ORACLE

How far is the nearest Pizzeria? – Let's see what the database says

ITOUG TechDay 2025

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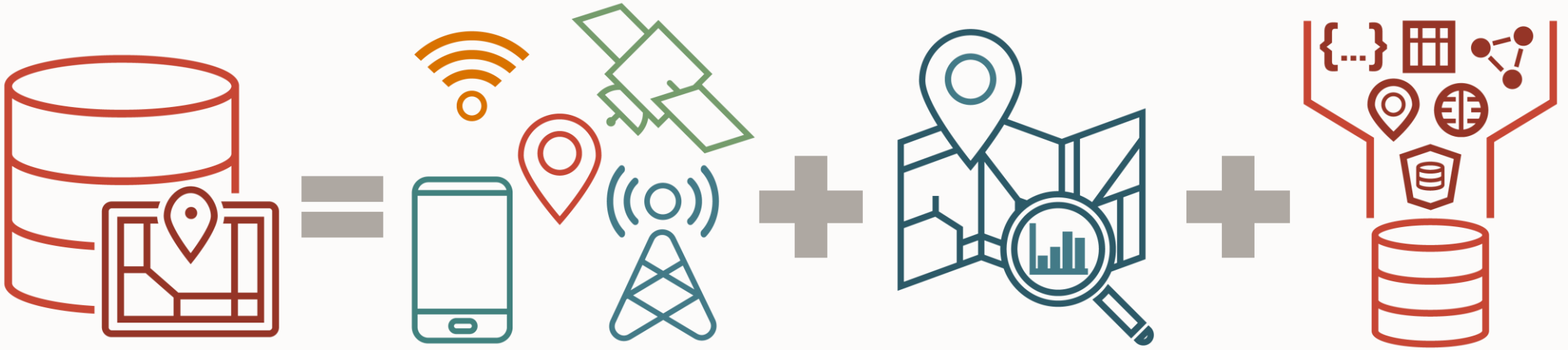
Why would you use Oracle Spatial?

Enabling location analysis in business operations and workflows



Oracle Spatial

Work with any location information

Perform spatial analysis & map visualization

Using applications & workflows based on converged Oracle Database

What is Oracle Spatial?

Spatial features in converged database

In-database functionality to

- Store and manage all kinds of geospatial data
- Perform spatial analysis where the data resides

Components, APIs & Services

Developer toolbox for

- Map visualization
- Advanced analytics
- Access to spatial functionality and processing workflows

Spatial Studio

Self-service tool to

- Enable non-experts to more easily analyze data
- Help developers build applications more quickly

What is Oracle Spatial?

Spatial Studio: Self-service access to Spatial features

What is Oracle Spatial?

Deployment

Spatial features in converged database

Integral part of

- Autonomous Database
- ExaCS and ExaC@C
- Database Cloud Service
- Database on-premises

Components, APIs & Services

Deployed on

- OCI Compute
- Available on OCI Cloud Marketplace
- On-premises

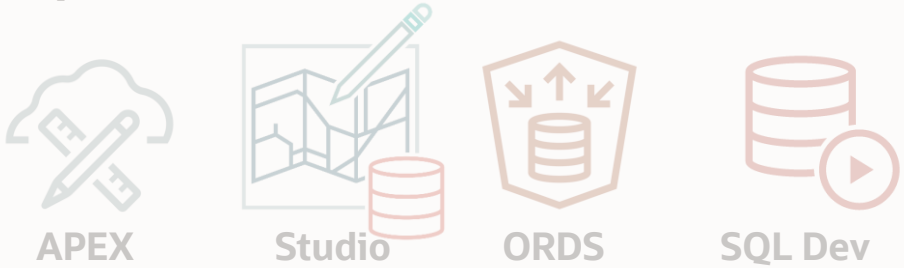
Spatial Studio

Deployed on

- OCI Compute
- Available on OCI Cloud Marketplace
- On-premises

Comprehensive platform for geospatial data and maps

Spatial with Dev Tools, Frameworks

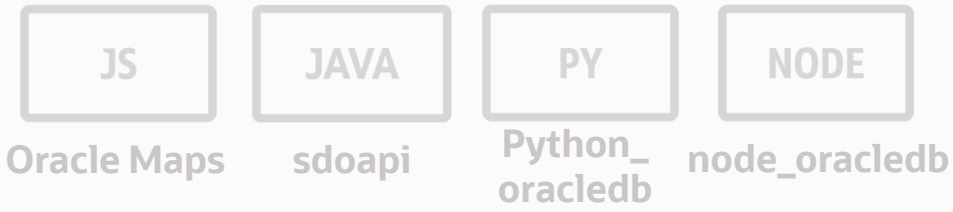


Spatial with PaaS and SaaS

Oracle Maps Cloud Service

Map Service | Geocoding Service | Routing Service

Spatial developer APIs/libraries



Spatial JEE components

Mapping | Web Services (OGC)

Geocoding | Routing | Network Analysis

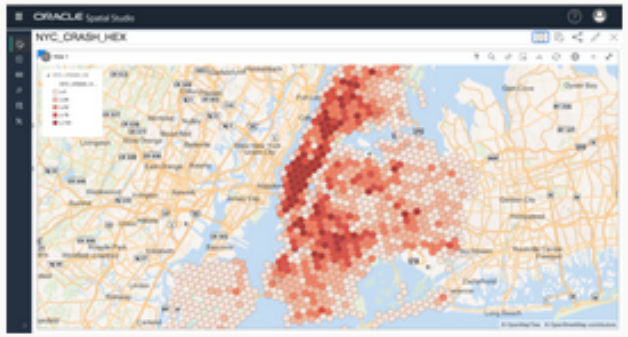
Spatial features of Oracle Database/Autonomous Database

Getting started

Getting started

Database / Technologies /
Get Started with Oracle Spatial Studio

Spatial Studio is a free web-based tool for use with Oracle Autonomous Database, Oracle Database Cloud Service, and Oracle Database on premises.



If you are an Oracle Database customer, in the Cloud or on-premises, then you are entitled to use the Spatial features of Oracle Database and Oracle Spatial Studio.

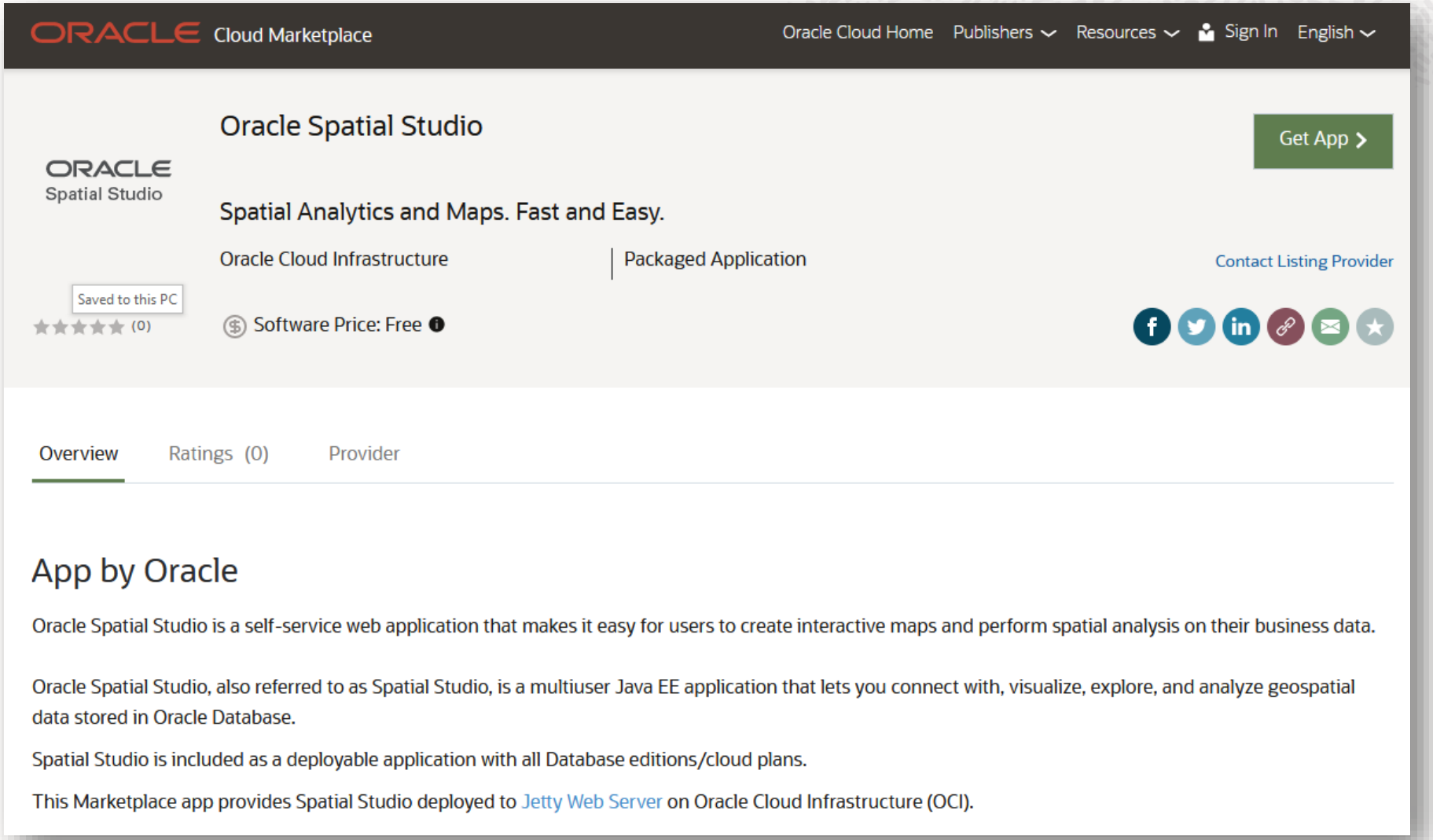
You can also try Spatial Studio for free using the Oracle Cloud Free Tier which provides free Autonomous Database and Compute instances.

Please note: Spatial Studio is backward compatible. So you should always use the latest release that supports your database version.

Using the Spatial Studio App in the Oracle Cloud Marketplace

https://www.oracle.com/database/technologies/spatial-studio/get-started.html

Installation



Lots of available data sources

Public

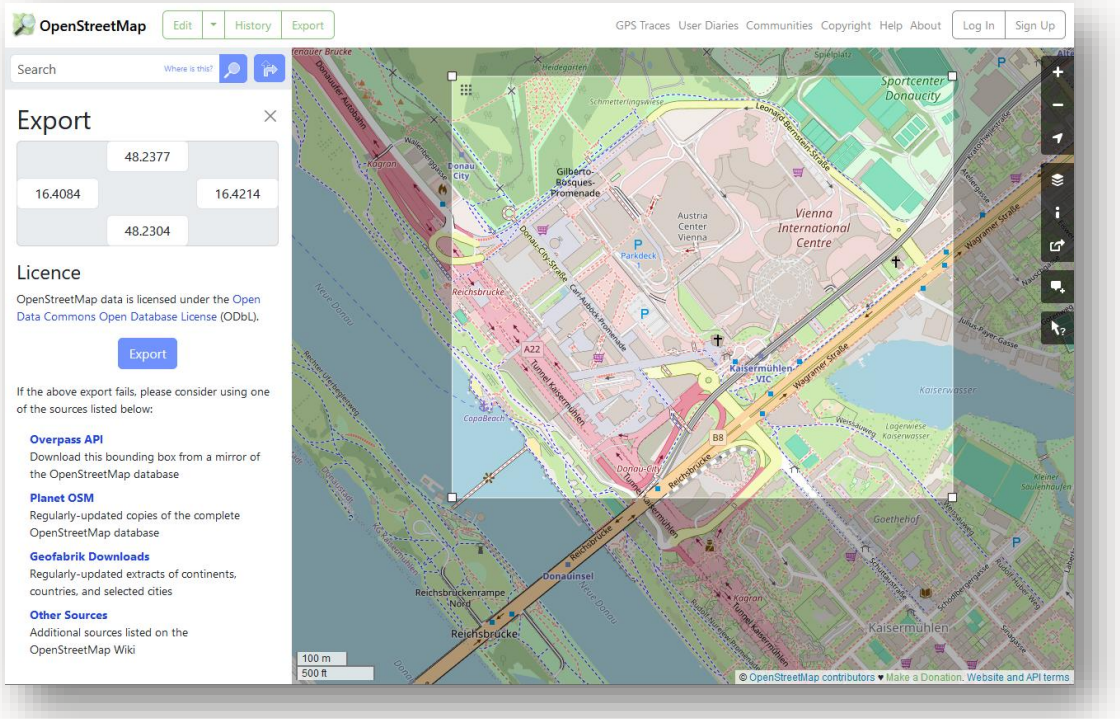
- Open Data portals
  - dati.comune.milano.it
- EU Inspire portal
- www.mapsforeurope.org
- …

Crowd-sourced

- OpenStreetMap
- gadm.org
- …

Commercial

- HERE
- Tomtom
- GfK Geomarketing
- …



Notes:

- Watch out for licensing restrictions
- Validate geometries

Complete Foursquare data set is now open source

See blog post by Øyvind Isene on how to load and analyze with Oracle Spatial

Demo

Demo flow

Find hotels and restaurants around conference location

- Show how to load and prepare Oracle Office locations (lat/lon)
- Load and geocode Hotels in Milan (.xlsx)
- Navigate to Via Massimo D'Azeglio 4
- Select conference venue
  - find hotels within 2 km
- Display on map and as table
- Show SQL statement and REST API
- Compute drive time/drive distance from conference venue
- Display geometry on map and results as table

Perform analysis on districts in Milan

- Load and prepare admin. Boundaries – Nuclei d'Identità Locale (NIL, Shapefile)
  - User Tooltip and Info Window for interactive analysis
- Perform Restaurant aggregation per NIL
  - Show result on map and table
  - Access results via REST endpoint
  - Display on geojson.io

Spatial Data and AI

New capabilities in OML4Py on Autonomous Database

OML4Py Spatial AI

Oracle Machine Learning for Python

Spatial AI

Autonomous Database Serverless

- Python API for all common spatial SQL operators and functions
- Pre- and post-processing functionality
  - Feature engineering
  - Gap filling
  - Spatial weights, spatial lag
- Spatial ML algorithms
  - Regression
  - Classification
  - Clustering
  - Anomaly detection
  - Colocation
- Support for pipelines (à la scikit-learn)
- Python, REST, SQL APIs

Preprocessing example: feature engineering to add a spatial metric

```
%python
block_group_nn_school_sdf = schools_sdf.nearest_neighbors(\
                                        block_groups_sdf, num_neighbors=1,\
                                        distance_col='DIST_TO_NEAREST_SCHOOL', qry_win_out_cols='GEOID')
block_group_nn_school_sdf = block_group_nn_school_sdf[['GEOID','DIST_TO_NEAREST_SCHOOL']]
z.show(block_groups_sdf.merge(block_group_nn_school_sdf, how='left', on='GEOID', keep_secondary_geometry=False).head())
```

Type to search

GEOID	MEDIAN_INCOME	MEAN_EDUCATION_LEVEL	MEAN_AGE	DIST_TO_NEAREST_SCHO
060376503005	53828.0	11.473	47.585	275.45
060376512222	60724.0	11.35	38.823	195.29
060376513026	82538.0	12.801	47.808	617.2

Detect density clusters in data from Oracle Spatial

Versioning low Zeppelin

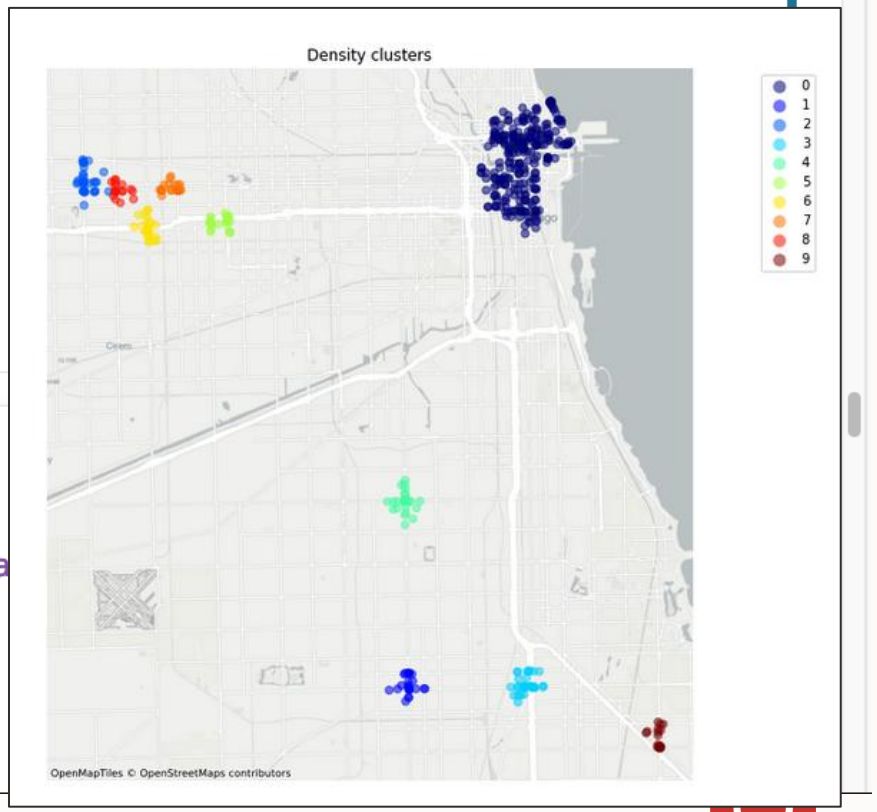
```
%python

X = accidents_injury_sdf[['geometry']].to_crs("EPSG:3857")
labels = dbscan.fit_predict(SCoordTransformer().transform(X))
np.unique(labels)
```

```
array([-1,  0,  1,  2,  3,  4,  5,  6,  7,  8,  9])
```

```
%python

_, axs = plt.subplots(figsize=(10, 10))
plot_clusters(X, labels, title='Density clusters', with_noise=False, with_bounds=Fa
```



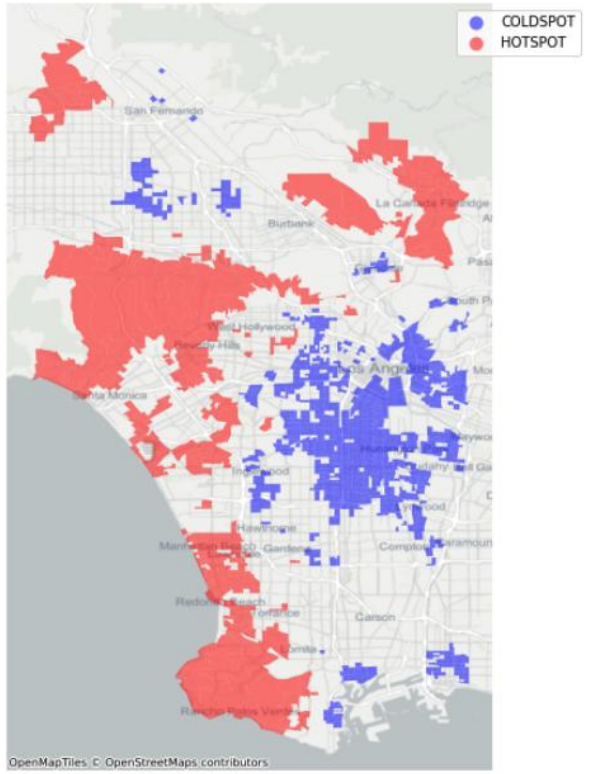
Detect hotspots and coldspots in data from Oracle Spatial

Versioning low Zeppelin

```
%python

X = block_groups_sdf[['MEDIAN_INCOME','geometry']].to_crs('epsg:3857')
lisa = LISAHotspotClustering(max_p_value=0.05, spatial_weights_definition=KNNWeightsDefinition(k=5))
lisa.fit(X)
np.unique(lisa.labels_)
```

```
array([-1,  1,  2,  3,  4])
```



Create desciptive labels for hotspots and coldspo

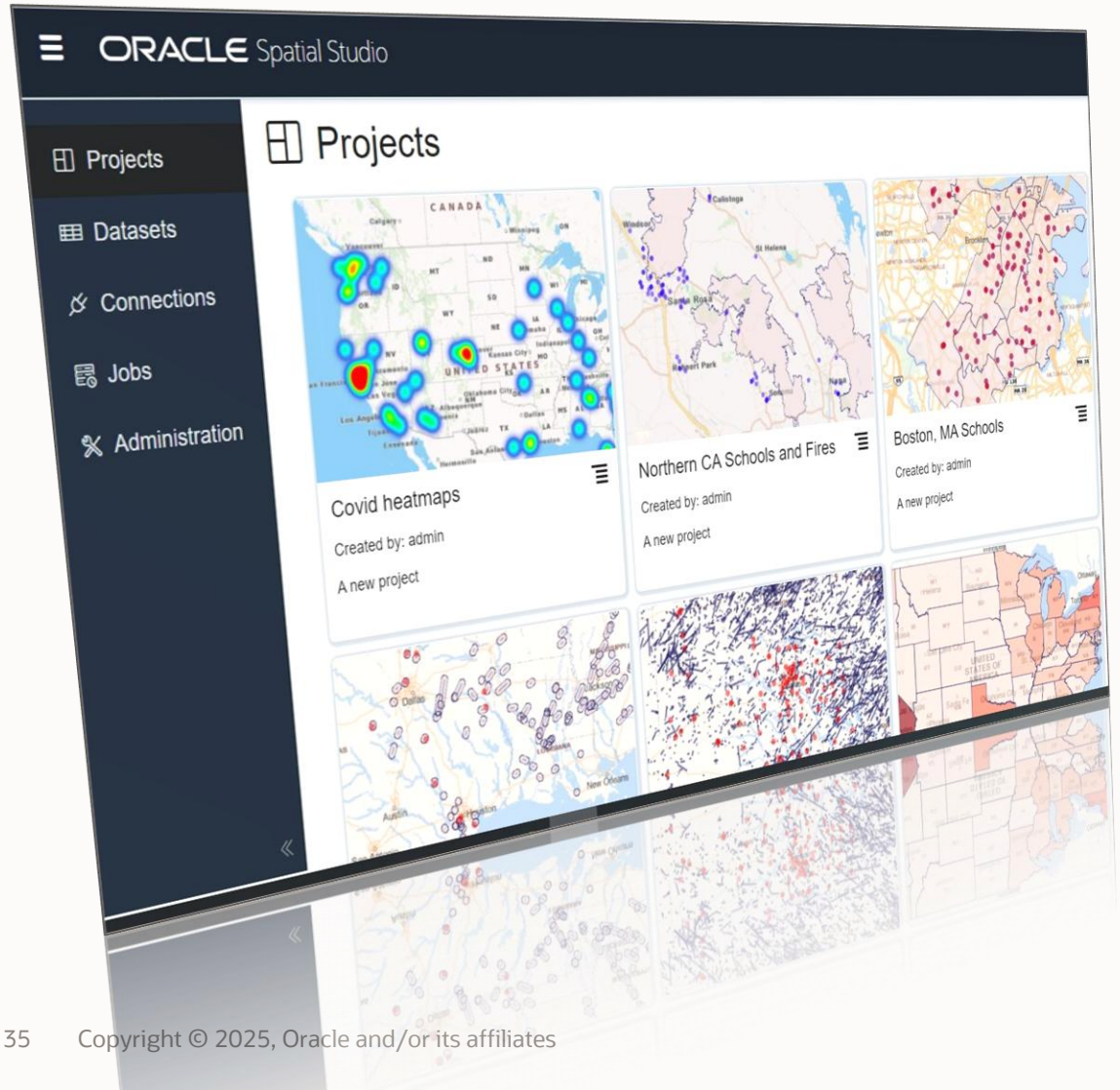
```
%python

get_label = lambda x: 'HOTSPOT'  if x==1 else ( \
                      'COLDSPOT' if x==3 else ( \
                       None ))
vf = np.vectorize(get_label)
block_groups_labelled = block_groups_sdf.add_column('QUADRANT', lisa.labels_)
```

Wrap-up

Spatial Studio – Summary

Map creation and spatial analysis for non-experts



Browser-based, self-service tool for analysts and developers

Analytics-oriented features

- Convert addresses to coordinates using Oracle Maps Cloud Service
- Hundreds of spatial operators and functions
- Spatio-temporal analysis
- Interactive visualization
- Integration with OAS/OAC

Developer-oriented features

- Prepare GPS or other geospatial data for analysis
- Generate complex SQL statements
- Publish results via REST

To Learn More

Spatial Features Homepage: oracle.com/goto/spatial

Spatial Studio: https://www.oracle.com/.../spatial-studio/get-started.html

YouTube Channel: youtube.com/c/OracleSpatialandGraph

Blogs: blogs.oracle.com/oraclespatial -> https://blogs.oracle.com/database/category/db-spatial

LiveLabs Workshops: https://livelabs.oracle.com

Forum: bit.ly/OracleSpatialHelp

Oracle Spatial and Graph User Group: linkedin.com/groups/1848520/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