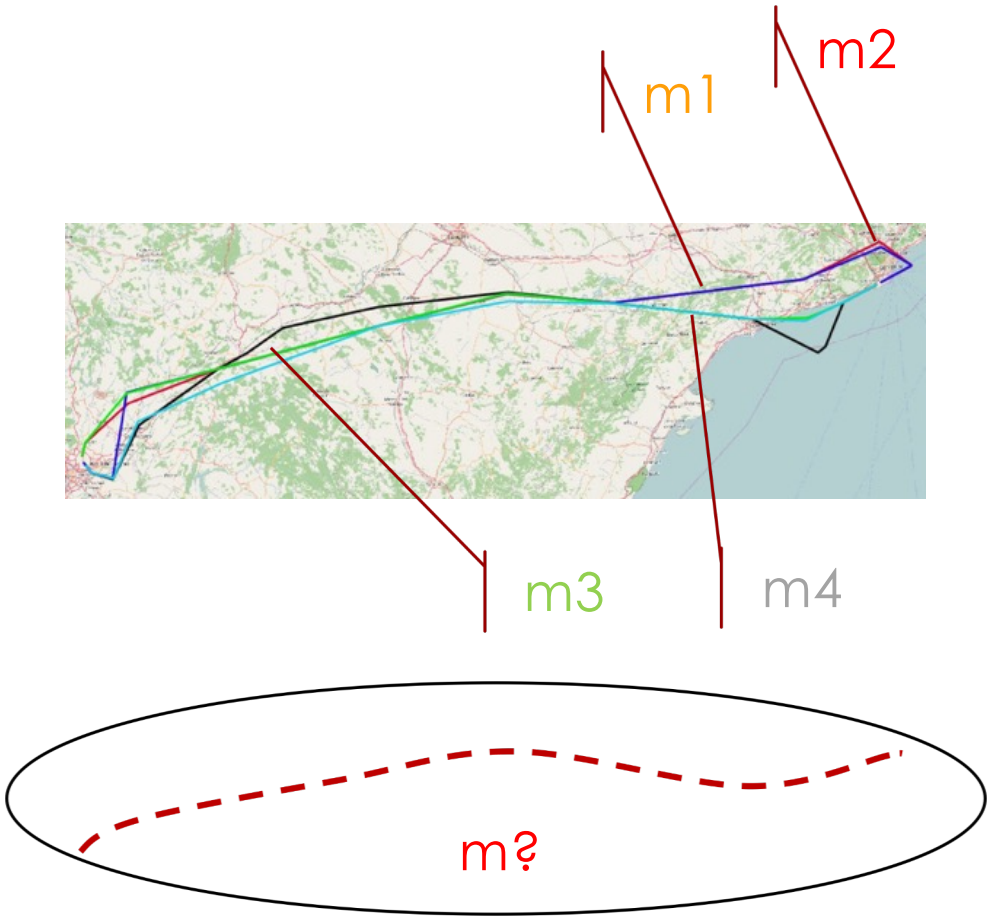
Data-driven trajectory prediction (cont.)

(Georgiou et al. 2019)

Method sketch:

Input: Flight plans, actual routes, local weather, aircraft type, etc.

1. Past enriched trajectories are **Clustered**; medoids of clusters ('representatives') are also produced
2. A **Predictive Model** (PM) is built for each cluster
3. For each new flight plan FP, the **k-closest matches** (PMs) are found
4. Output: top-*k* PMs w.r.t. query FP



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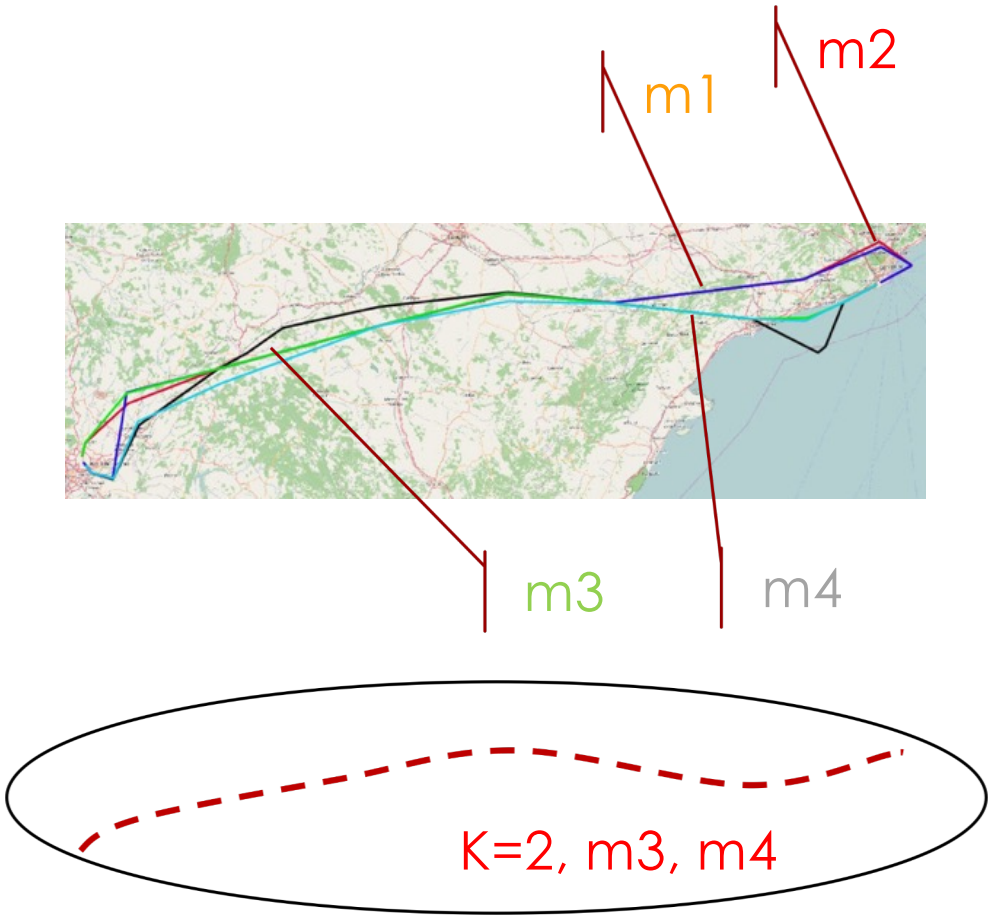

Data-driven trajectory prediction (cont.)

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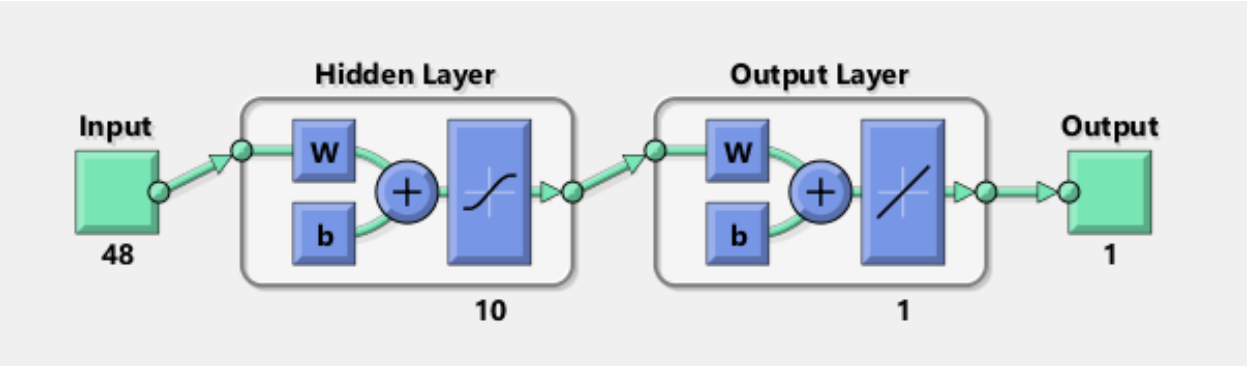
- Hidden Markov Model (HMM)
- Linear Regressor (LR)
- Decision Tree (CART)
- Neural Network (NN-MLP), etc.

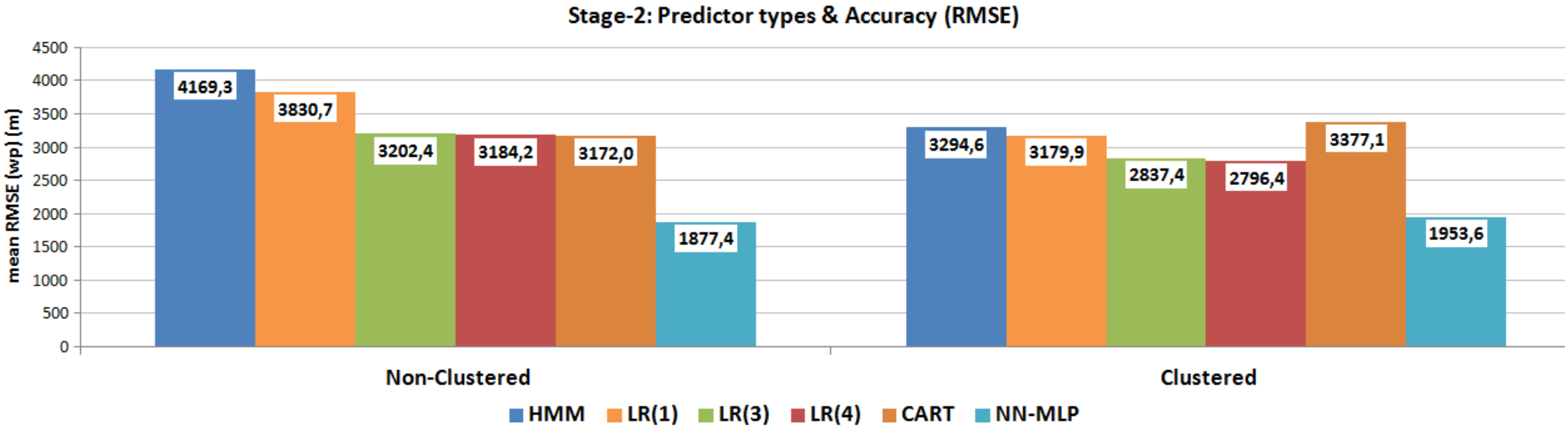
Example (below) of Non-linear Regressor: NN-MLP
input (48): Flight Plan waypoints
output (1): deviation of prediction from a waypoint



Data-driven trajectory prediction (cont.)

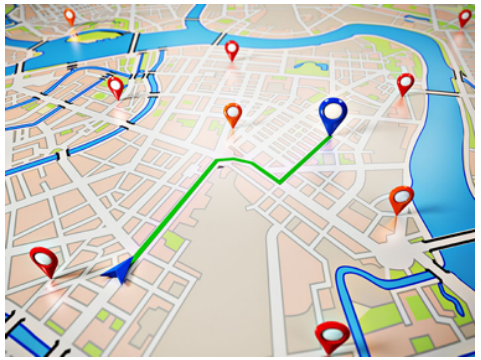
(Georgiou et al. 2019)

- **Pre-flight TP based on enriched flight plans**: NN/MLP regressor can provide **waypoint error** < 2 km (3-D), clustering in general helps linear models.



Summary

- The field of **Mobility Data Management and Exploration** (Pelekis & Theodoridis, 2014) has many success stories to tell on:
  - data storage and processing techniques, DBMS extensions, etc.
  - data mining (cluster analysis, hot path / hot spot discovery, etc.)



- The new MDA era that emerges is about
  - **Context-enriched trajectories**: annotated information about when, where, what, how, why
  - **Big mobility data**: voluminous, complex, heterogeneous information about movement of objects

Research challenges

Research Questions	Research Challenges
*How can we **reconstruct** and **enrich** trajectories out of movement data?*	We need methods for **building semantically rich trajectories** from heterogeneous and multidimensional data.
*How can we **infer** interesting knowledge from them?*	We need data analytics methods capable of taking into account the multiple aspects of enriched trajectories. Examples: **similarity** analysis, **clustering**, **graph** analysis, **prediction** etc..
*How can we deal with the **Big Data** characteristics?*	We need **scalable**, **efficient**, **real-time** data storage and analytics methods.

Acknowledgments

Ack EU support through grants:

- **Track & Know** – Big Data for Mobility Tracking Knowledge Extraction in Urban Areas. H2020 2018-20 [trackandknowproject.eu]
- **MASTER** – Multiple Aspect Trajectory Management and Analysis, Marie-Curie 2018-22 [master-project-h2020.eu]
- **datAcron** – Big Data Analytics for Time Critical Mobility Forecasting, H2020 2016-18 [datacron-project.eu]
- **DART** – Data-Driven Aircraft Trajectory Prediction Research. SESAR 2016-18 [dart-research.eu]

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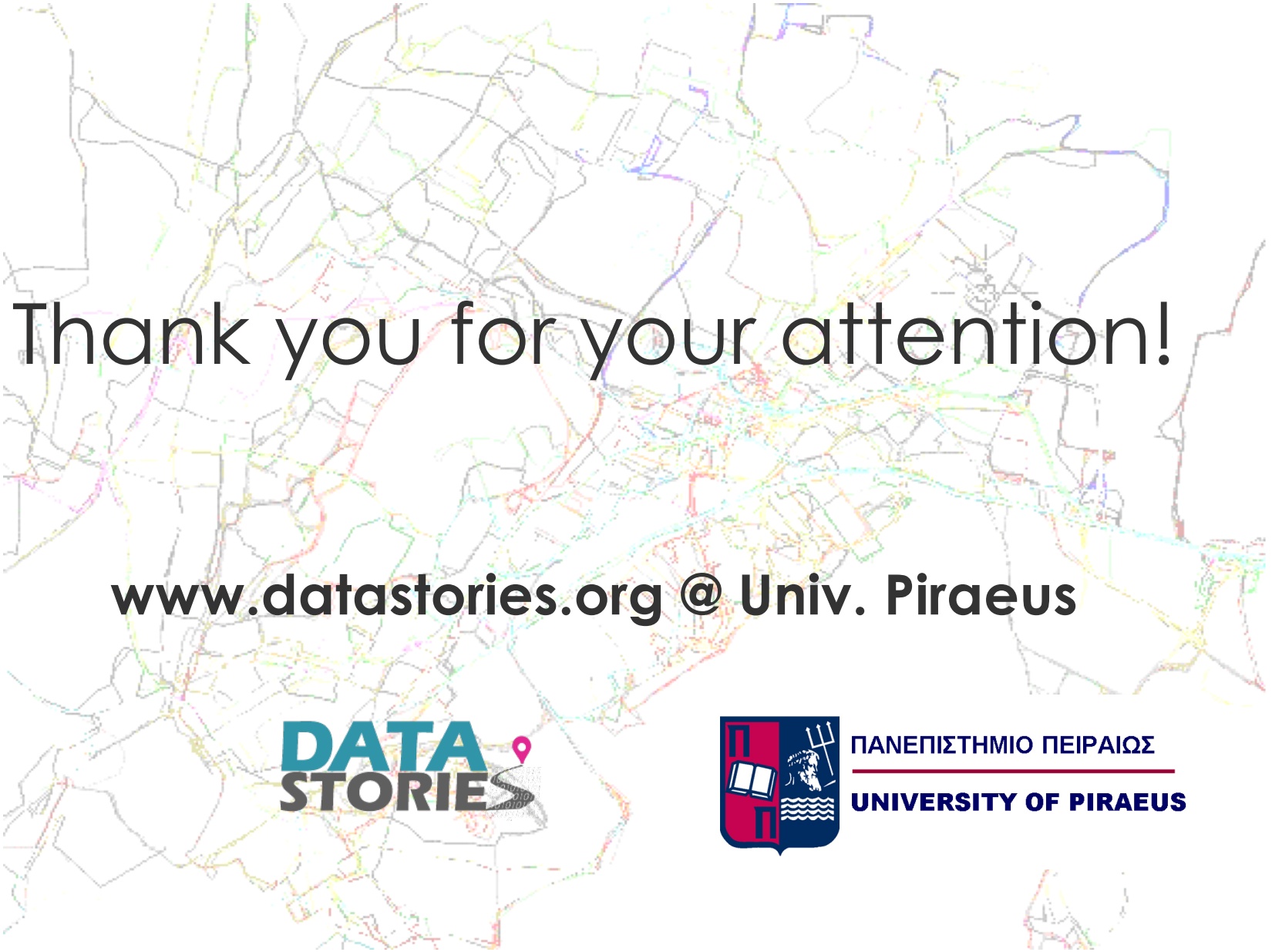
The Data Science Lab @ UniPi.GR

- Our research agenda:
  - Big data management
  - Mobility data analytics
  - Text mining (sentiment analysis, etc.)
  - Deep learning in audio / music
  - Semantic integration

  etc.



Thank you for your attention!

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