Digitalized Logistics

Advanced Analytics@POST AG

Christoph Bodner & Thomas Laber

AGENDA

	01	02	03
Topics	Who we are (obligatory marketing stuff…)	What we do	How we do it
	Data Science@Post AG: - Overview: Post AG - Interdisciplinary team	Projects we work on: - Parcel volume forecast - Expected delivery times	With a combination of: - Math/statistics - Coding (Azure + R) - Grit & perseverance☺

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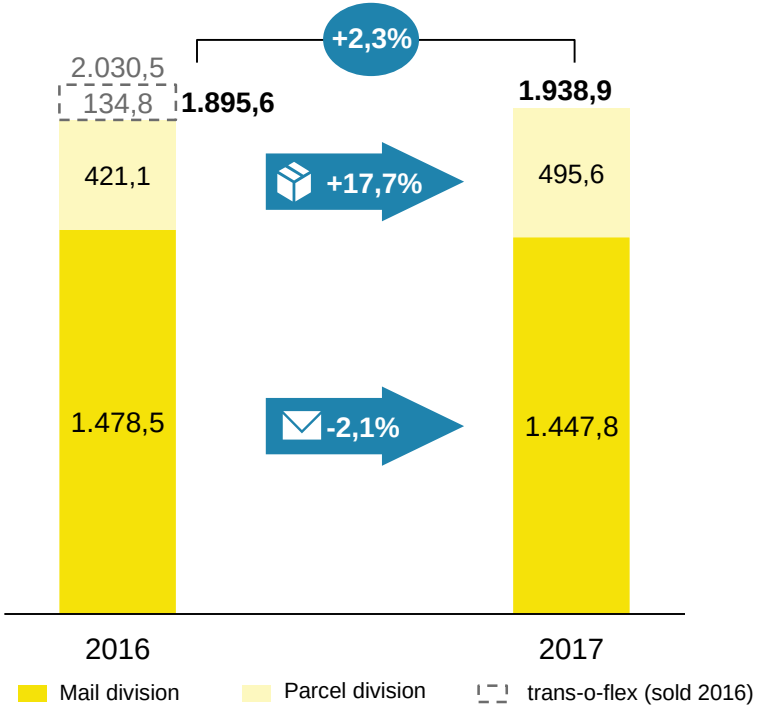
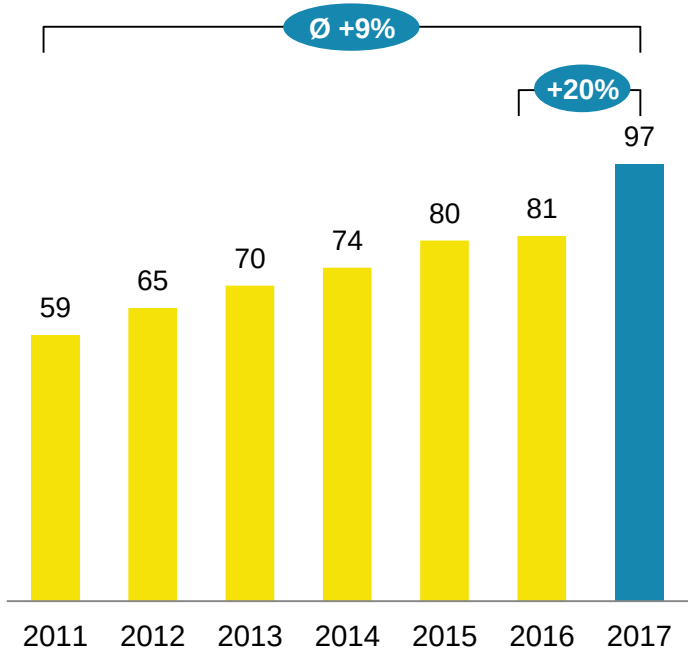
OVERVIEW: POST AG
COMPANY PERFORMANCE & PARCEL VOLUMES OVER TIME

SALES PERFORMANCE
mio EUR



PARCEL VOLUMES OF AUSTRIAN POST
mio parcels



OVERVIEW: POST AG
STRONG PRESENCE IN EASTERN EUROPE

GROWTH FOCUS ON PACKAGE & LOGISTICS DIVISION

OUR TEAM
PEOPLE WHO LIKE $\pi z^2 a$ IN EVERY FORM☺

Christoph Bodner

Lead Data Scientist

Quantitative Finance (WU)
Prev.: KPMG

Thomas Laber

Senior Data Scientist

Business Informatics (TU)
Prev.: Accenture

Martin Blöschl

Junior Data Scientist

Computational Intelligence (TU)

Raphael Pesl

Junior Data Scientist

Mathematics (TU)

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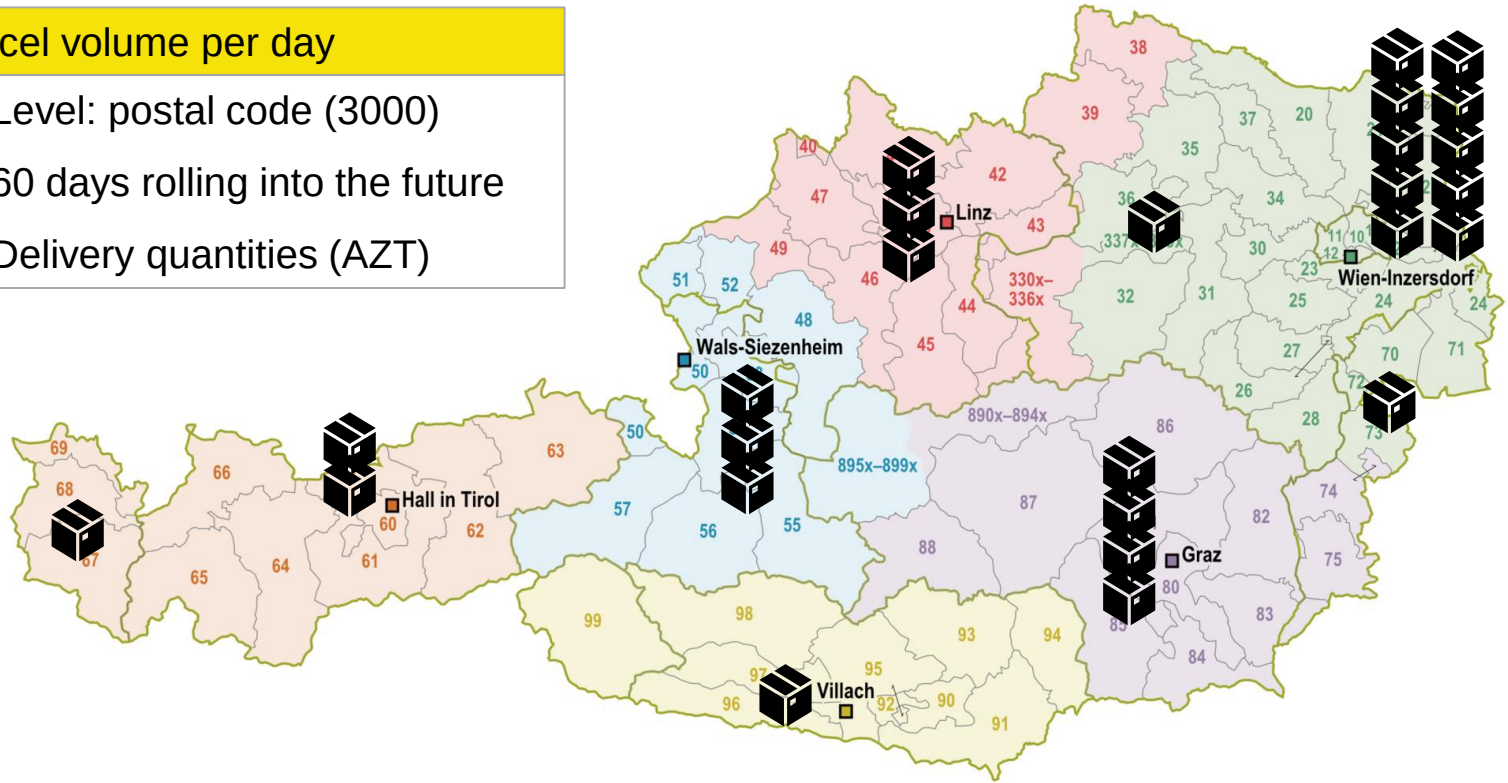
Parcel Volume: Daily Forecast

PARCEL VOLUME FORECAST

HOW MANY PARCELS WILL WE NEED TO DELIVER IN THE FUTURE?

Parcel volume per day

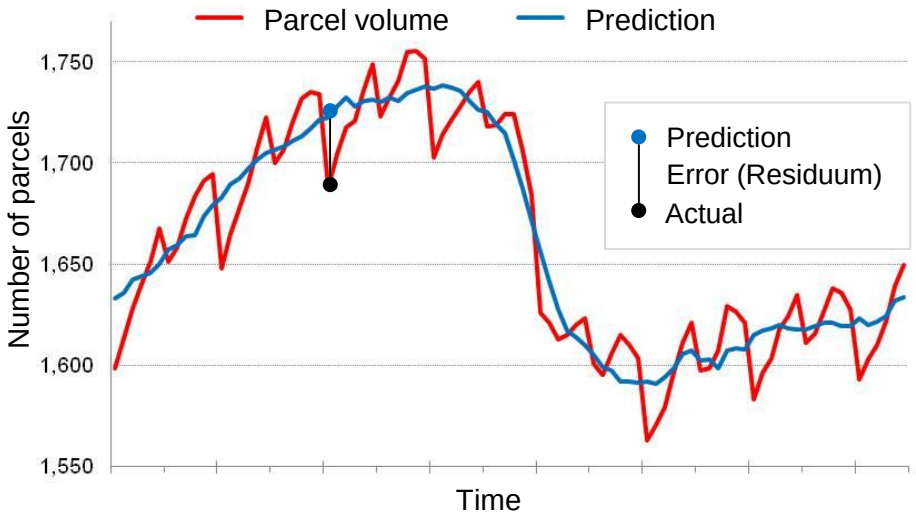
- Level: postal code (3000)
- 60 days rolling into the future
- Delivery quantities (AZT)



THE PROBLEM IS SIMPLE TO FORMULATE …
… BUT NOT THAT EASY TO SOLVE

Post

Parcel volume over time



As small as possible

Package volume = prediction + error

h(X)

How can we find the optimal h(X)?

$$\hat{h} = arg \min_{h \in H} R_{emp}(h)$$

where:

$$R_{emp}(h) = \frac{1}{m} \sum_{i=1}^{m} L(h(x_i), y_i)$$

SO THE QUESTION IS:
HOW DO WE FIND THE OPTIMAL PREDICTION FUNCTION?

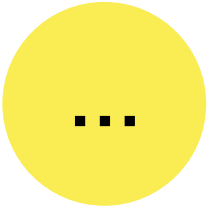
There are lots of different ways to find h(X):

Neural networks

Linear Regression
(Image is no mistake ☺)

Gradient Boosting
(with decision trees)

currently in use



other models

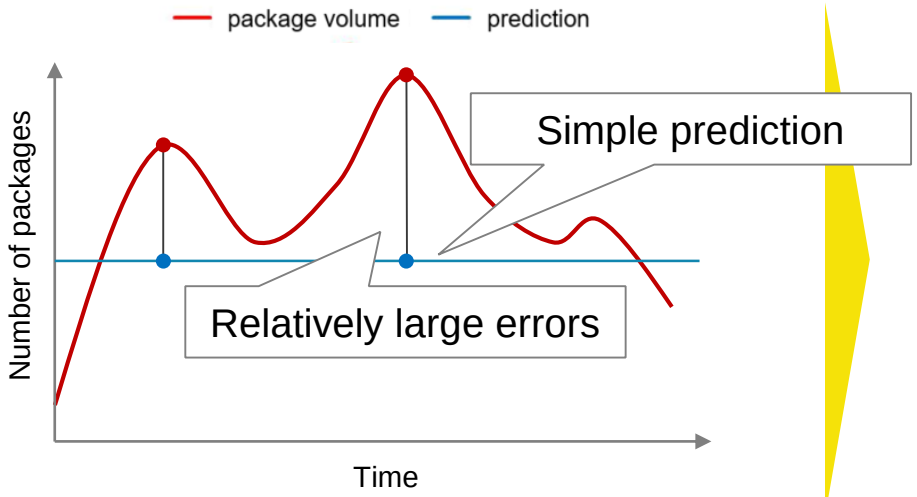
BUT NEURAL NETS ARE SO SEXY!
WHY USE GRADIENT BOOSTING?

Gradient Boosting offers a very good combination of complexity & performance

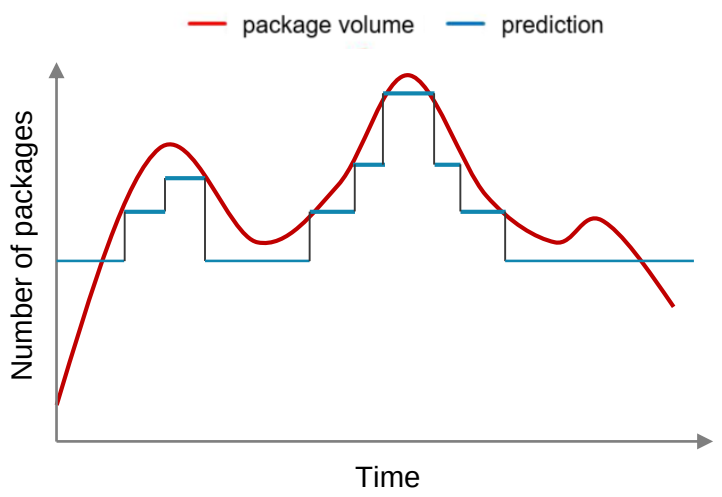
Source: Toyota + Black Hawk: blog.kaggle.com/2017/01/23/a-kaggle-master-explains-gradient-boosting/

LET‘S TAKE A DEEPER LOOK
HOW DOES GRADIENT BOOSTING WORK?

Start with simple prediction ...

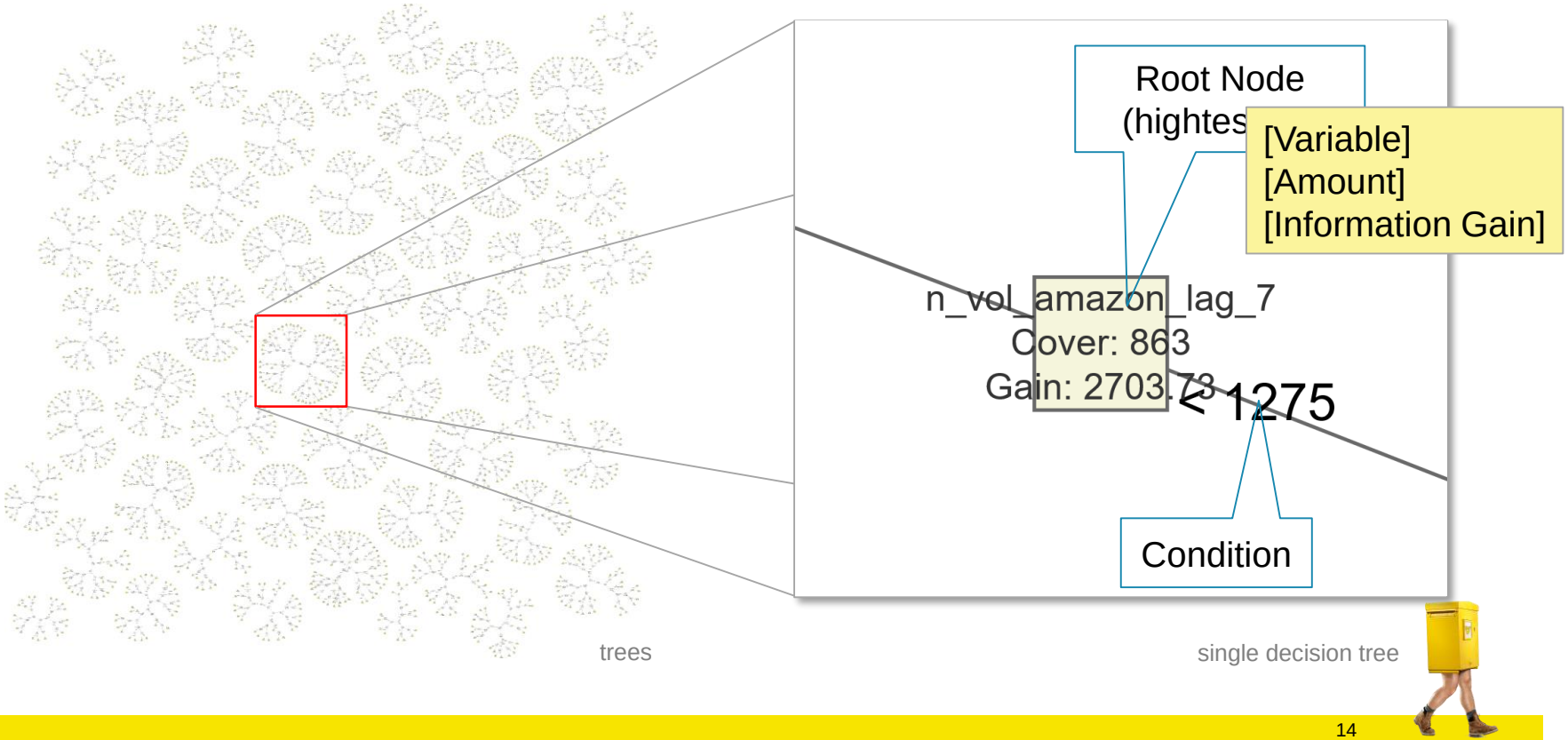


... and gradually improve

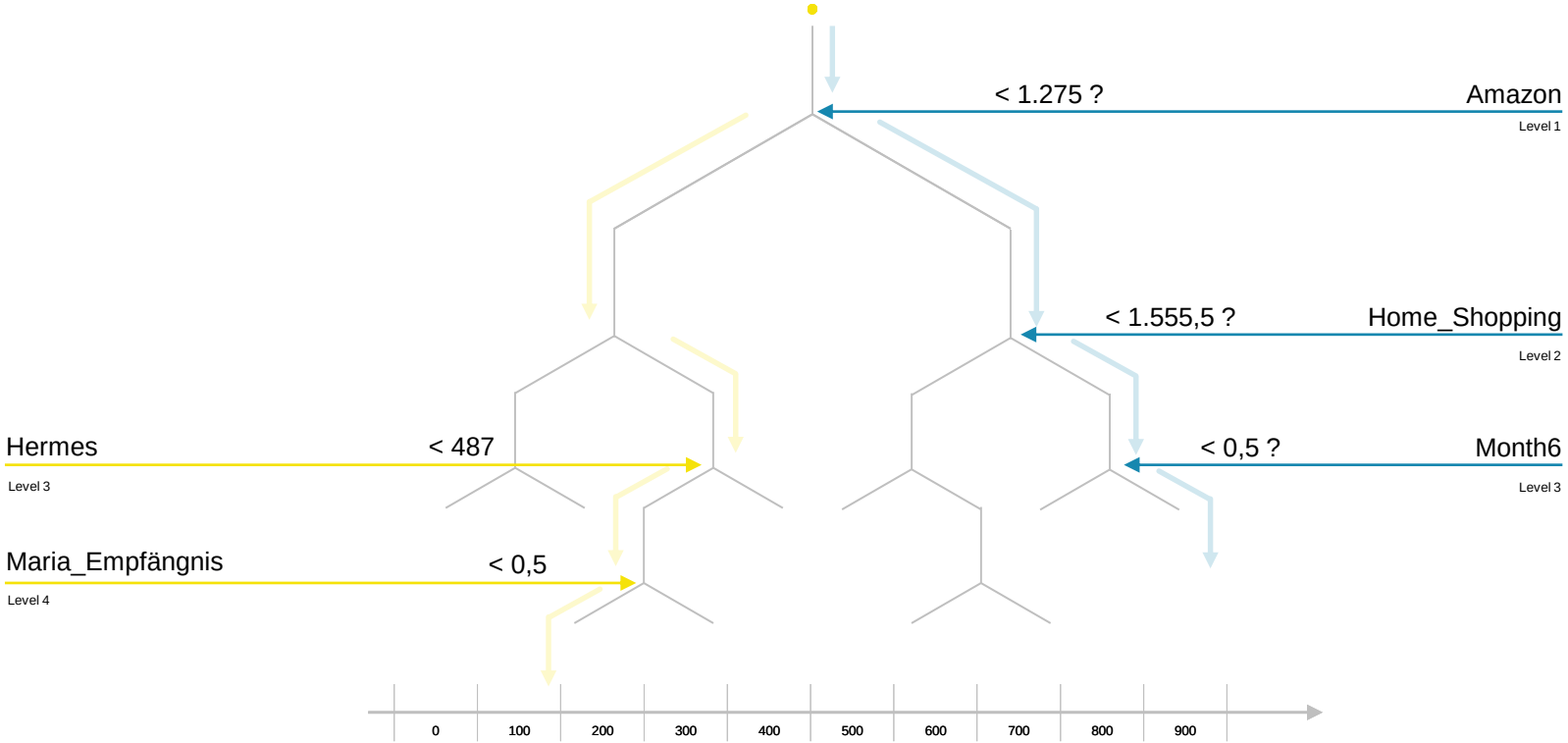


Individual weak forecasts are combined to form a strong prediction

XGBOOST - OVERVIEW
VISUALISATION



XGBOOST
A CLOSER LOOK



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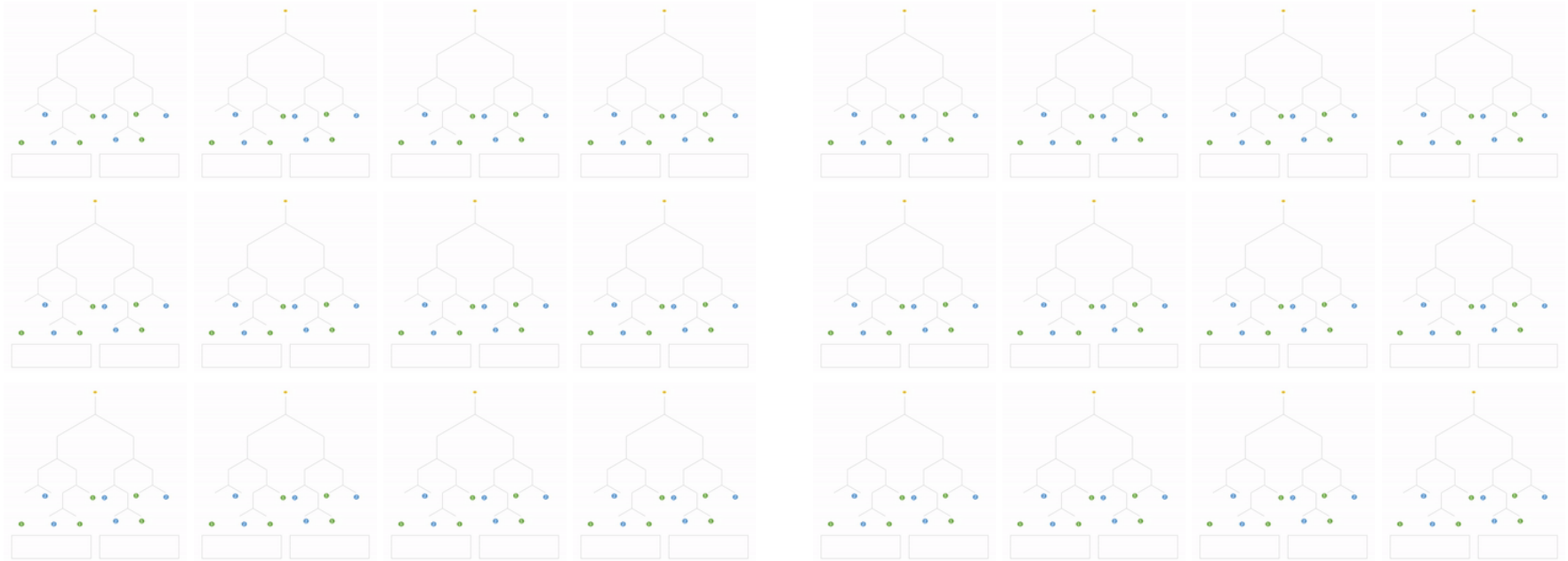
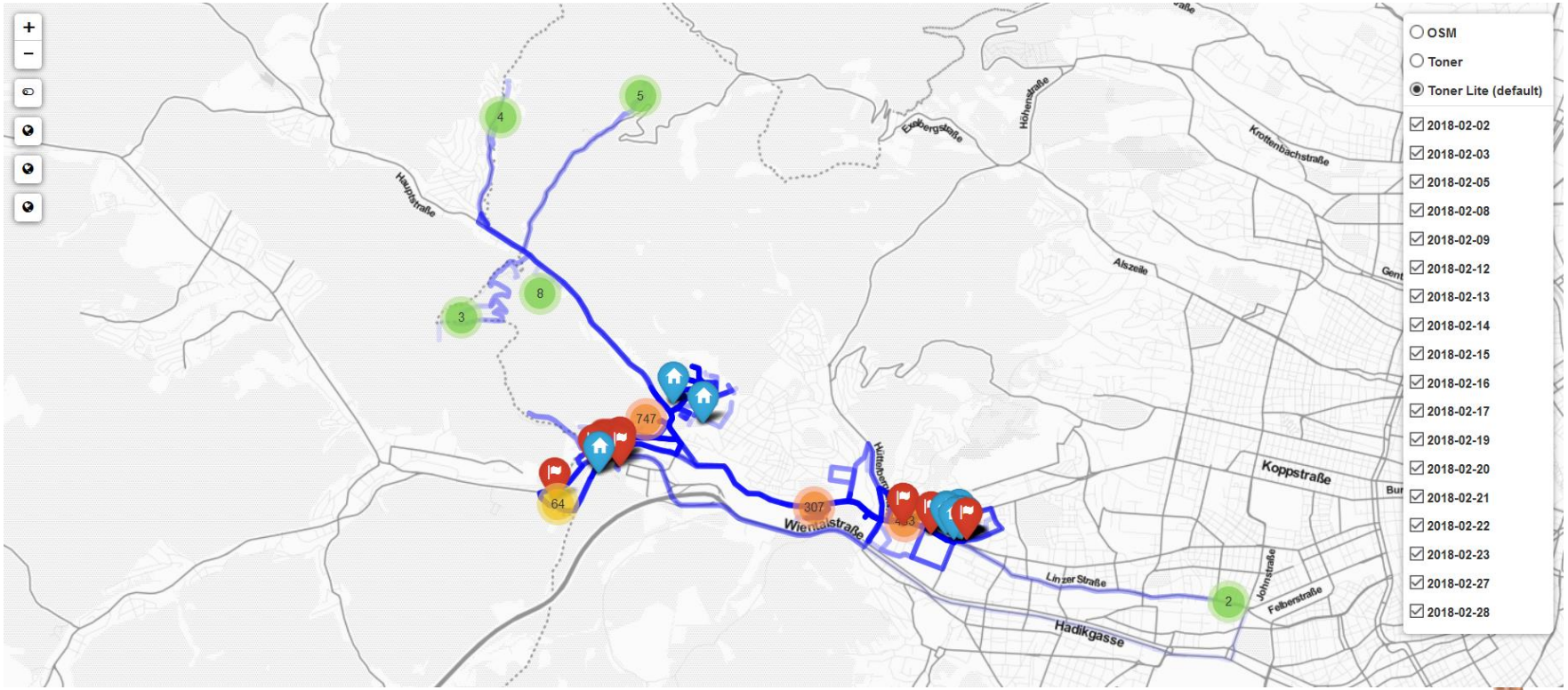


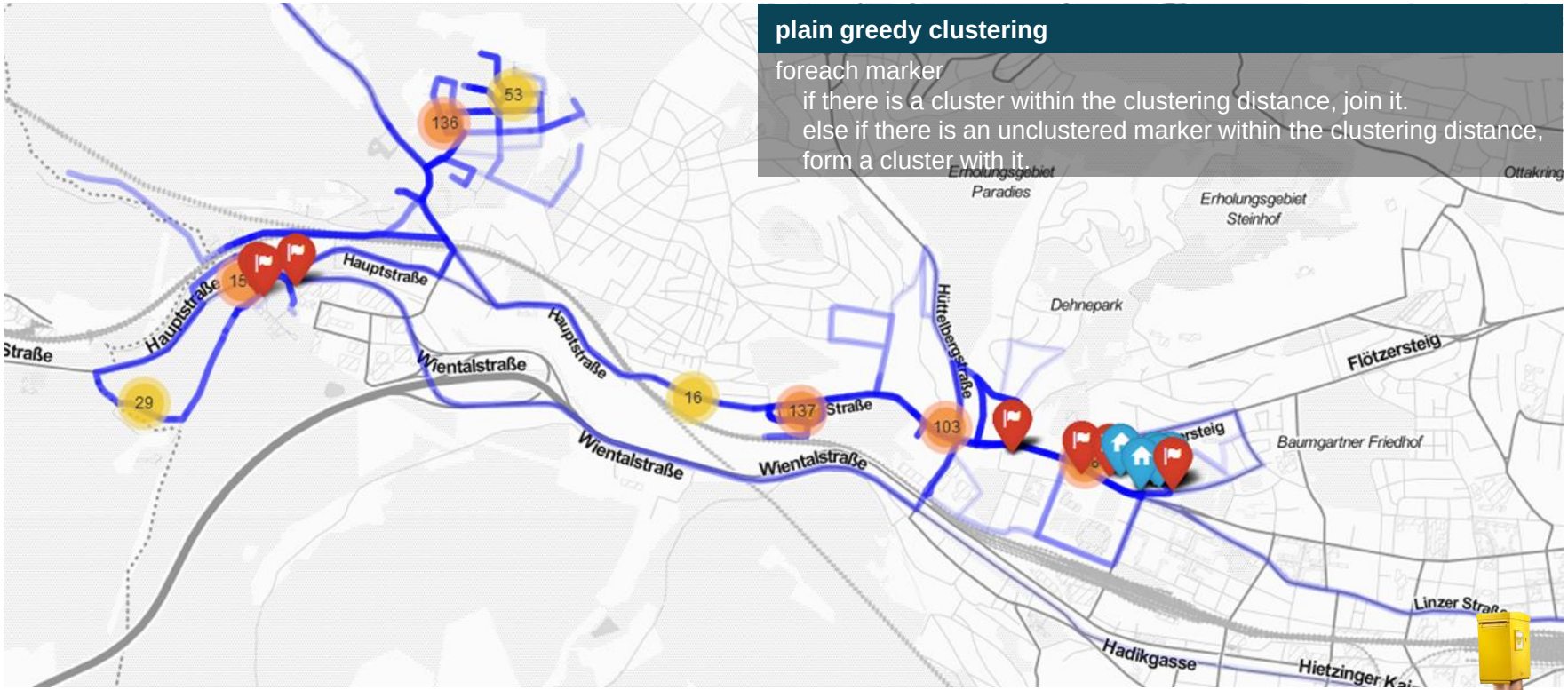
Parcel Delivery: 1h-Time Window

PREDICTING PARCEL DELIVERY TIMES

PROBLEM OVERVIEW



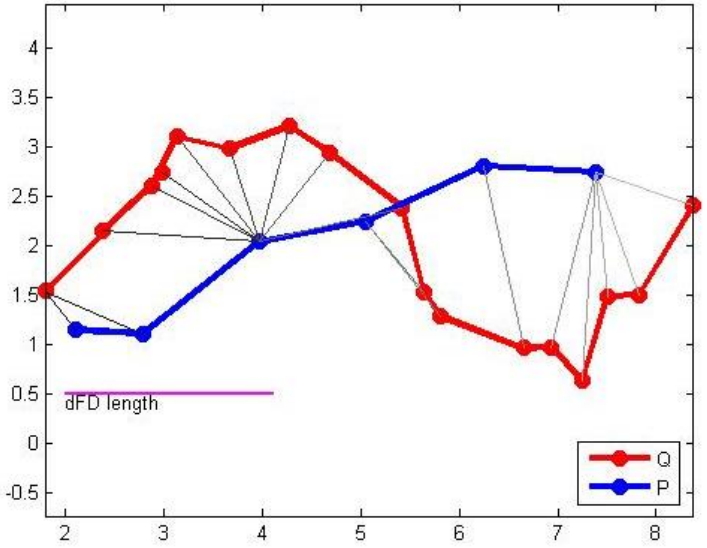
MOSTLY VERY CONSTANT TOURS
DELIVERY ‘CLUSTERS‘ CLEARLY VISIBLE

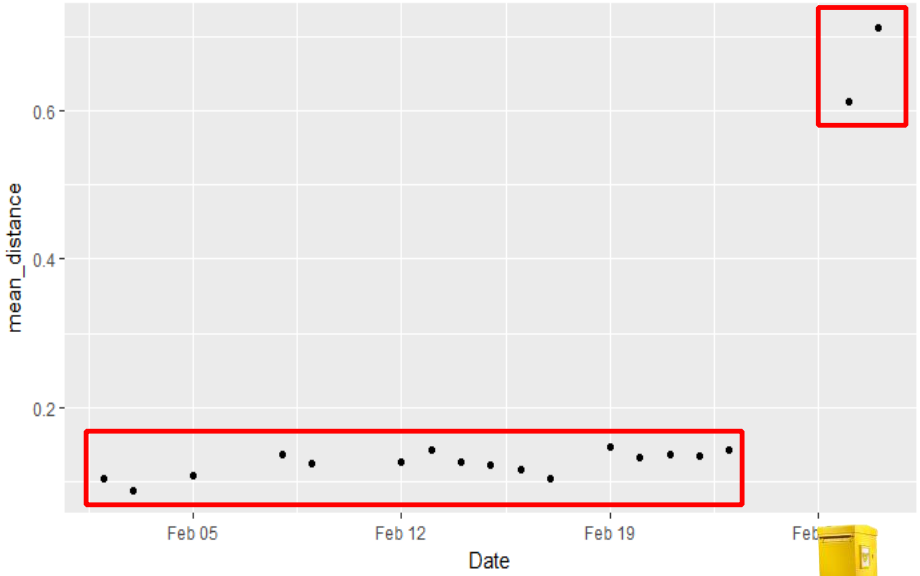


SOMETIMES DRASTIC DIFFERENCES
TOUR CAN CHANGE RAPIDLY

Using Frechet-distance to compare tours …

... shows rapid change from one day to next

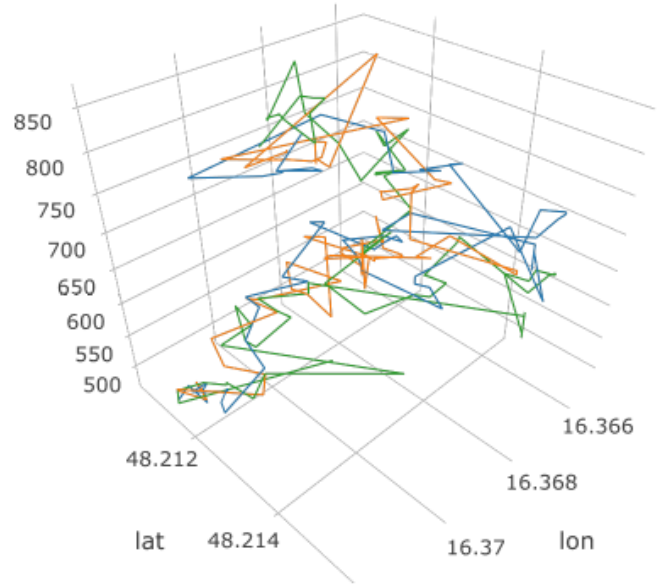




Source: http://www.kr.tuwien.ac.at/staff/eiter/et-archive/cdtr9464.pdf
https://www.rdocumentation.org/packages/kmlShape/versions/0.9.5/topics/distFrechet

HOW CAN WE PREDICT DELIVERY TIMES?
IDEA: FIND ‘SIMILAR’ ROUTES IN THE PAST

Routes in location-time matrix (part of Vienna)



When are two routes similar?

- Similar trajectory, but differing stops and time points
- Similar trajectory, similar stops and differing time points
- Similar trajectory, similar stops and similar time points

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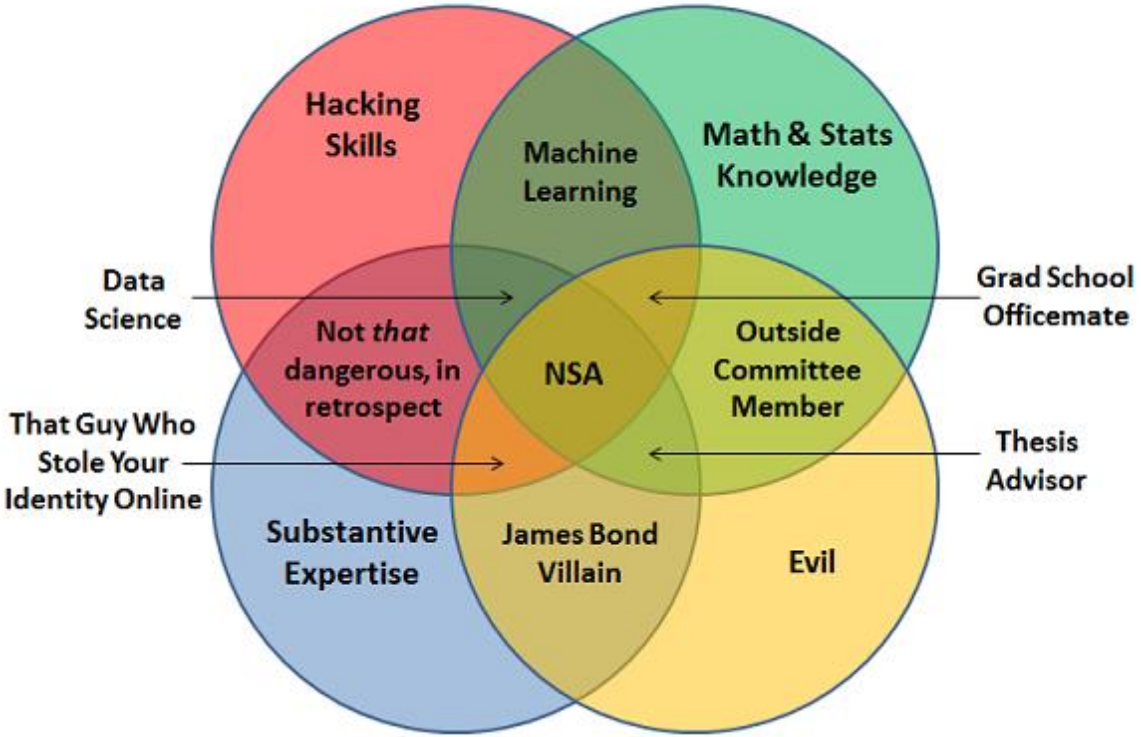
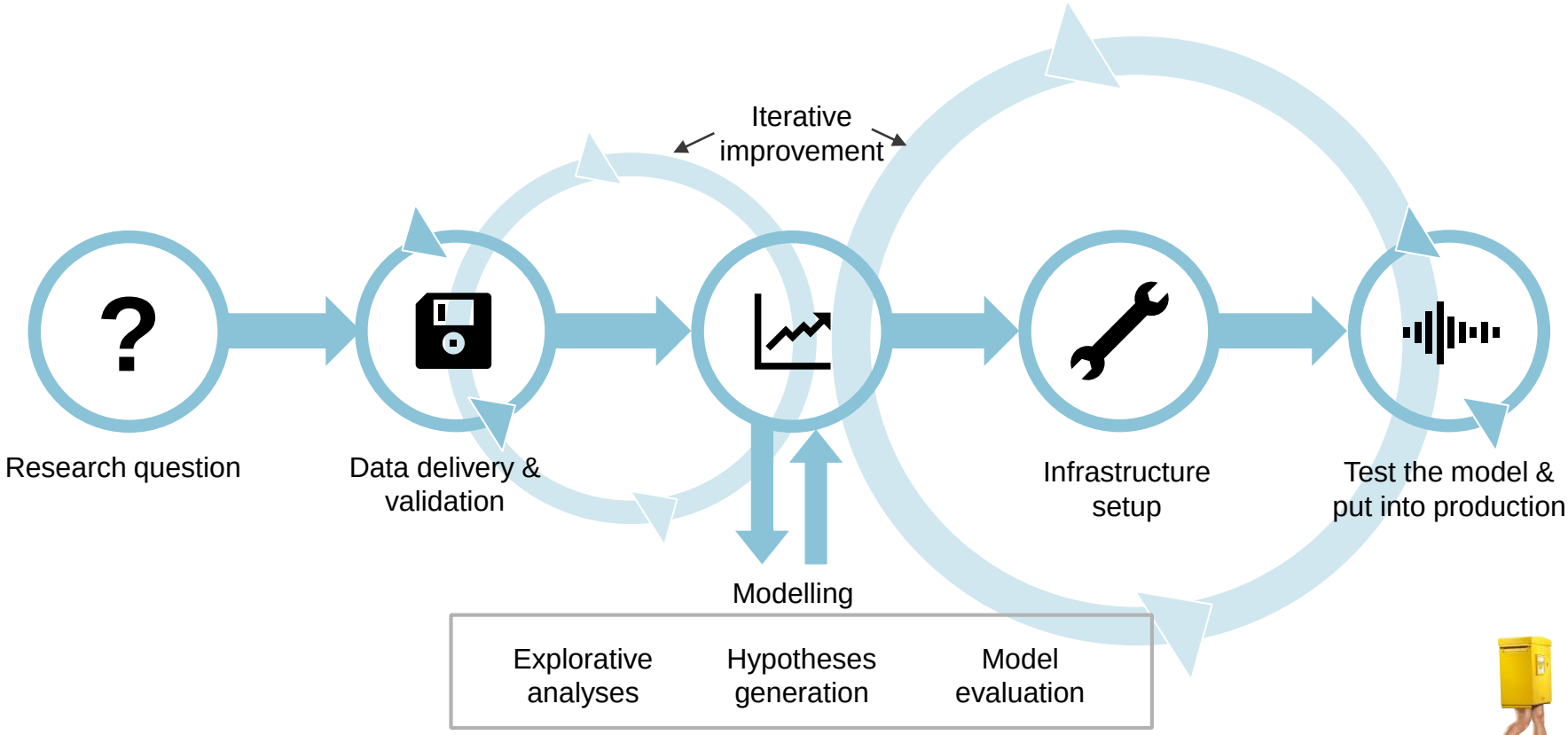
DATA SCIENTISTS NEED MANY SKILLS
ASKING THE RIGHT QUESTIONS ≥ ALGORITHMS

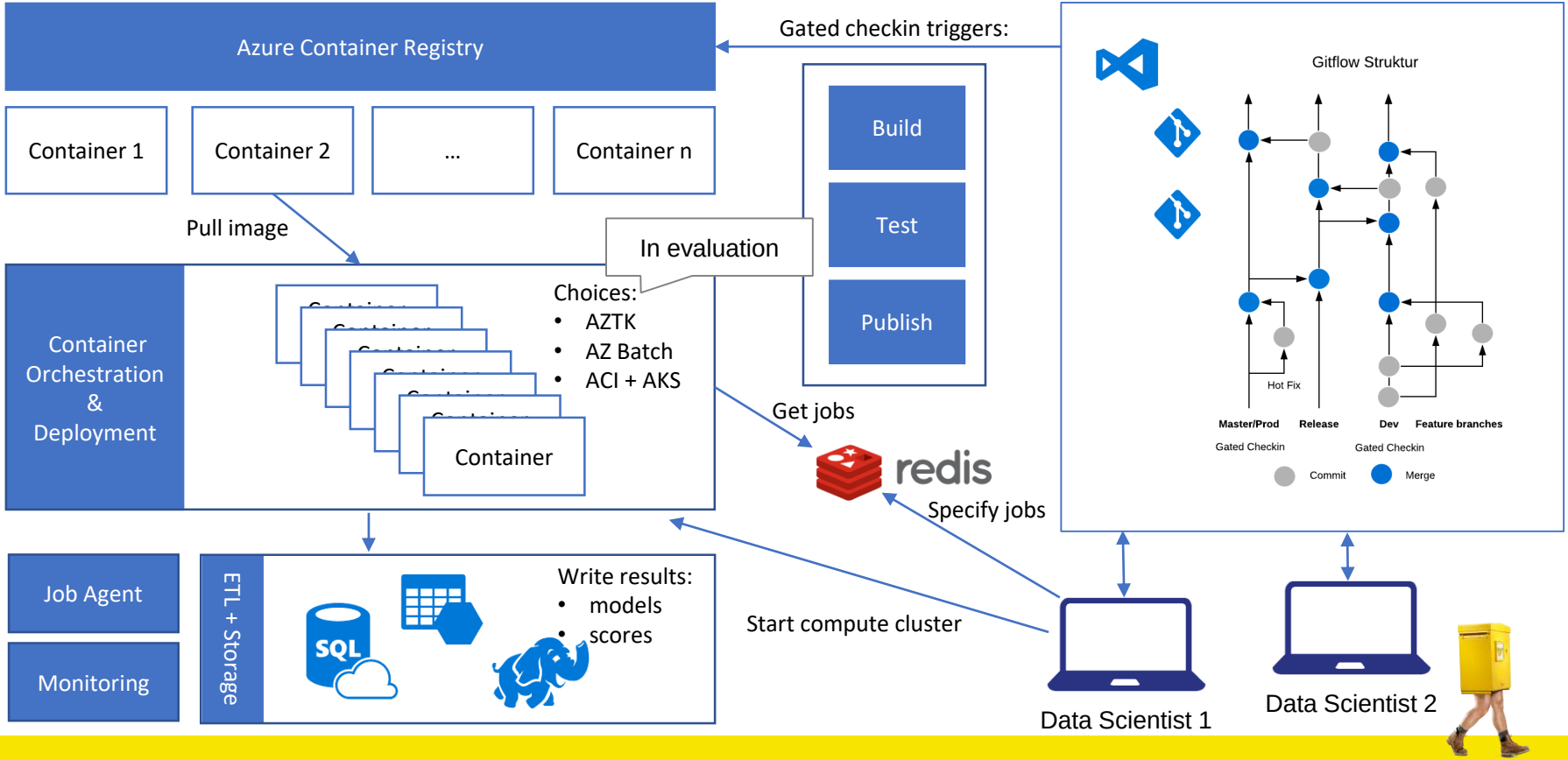


Source: http://joelgrus.com/2013/06/09/post-prism-data-science-venn-diagram/

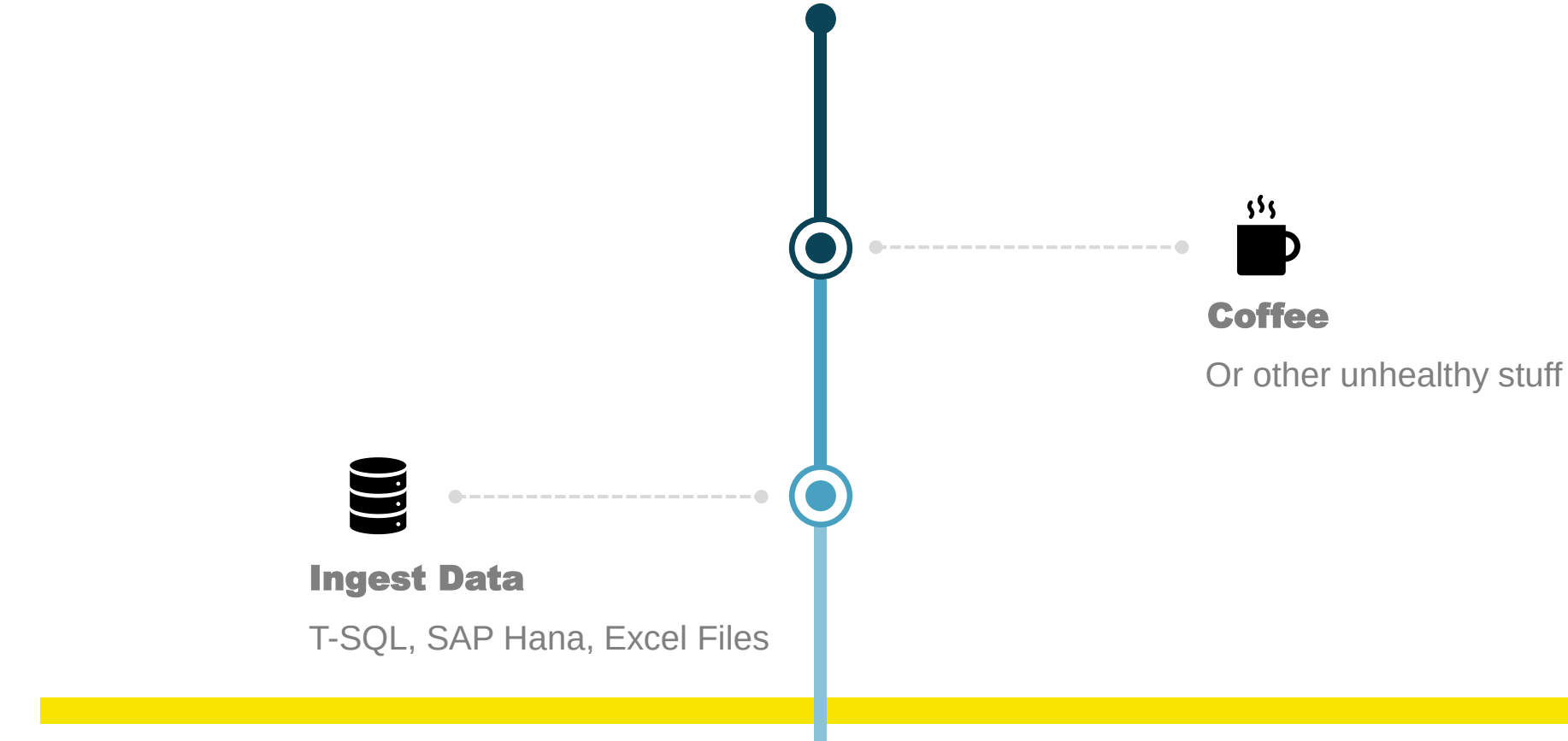
PROCESS OVERVIEW
DATA SCIENCE PROJECTS ARE ALWAYS “AGILE”



OUR STACK
WE ARE CURRENTLY BUILDING A HPC ENVIRONMENT



A Day in the Life of a Data Scientist

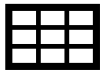

Coffee
Or other unhealthy stuff
Ingest Data
T-SQL, SAP Hana, Excel Files

Explore Data

Test hypotheses

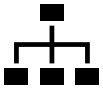
Data Validation

Done in R or Python



Feature Engineering

Identify relevant variables
or create them



Deployment

Does is scale?
Are we ready for the cloud?
Is the cloud ready for us?

Prototyp Model

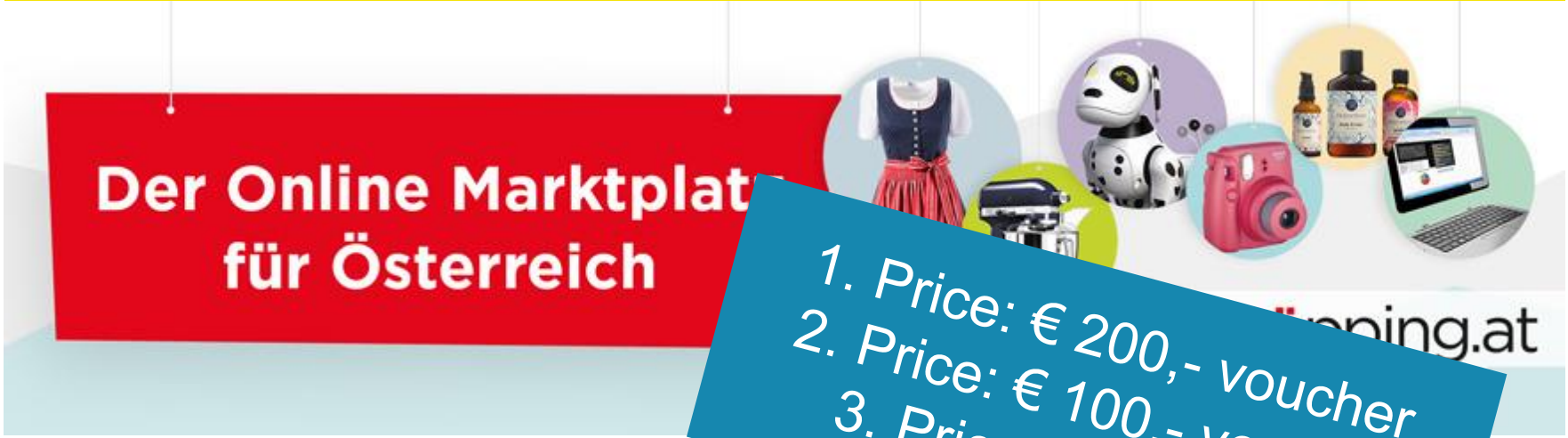
create a baseline
Scrum Demo

LET‘S TAKE A LOOK…

Data Science Challenge

PREDICTION CHALLENGE
FORECAST & WIN!

Predict 1h-delivery-time windows for our customer parcels



All the information you need:

https://github.com/POSTAG/time_window_prediction

THANK YOU FOR YOUR ATTENTION!