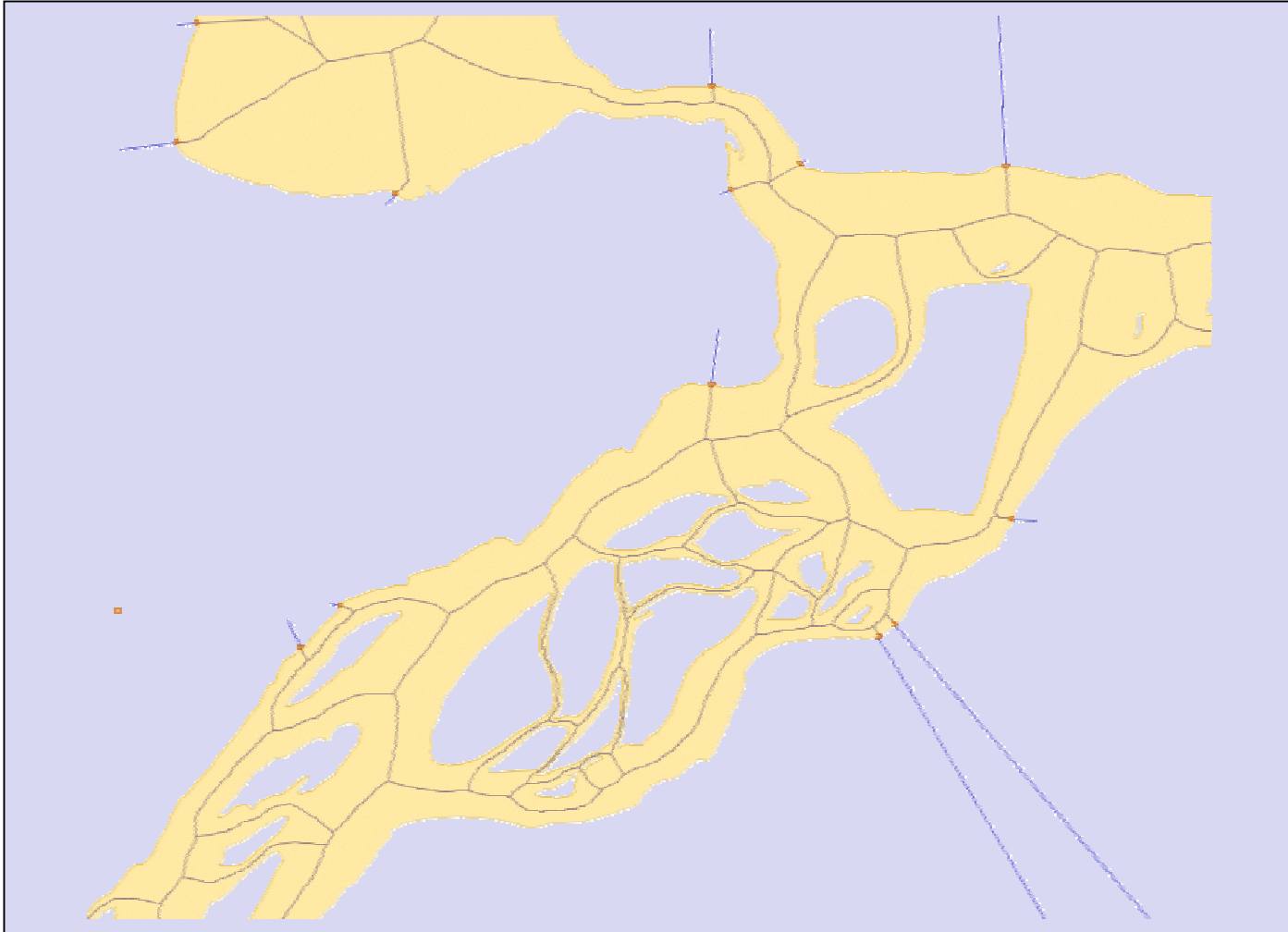
***Result States:**

332	126	Pending
127	51	Inconsistent
776	1656	Integrated

Naming streams (an initial stage in the process)



Skeletons in water bodies, based on Voronoi



Thanks very much for listening.

For further information, please visit:

<http://www.jump-project.org>