

# TrajAnalytics: A Web-Based Visual Analytics Software of Urban Trajectory

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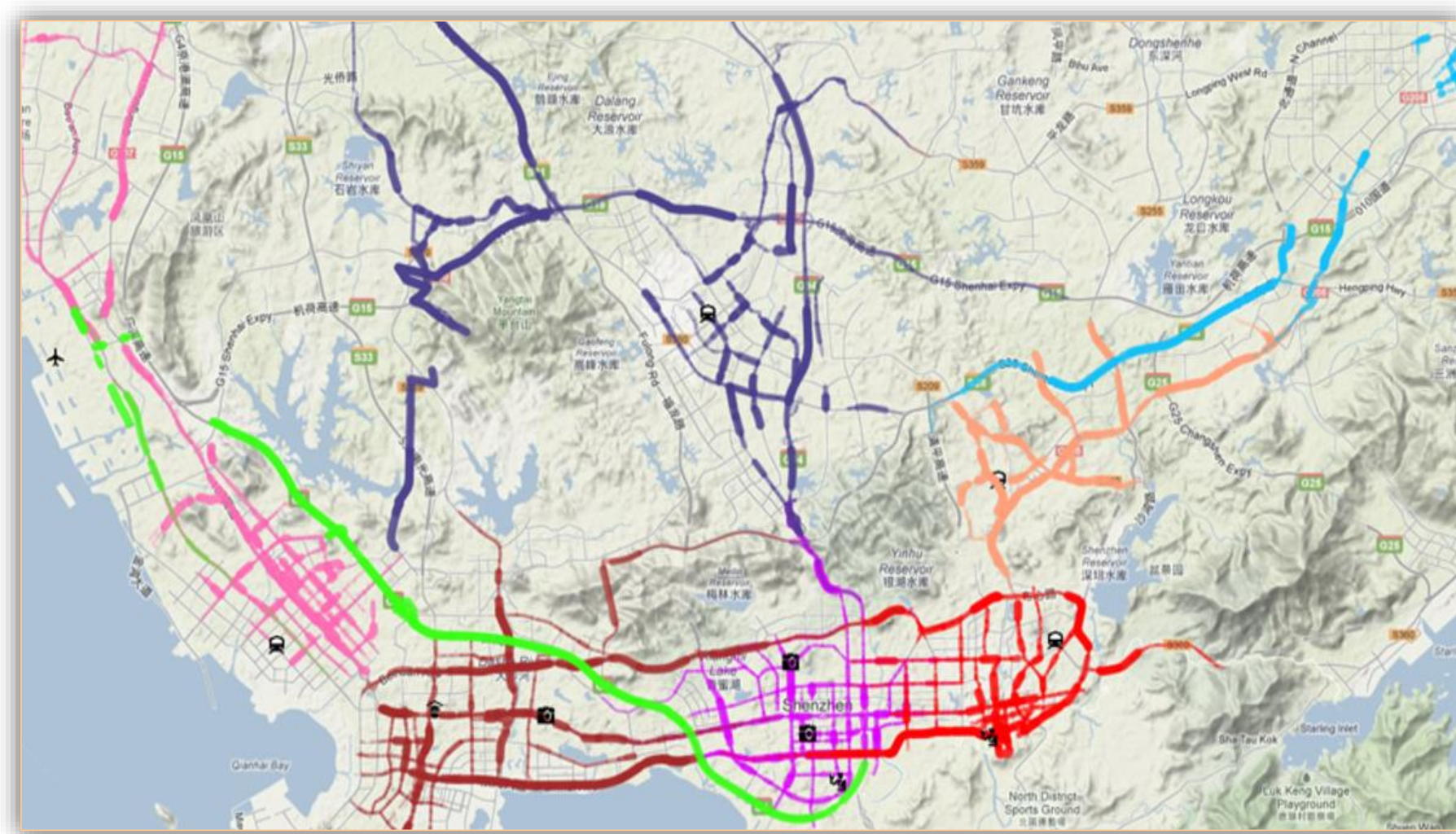
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## Introduction

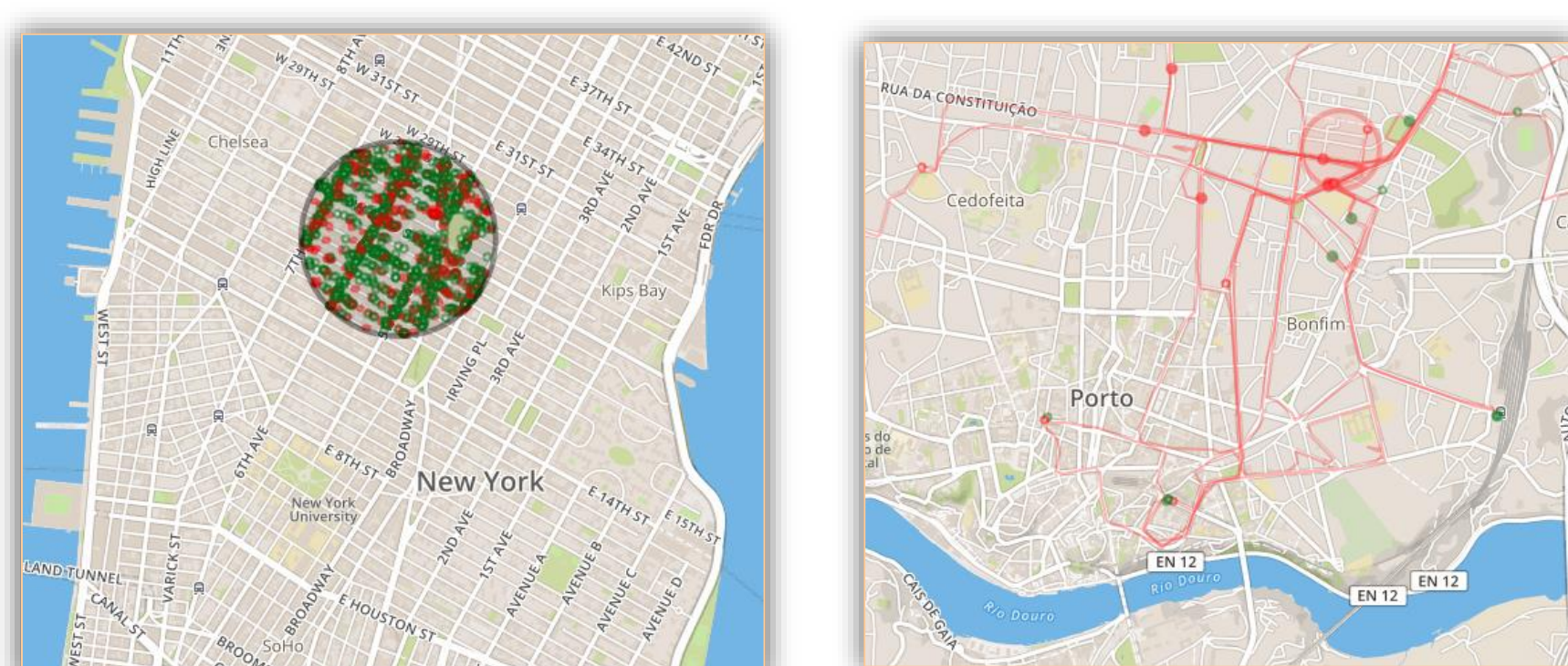


Advanced technologies in sensing and computing have created urban trajectory datasets of humans and vehicles travelling over urban road networks. Understanding and analyzing the large-scale, complex data reflecting city dynamics is of great importance to enhance both human lives and urban environments. Domain practitioners, researchers, and decision-makers need to *store*, *manage*, *query* and *visualize* such big datasets.

We develop a software system named **TrajAnalytics**, which explicitly supports interactive visual analytics of the emerging trajectory data. It offers data management capability and support various data queries by leveraging web-based computing platforms. It allows users to visually conduct queries and make sense of massive trajectory data.

## Urban Trajectory Data

- ❖ Large amount of trajectory data sets is collected by transportation administrations, companies, and researchers.
- ❖ The trajectory data records real time moving paths sampled as a series of positions over urban networks.
- ❖ Rich and heterogeneous information can be associated at each position, including human and vehicle attributes, geographical features, business/urban information, and more.
- ❖ Such data is big, spatial, temporal, dynamic, and unstructured.
- ❖ In the prototypes of the **TrajAnalytics** software, two public datasets are utilized: the O/D (origin/destination) dataset from the taxi trips in New York city, and taxi trajectory data of Porto city, Portugal.

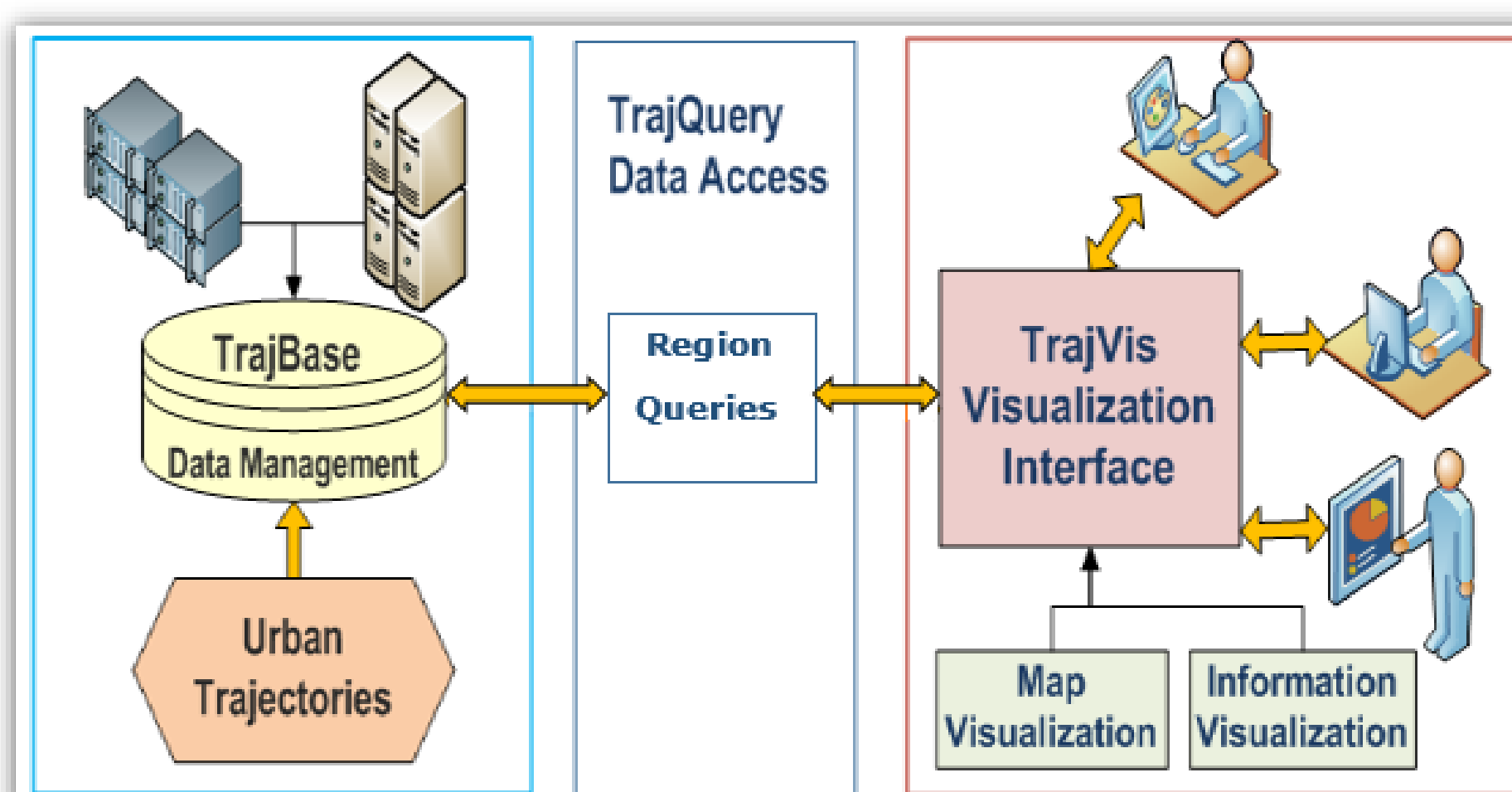


## TrajAnalytics Software Design

- ❖ Powerful computing platform so that domain users are not limited by their computational resources and can complete their tasks over daily-used computers or mobile devices.
- ❖ Easy access gateway so that the trajectory data can be retrieved, analyzed and visualized by different transportation researchers, and their results can be shared and leveraged by others.
- ❖ Scalable data storage and management which support a variety of data queries with immediate responses.
- ❖ Exploratory visualizations that are informative, intuitive, and facilitate efficient interactions.
- ❖ A multi-user system which allows simultaneous operations by many users from different places.

## TrajAnalytics Framework

TrajAnalytics consists of three components: scalable data management (**TrajBase**), effective data query (**TrajQuery**), and interactive visual interface (**TrajVis**).



TrajAnalytics Software Framework.

## TrajBase

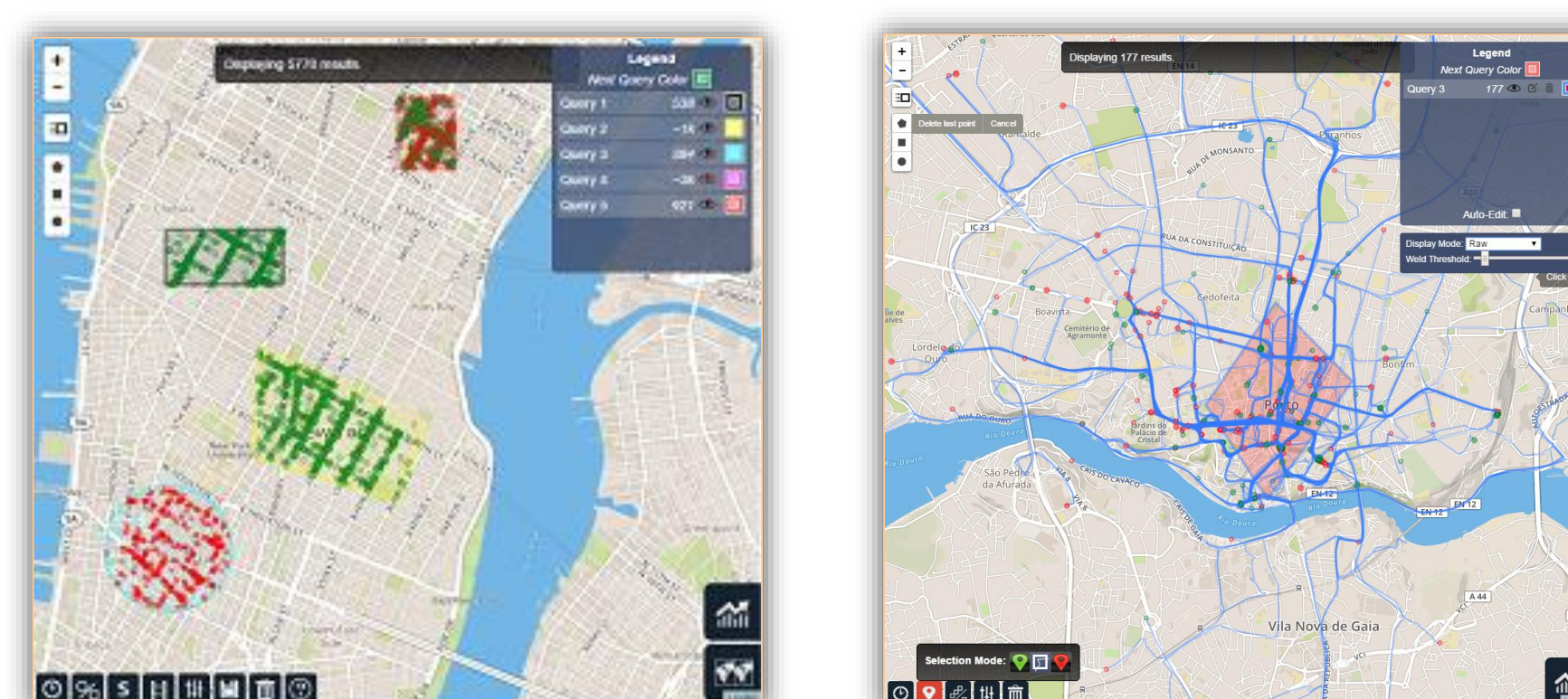
A scalable database is specifically designed for storing and managing big trajectory data. TrajBase supports using MySQL, PostgreSQL, and MongoDB. It facilitates fast computation over various data queries in a remote and distributed computing environment.



## TrajQuery

TrajQuery supports the user to conduct spatial queries combined with temporal constraints to extract taxi trips or trajectories. The spatial queries allow users to flexibly combine regional queries over :

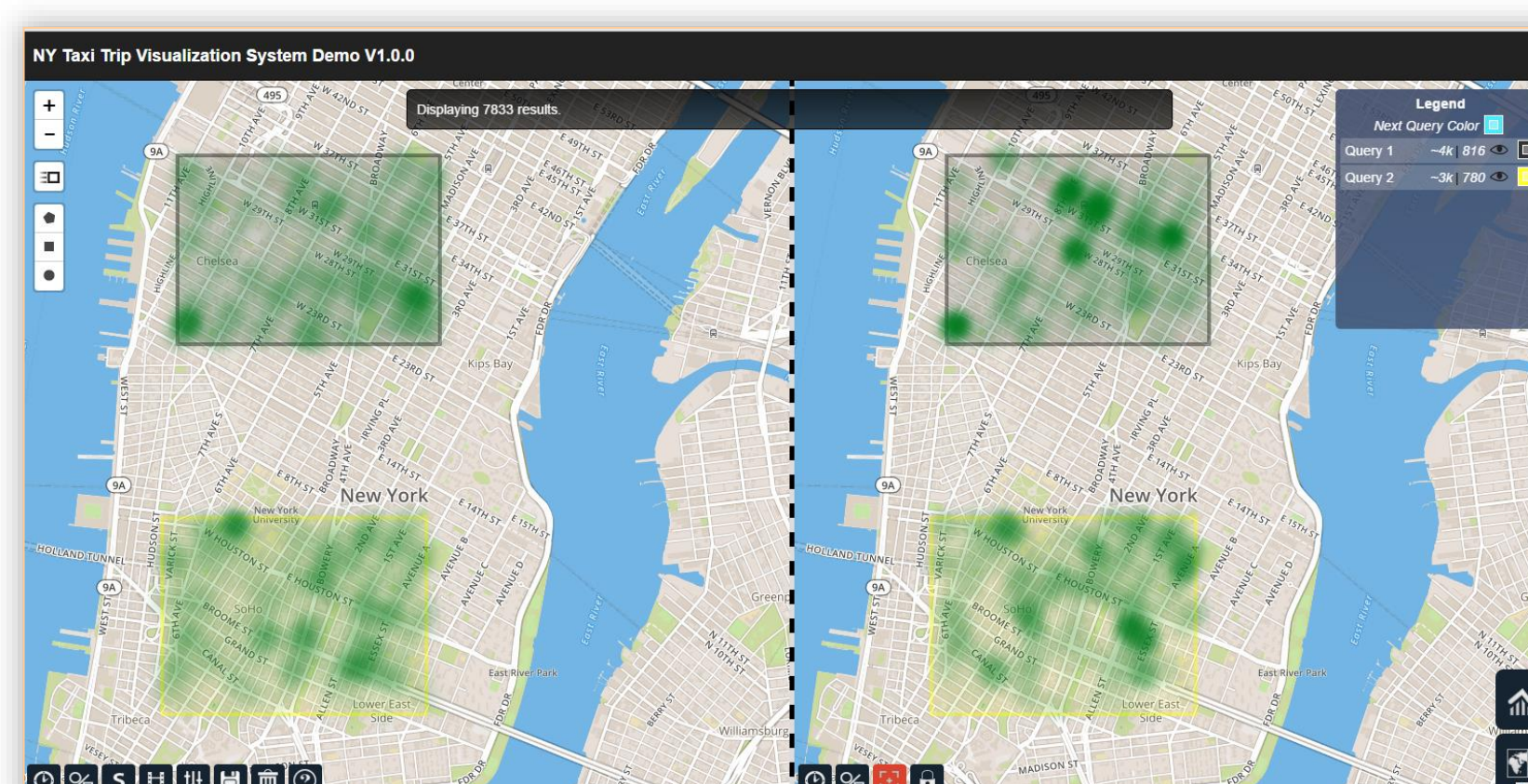
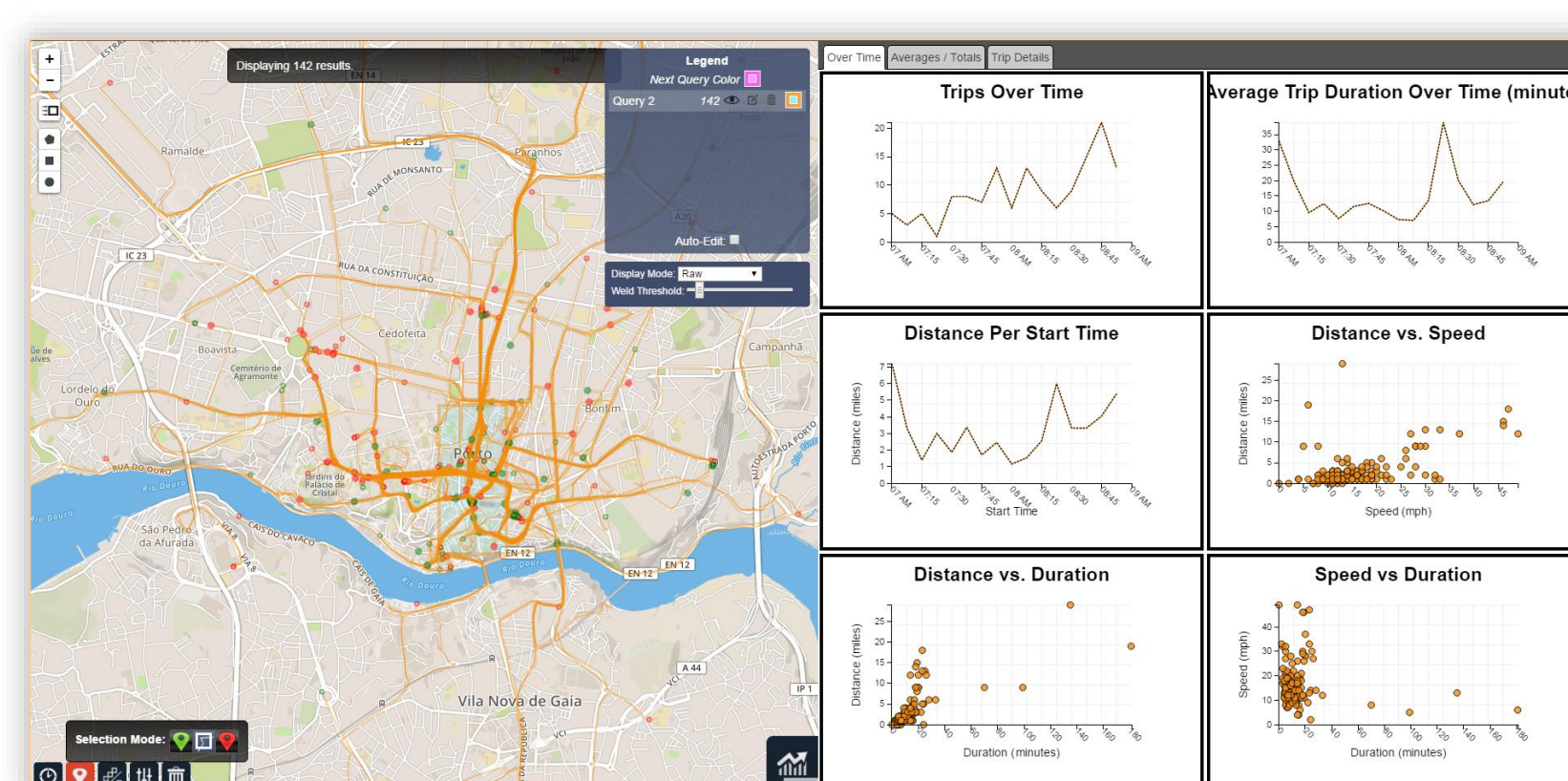
- ❖ pick-up regions.
- ❖ drop-off regions.
- ❖ traversed (passed) regions.



## TrajVis

The visualization interface contains four views:

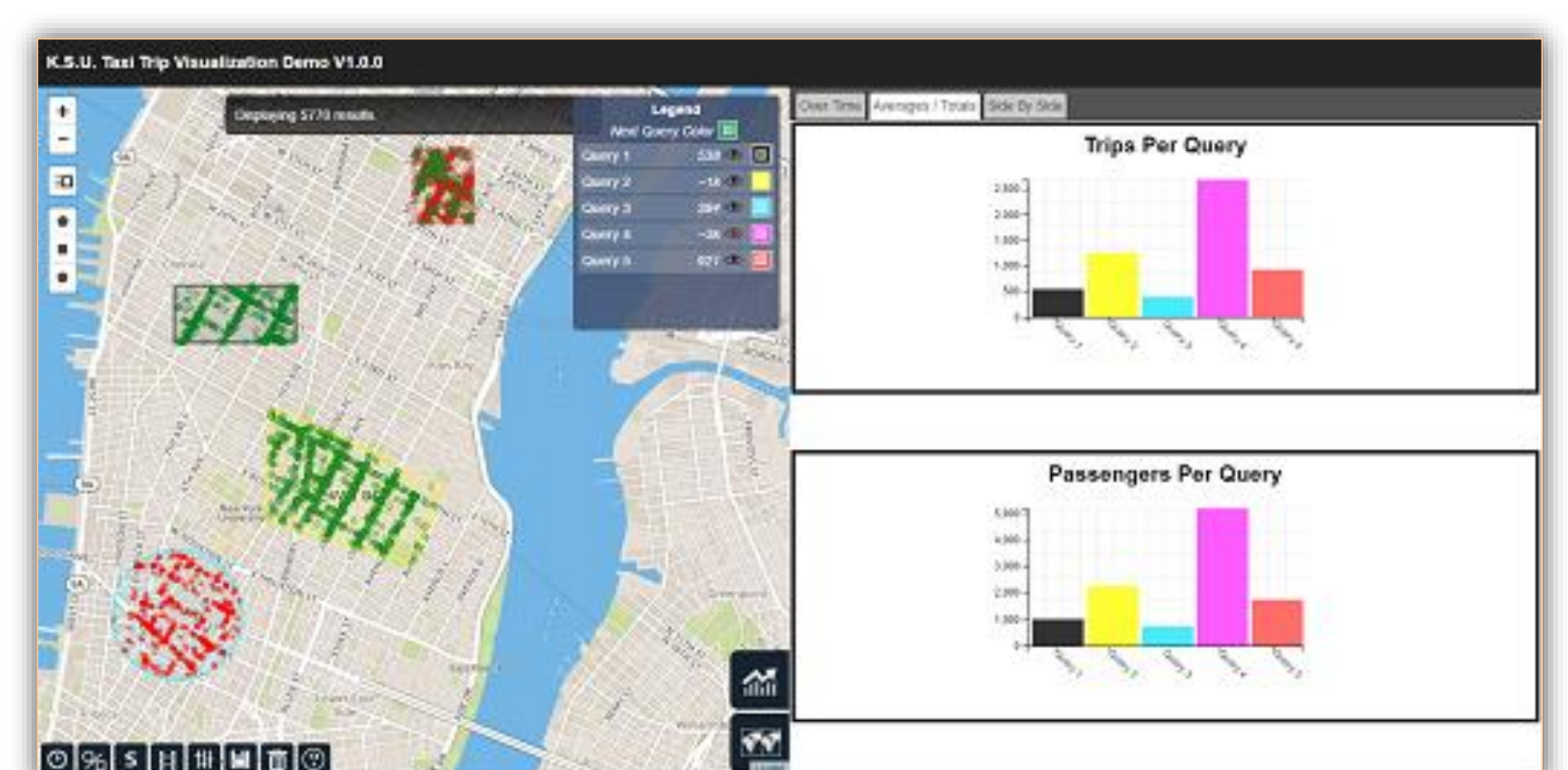
- ❖ map view.
- ❖ list view of queries.
- ❖ side-by-side comparison view.
- ❖ visual report view.



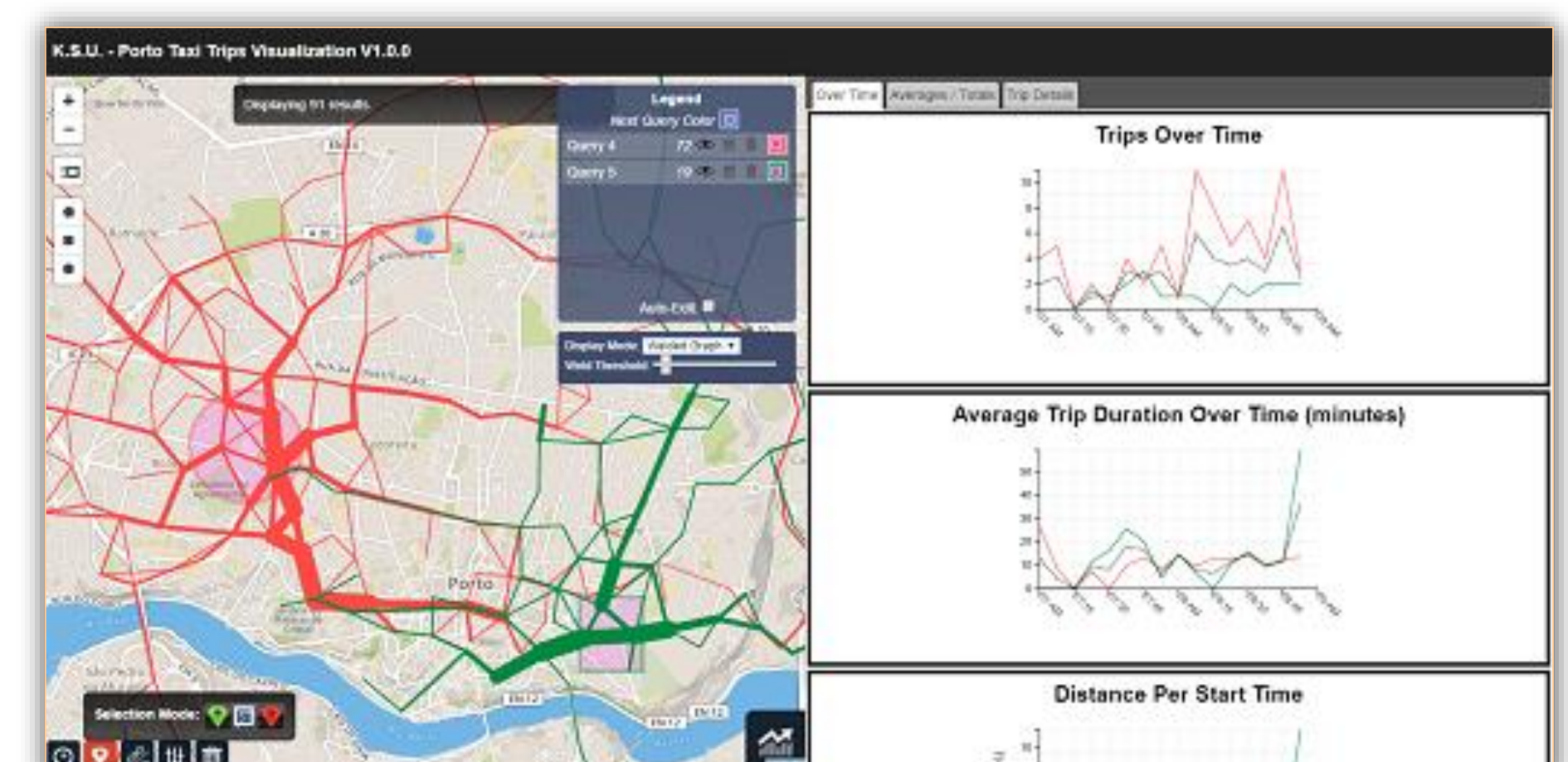
## Prototypes & Codes

Two prototypes of New York (O/D) and Porto (full trajectory) are implemented and published online for test use. The web-based system is implemented with JavaScript libraries where Leaflet.js is used for interactive map and D3.js is for visual charts and diagrams. We also made two tutorial videos to demonstrate how to use the software with a complete description of functions. Prototype source code is freely accessible with a BSD licenses. Please visit:

<http://vis.cs.kent.edu/software.html>



NY City Taxi Trajectory prototype  
<http://vis.cs.kent.edu/Project1.html>



Porto City Taxi Trajectory prototype  
<http://vis.cs.kent.edu/Project2.html>

## Conclusion

The mobility and behavior of moving humans and transportation vehicles form the basic component in human society. Our software facilitates easy, online exploration of big trajectory data. It will advance a broad spectrum of applications by enabling researchers to visually analyze the emerging trajectory data.

## Contact Information

Project Website: <http://vis.cs.kent.edu/>  
Facebook: <https://www.facebook.com/groups/TrajAnalytics/>

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