GPS-based Travel Diaries

Handling GPS Signal Loss using Accelerometer Data

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Motivation for automated GPS data processing

Complementation for travel diaries

Reliable information on

- Route choice
- Times
- Short trips / activities

Longer observation periods due to reduced response burden for participants.

Application for automated GPS data processing

peacox

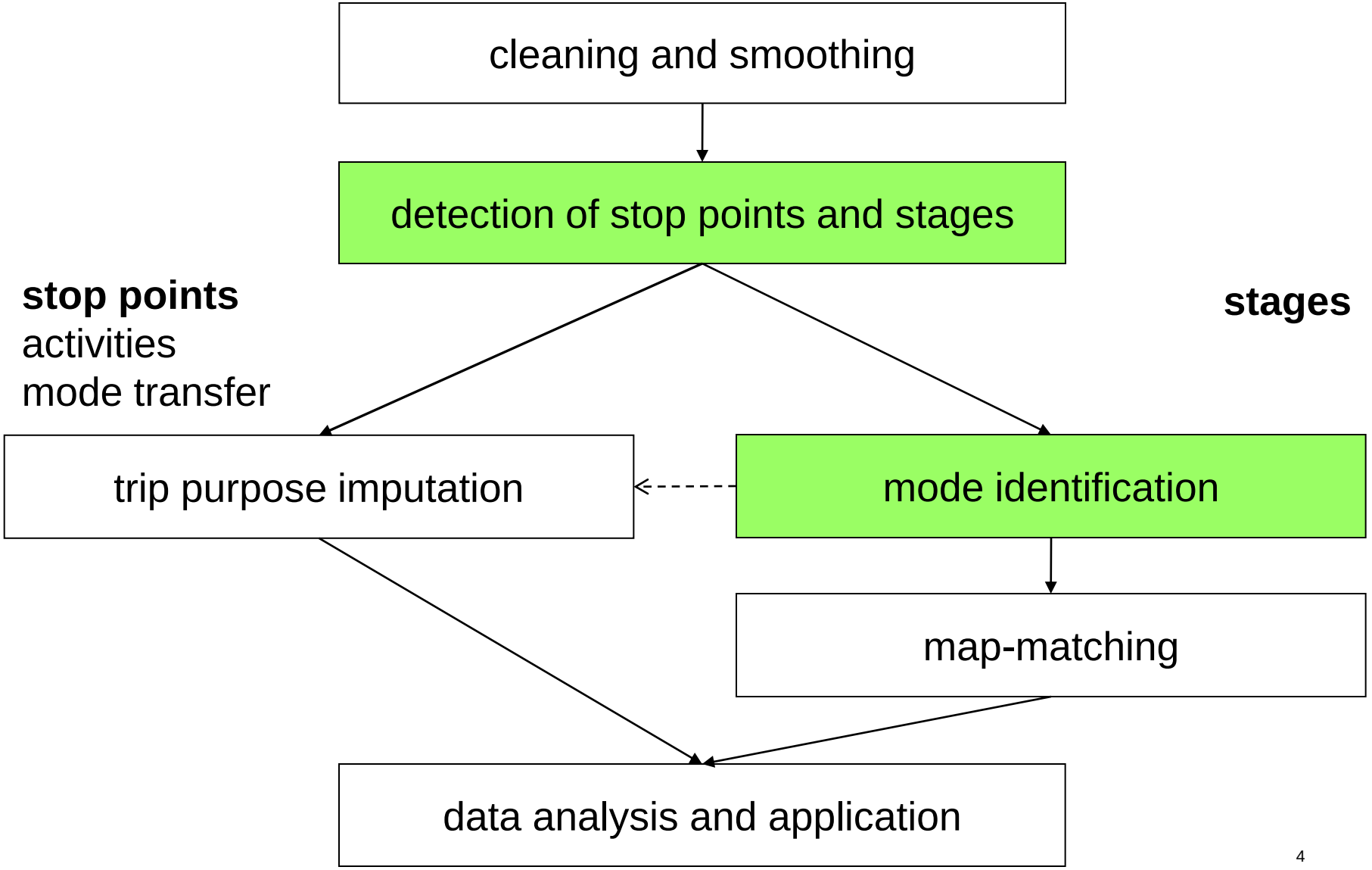
Smartphone App: Persuasive Advisor for CO2-reducing cross-modal trip planning

Calculation of CO2 emissions based on automated travel diary

Personalized recommendation of modes and routes based on

- travel history (e.g. mode share, walking speed)
- current mode of transport (near real time)
- trip purpose

Processing framework for GPS and accelerometer data

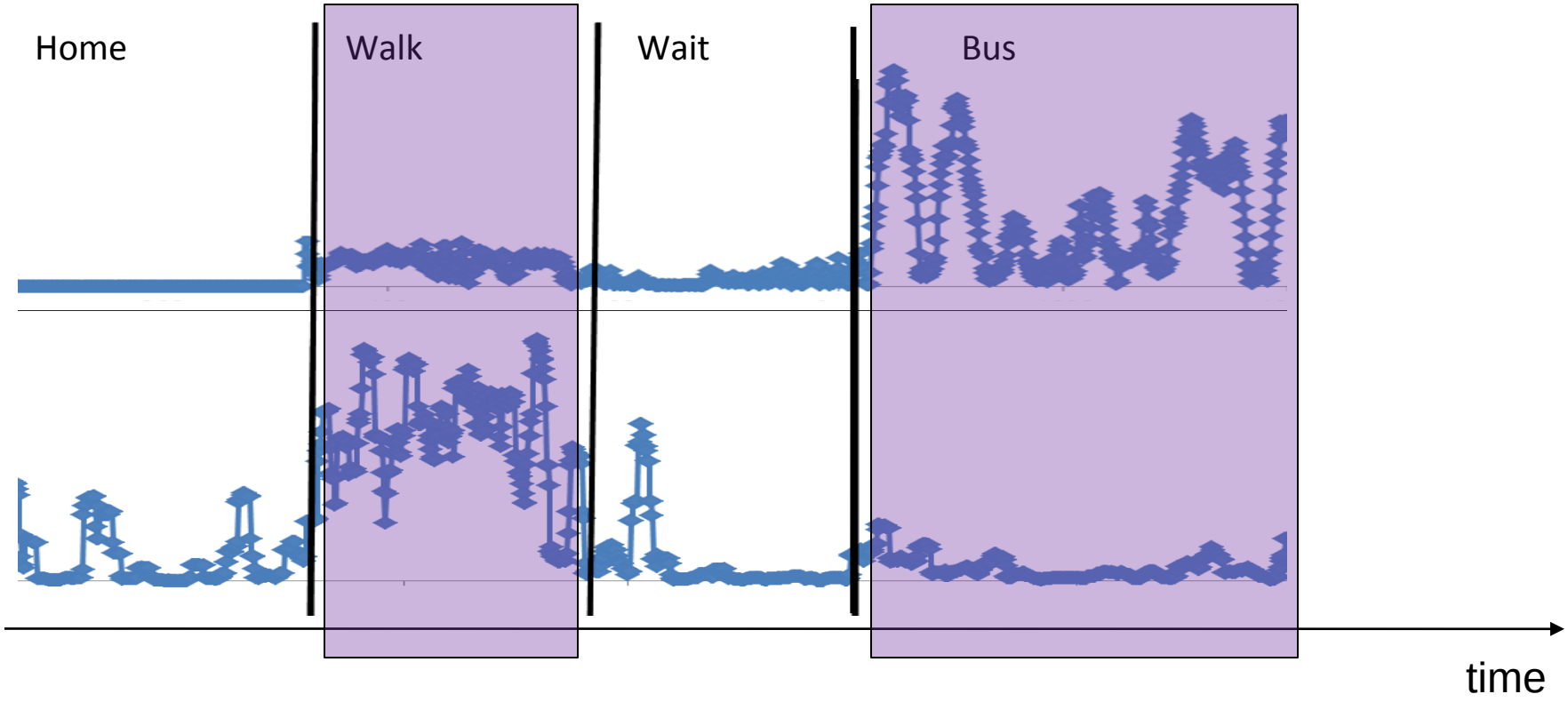


Stop point and mode identification – up to now

Determine stop points point density, low accelerometer, **GPS gaps**

Calculate features resulting stages

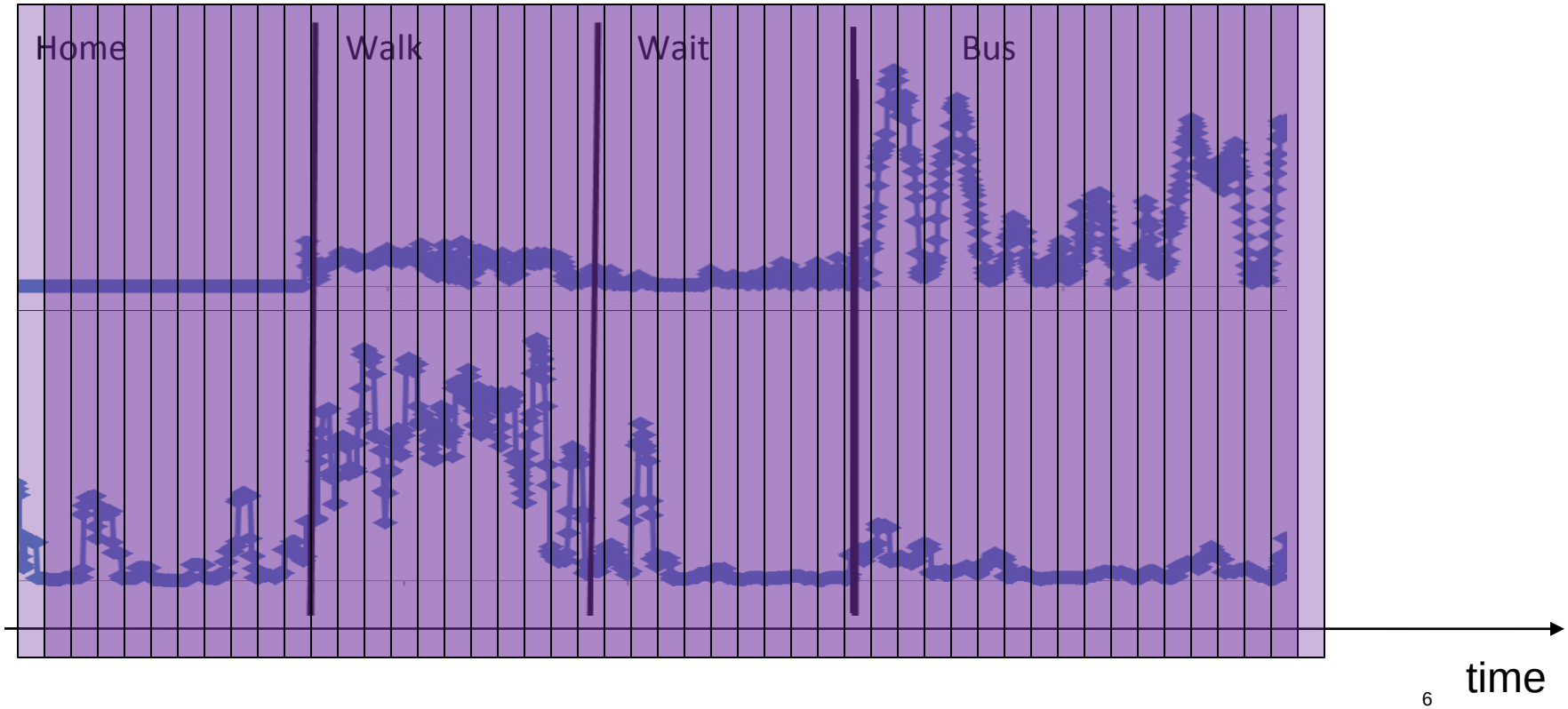
Mode identifiction using fuzzy rule system



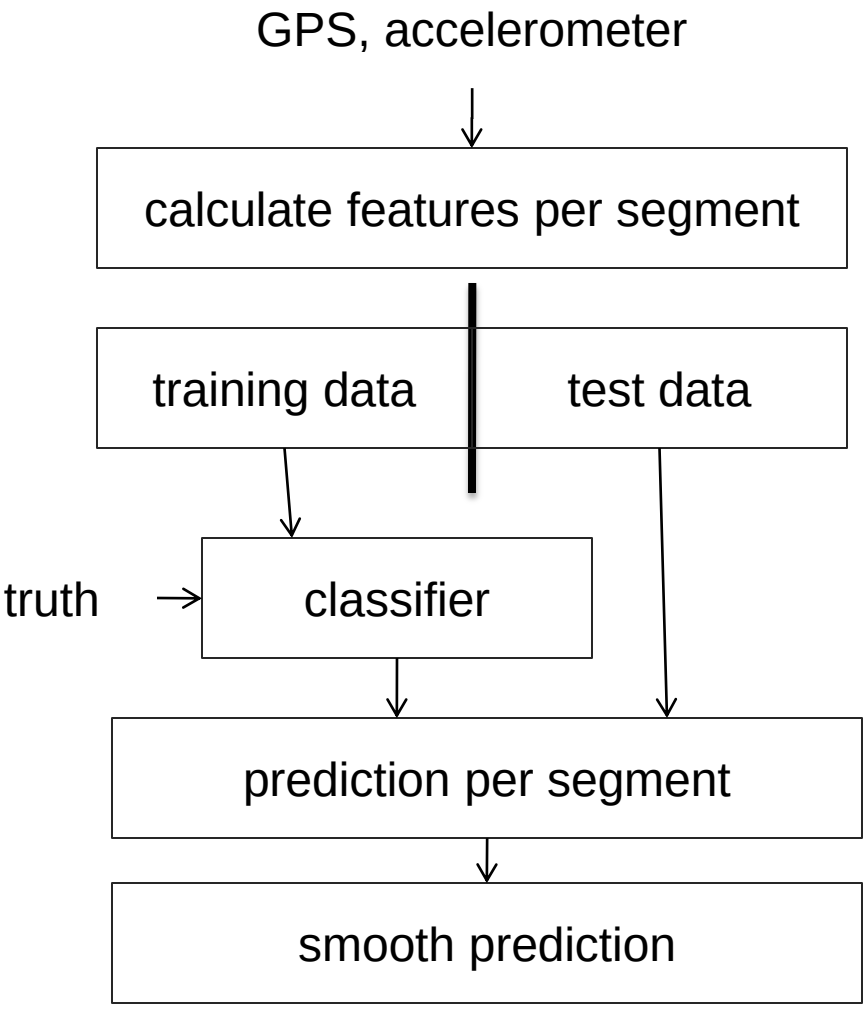
Stop point and mode identification – new approach

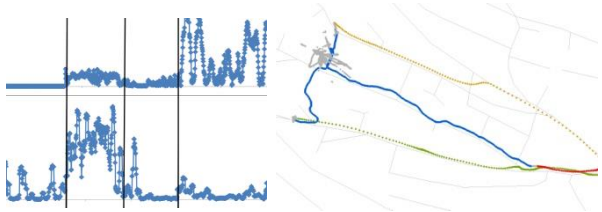
Calculate features for overlapping windows:

- More training data
- Near real time capability
- Determination of stop points and mode in one step



Stop point and mode identification – classification problem



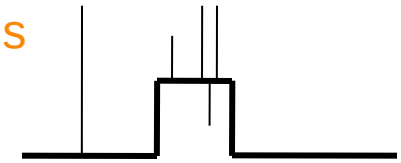


window size (40s), overlap (50%)

cut timeline in the middle per person

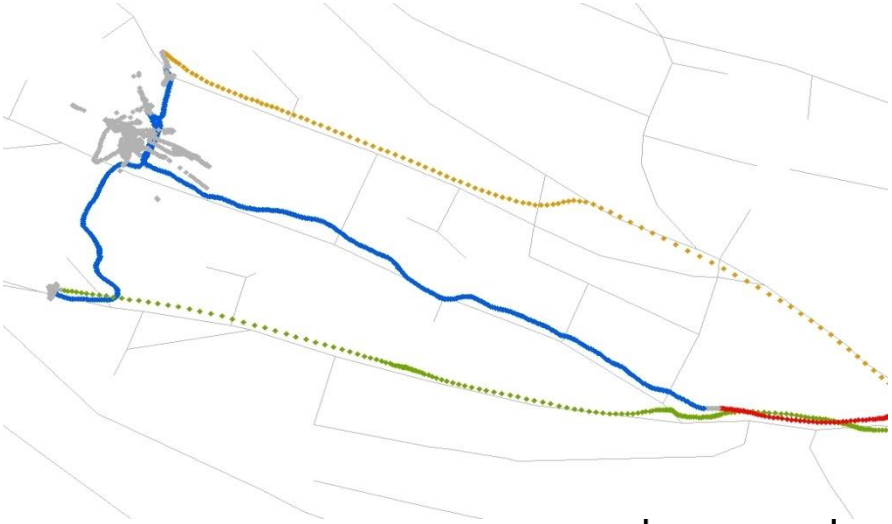
random forest

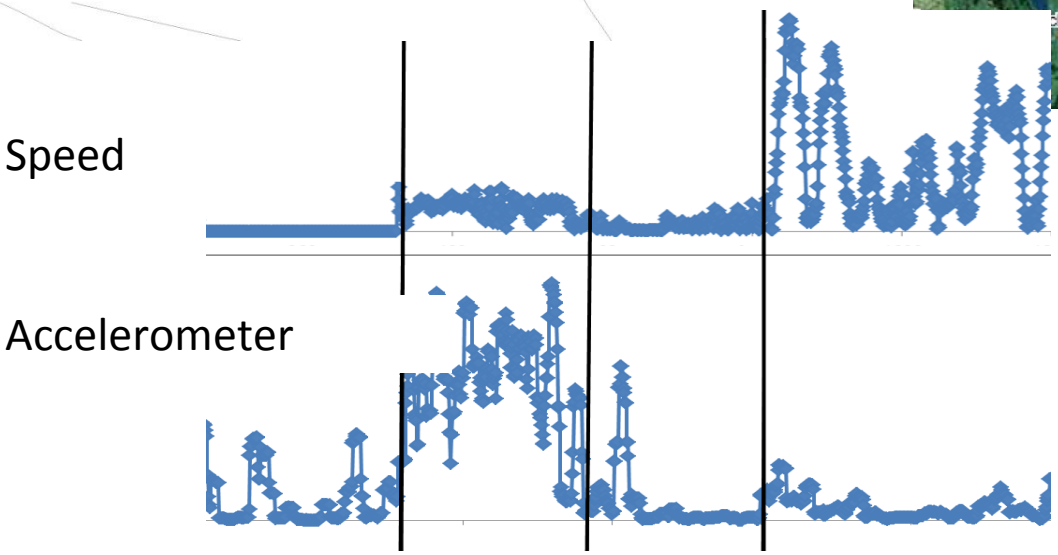
Minimum durations
Activities: 3 min
Walks: 1.5 min



Data

GPS and accelerometer - 1 point / second





Features

GPS:

- Speed (mean, percentiles)
- Density

Accelerometer

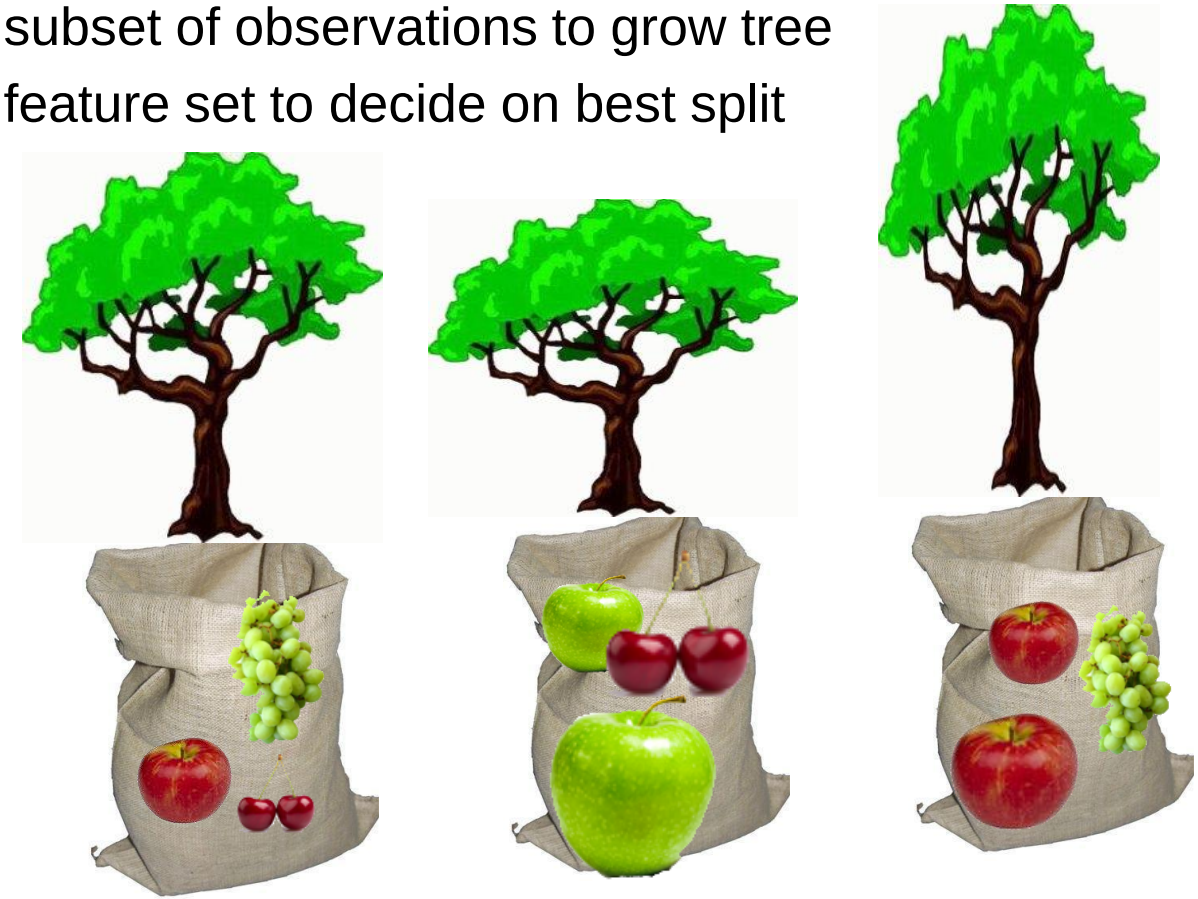
- Min, max, mean, standard deviation of the absolute of the accelerometer vector
- Energy and root mean square of STFT (short term fourier transform)
- Mean, max of the change in direction of the accelerometer vector

Random forests: Ensemble of decision tree

A random forest consists of many decision trees. Each tree has one vote.

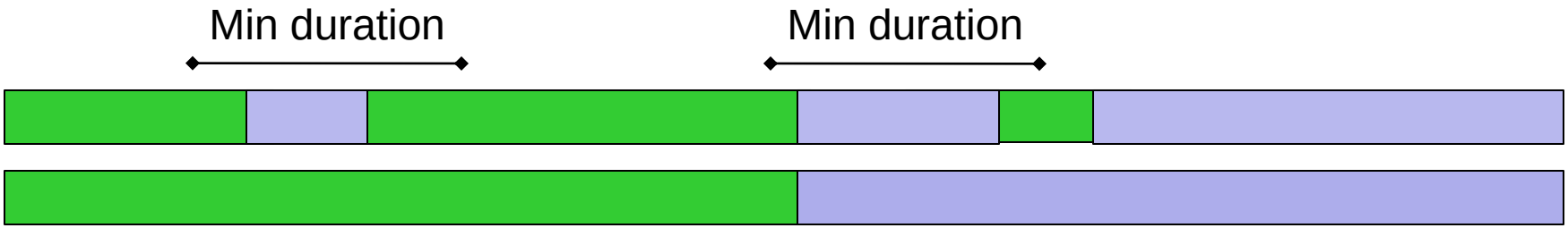
Randomness:

1. Random subset of observations to grow tree
2. Random feature set to decide on best split

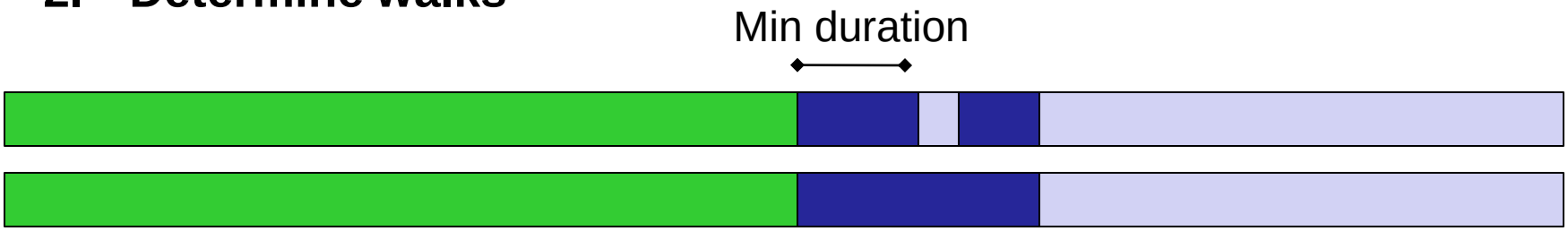


Smoothing predictions

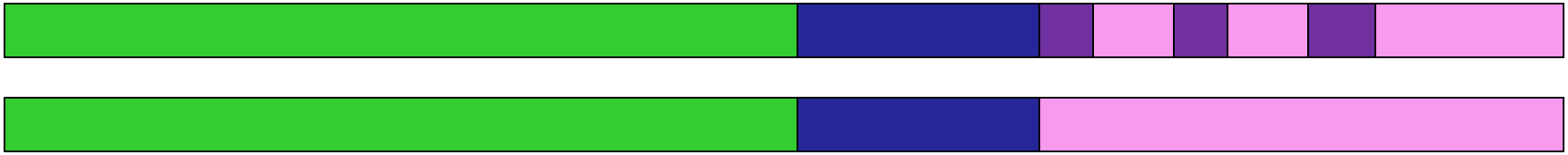
1. Determine activities



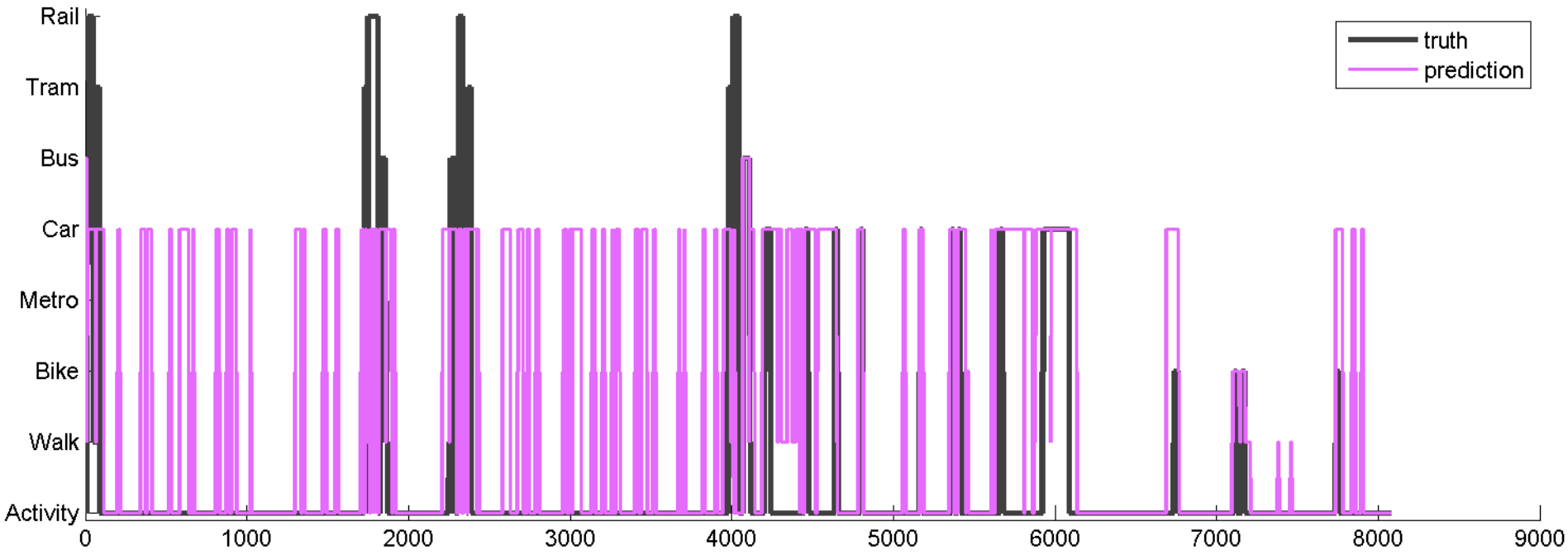
2. Determine walks



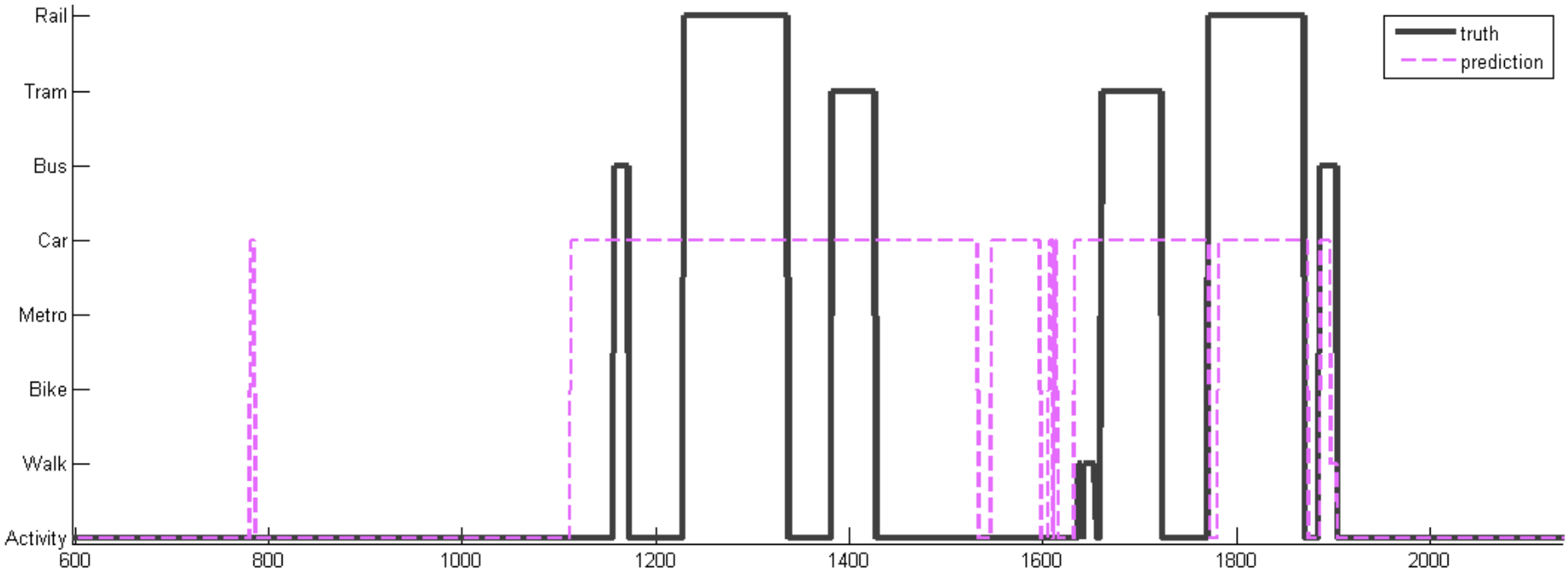
3. Set mode for remaining movements



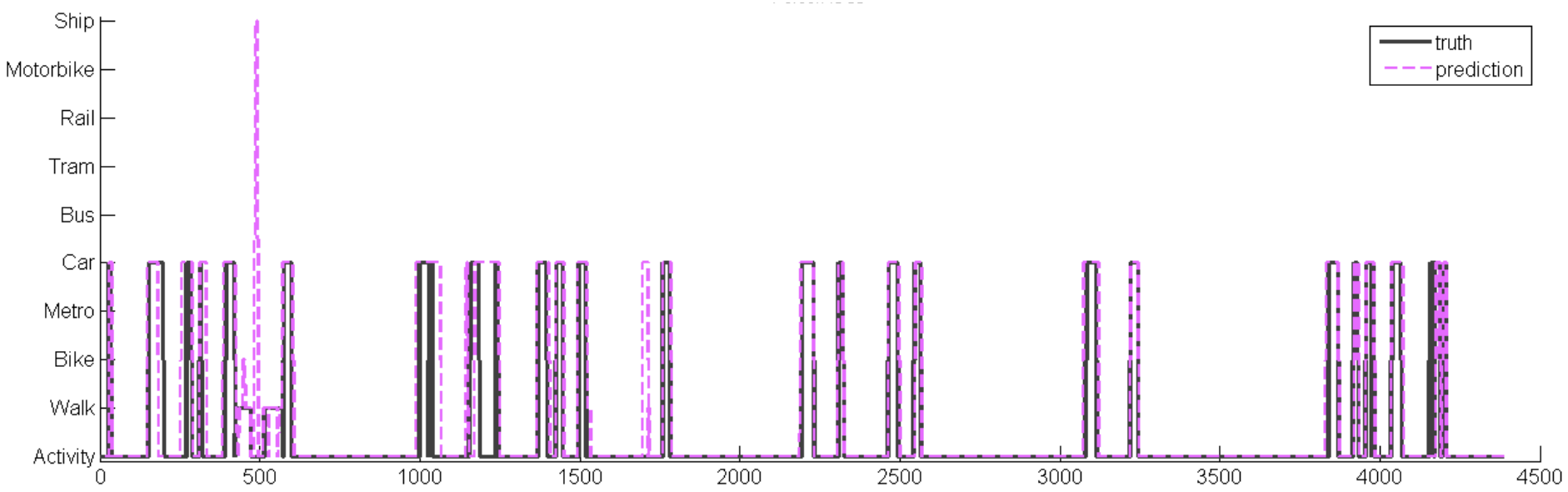
Results – bad example



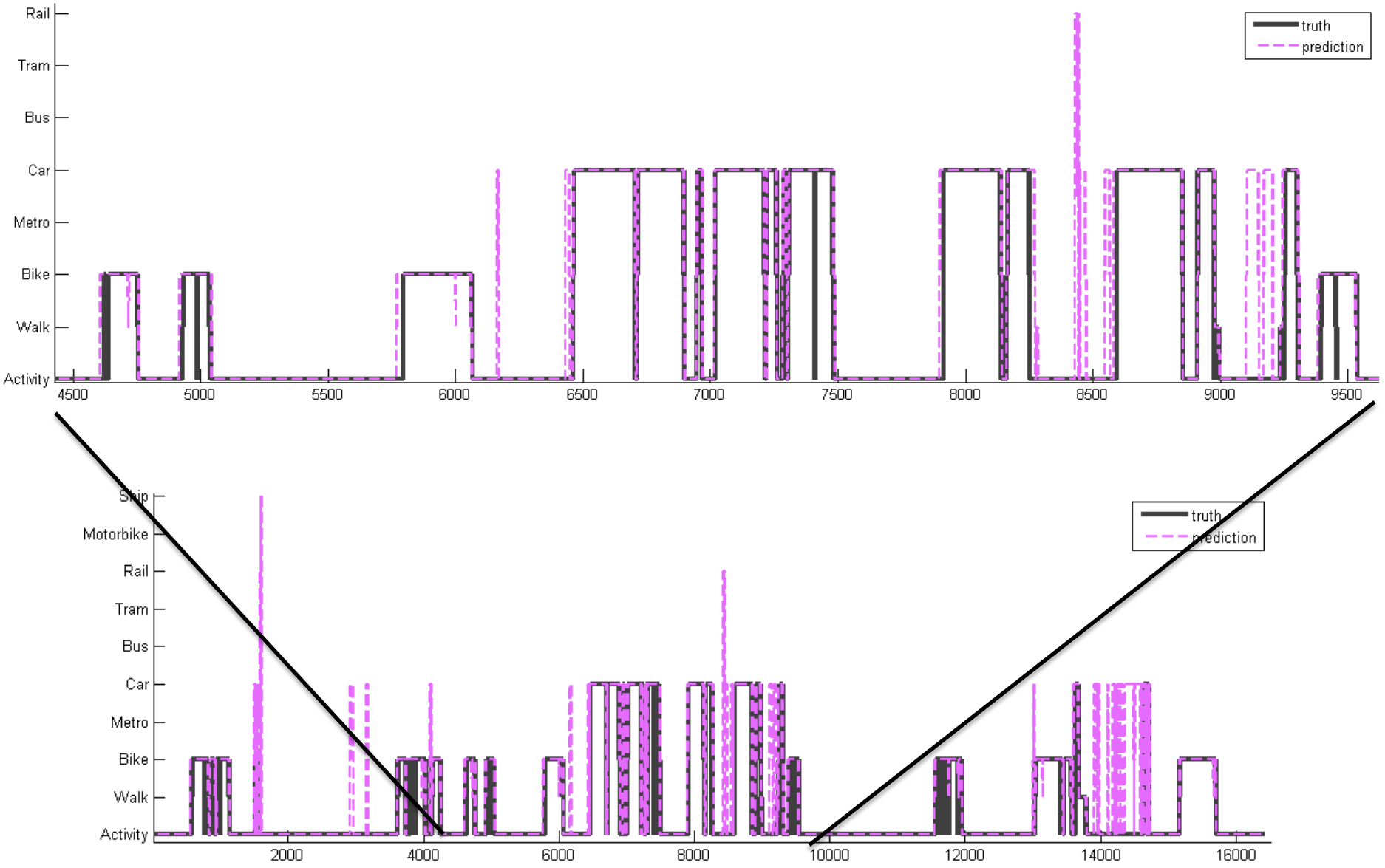
Results – bad example



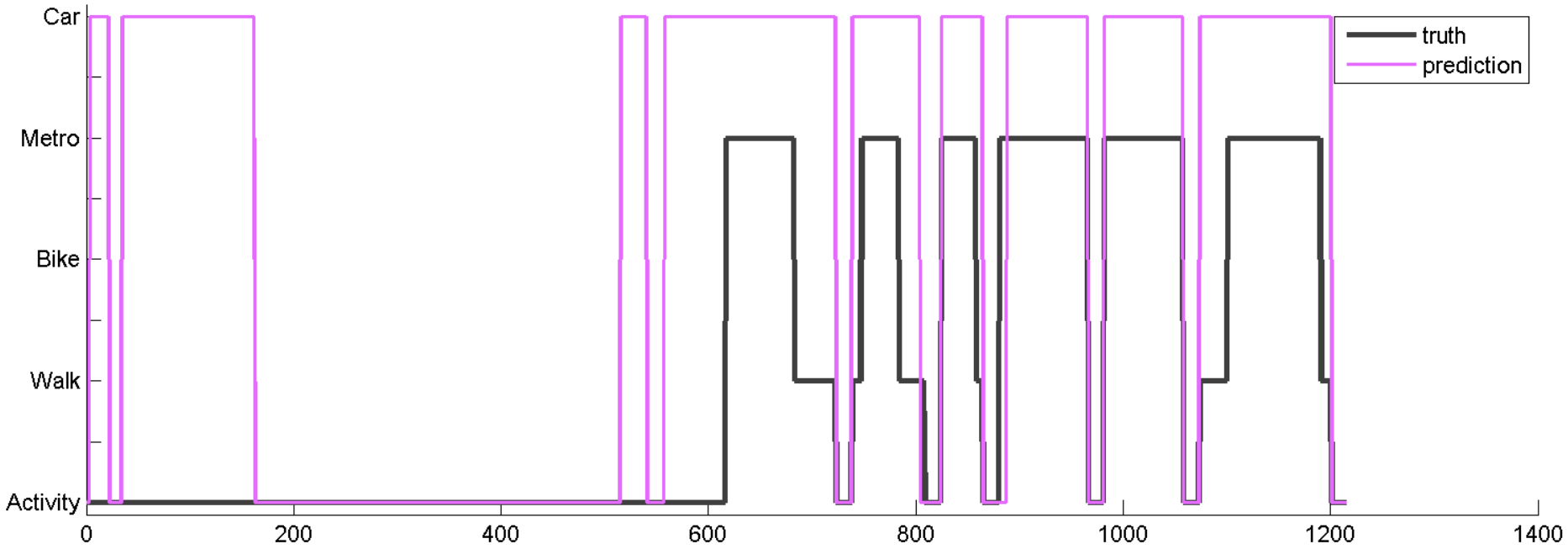
Results – good example



Results – good example



Results – Metro stages



Conclusion and outlook

Preliminary results promising:

- Distinction between activities and movement is good
- Determination of mode not yet

Improvement potential:

- Use all available data (approx.10 times more)
- Test different classifiers
- Analyze influence of window size and overlap
- Analyze prediction smoothing (minimum duration)
- Feature selection (e.g. add public transport network)

Define when a diary is well represented

Questions

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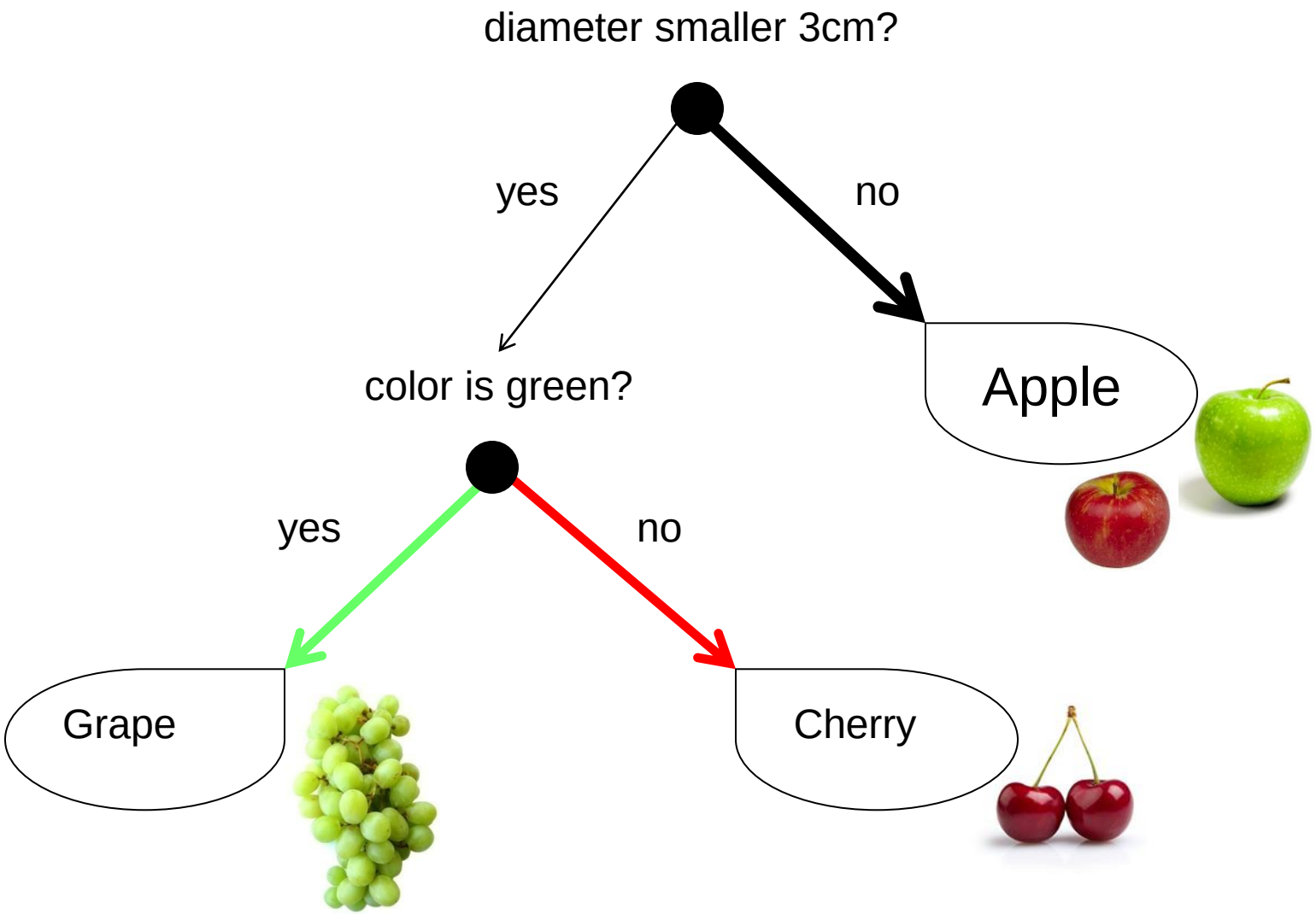
Random forests: Ensemble of decision trees



First approach: feedback during stop point detection

moving gap if simple speed > threshold (5m/s)

use accelerometer of gap to distinguish between movement and no movement / walk