POLYTECHNIQUE MONTRÉAL

UNIVERSITÉ D'INGÉNIERIE

IVADO

transdim: Machine Learning for Transportation Data Imputation and Prediction

Reproducible Research Workshop

TRB 103rd Annual Meeting · Washington, D.C.

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Open-source & reproducible research:

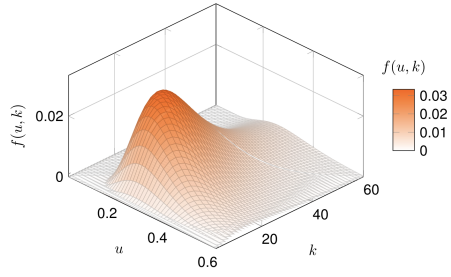
1. GitHub repository: https://github.com/xinychen/transdim
2. Slides: https://xinychen.github.io/slides/transdim.pdf

ML algorithms

transdim

(1.1k stars)

Visualization tools

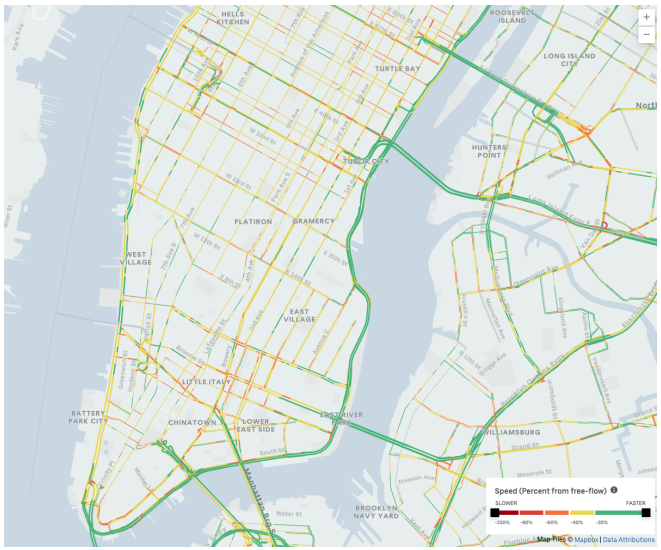


awesome-latex-drawing

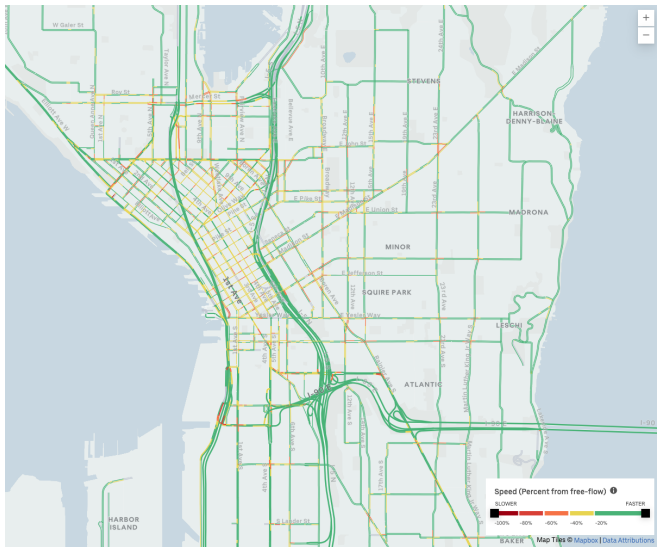
(1.2k stars)

Storytelling with Data

- Uber (hourly) movement speed data



NYC movement



Seattle movement

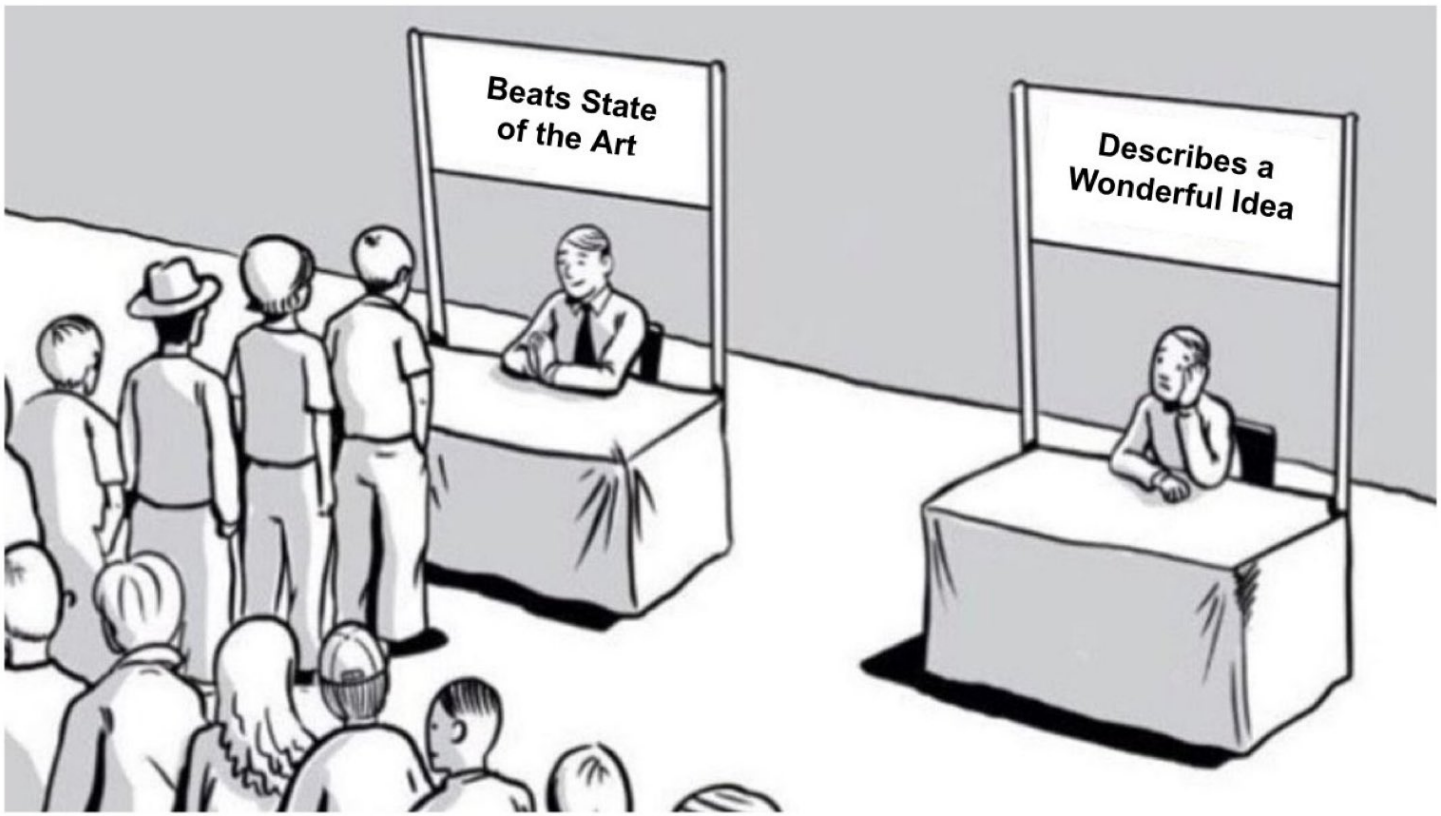
- {road segment, time step (hour), average speed}
- $\boldsymbol{Y} \in \mathbb{R}^{N \times T}$ with N spatial locations $\times$ T time steps
- Computing hourly speed: Road segments have 5+ unique trips.

Issue: Insufficient sampling of ridesharing vehicles on the road network!

Storytelling with Data

- Data
- Quality
- Sparsity
- Estimation
- Imputation
- Interpolation
- Forecasting

Storytelling with Data



Source: Twitter

Traffic Data Processing

Computing with `numpy` (numerical computing in Python)

- Data format: `.npz` (compressed format of `.npy`)
- Example
- Easy to connect with `numpy` (in CPU environment) & `cupy` (in GPU environment)

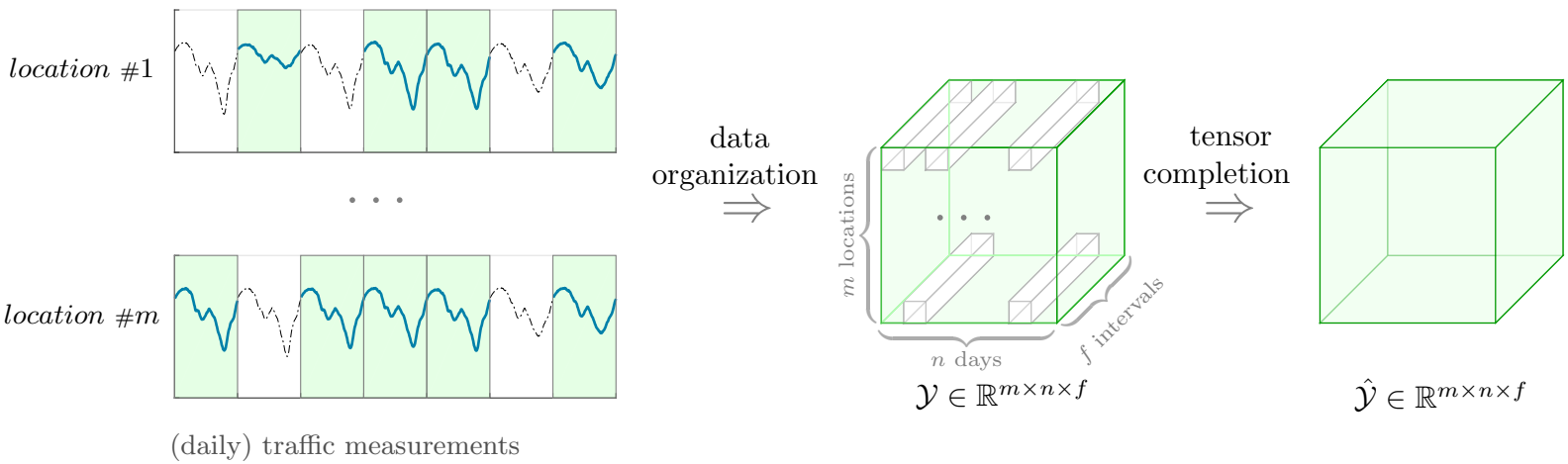
Reformulate Traffic Data Imputation

- Represent traffic data as tensors

$$g : \boldsymbol{Y} \in \mathbb{R}^{m \times t} \rightarrow \boldsymbol{\mathcal{Y}} \in \mathbb{R}^{m \times n \times f}$$

- Tensor completion(Observed index set Ω)

$$\underbrace{\mathcal{P}_{\Omega}(\boldsymbol{\mathcal{Y}})}_{\text{Partially observed}} \xrightarrow{\text{Estimate}} \underbrace{\mathcal{P}_{\Omega}^{\perp}(\boldsymbol{\mathcal{Y}})}_{\text{Unobserved}}$$



Reformulate Traffic Forecasting

Why?

Academic:

- Provide platform and benchmark for comparison
- Stimulate new algorithmic ideas

Industry:

- Solution to ...

Next-step plan:

- Spatiotemporal data modeling:
  https://spatiotemporal-data.github.io

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Thanks for your attention!

Any Questions?

About me:

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