

PUMP DOWN THE JAM

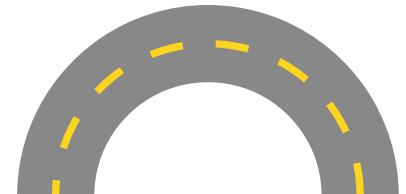
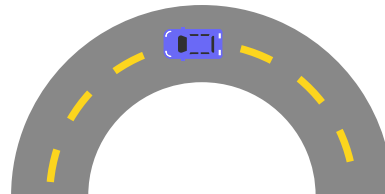
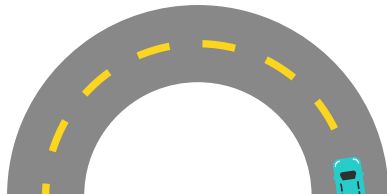
Predicting traffic density in Hamburg to help you skip the jams.

Capstone Project
neufische Data Science Bootcamp
30/03/2023

The Team



Dr. Christopher Hedemann	Gunnar Oehmichen	Dr. Martin Stark	Dr. Sarah Wiesner
<ul style="list-style-type: none">● Climate Scientist● Data Scientist	<ul style="list-style-type: none">● Environmental Scientist● Data Scientist	<ul style="list-style-type: none">● Sustainability Researcher● Data Scientist	<ul style="list-style-type: none">● Earth System Researcher● Data Scientist





**"You are not stuck in traffic.
You are traffic."** (Unknown)



Hamburg

Capital of traffic jam in 2022

Traffic obstructions increased travel times by

66 hours

over the year for the average driver

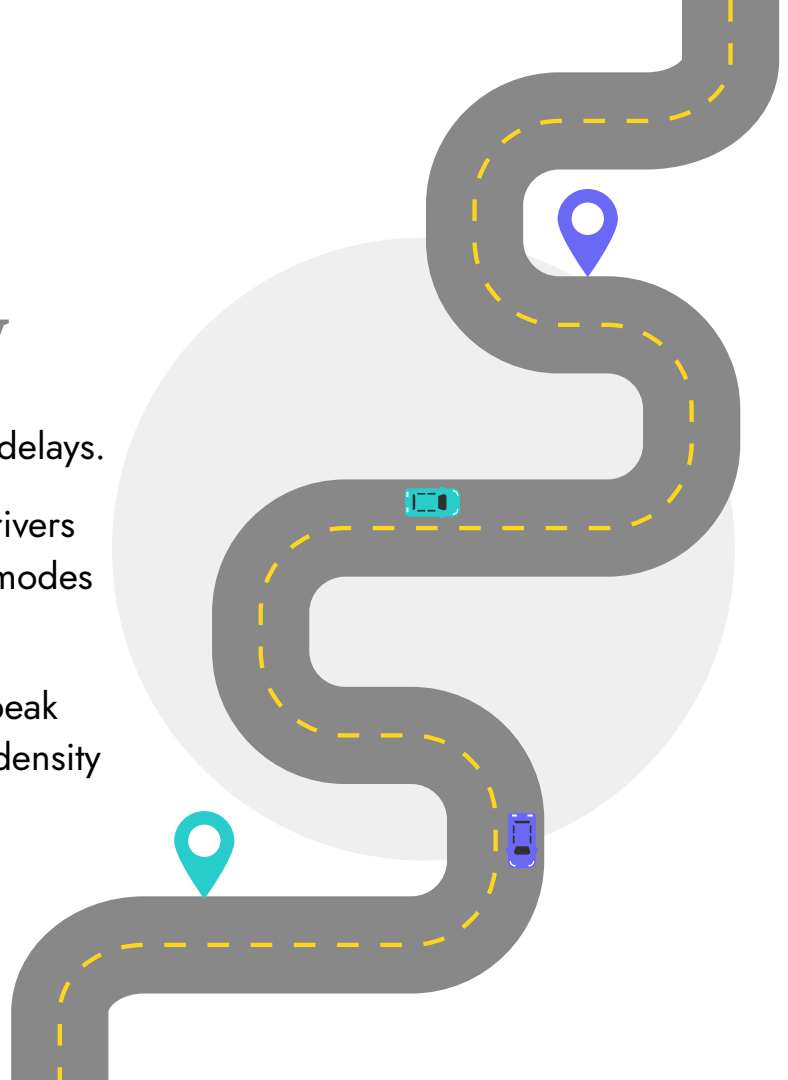
10 km in 23 min

≈ 26 km/h

The main idea

Predict traffic density

- High density traffic is an issue in cities and causes delays.
- A product to predict tomorrow's traffic and allow drivers to plan their daily transport routes or use different modes of transport.
- If enough drivers choose transport alternatives on peak days, this could contribute to a lessening of traffic density and traffic jams.
- Used by: Drivers, radio stations, cities



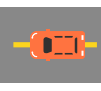
Traffic counting stations



image source: https://de.wikipedia.org/wiki/Hauptverkehrsstra%C3%9Fennetz_von_Hamburg

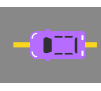
Inner City

5 city center junctions



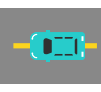
Suburbs

8 roads in the outer Hamburg area



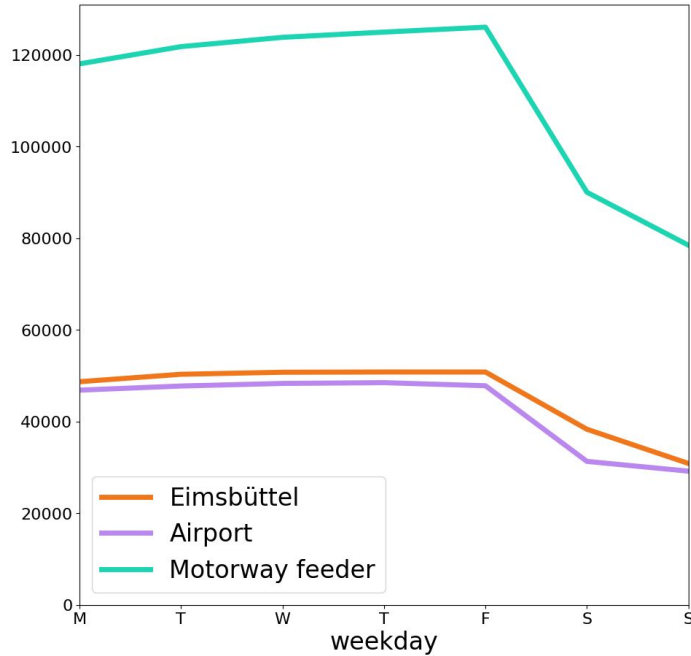
Motorway feeder

3 roads to/from Autobahn

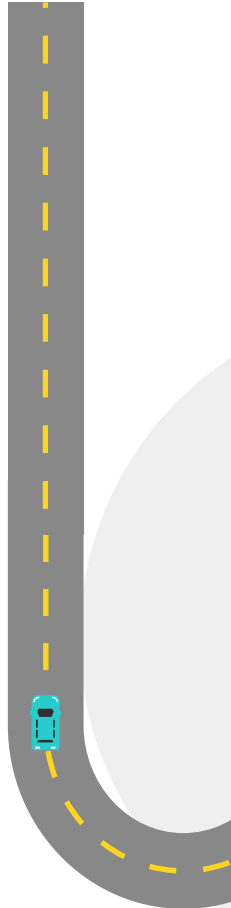
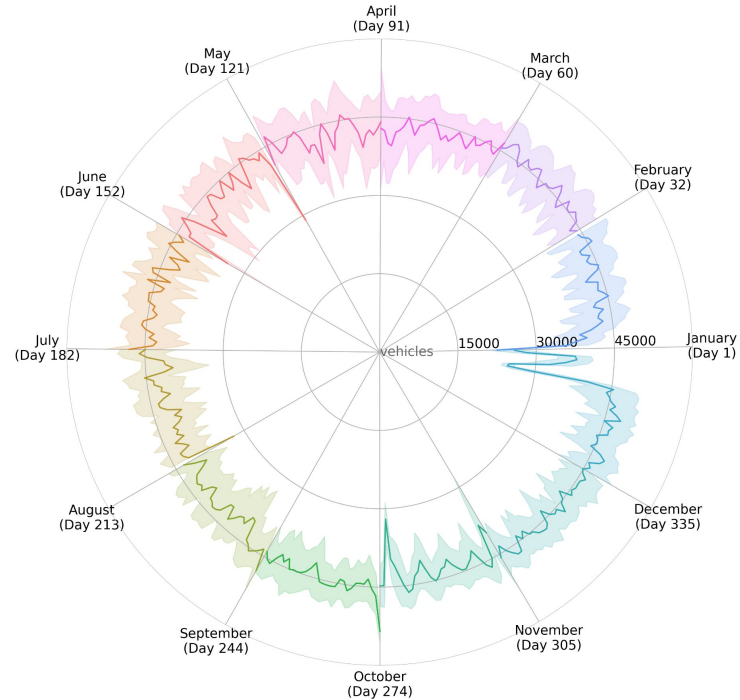


Cycles of traffic

Weekly cycle



Annual cycle



What influences tomorrow's traffic?

German federal holidays,
Hamburg school holidays

Holidays



air temperature, rain,
wind, sunshine

Weather (numerical)



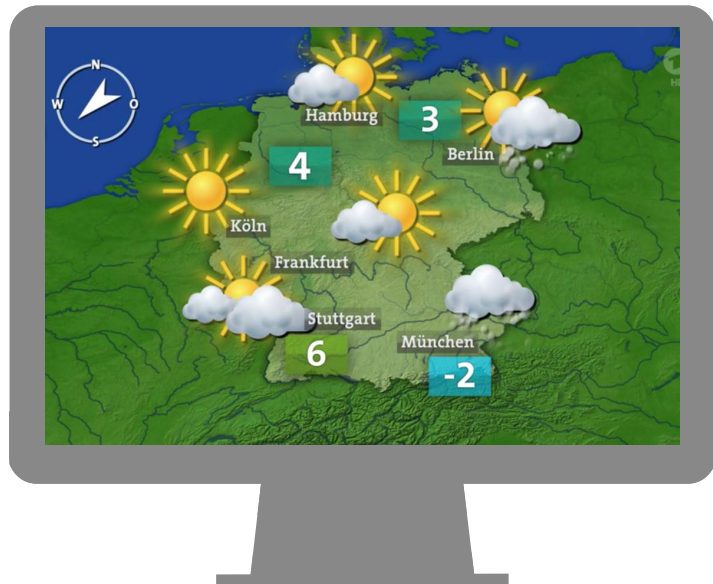
Events

Hamburg-specific events,
selected roadworks



Weather (categorical)

"good", "bad", "unsuitable for
driving a car" and "neutral"



Weather forecast

How do I go to work? When shall I leave?

Good weather → might go by bike or foot

Bad weather → might prefer to go by car

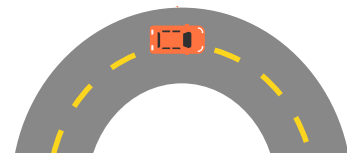
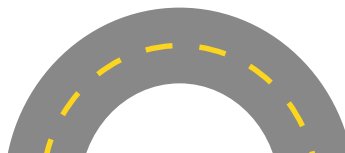
Driving unfriendly weather → might go by public transport or stay at home

Alternatives

38 % bike
58 % public transport
"several times/week"

Hamburg

11 % rainy times



Calendar and events



Public holiday



Event

01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

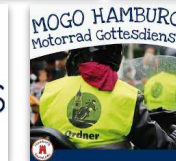
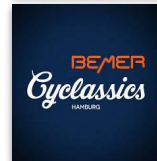
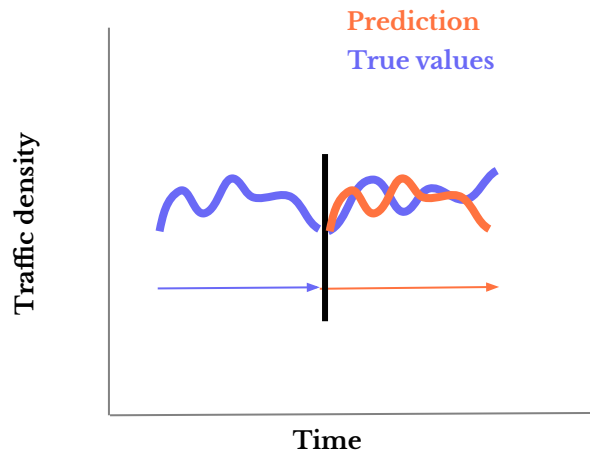


image sources: respective websites

Model selection

Baseline model

Due to high seasonality, copying the last equivalent weekday performs surprisingly well.



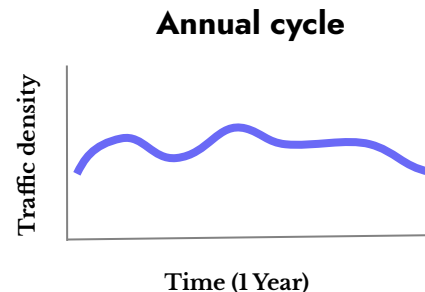
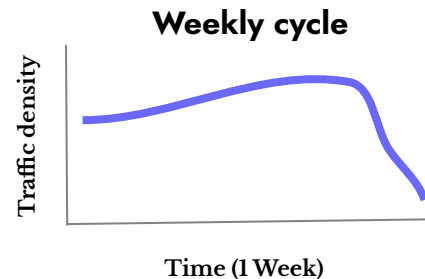
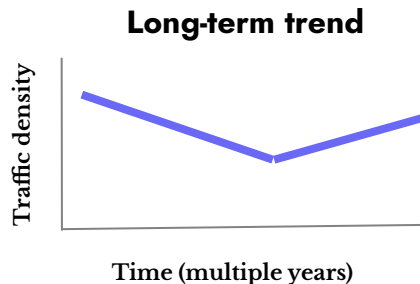
Model selection

Baseline model

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Basic Prophet

- Time series forecasting with strong seasonality
- Automatic decomposition
- With built-in German public holidays



Model selection

Baseline model

Due to high seasonality, copying the last equivalent weekday performs surprisingly well.

Basic Prophet

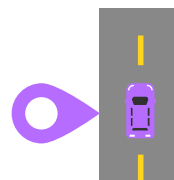
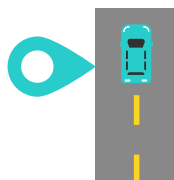
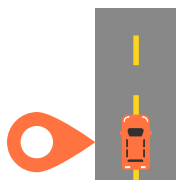
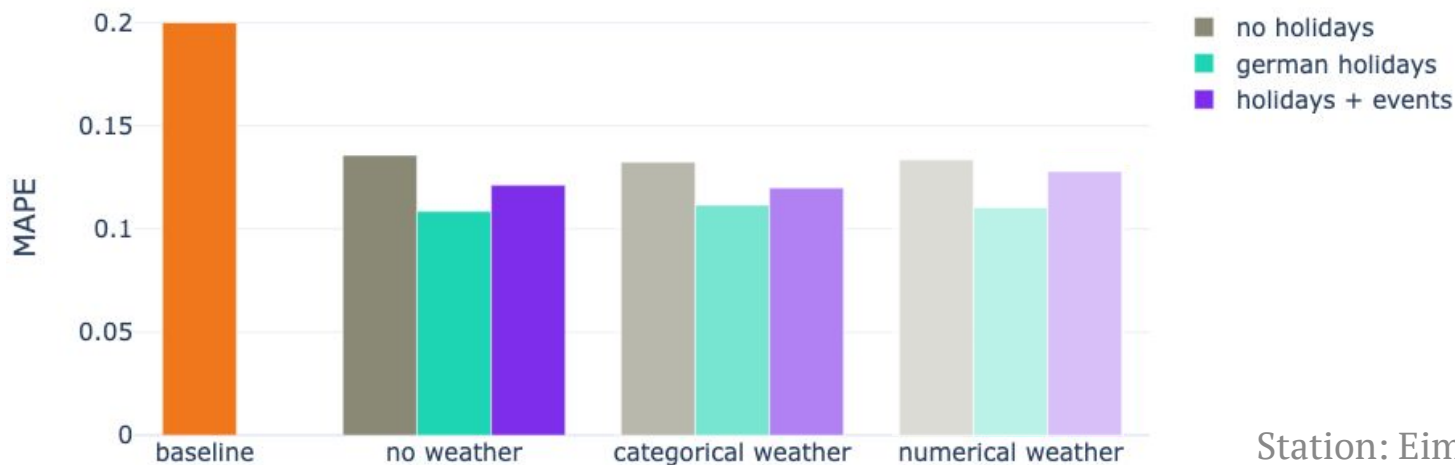
- Time series forecasting with strong seasonality
- Automatic decomposition
- With **built-in German public holidays**

Advanced Prophet

- Adding:
 - **Hamburg school holidays**, special events
 - **Weather** (categorical, numerical) as explanatory time-series

Model evaluation

MAPE = mean absolute percentage error



Model evaluation

MAPE = mean absolute percentage error



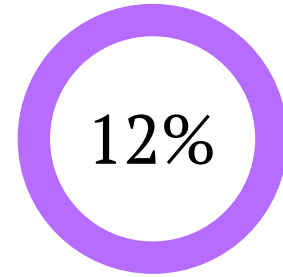
Baseline

using the value 7 days ago



Basic Prophet

German holidays
no weather



**Advanced
Prophet**

Hamburg holidays + events
weather

Model evaluation

MAPE = mean absolute percentage error



Baseline

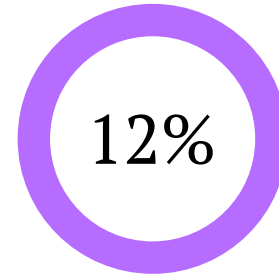
using the value 7 days ago



Basic Prophet

German holidays
no weather

Local events seem to not
have a big impact (mostly
weekends, only small-scale)



**Advanced
Prophet**

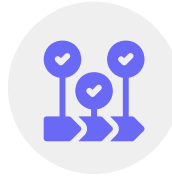
Hamburg holidays + events
weather

Weather is possibly already
included in seasonality →
overfitting

Model application

Model Selection

Basic prophet with german holidays



Model-training

Train for parameterised best model for each station



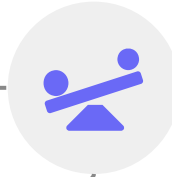
Dashboard

Feed predictions into interactive dashboard



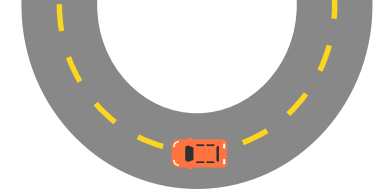
Hyper-Parameter Search with CV

For chosen model for all 16 stations



Daily Prediction

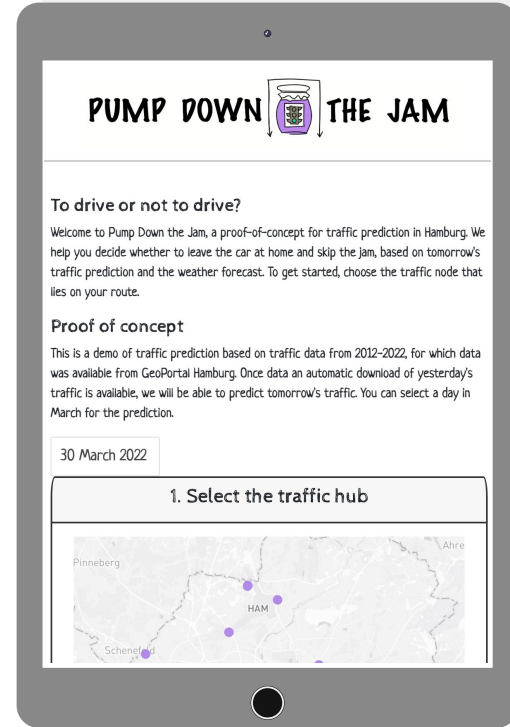
Procedure to predict traffic for single day for single station



Dashboard

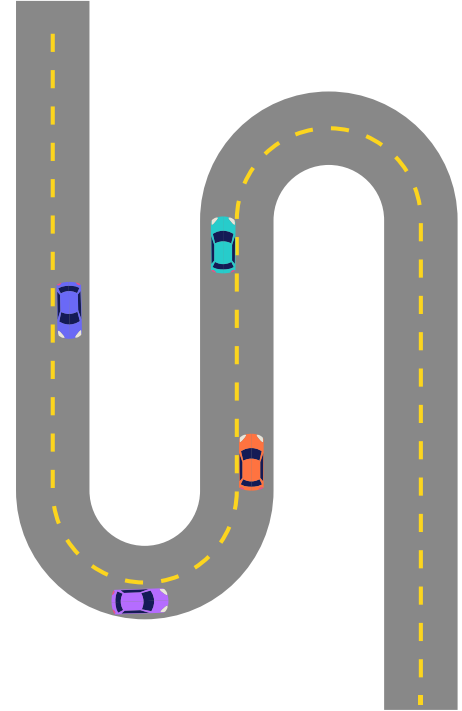
We have developed an interactive dashboard as a proof-of-concept.

<https://pump-down-the-jam.herokuapp.com/>



Potential future applications

- Update data and model every evening: dependent on collaboration with Hamburg Geoportal
- Visualise traffic density as a map
- Understand the (complex) behaviour of different commuters (cyclists, drivers, public transport users) during different weather conditions
- Rollout to other major cities in Germany and Europe



Thanks!

Data was provided by

Behörde für Verkehr und Mobilitätswende
(Freie und Hansestadt Hamburg)

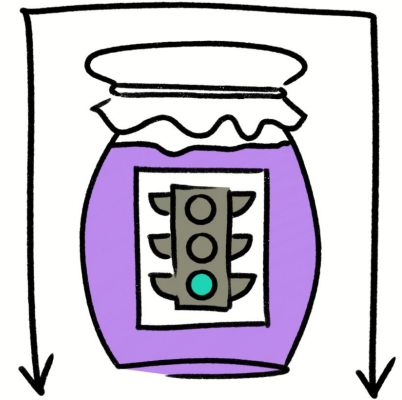
Meteorologisches Institut Universität Hamburg

Logo design by

Elise Hedemann

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PUMP DOWN



THE JAM