**Algorithmus Schmiede**

Data Science | Numerik | Physik

# Understanding AI in Manufacturing

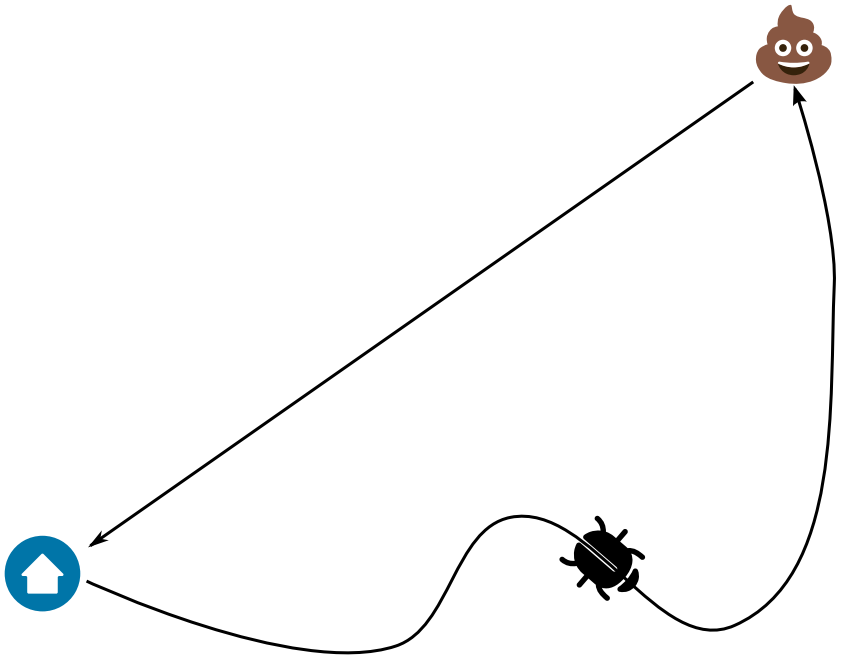
**Dr. Markus Dutschke**

# Definition AI

- Artificial Intelligence (AI):
  Solving complex cognitive challenges
  e.g. also chess computers (1951, 1967, 1996)

- Machine Learning (ML):
  Algorithms configure themselves on the basis of data
  e.g. neural networks, transformers

# Intelligence of the dung beetle



**Künstliche Intelligenz**
Joachim Reinhart, Oliver Mayer, Christian Greiner
ISBN: 978-3-8343-3511-1

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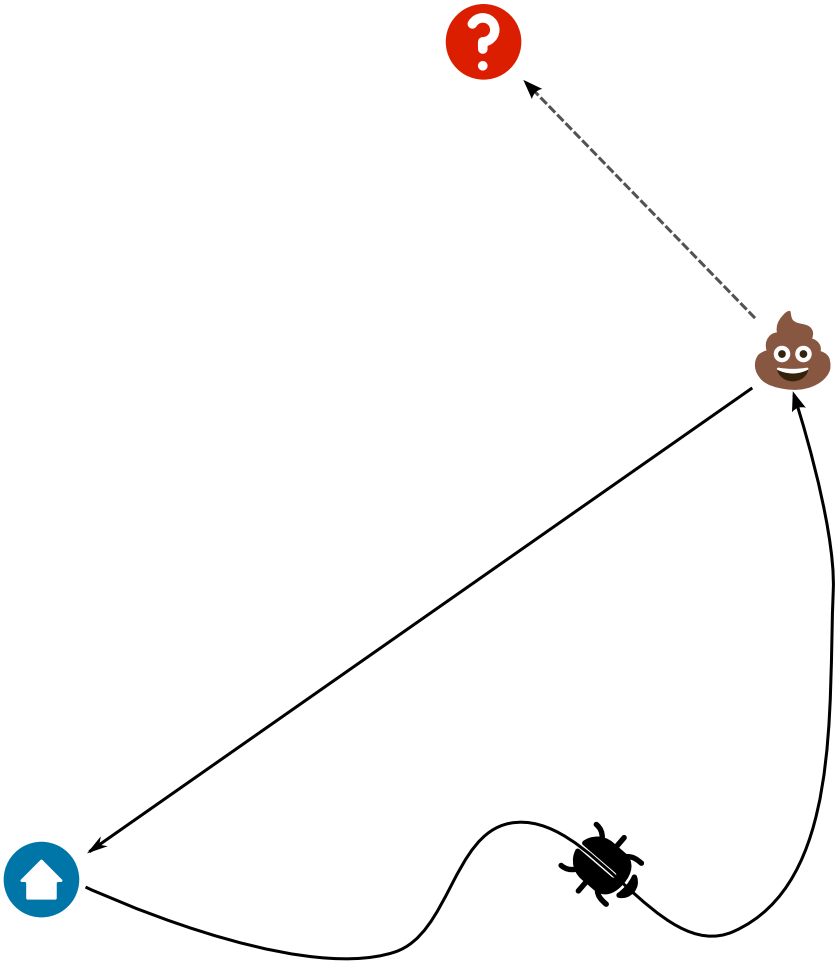

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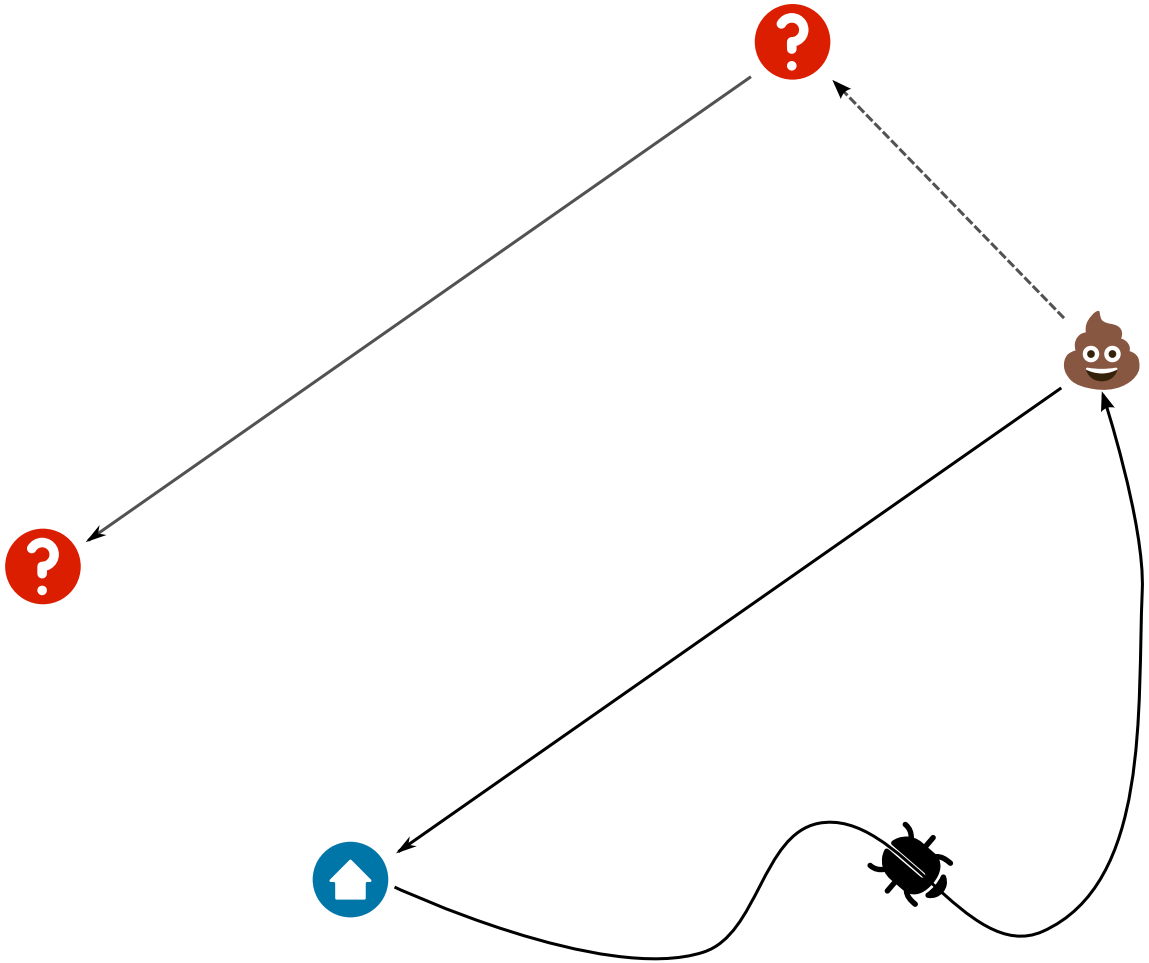

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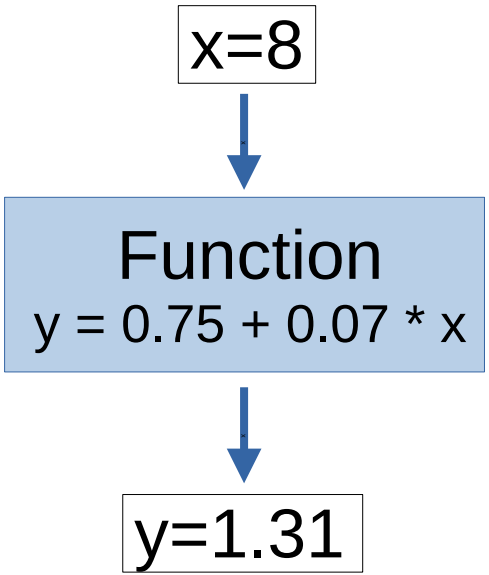
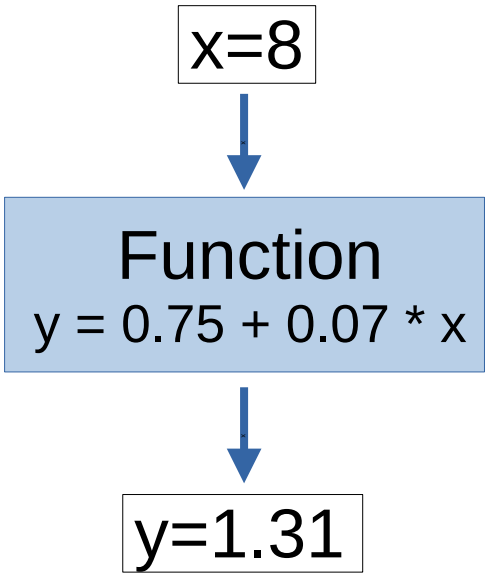
# Function ► Regressor




Explored

# Function ► Regressor

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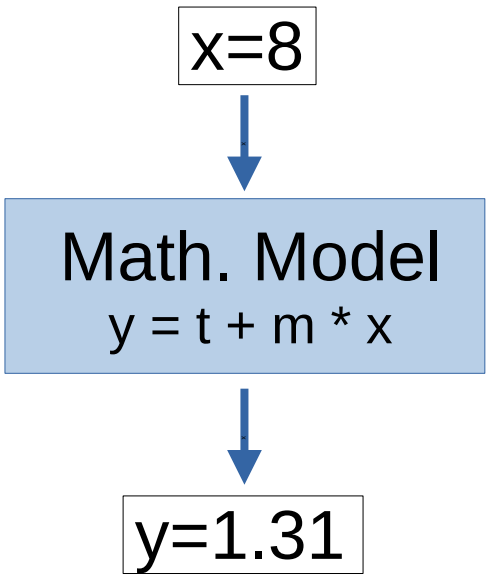
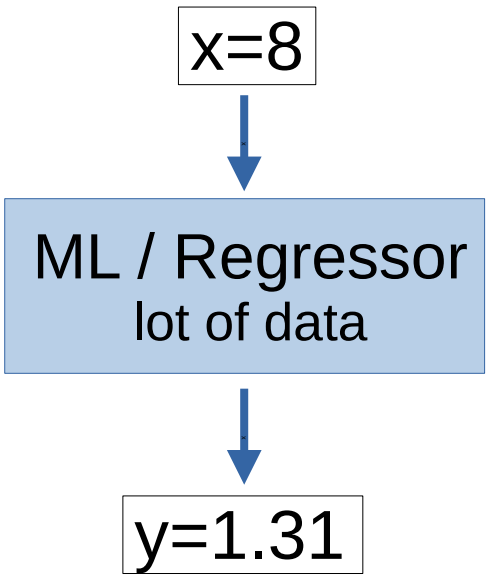
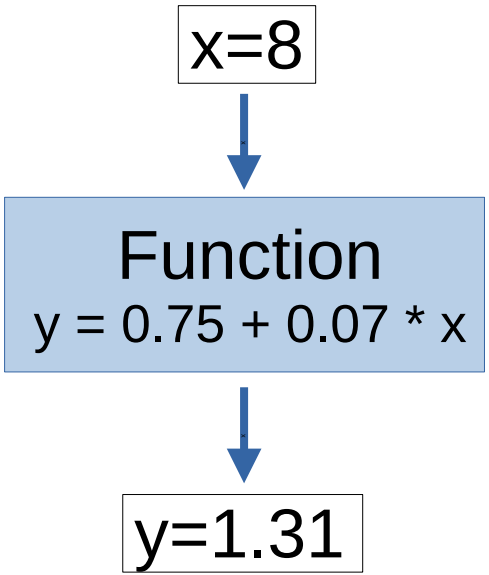



Domain Knowledge



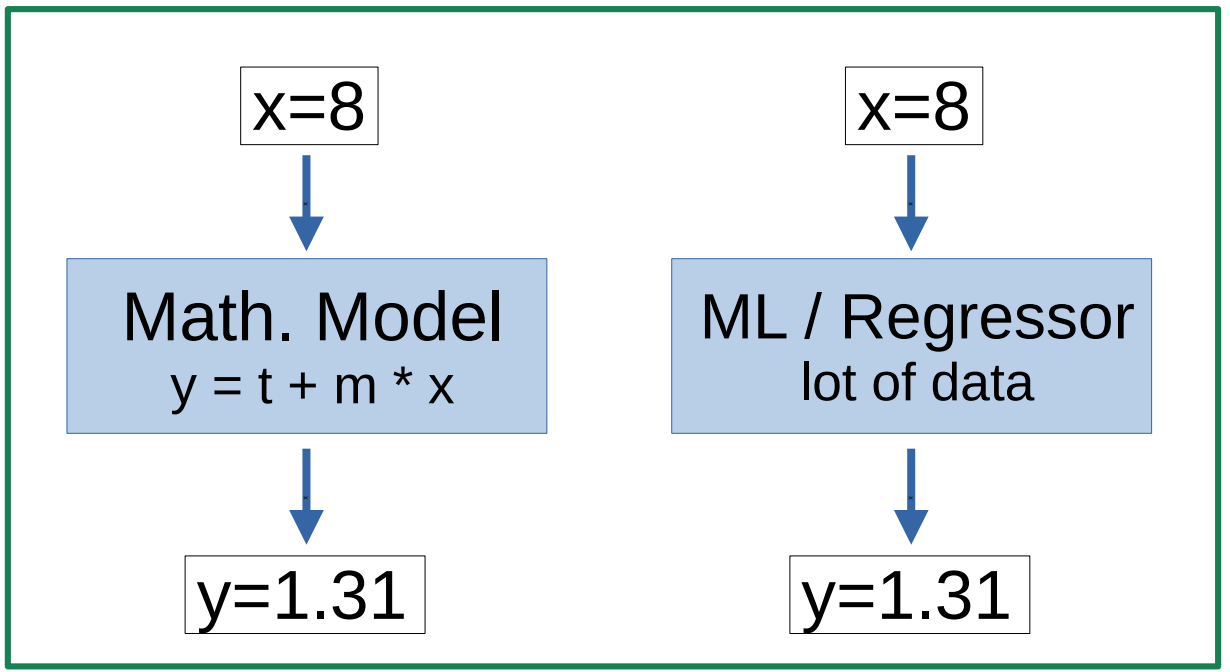

Data Driven

# Function ► Regressor




Explored

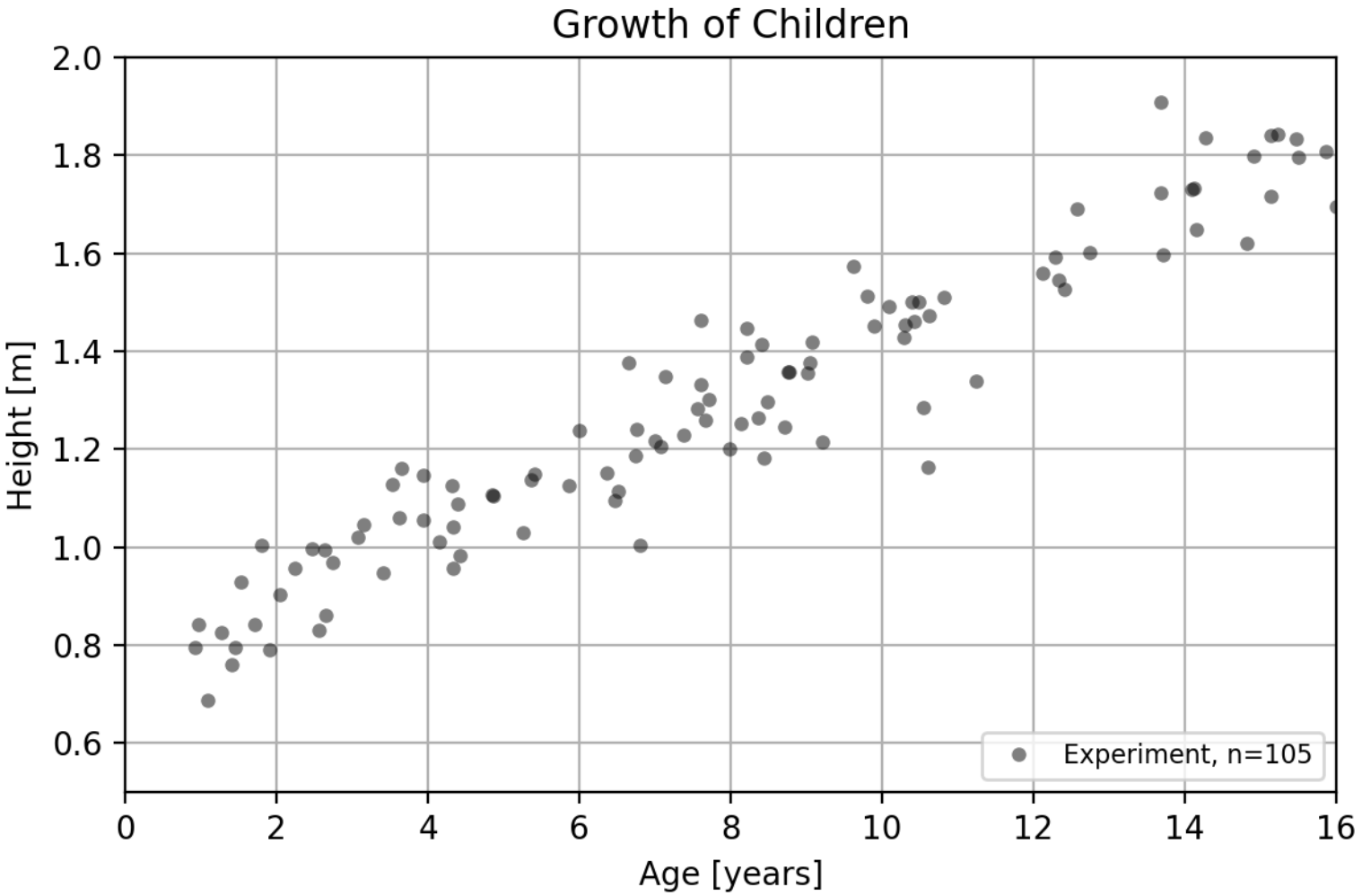
This Talk




Domain Knowledge

Data Driven

# Linear Regression




Source:
**German federal health reporting**
www.gbe-bund.de

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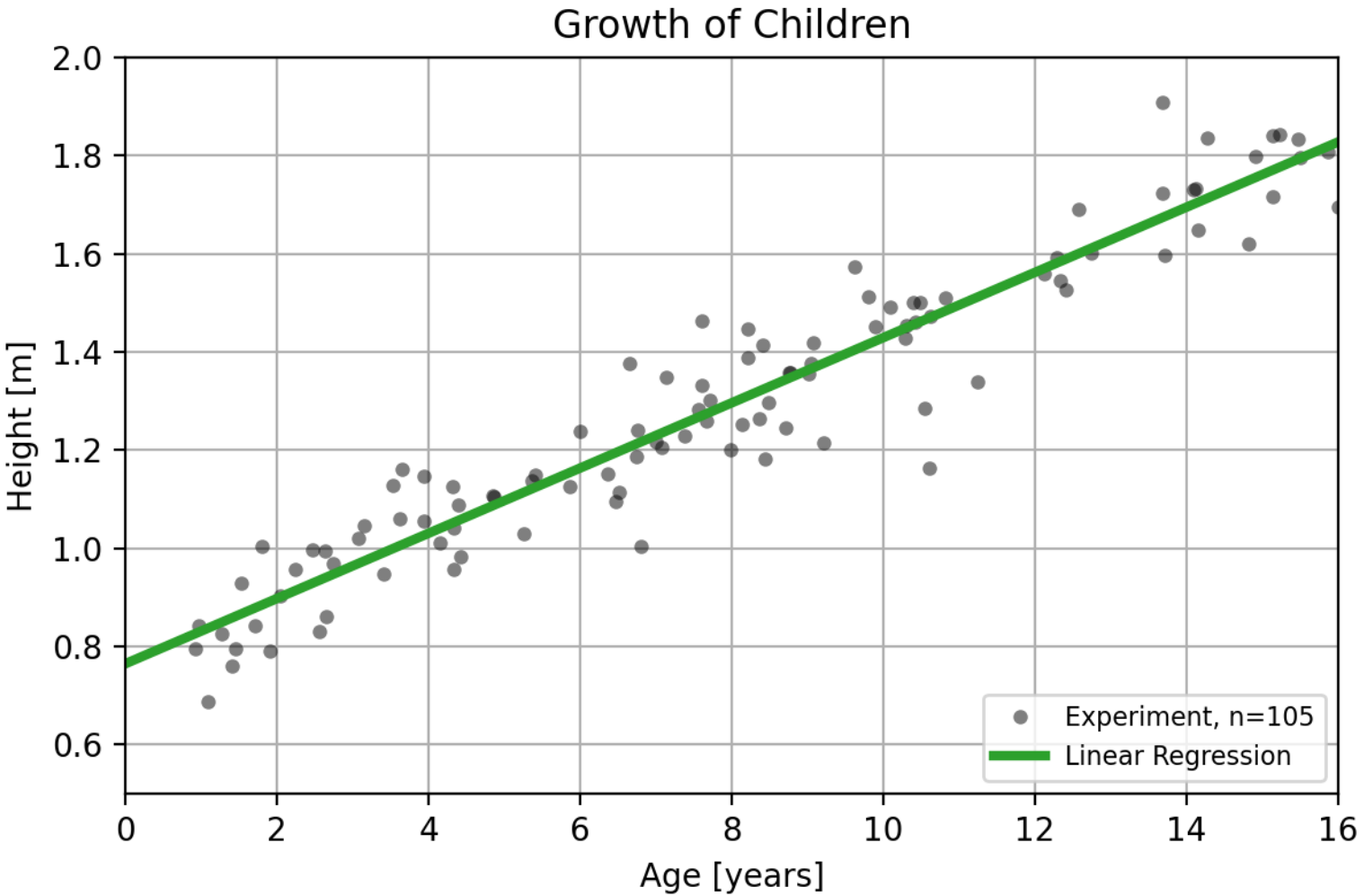


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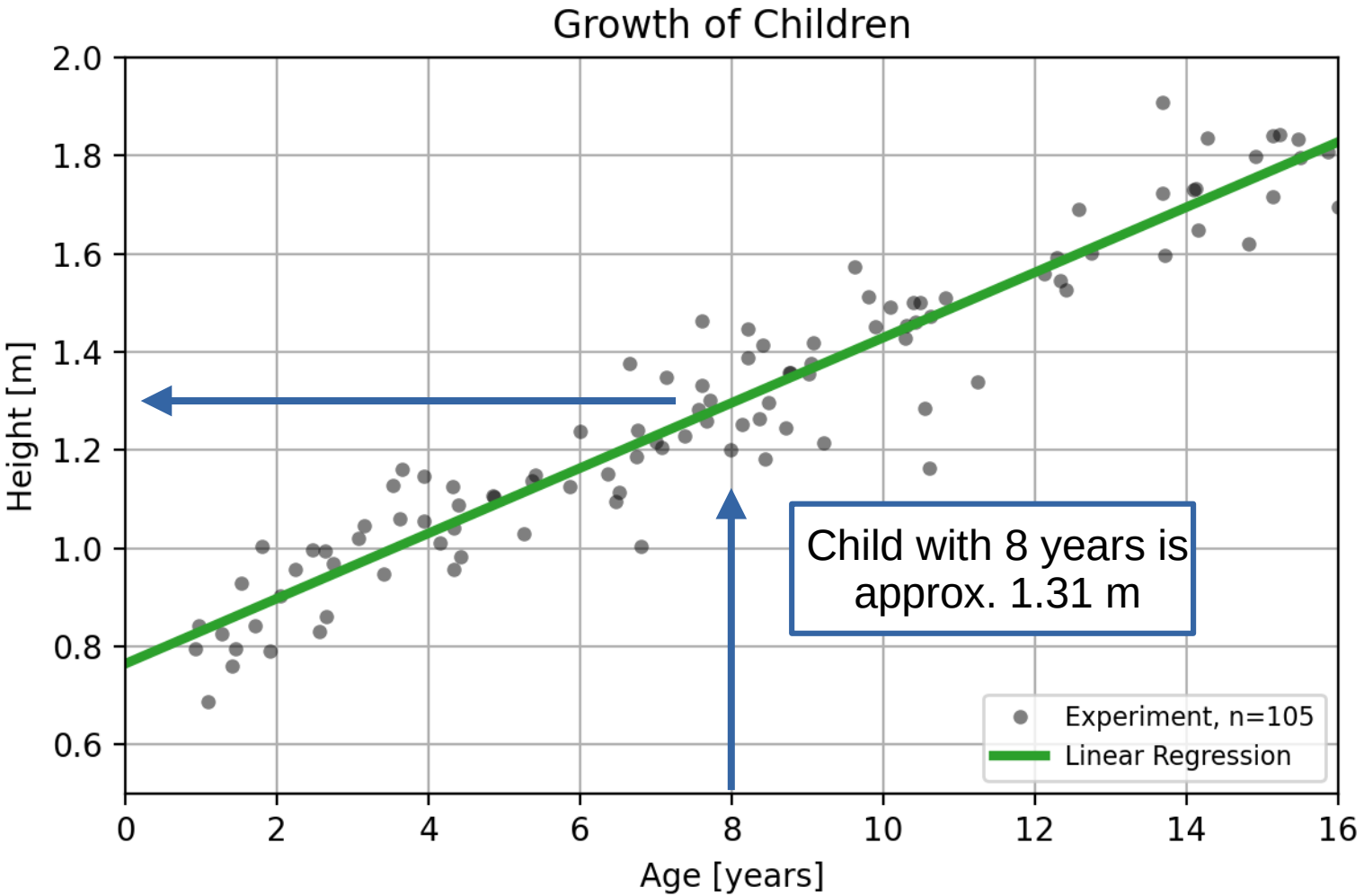


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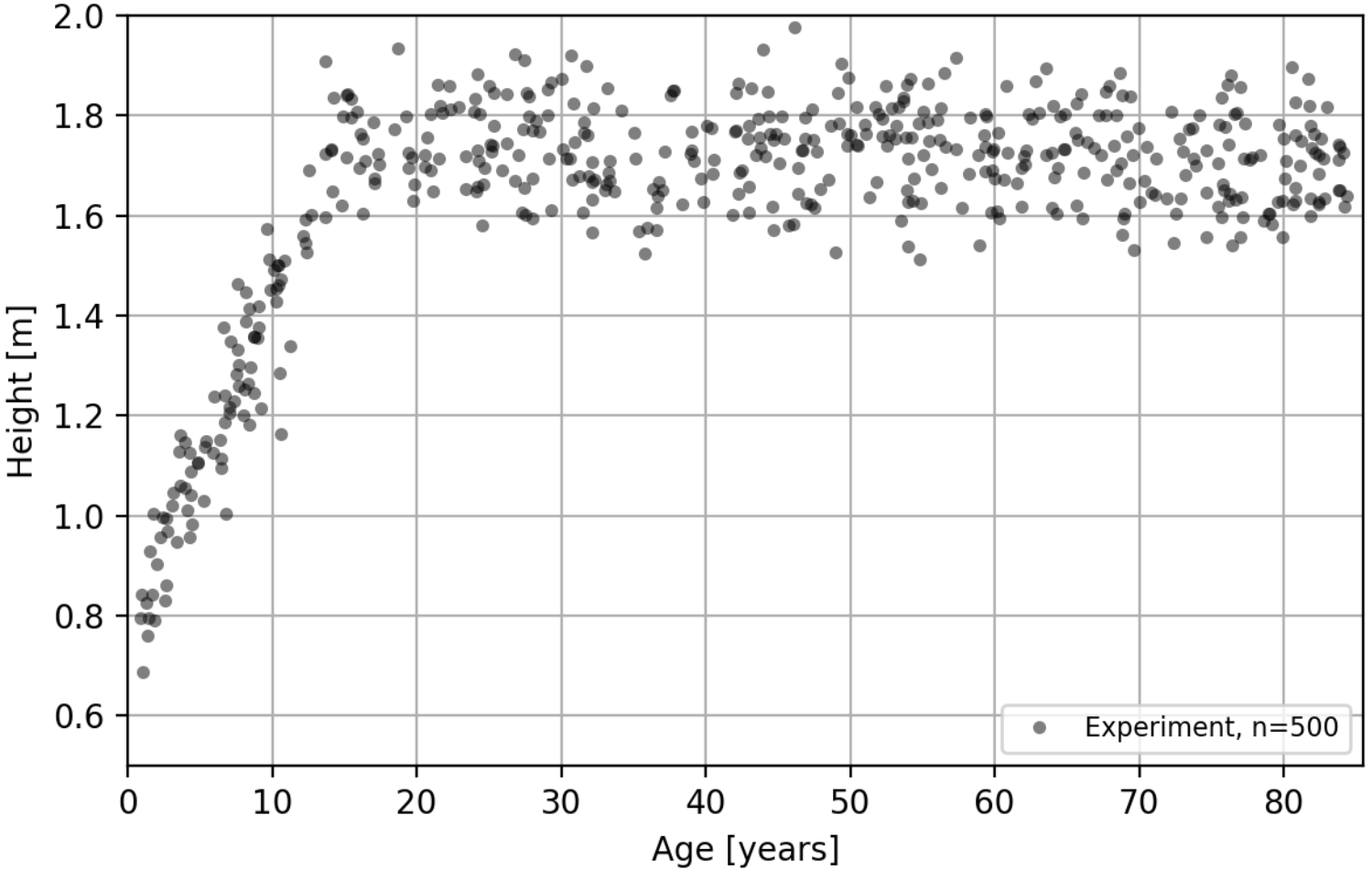
# Overview Regressors

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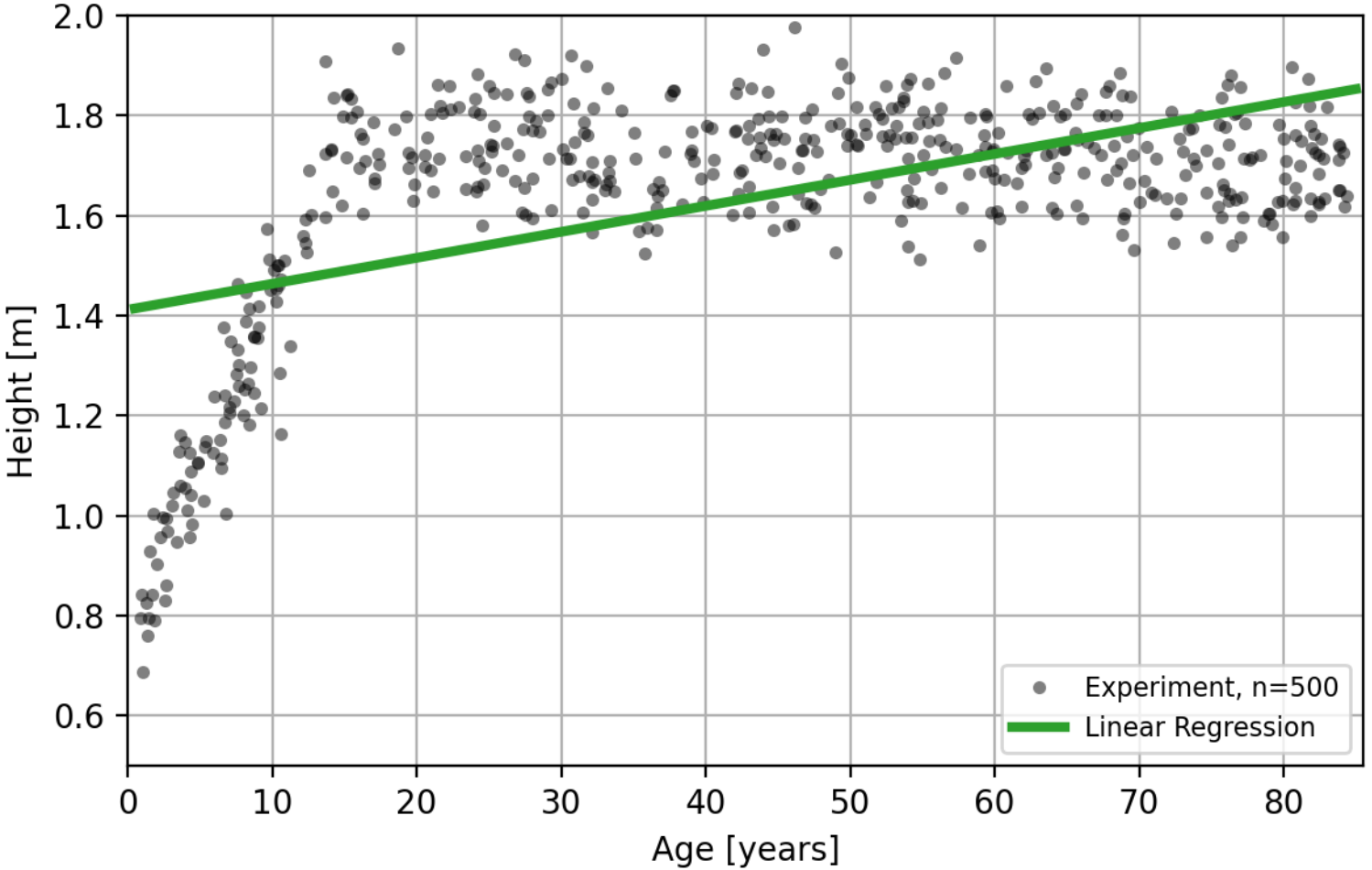


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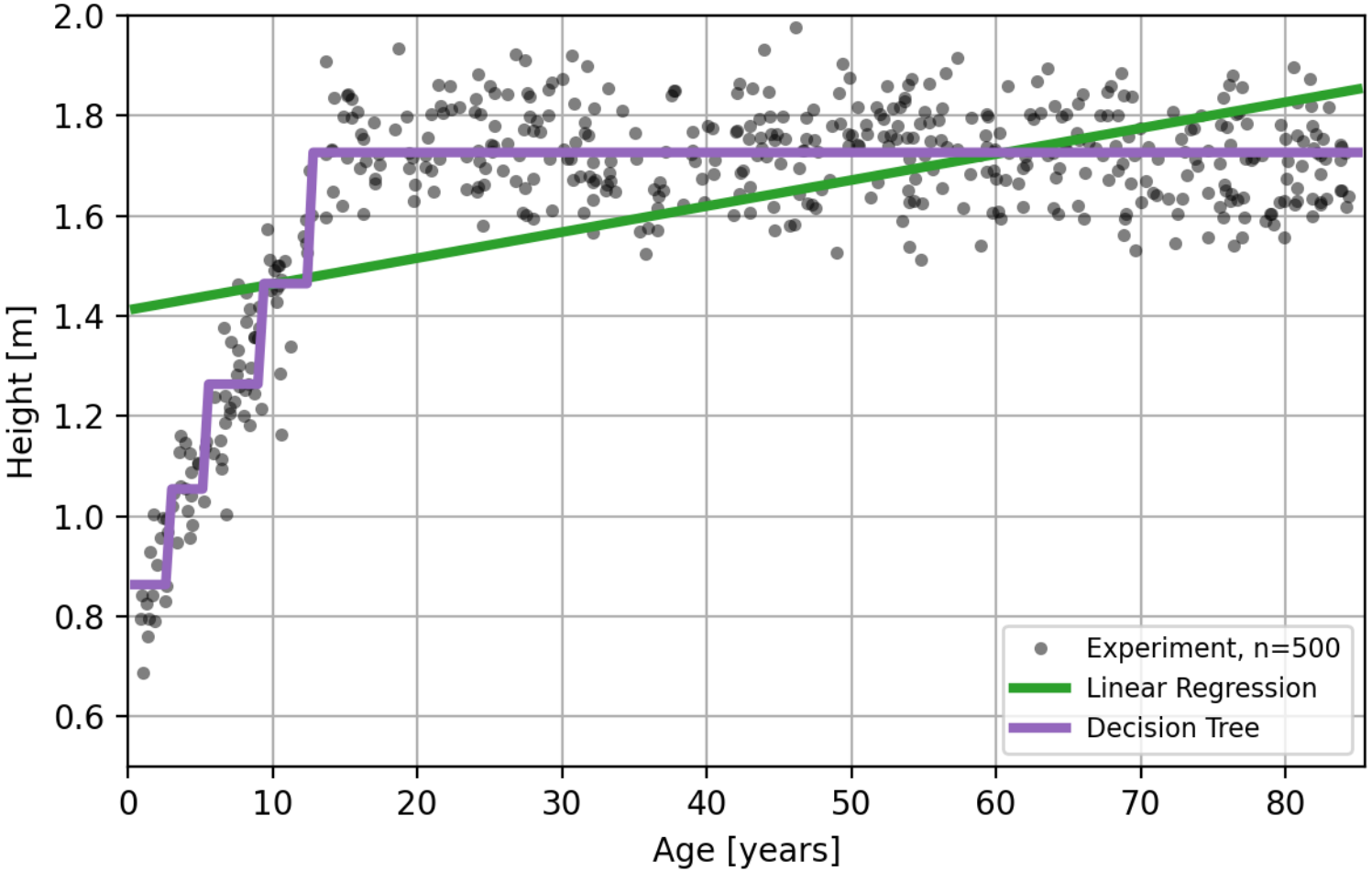


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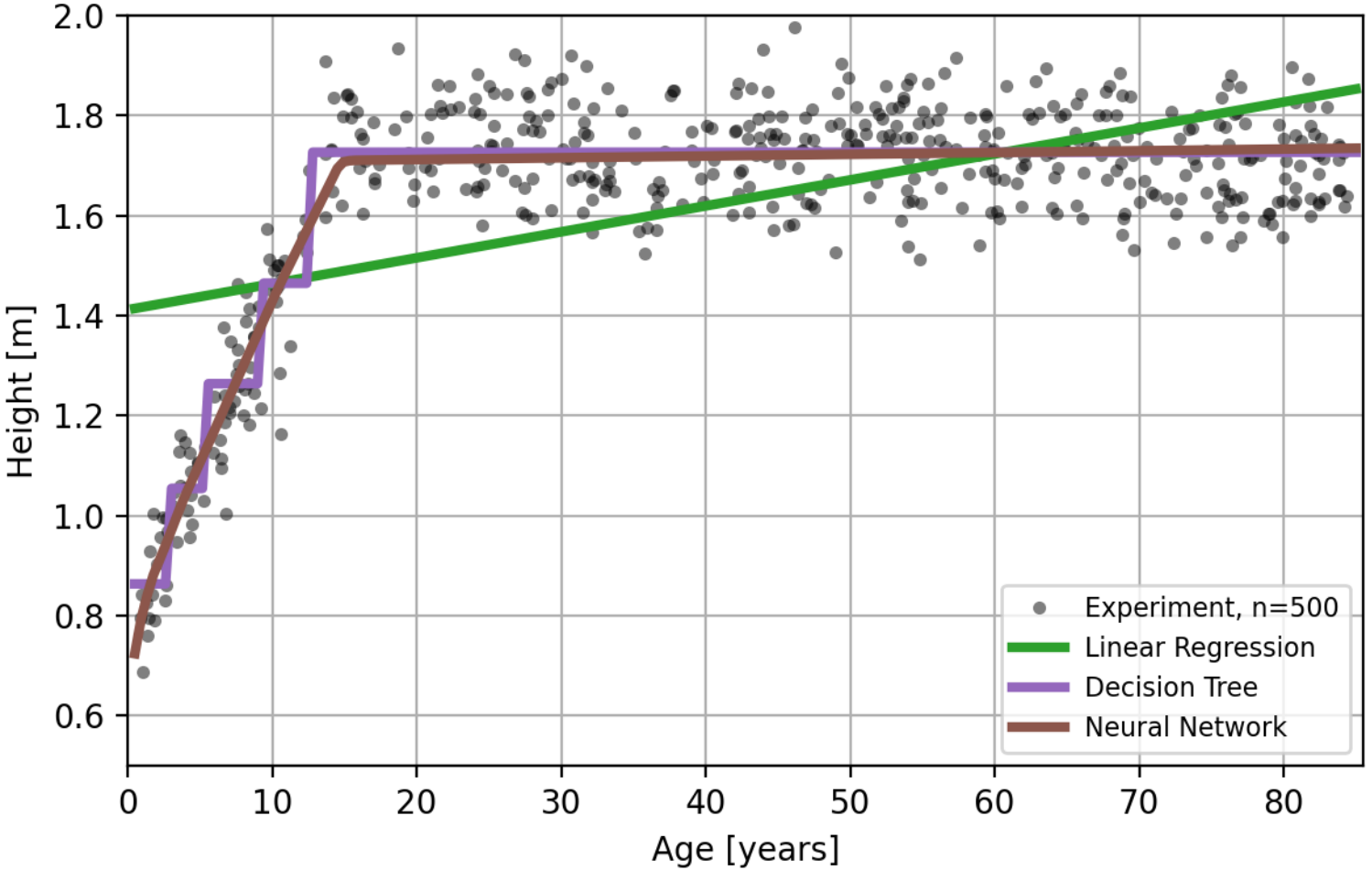


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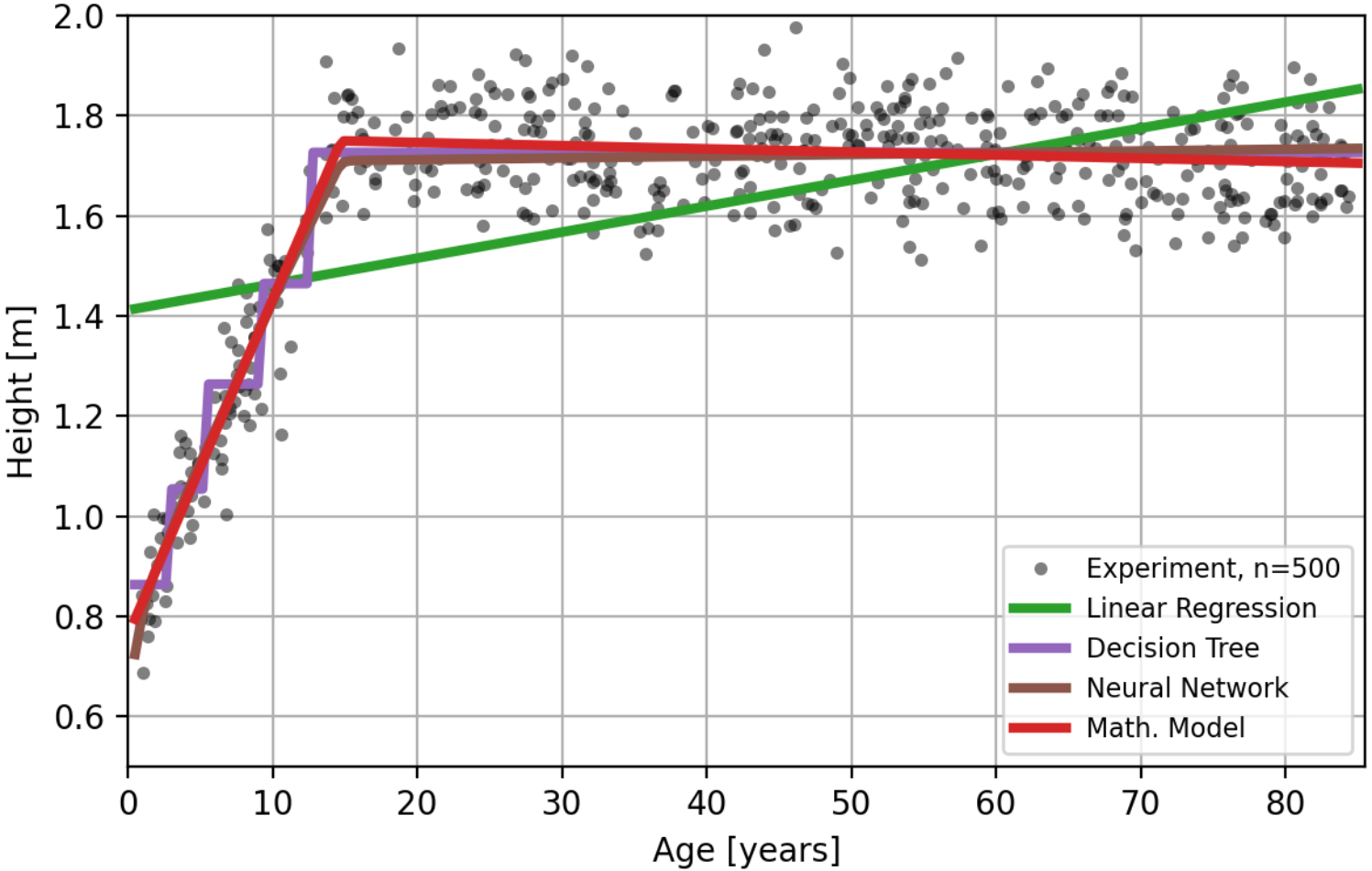


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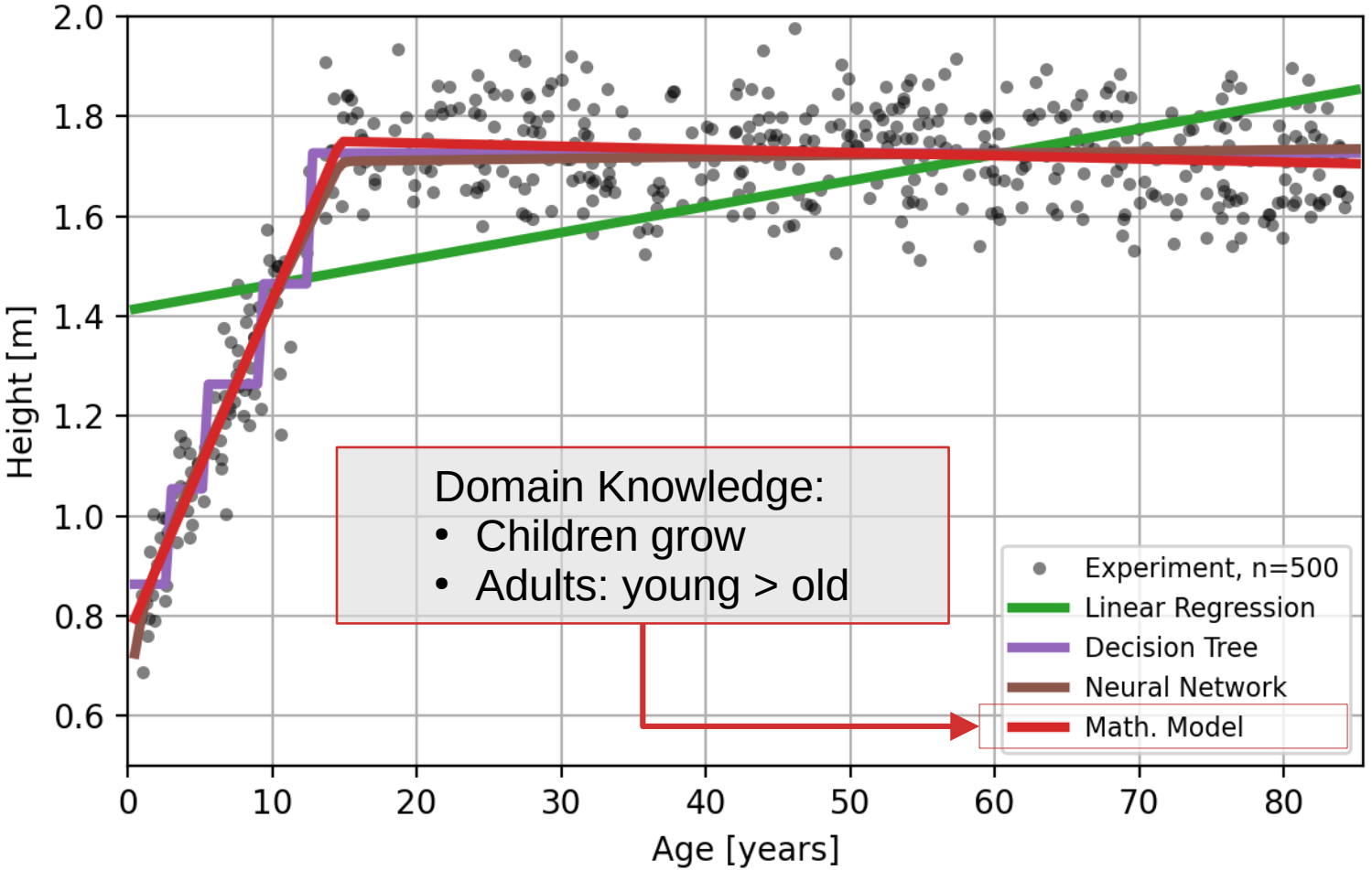


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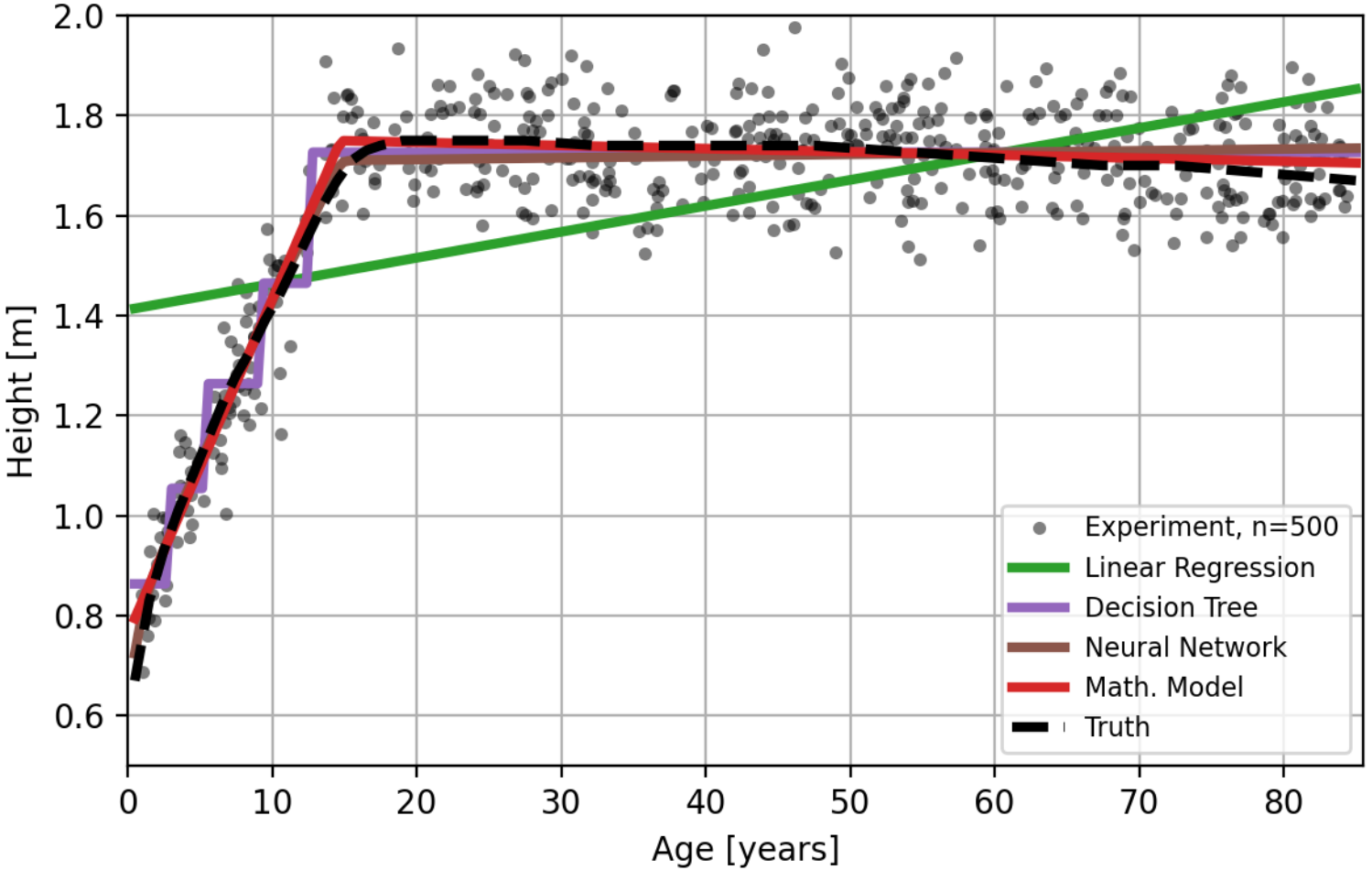


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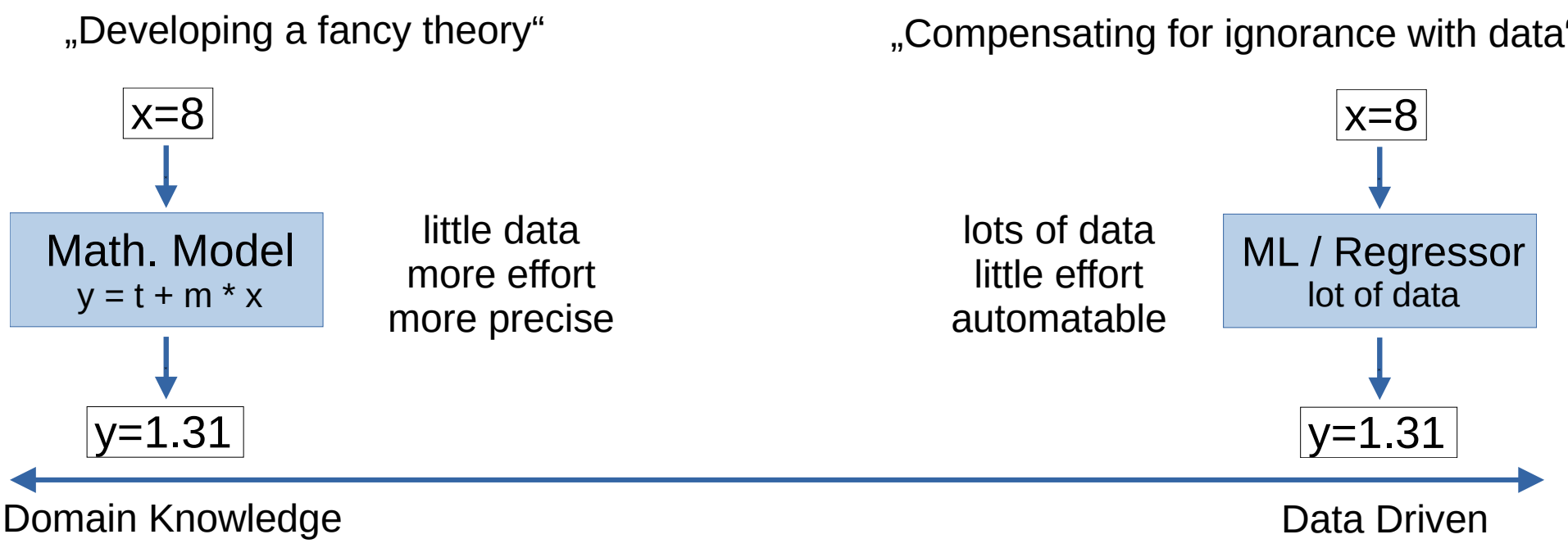
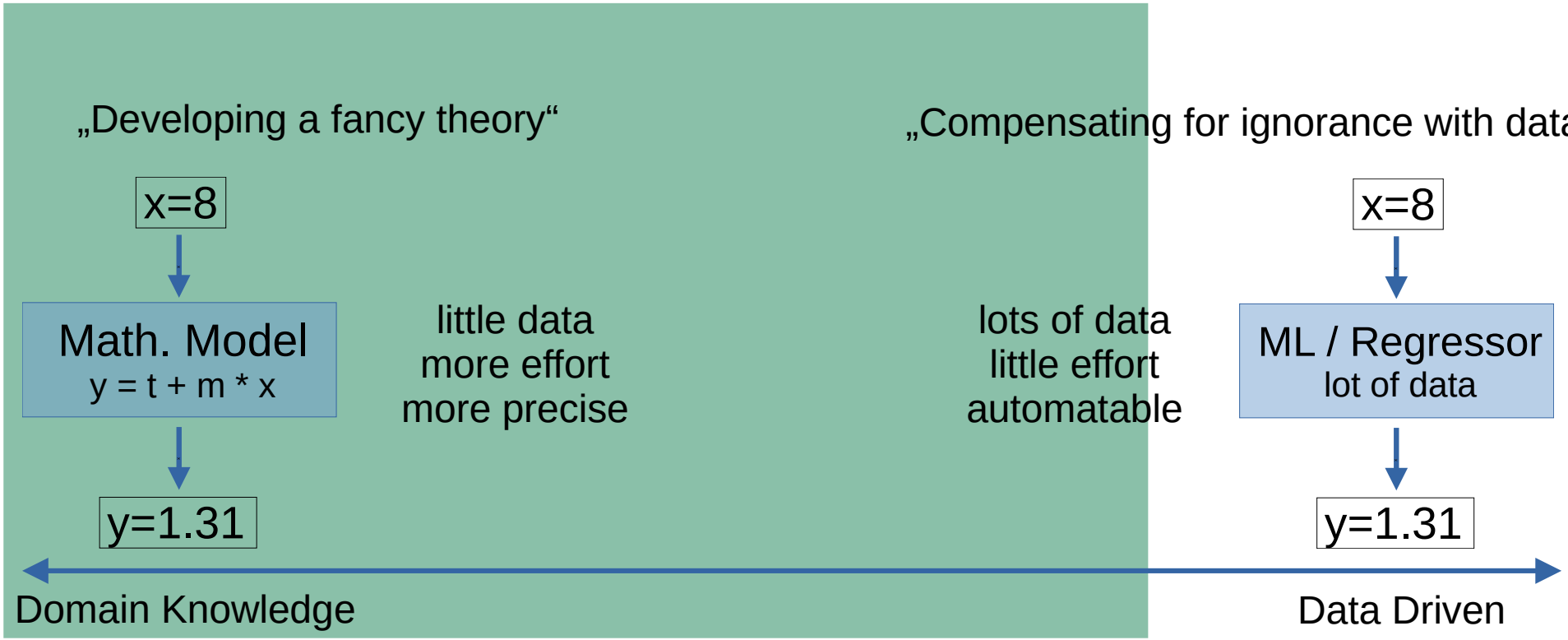
# AI Solution Strategies

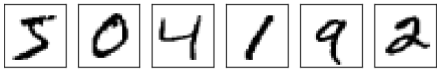


# AI Solution Strategies

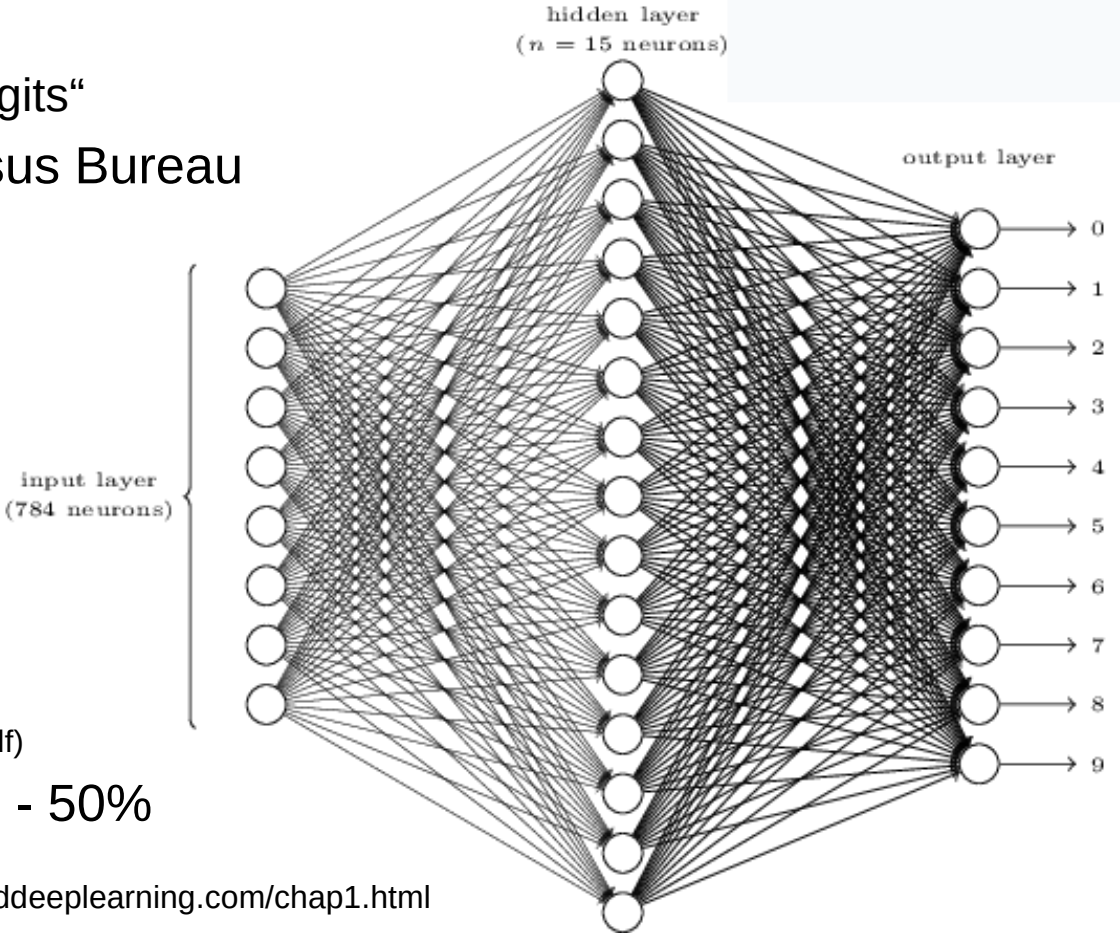
Algorithmus Schmiede
Data Science | Numerik | Physik



# NN @ Handwritten Digits



- NIST data set „handwritten digits“
- 250 authors from US Census Bureau
- Training: **60 000 Digits**
- Test Data: 10 000 Digits


- Precision with ML: 99,79%
  (https://proceedings.mlr.press/v28/wan13.pdf)
- Precision without ML: 20% - 50%

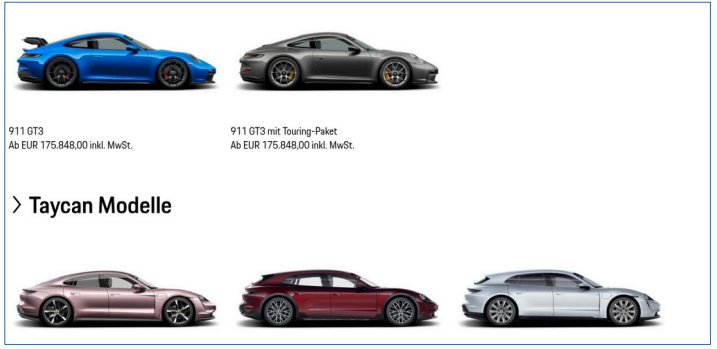
http://neuralnetworksanddeeplearning.com/chap1.html

# AI: Problems and Risks

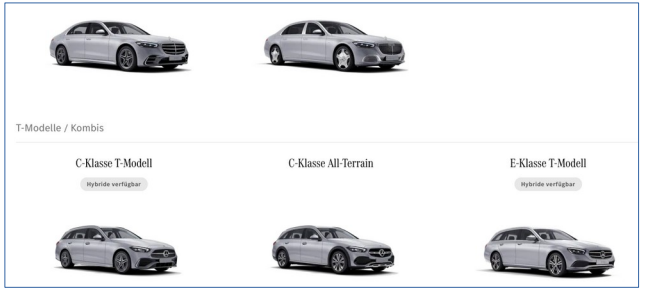
# Bias in Training Data

## Task: Picture -> Brand

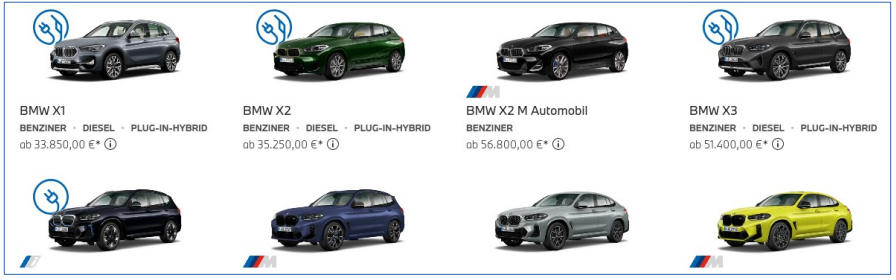
https://www.porsche.com/germany/models/



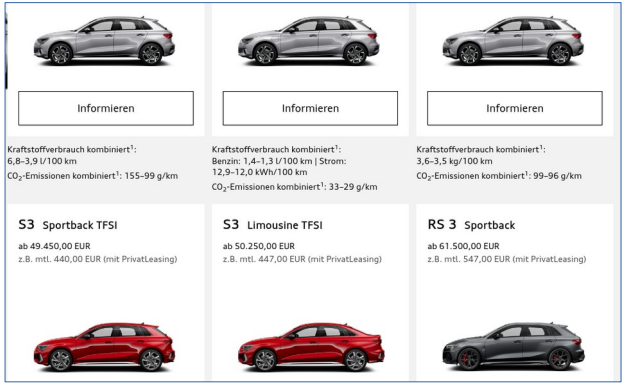

https://www.mercedes-benz.de/passengercars/models.html



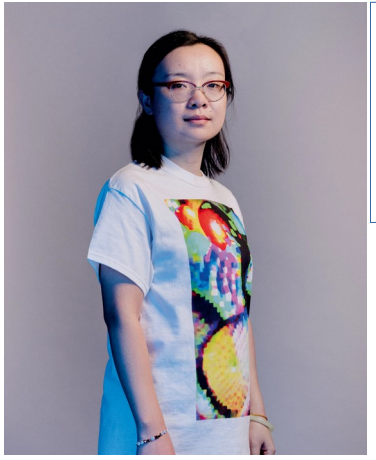

https://www.bmw.de/de/neufahrzeuge.html




https://www.audi.de/de/brand/de/neuwagen.html



# Hacking Neural Networks



ALEX LEE SECURITY 11.05.2020 06:00 AM wired.co.uk

## This ugly t-shirt makes you invisible to facial recognition tech

Researchers at Northeastern University have developed an adversarial example that works even when printed onto a moving fabric

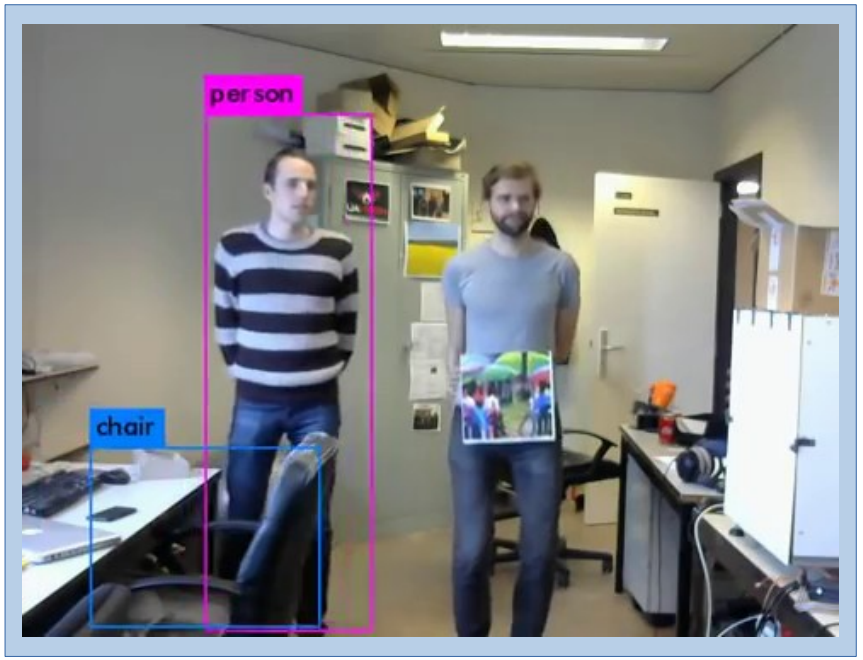
## Fooling a Real Car with Adversarial Traffic Signs

*Nir Morgulis, Alexander Kreines, Shachar Mendelowitz, Yuval Weisglass*

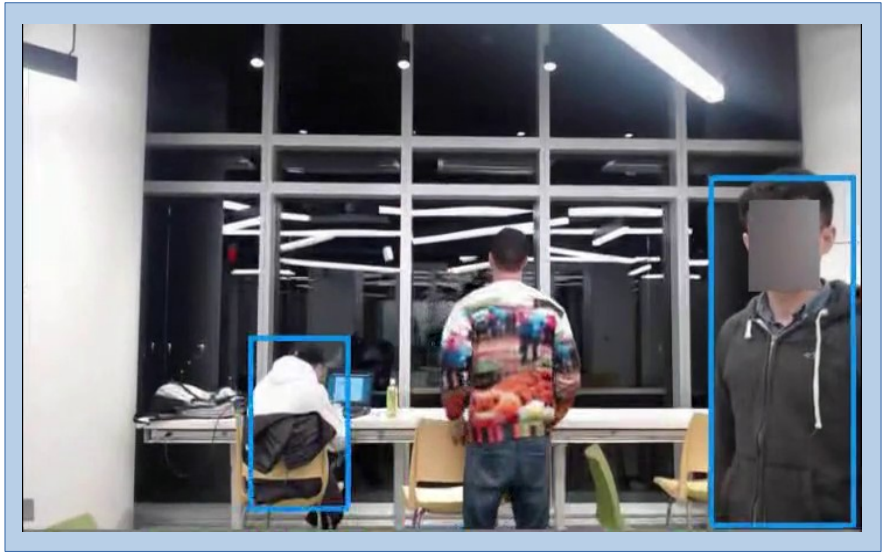
Harman International, Automotive Security Business Unit arxiv.org


classification: **30 km/h**

# Hacking Neural Networks




Anonymous CVCOPS:
Generating adversarial patches against YOLOv2
https://www.youtube.com/watch?v=MIbFvK2S9g8

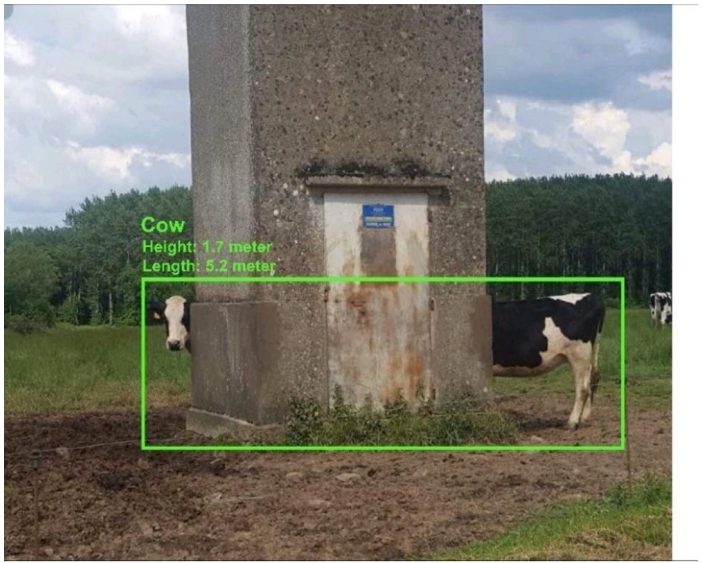


https://www.cs.umd.edu/~tomg/projects/invisible/

# Plausibility & Context

Pascal BORNET • 3rd+
LinkedIn Top Voice in Tech | ...
1mo • + Follow

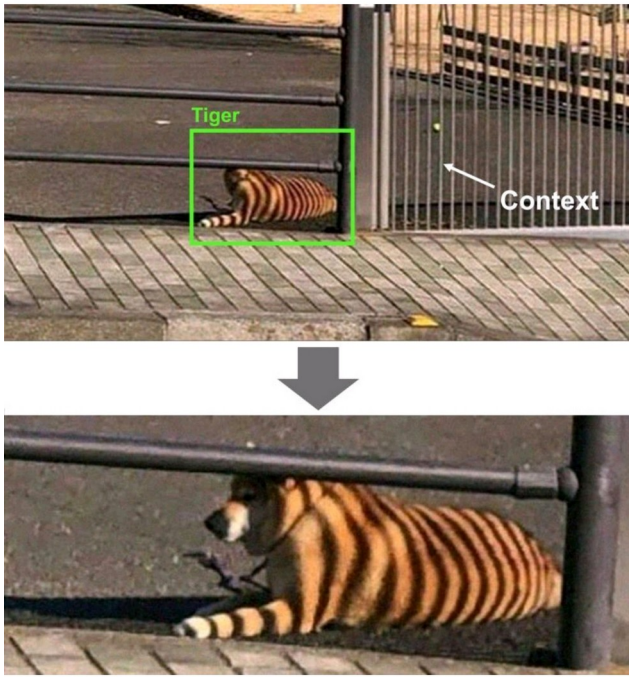
The longest cow in the world 😂...
Or how to deceive an AI program!... see more




Source: LinkedIn

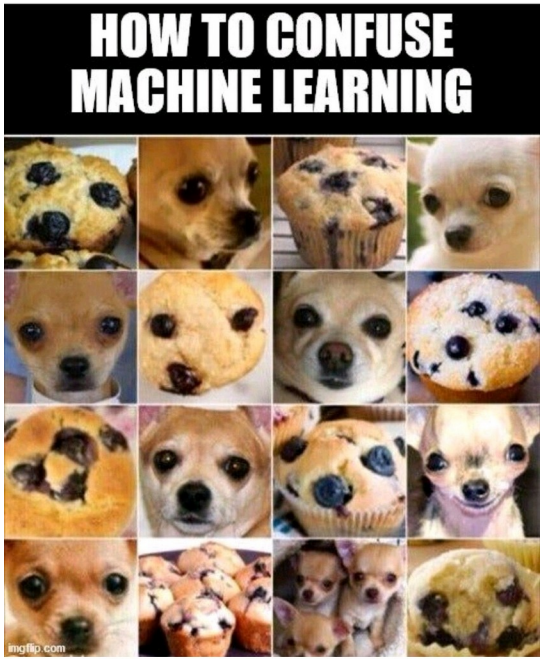
Pascal BORNET • 3rd+
LinkedIn Top Voice in Tech | Keynote ...
1d • + Follow

Data without context is just useless and misleading!
🙂... see more




avyana
324 followers
4d • + Follow

How to Confuse Machine Learning... see more



# Spectacular AI-Fails



# Areas of application

**Machine Learning (esp. Neuronal Networks):**
- Images, sound, language, art
- Rules that cannot be clearly described (e.g. marketing, trends, psychology)
- Lots of (cheap) data
- Rapidly changing system (e.g. social media)
- Individual errors are no big deal

**Model Based Algorithms:**
- Extremely reliable
- Data points very expensive
- Clear rules in the system (e.g. physics, mathematics)

# Hybrid Solutions:
# e.g. visual inspection

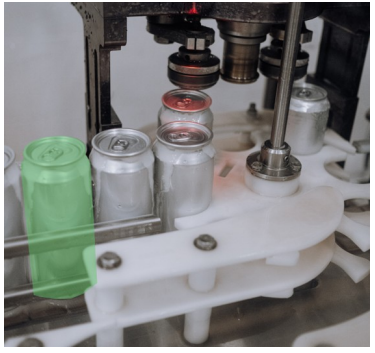
**Bad:**

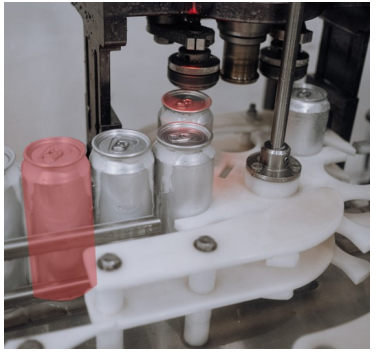
Directly classify as good/bad

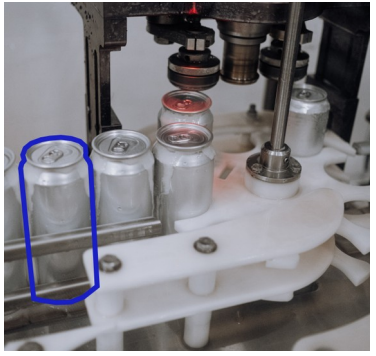
- Lot of training
- Lot of bad examples needed
- New defects are not detected

**Good:**

- Object detection by NN / YOLO
- Testing according to physical criteria (color gradient, light reflection, ...)





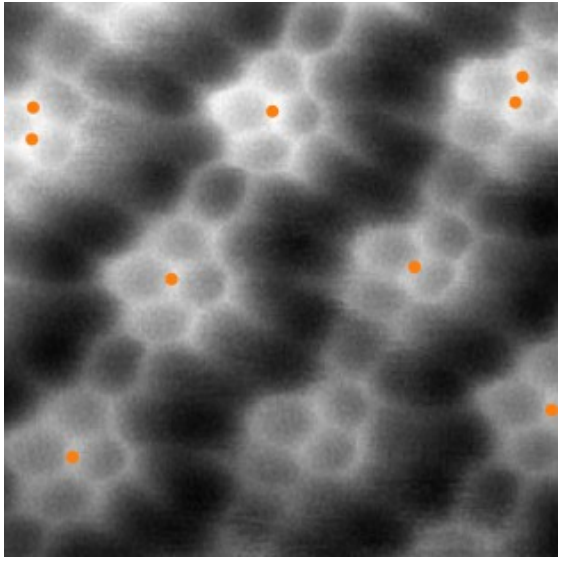


# Sensor Tuning with AI

- Topography by laser distance measurement:
  gray level = height
- **Task**: reconstruct color information from real object
- Experience:
  strong measurement artifacts at certain spots

Solution:

- Neural Network to construct color at specific spots
- Precision: 80% (requirement fulfilled)
- 1-2 weeks work
- No system understanding
- No domain transfer investigated



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4050271/

# Natural Language Processing

Vor einigen Wochen ließ ich eine Darmspiegelung (zur Vorsorge) durchführen. Nachdem ich das Thema seit mehreren Monaten verschoben hatte, war ich überrascht, wie schnell, taktvoll und komplikationslos alles verlaufen ist. Die Angst war völlig unbegründet!

↓

woch liess darmspiegel vorsorg durchfuhr nachd thema seit mehr monat verschob uberrascht schnell taktvoll komplikationslos verlauf angst vollig unbegrundet

↓

vector with 100 000 entries (most of them 0)

**[0,00; 0,20; 0,00; 0,03; 0,00; 0,00; 0,71; ...]**

**Rating: 2**
German scale:
1 best, 6 worst

Guy doing colonoscopy:
reads like rating 1

https://data.world/mc51/german-language-reviews-of-doctors-by-patients-2021

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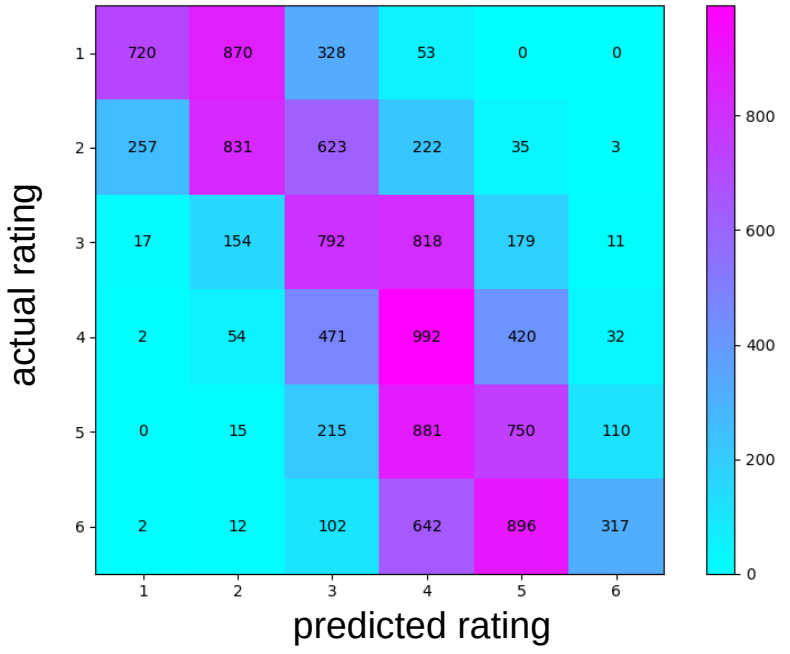


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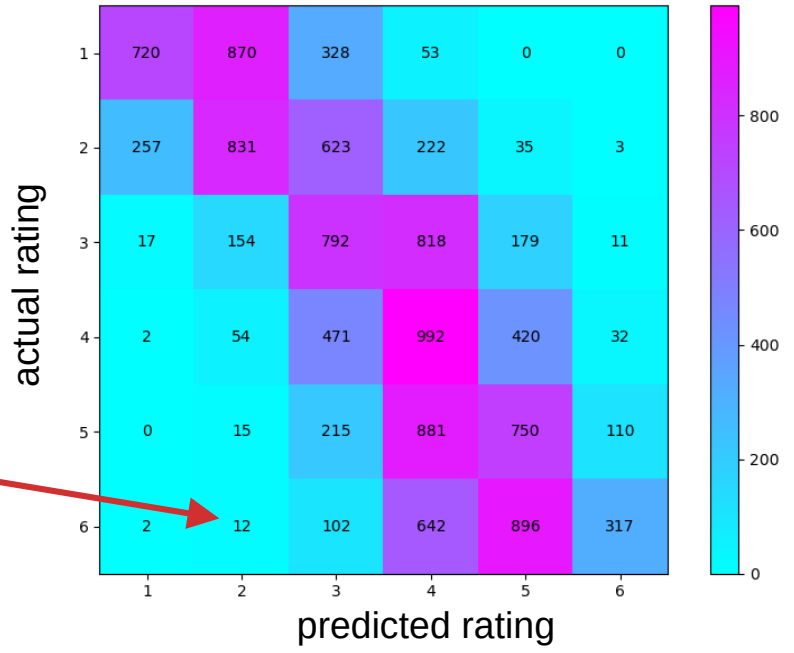
vector with 100 000 entries (most of them 0)

**[0,00; 0,20; 0,00; 0,03; 0,00; 0,00; 0,71; ...]**

**Rating: 2**
German scale:
1 best, 6 worst

Great doctor! Thanks for everything
[translated from German]




https://data.world/mc51/german-language-reviews-of-doctors-by-patients-2021

# Clustering

**Mostly intermediate step in AI projects**

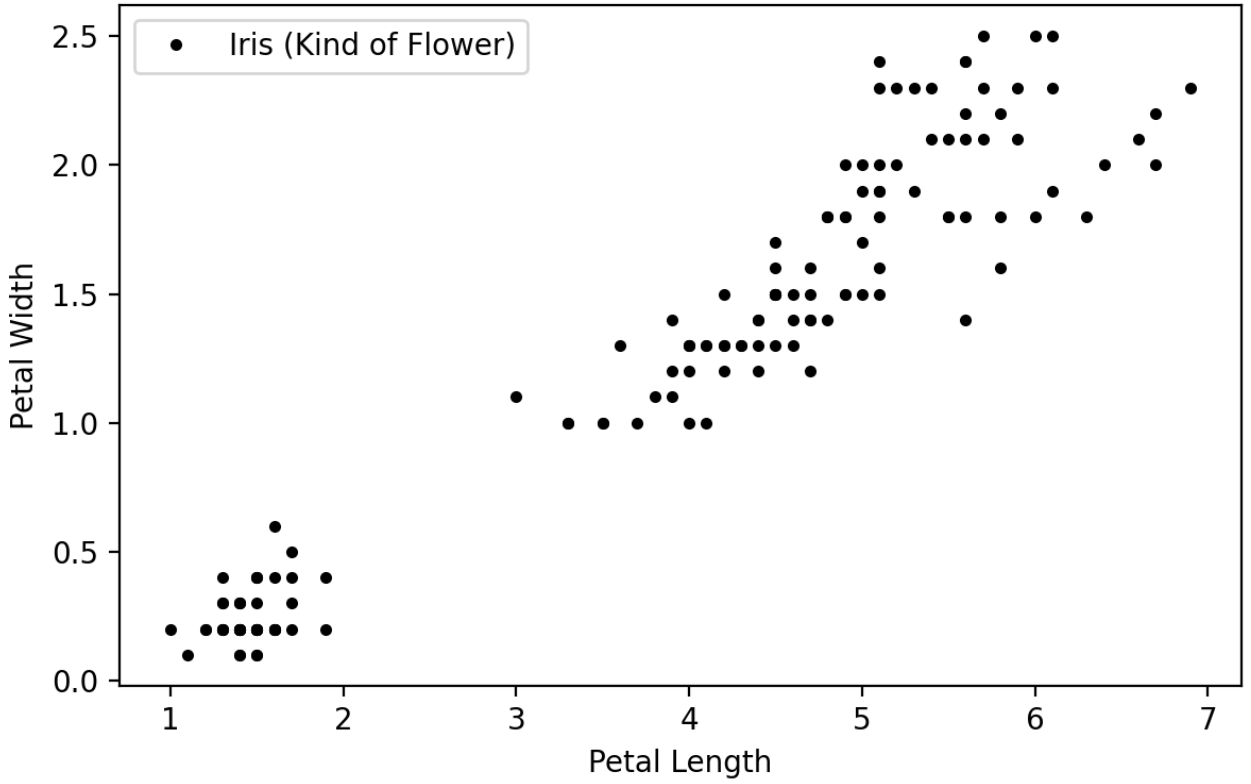
- Gaining an overview
- Fewer data points for training
- Identification of outliers

**Example:**

Quality fluctuations in the processing of irises (kind of flower) into cosmetics

# Clustering

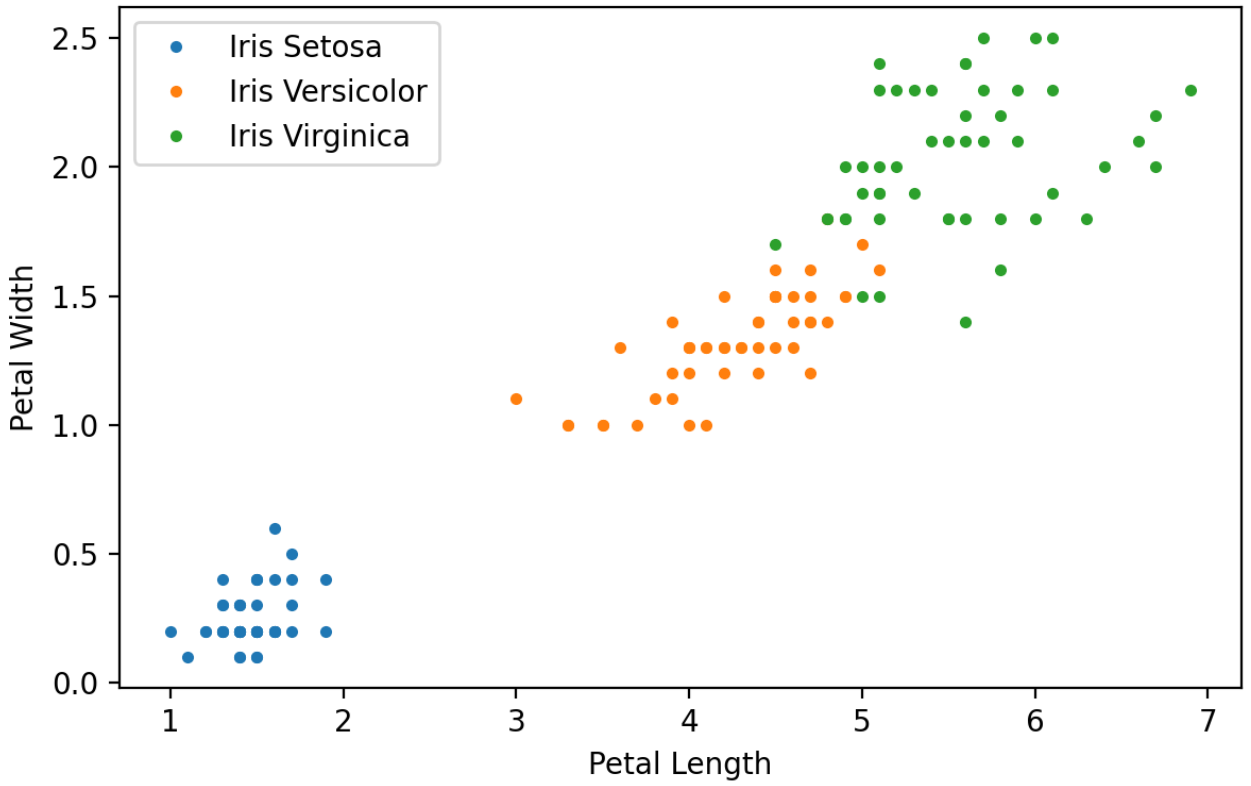
Idea: analysis of processed irises
Data: sepal/petal + length/width




Soure: **Iris flower data set**
https://en.wikipedia.org/wiki/Iris_flower_data_set

# Clustering

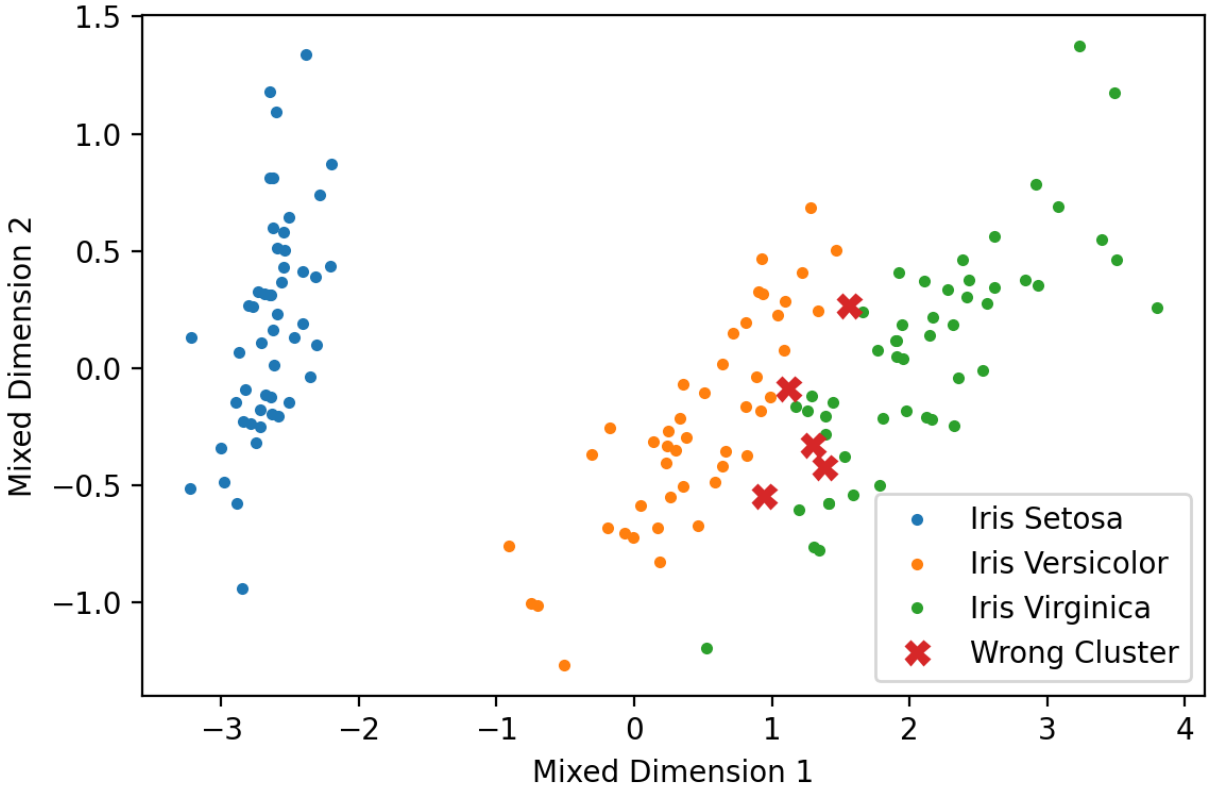
Approach: species dependent processing




Soure: **Iris flower data set**
https://en.wikipedia.org/wiki/Iris_flower_data_set

# Clustering

Next step: expensive determination of species at boundary




Soure: **Iris flower data set**
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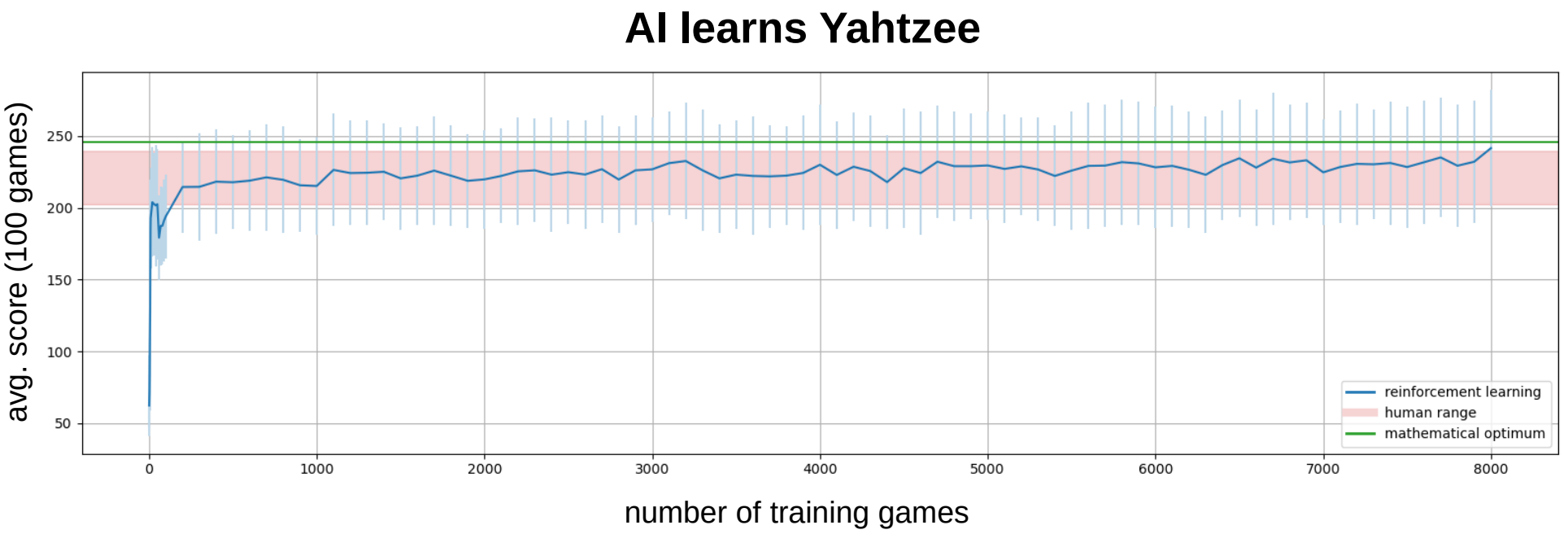
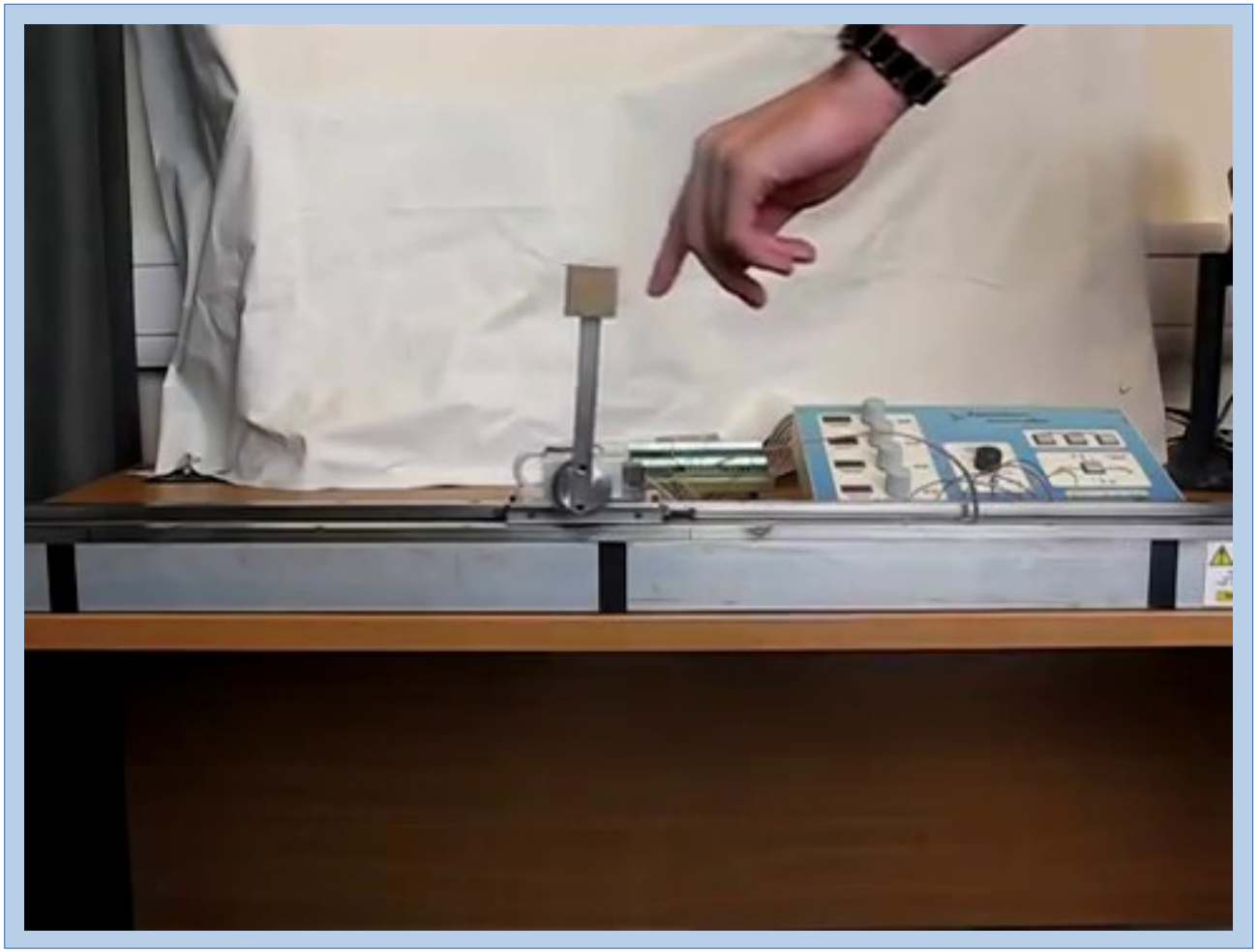
# Reinforcement Learning

Current situation, control signal ► final score

e.g. dynamic pricing,
e.g. compensation of raw material fluctuations in production



# Reinforcement Learning



**PilcoLearner: Cart-Pole Swing-up**
https://youtu.be/XiigTGKZfks

# Kind regards

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