



National Technical University of Athens (NTUA)
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Mining Spatiotemporal Features of City Traffic

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Short-term Traffic Forecasting Today

New sources of Data (Smartphones etc.) -
Big Data

Deep Learning

High temporal resolution

Potential Accurate
Predictions!

On the other hand...

Overwhelming use of Machine Learning
and Deep Learning

“Black Box” approaches

No interpretation





Identifying Spatiotemporal Relations

Statistical Metrics (solid mathematical foundation)

Efficient Traffic Management

Insight on Traffic Mechanics

“Whys” and “Hows” of Traffic

Addressed internally in advanced Deep Learning Structures (LSTM, CNN)

Lack of network wide information

Scope of paper

Analysis of spatiotemporal dependencies, disengaged from the modeling process

Assess the improvement in accuracy by using Deep Learning (LSTM)



Available Data

3,2 million GPS trajectories

DiDi vehicles

Xi'an, China

2-30 November 2016

Exact position every 2-4 sec (750 million points)



Data Preprocessing

Coordinate Transform

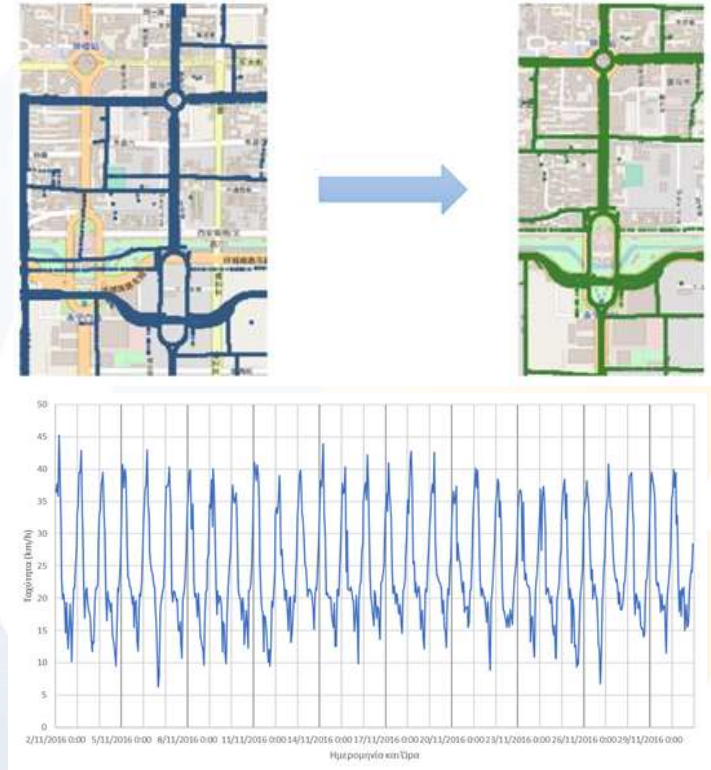
Match to the road network of Xi'an

Calculate speed between consecutive points

Group by road section and 15 minutes

Calculate the mean of each group

Timeseries of speed of each road section






Spatiotemporal Dependencies Detection



Pearson's Correlation (Linear Correlation)



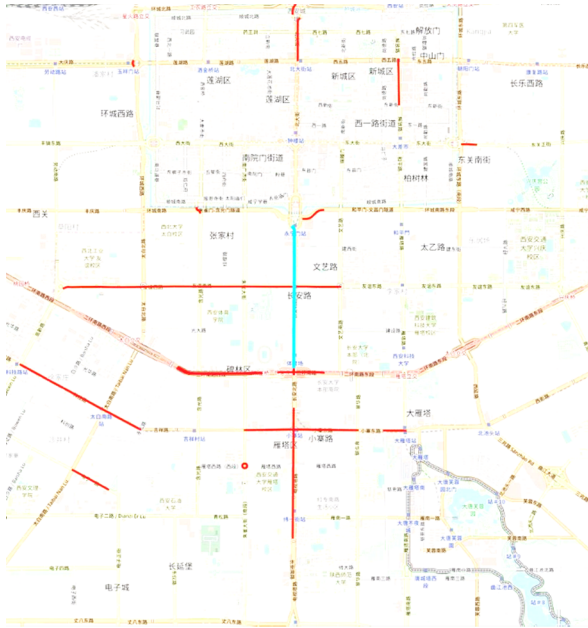
Mutual Information (Linear and Non-linear Correlation)



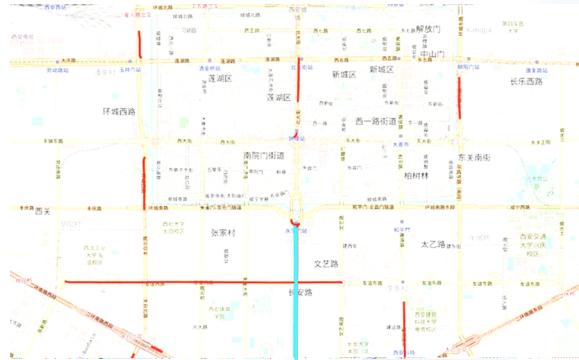
Dynamic Time Warping (Timeseries Similarity)

Comparative Results

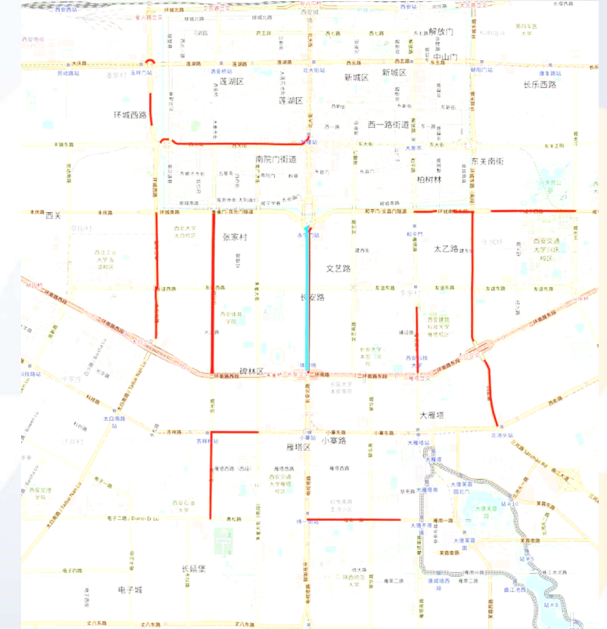
● Target section ● 20 most correlated sections



Pearson's Correlation



Mutual Information

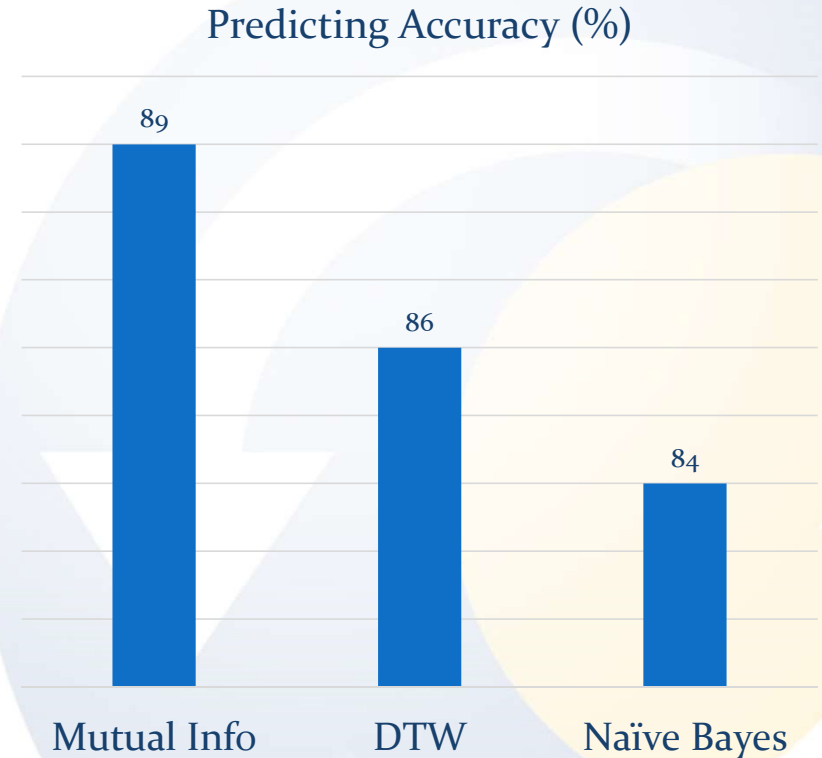


Dynamic Time Warping

Evaluation using Bayesian Classifiers

Development of 3 Bayesian Classifiers

- Mutual Info sections
- Dynamic Time Warping sections
- All sections





LSTM Initialization

21 Sections' speed prediction (15 min horizon)

Mutual Info Relations

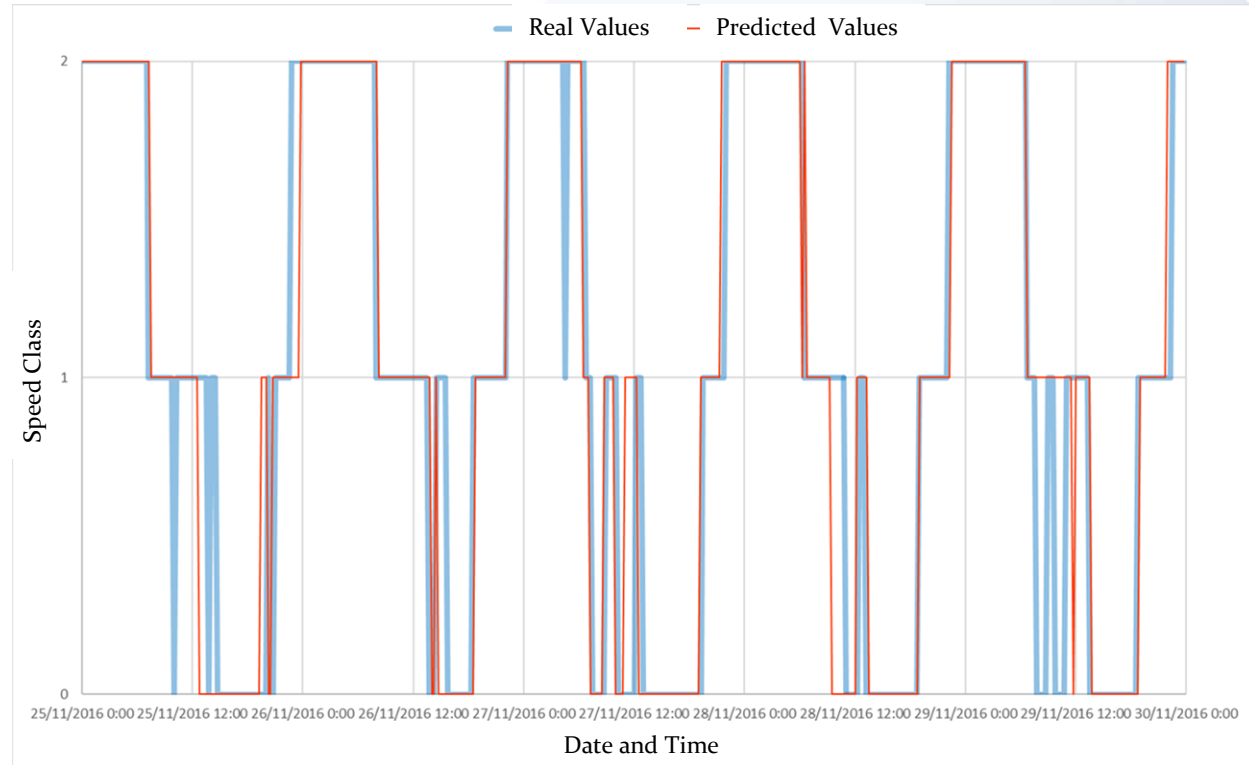
Classify into 3 classes using descriptive statistics

Train and Test data split (24 days – 5 days)

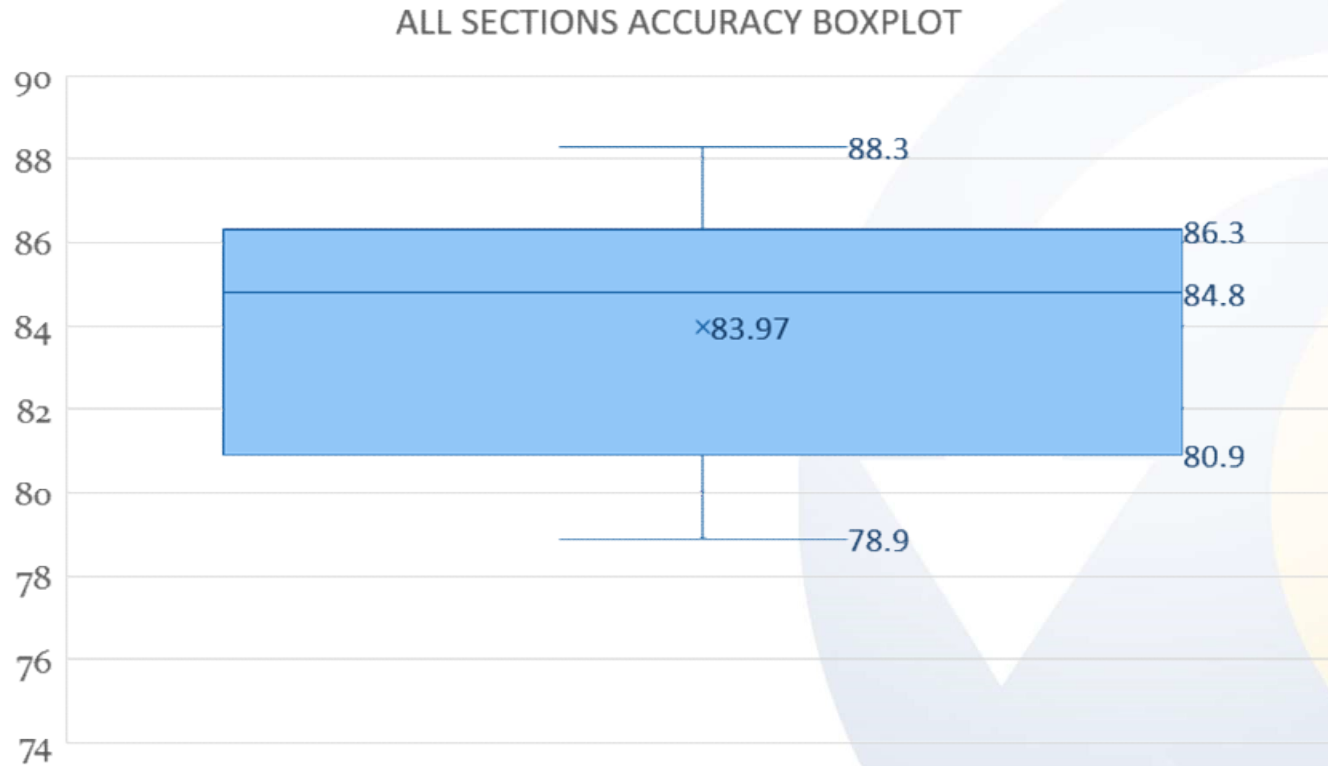
Short-term prediction results (1/2) – Each section

REAL		PREDICTED		
		<20 km/h	20-26 km/h	>26 km/h
		105	35	0
	<20 km/h	105	35	0
	20-26 km/h	18	143	6
	>26 km/h	0	6	167

METRICS	LSTM 15MIN
ACCURACY	0.86
RECALL (SENSITIVITY)	0.86
PRECISION	0.86
F1 – SCORE	0.86



Short-term prediction results (2/2) – All sections





Conclusions

- ✓ Spatiotemporal analysis -> better interpretation
- ✓ General use metrics give clear insight of dependencies
- ✓ More accurate predictions
- ✓ LSTM networks provide accurate network wide results



Future Research

More data

Real time predictions

Whole network predictions

Larger forecasting horizons



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