

# **Spatiotemporal Data Visualization with Python**

A Course for Undergraduate Students

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南方科技大学



Southern University  
of Science and  
Technology

# Content

A quick look...



# Target

Throughout this class, you will:

- Understand some basic concepts of spatiotemporal data
- Code and compute with spatiotemporal data in Python
- Visualize and analyze spatiotemporal data

## Sources

- Slides: [https://xinychen.github.io/slides/visual\\_stdata.pdf](https://xinychen.github.io/slides/visual_stdata.pdf)
- Examples: <https://spatiotemporal-data.github.io>

# Research Interests

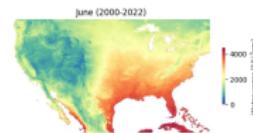
- **Machine Learning** (e.g., Matrix/Tensor computations, numerical optimization, supervised/unsupervised learning)
- **Data Mining** (e.g., Spatiotemporal data modeling, geospatial data analysis)



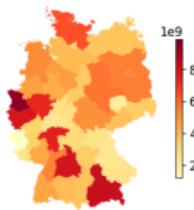
Transportation



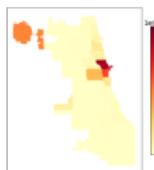
Mobile service



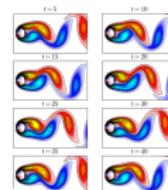
Climate



Energy



Mobility



Dynamical system

- **AI for Science** (e.g., Urban science, dynamical systems, computational social science)

# Past Works

Open-source & reproducible research:

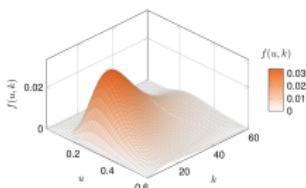
- <https://github.com/xinyuchen>

Algorithms



transdim  
**(1.1k stars)**

Tools



awesome-latex-drawing  
**(1.2k stars)**

Tutorials



latex-cookbook  
**(1.2k stars)**  
(THU Press)

Spatiotemporal Data Modeling (STD) Initiative

- Homepage: <https://spatiotemporal-data.github.io>
  - Areas: Data science & machine learning & AI for science
  - What will we do?
    - Coding and computing with data
    - Posting scientific questions
    - Supporting open-source and reproducible research

Matching Taxi Trips with Community Areas

These are three basic steps to follow for processing test trial data:

- Download taxi trips in 2022 in the `.csv` format, e.g., `Taxi_Trips_2022.csv`
  - Use the `pandas` package in Python to process the raw trip data.
  - Match trip pickup/dropoff locations with boundaries of the community areas.

```
import pandas as pd
```

For each taxi trip, one can select some important information:

- **Trip Start Timestamp:** When the trip started, rounded to the nearest 15 minutes.
  - **Trip Seconds:** Time of the trip in seconds.
  - **Trip Miles:** Distance of the trip in miles.
  - **Pickup Community Area:** The Community Area where the trip began. This column will be blank for locations outside Chicago.
  - **Dropped Community Area:** The Community Area where the trip ended. This column will be blank for locations outside Chicago.

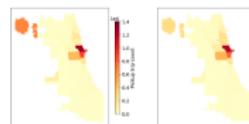
```

df = pd.DataFrame()
df['Trip Start Timestamp'] = data['Trip Start Timestamp']
df['Trip Seconds'] = data['Trip Seconds']
df['Trip Miles'] = data['Trip Miles']
df['Picking Community Area'] = data['Picking Community Area']
df['Dropoff Community Area'] = data['Dropoff Community Area']

del data

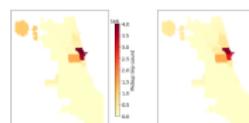
```

Figure 2 shows taxi pickup and dropoff trips (2022) on 77 community areas in the City of Chicago. Note that the average trip duration is 1207.75 seconds and the average trip distance is 8.16 miles.

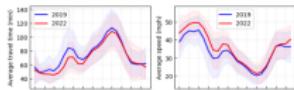


**Figure 2.** Taxi pickup and dropoff trips (2022) in the City of Chicago, USA. There are 4,763,981 remaining trips after the data processing.

For comparison, Figure 3 shows taxi pickup and dropoff trips (2019) on 77 community areas in the City of Chicago. Note that the average trip duration is 916.62 seconds and the average trip distance is 0.9 miles.



**Figure 3.** Taxi pickup and dropoff trips (2019) in the City of Chicago, USA. There are 12,484,622 remaining trips after the data processing. See the data processing code.



**Figure 6.** Average travel time and speed from area 32 (i.e., Downtown) to area 76 (i.e., Almont) in both 2019 and 2022

# Thanks for your attention!

Any Questions?

Slides: [https://xinychen.github.io/slides/visual\\_stdata.pdf](https://xinychen.github.io/slides/visual_stdata.pdf)

## About me:

- Homepage: <https://xinychen.github.io>
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