SAIL

SUSTAINABLE LIFE-CYCLE OF
INTELLIGENT SOCIO-TECHNICAL SYSTEMS

Hackathon Industrial Workspaces

07.06.2024

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INTELLIGENT SOCIO-TECHNICAL SYSTEMS

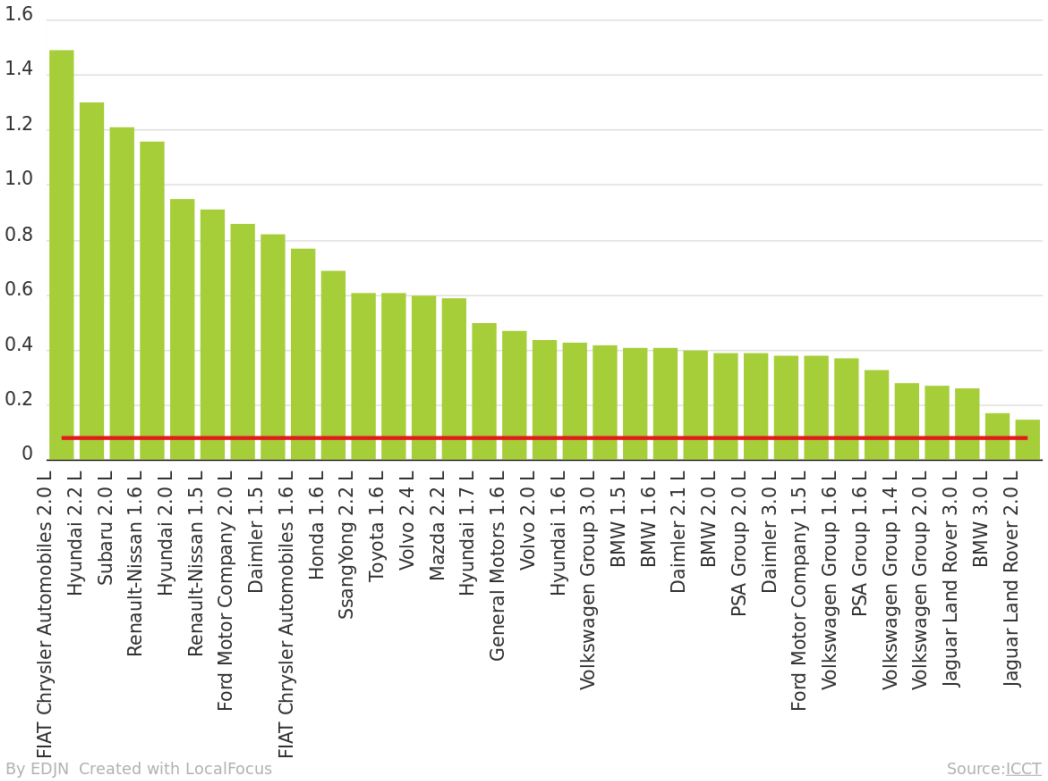
Challenge

Diesel emissions scandal

- Engines: Diesel vs. gasoline
  - less CO2
  - higher exhaust fumes
- Automotive companies claimed to use exhaust aftertreatment
- Seems to work in approval
- It did not seem to work in practice

https://de.wikipedia.org/wiki/Datei:VW_Golf_TDI_Clean_Diesel_WAS_2010_8983.JPG CC BY-SA

Diesel emissions scandal



https://en.wikipedia.org/wiki/File:Nitrogen_oxide_on-road_emissions_by_manufacturer_and_capacity.svg CC BY-SA

- Many cars got new software
- This update allowed to keep the emissions legislature
- How does *software* do this?

Engine Control Units (ECUs)

ECUs, small computers in cars, control the combustion, e.g. via

- injection patterns and
- air flow

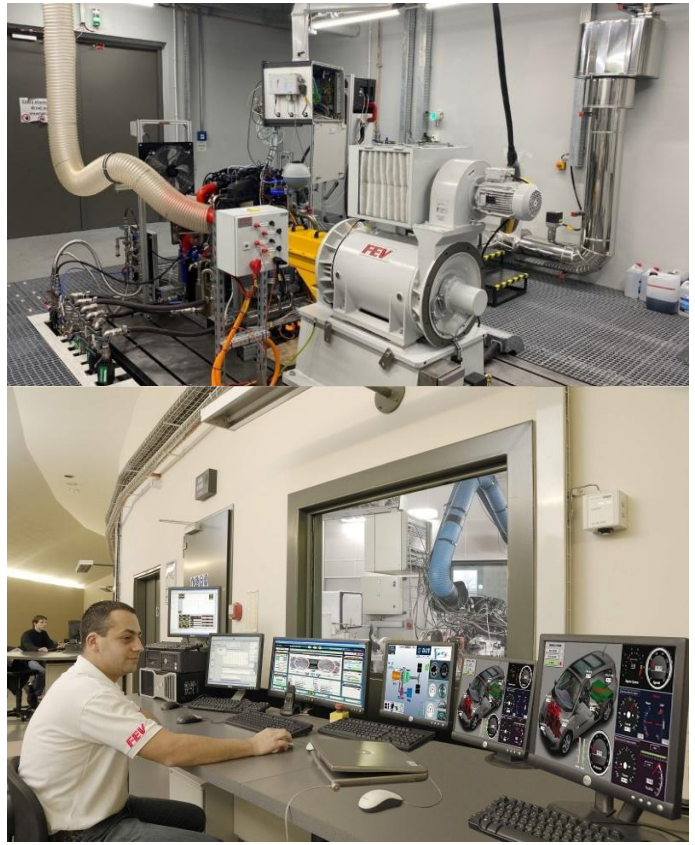
under various circumstances, e.g.

- load and speed of the engine,
- engine temperature,
- outside air pressure, or
- exhaust aftertreatment mode.

Calibrate many parameters

https://www.bosch-mobility.com/en/solutions/control-units/engine-control-unit/

Calibration



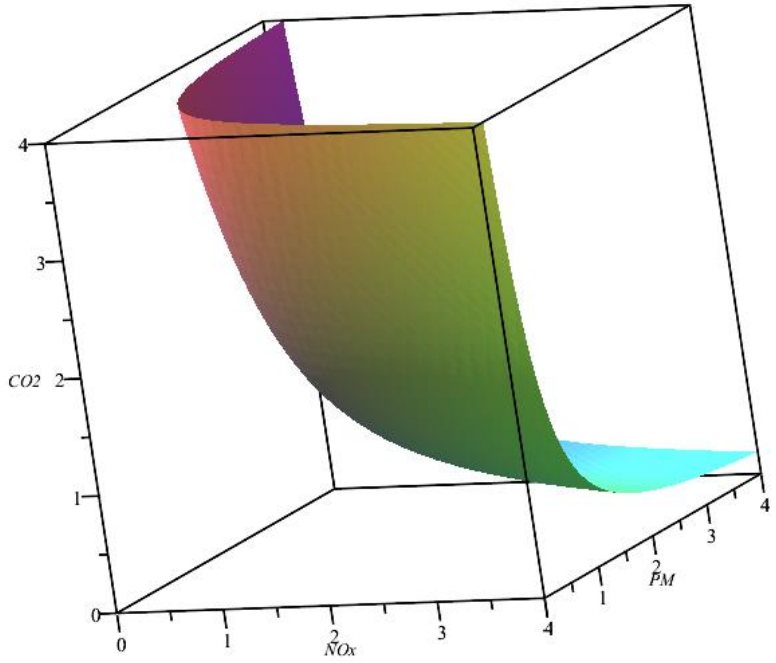
https://www.linkedin.com/pulse/engine-test-benches-fev-polska/

- Measure engine at test benches
  - Very expensive!
- Generate an engine model
- Optimize the engine via the model
  - Different for each legislature
- Validate
  - high altidues, deserts, arctic, vaious fuels, …

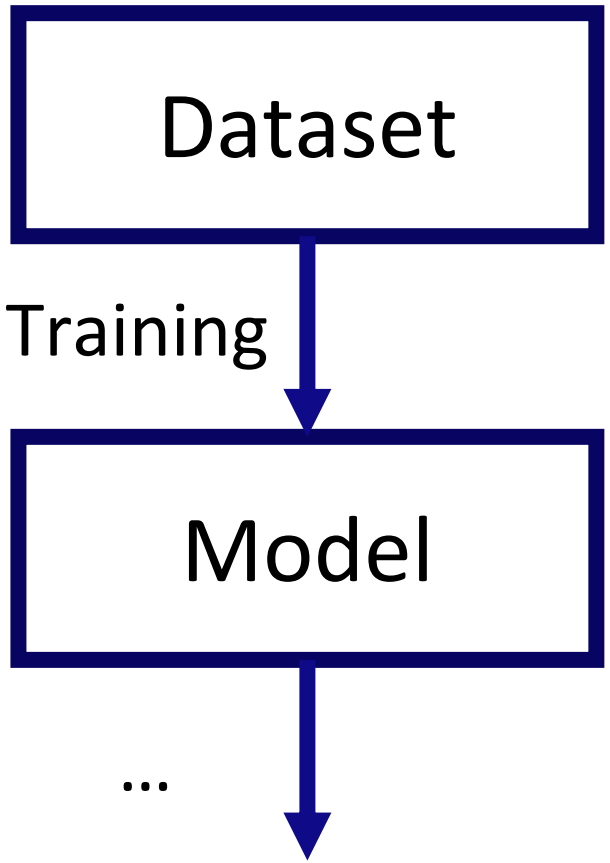
Reality is much more complicated

Optimization

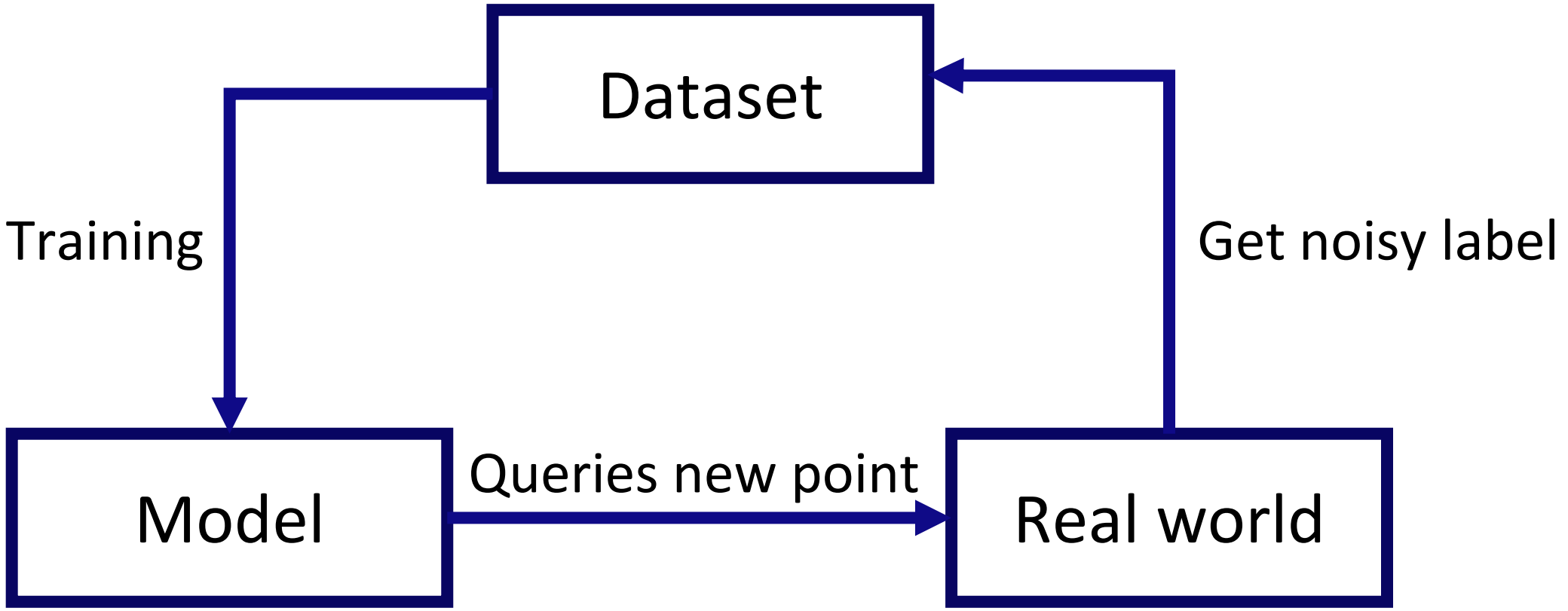
- Reducing NOx increases CO2 or particulate matter (PM)
- Legislature restricts all three
  - The engine power was reduced after Diesel emissions scandal
- Observe Safety restrictions
  - E.g. high cylinder pressure stops engine
- Various other factors apply
  - E.g. clean PM sensor after measuring high PM values
- Values of cylinder pressure and PM are unknown in advance



Usual Hackathon



Active Learning



The data

- Initial dataset of 100 points which are safe

- Features:
  - Engine Speed [1/Min]
  - Engine Load [mg/Hub]
  - Railpressure [bar]
  - Air supply [kg/h]
  - Main Injection: Crank angle [°CA]
  - Intake pressure [mbar]
  - Back pressure [mbar]
  - intake temperature [°C]

- Outputs:
  - Goals
    - NOx [g/h]
    - CO2 [kg/h]
  - Goals and minor „safety“
    - PM 1 [g/h]
    - PM 2 [mg/m^3]
  - Safety:
    - Pressure cylinder [bar]

Data constraints

- Real world systems have constraints
- Input constraints can be fulfilled beforehand

- You will get the input constraints as pdf and code
- Queried points are checked

- Output constraints are trickier
- The safety can only be estimated by your model

- PM 1: ≤ 6
- PM 2: ≤ 16
- Pressure cylinder: ≤ 160

The task

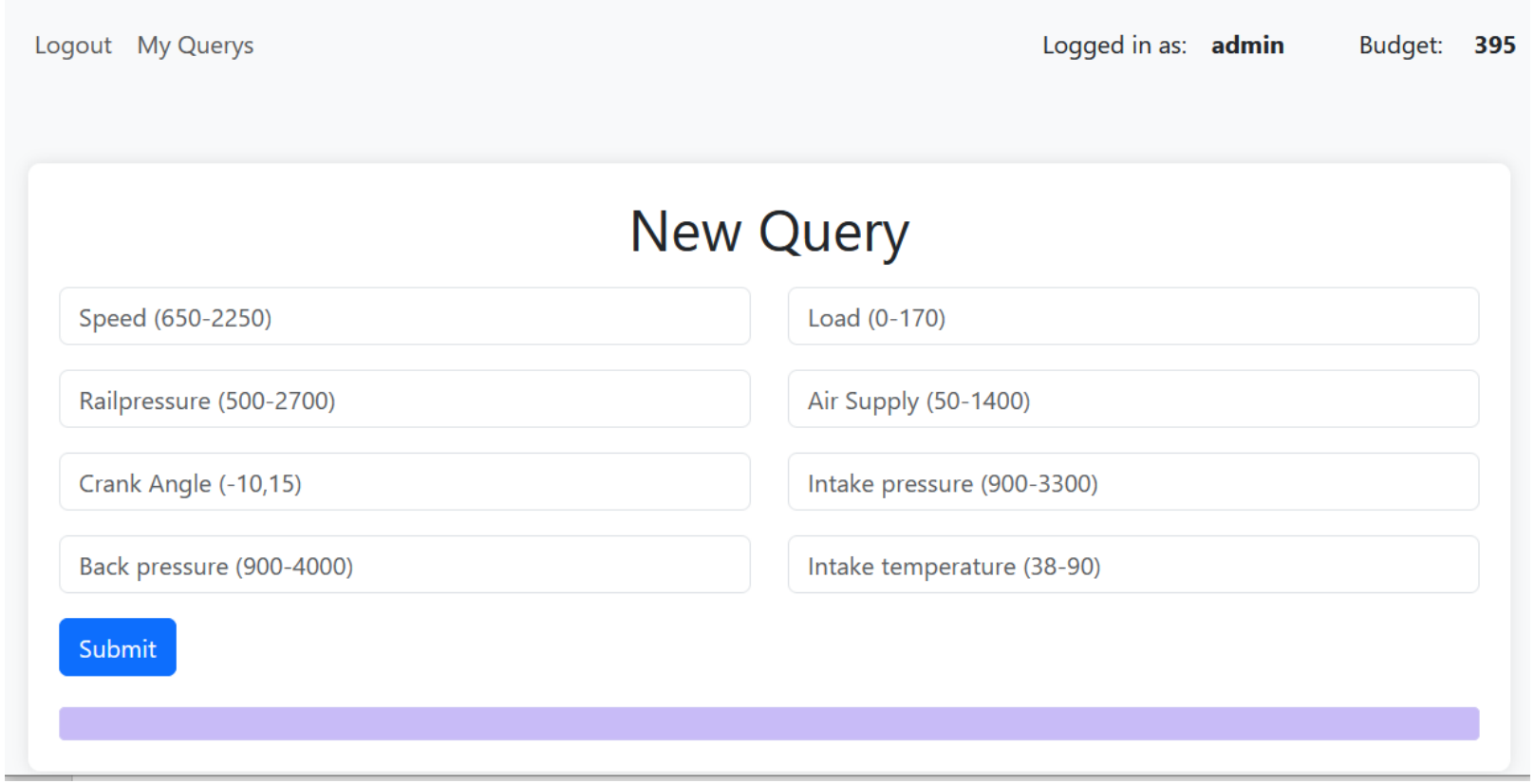
- You have a finite budget of measurements (400)
- Learn the underlying system as good as you can
  (Lowest scaled MSE on safe area)
- If you violate one or two of the PM channels, you will lose 1 additional measurement
- If you violate the pressure cylinder channel, you will lose 10 additional measurements (this should not happen often)

Final submission

- Download the submission.csv file
- Make inference with your model of choice of the objective columns
- Make inference on each point, even if it is not safe
- The MSE on safe area is decisive!
- Send your submission per mail to joern.tebbe@th-owl.de
- Pitch your strategy in a short presentation

The interface

- URL: hackathon-sail.de/app.cgi
- Login with your team name and the given password



Hints and Rules

- To Do:
  - Use Data Science skills
  - Visualize the data
  - Train a model on your current data
  - Decide which points improve your model while being safe
  - Update your model and keep iterating
  - Have fun

- Not to Do:
  - Evaluate only at submission points (they are too many)
  - Search for domain knowledge (it will not help you)
  - Try to hack the server (if we find out, you are banned)
  - Use queried data from other groups (if we find out, you are banned)

Prizes

- 1st Place: 1,000 EUR
- 2nd Place: 400 EUR
- 3rd Place: 200 EUR

Teambuilding

- Teams of 4
- Use the guided tour to connect and build groups

Organization

- Location
  - Registration Desk/ Toilets/ Showers/ Sleeping Room/ Relaxation Room/ Food/ Snacks/ Drinks
- The plates must remain in the CITRUS. For snacks there are disposable plates at the snack buffet.
- The door next to the registration desk is to be used for entering/leaving. The other doors remain closed.

Bingo

- Please find people that fulfill the criteria and write their name down
- The winner gets a prize :)

Have a nice Hack!

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