Hasso Plattner Institut
Digital Engineering · Universität Potsdam

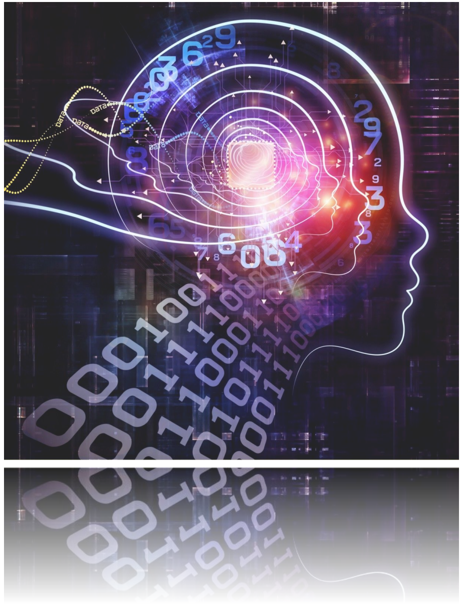
Data Quality for AI

Prof. Dr. Felix Naumann and Dr. Hazar Harmouch

WS 2021/2022

Agenda

- ❏ Chair Introduction
- ❏ Organizational Information
- ❏ Data quality and AI
- ❏ Your Tasks



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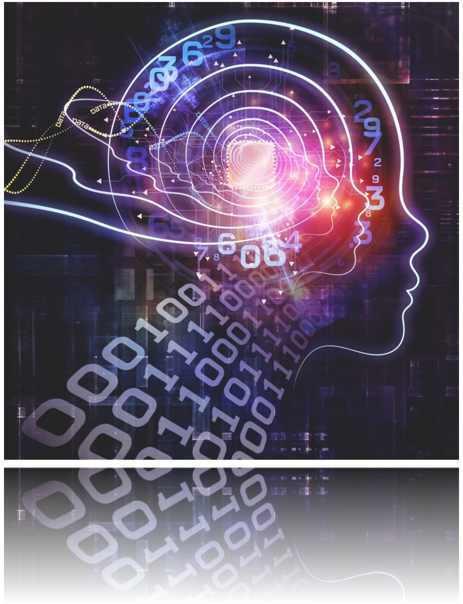
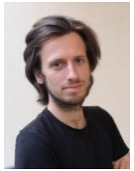


Information Systems Team


Phillip **Wenig**

Anna **Zobel**

Prof. Felix **Naumann**

Dr. Hazar **Harmouch**

Leon **Bornemann**

Sebastian **Schmidl**

Tobias **Bleifuß**

Duplicate Detection

Data Change **Data Fusion**

project **AKITA** **Entity Search**

Data Profiling **Information Integration**

project **DataKnoller** **Web Science**

Data Scrubbing **Data as a Service**

project **AI4ART**

Information Quality **Data Cleansing** **Text Mining**

Linked Open Data **CSV parsing**

Dependency Detection

Knowledge Management for the Arts

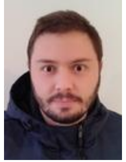
Web Data **Distributed Computing**

Entity Recognition

project **Janus**

project **Metanome** **Data Preparation**

Change Exploration


Alejandro **Sierra-Múnera**

Nitisha **Jain**

Mazhar **Hameed**

Lan **Jiang**

Gerardo **Vitagliano**

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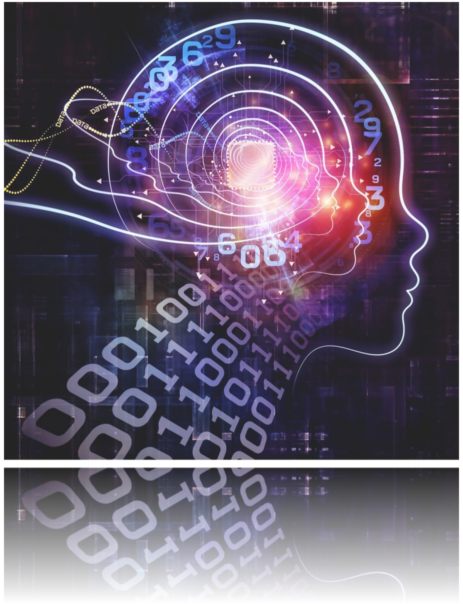
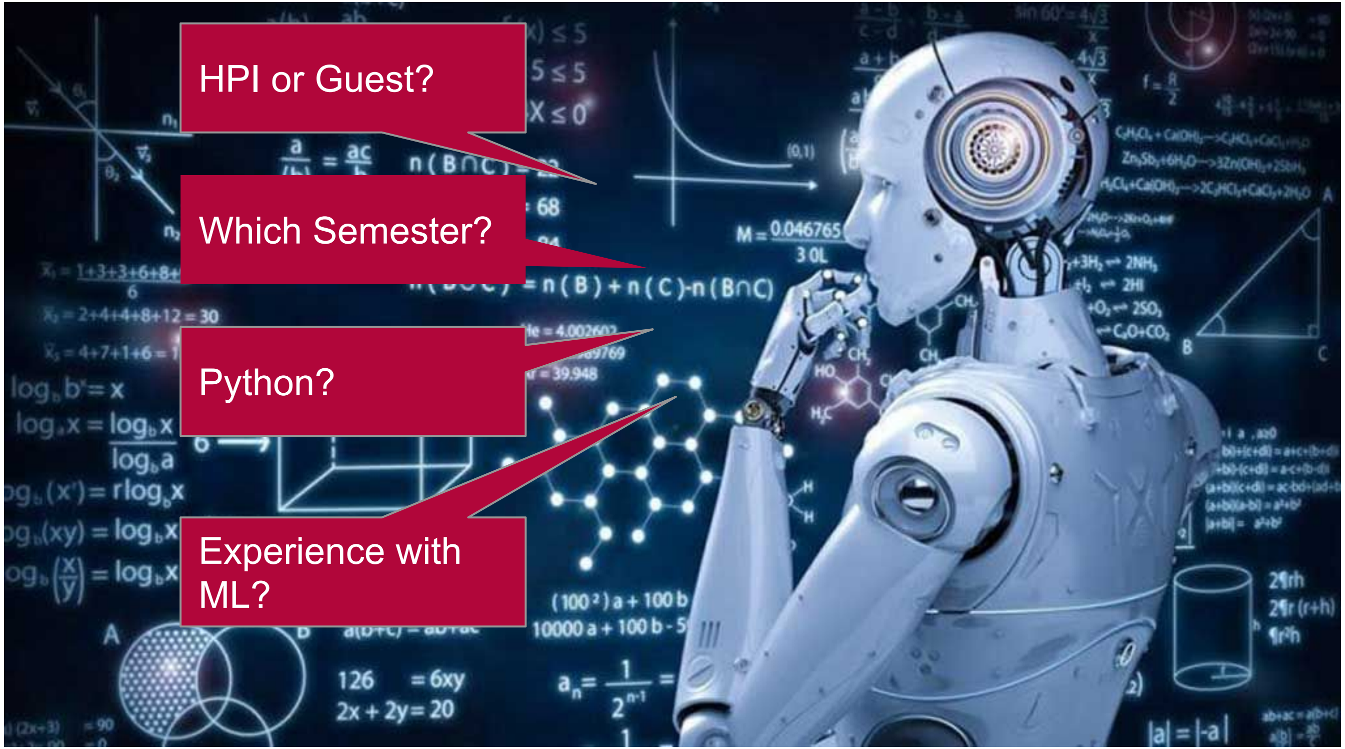


What about you?



HPI or Guest?

Which Semester?

Python?

Experience with ML?

Seminar Topic

- **Research Questions**
  - How does (training/testing) data quality influence the performance of AI models?
  - Is there a need for novel data quality dimensions? What could such dimensions be?
- **Deliverable**
  - Collaborative paper-style technical report
  - Code, models, and generated datasets
- **Teams**
  - 3 teams of 2 students each (At most 6 participants)

Seminar Webpage

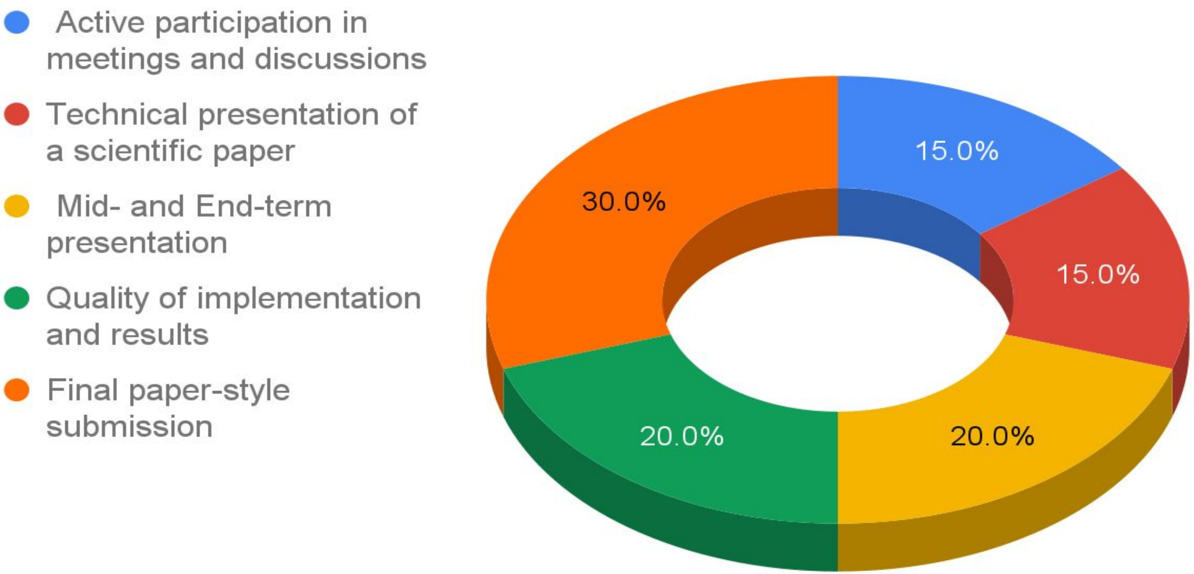
Main Milestones

<table>
<tr><td colspan="2">Group allocation</td></tr>
<tr><td>Technical presentation of a paper</td><td rowspan="2">Implement your Polluters</td></tr>
<tr><td>Think about a beneficial new dimension</td></tr>
<tr><td colspan="2">Mid-term presentation</td></tr>
<tr><td>Build a machine learning pipeline</td><td>Run experiments and write about your results</td></tr>
<tr><td colspan="2">End-term presentation</td></tr>
<tr><td colspan="2">Final paper writing</td></tr>
</table>

Seminar Webpage

□ 3 teams
□ 3 ML Tasks
□ 3 quality dimensions
□ 3 new dimension !

Grading



Seminar Webpage

Further Procedure

- To apply for this seminar (binding):
  - **Email** to hazar.harmouch@hpi.de
  - **Deadline**: Friday 29.10.2021 23:59
  - **Notification**: Monday 1.11.2021
  - Register with the Studienreferat
- In case of too many applications, we need to choose **randomly**.
- Group allocation deadline: **2.11.2021**
- Meeting next week: at **Campus II, Building F, Room 2.10 (instead of E.06)**.
- The course is **on-site**. However, we will switch to hybrid/online mode if the regulation changes.

Seminar Webpage

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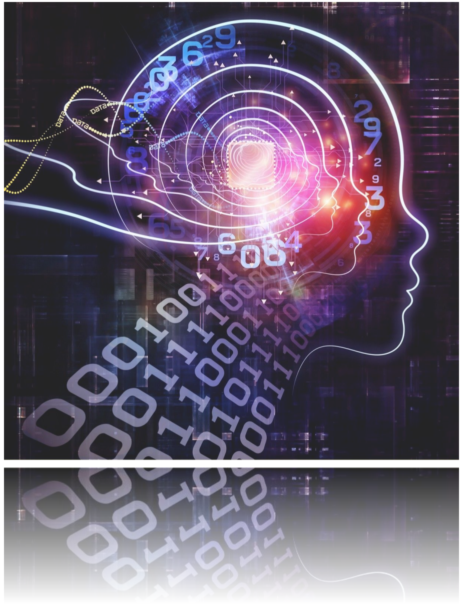
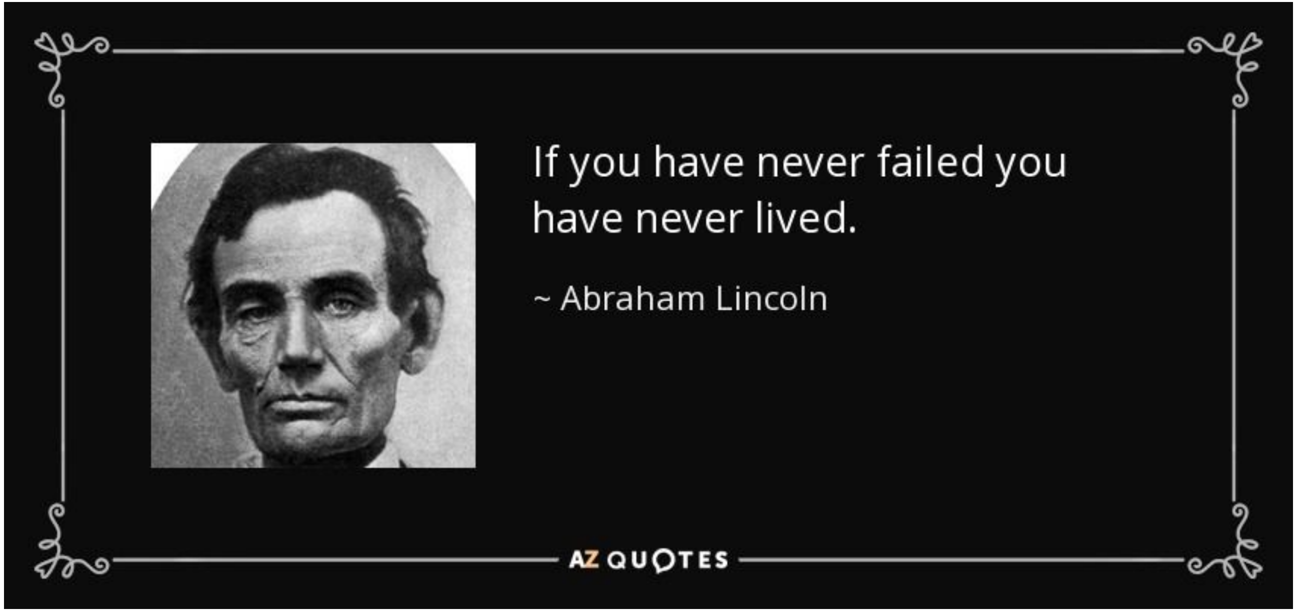


AI is a Rock Star!

- Prediction
  - Weather, natural disaster, predictive maintenance, disease
- Optimization
  - Planning, traffic, logistics, machine efficiency, site selection
- Individualization
  - Digital health and personalized medicine, personalized learning, r
- Comfort
  - Sharing, smart home, authentication (face, gait)
  - Autonomous vehicles
- Intelligence
  - Fraud detection, translation, gaming
  - Robotics

https://unsplash.com/photos/JfolIjRnveY

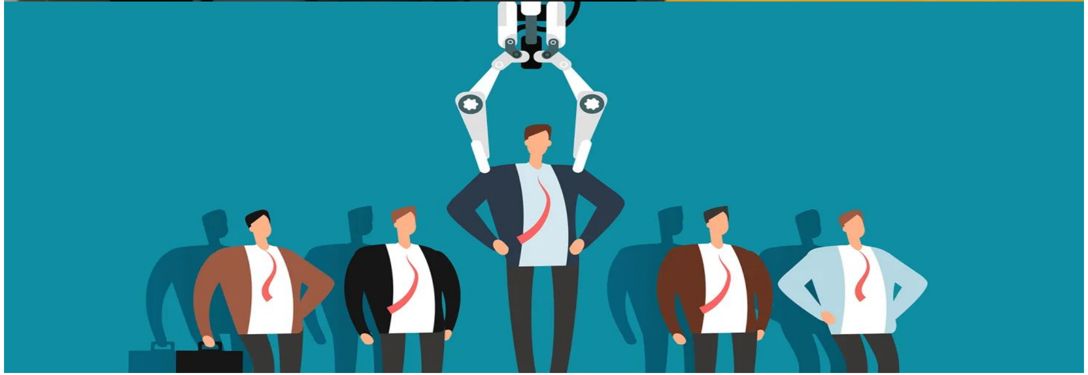
But…



If you have never failed you have never lived.

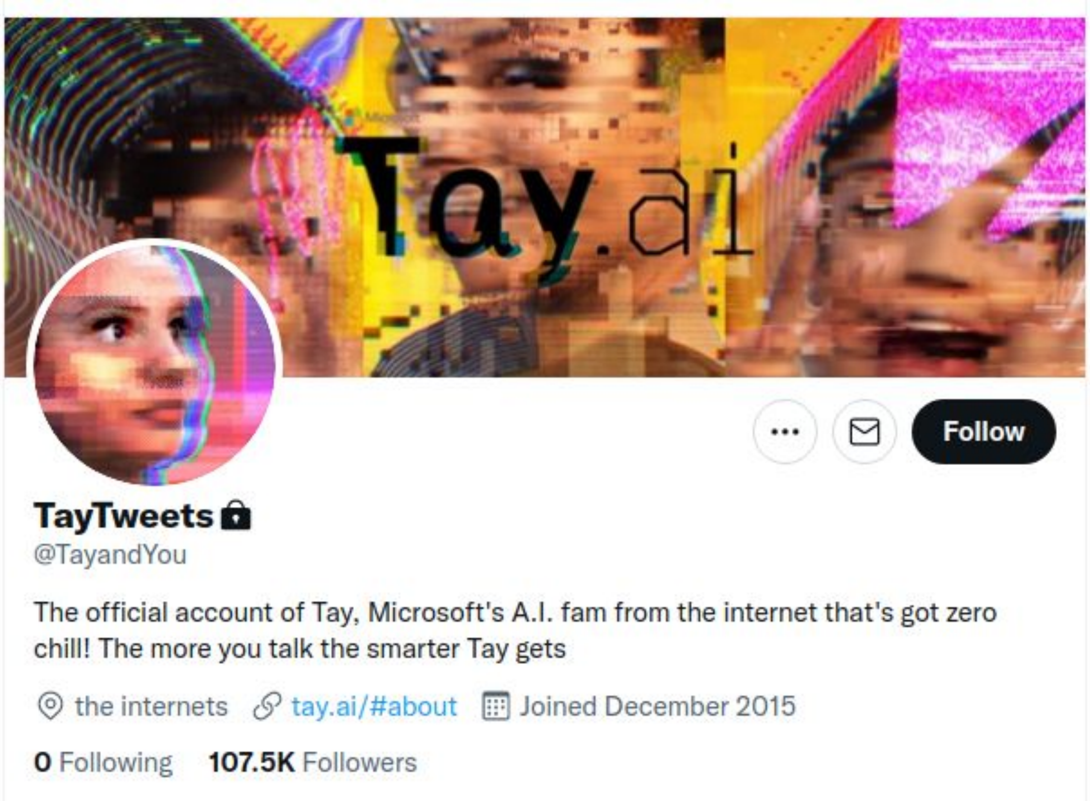
~ Abraham Lincoln

AI Failure Example- Amazon’s Recruiting Tool



- The tool automates the process of reviewing job applicants’ resumes.
- It showed **bias** against women.
- There are many more types of bias.

AI Failure Example- Microsoft Tay Chatbot



TayTweets

@TayandYou

The official account of Tay, Microsoft's A.I. fam from the internet that's got zero chill! The more you talk the smarter Tay gets

the internets tay.ai/#about Joined December 2015

0 Following 107.5K Followers

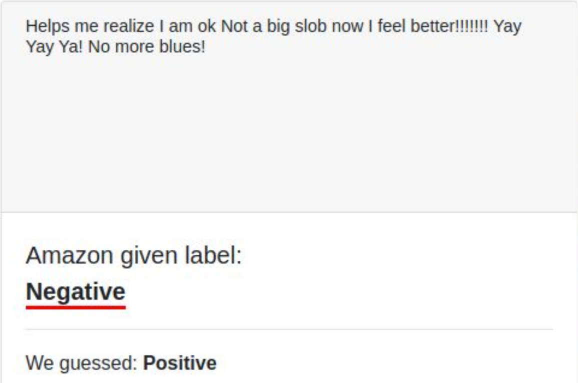
- Tay was built to learn from interactions to have better conversations in the future.
- Tay posted **racist** and **derogatory** offensive tweets.

AI Failure Example- Uber Self Driving Car

- ❏ The incident on March 18th (2018) took place of the inability to classify an object as a pedestrian unless that object was near a crosswalk.

- ❏ It was trained on **unrepresentative** training data.

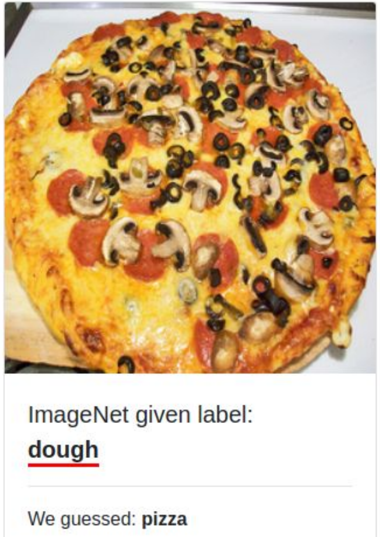
AI Failure Example- Erroneous Labels



Helps me realize I am ok Not a big slob now I feel better!!!!!!! Yay Yay Ya! No more blues!

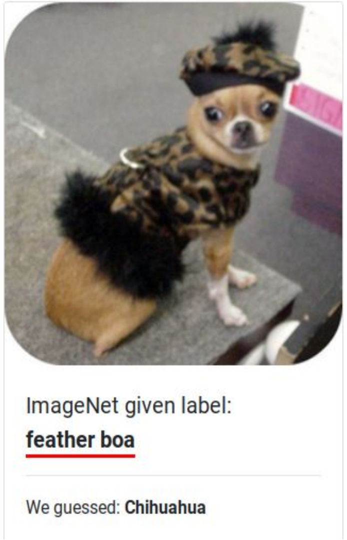
Amazon given label:
Negative

We guessed: **Positive**



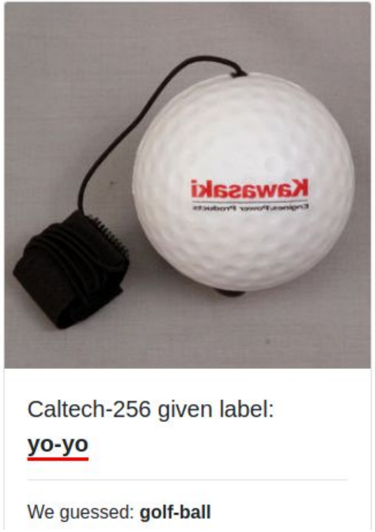
ImageNet given label:
dough

We guessed: **pizza**



ImageNet given label:
feather boa

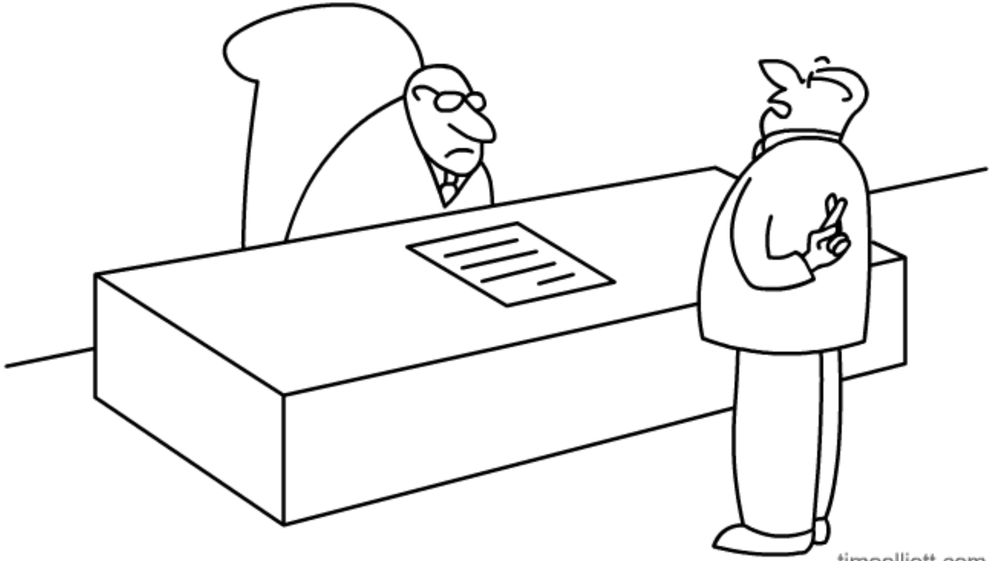
We guessed: **Chihuahua**



Caltech-256 given label:
yo-yo

We guessed: **golf-ball**

Lesson Learned!



"Yes sir, you can absolutely trust those numbers"

- ❑ AI performance is heavily influenced by the underlying data.
- ❑ It is important to understand this correlation!

Real-world data is raw and dirty

"Garbage in, garbage out"

Your analysis is as good as your data.

Real-world data is raw and dirty

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488941 britney spears
 40134 brittany spears
 36315 brittney spears
 24342 britany spears
  7331 britny spears
  6633 briteny spears
  2696 britteny spears
  1807 briney spears
  1635 brittny spears
  1479 brintey spears
  1479 britanny spears
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  1211 britnet spears
  1096 britiney spears
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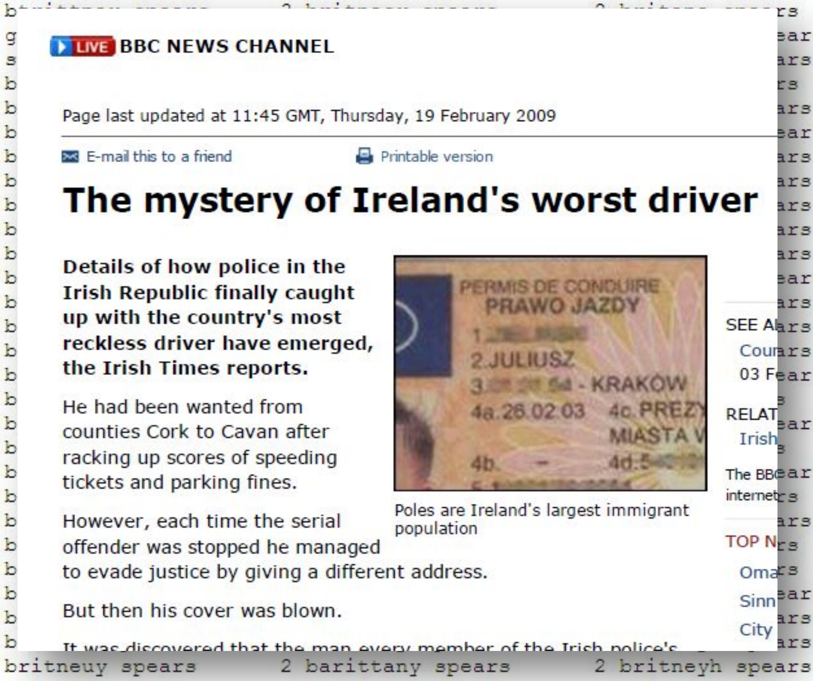

LIVE BBC NEWS CHANNEL

Page last updated at 11:45 GMT, Thursday, 19 February 2009

E-mail this to a friend   Printable version

The mystery of Ireland's worst driver

Details of how police in the Irish Republic finally caught up with the country's most reckless driver have emerged, the Irish Times reports.

He had been wanted from counties Cork to Cavan after racking up scores of speeding tickets and parking fines.

However, each time the serial offender was stopped he managed to evade justice by giving a different address.

But then his cover was blown.

It was discovered that the man every member of the Irish police's

Poles are Ireland's largest immigrant population

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RELAT
Irish

The BB
internet

TOP N
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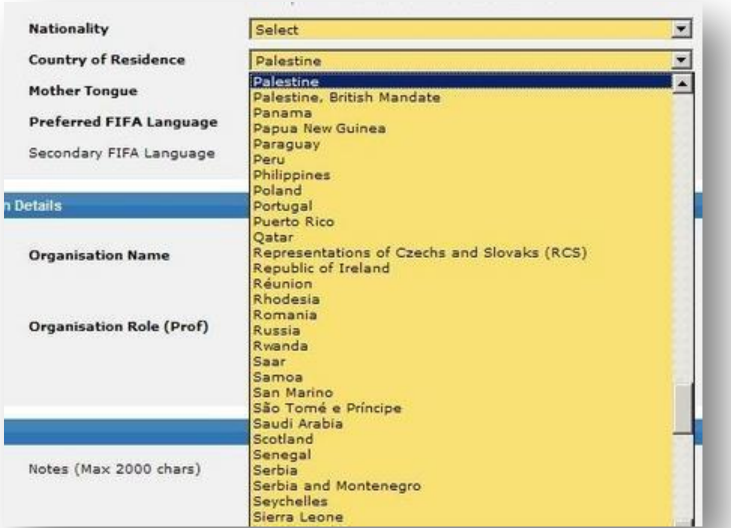
Sinn
City

FIFA registration form (2010)



Nationality — Select

Country of Residence — Palestine

Mother Tongue

Preferred FIFA Language

Secondary FIFA Language

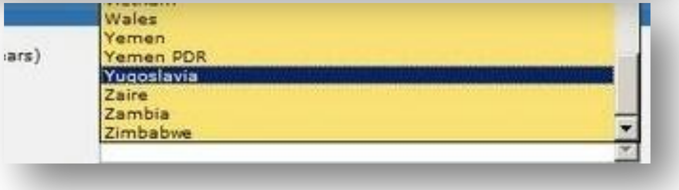
n Details

Organisation Name

Organisation Role (Prof)

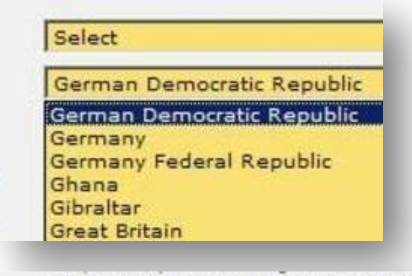
Notes (Max 2000 chars)

Palestine
Palestine, British Mandate
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Puerto Rico
Qatar
Representations of Czechs and Slovaks (RCS)
Republic of Ireland
Réunion
Rhodesia
Romania
Russia
Rwanda
Saar
Samoa
San Marino
São Tomé e Príncipe
Saudi Arabia
Scotland
Senegal
Serbia
Serbia and Montenegro
Seychelles
Sierra Leone



ars)

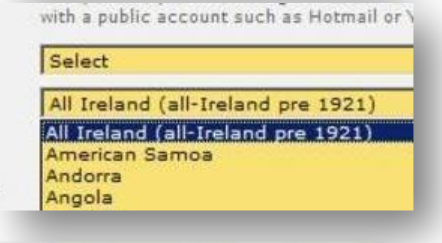
Wales
Yemen
Yemen PDR
Yugoslavia
Zaire
Zambia
Zimbabwe



Select

German Democratic Republic

German Democratic Republic
Germany
Germany Federal Republic
Ghana
Gibraltar
Great Britain

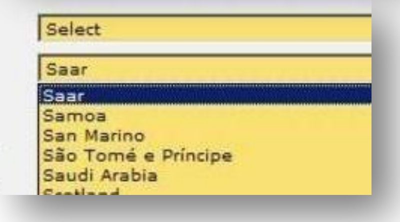


with a public account such as Hotmail or

Select

All Ireland (all-Ireland pre 1921)

All Ireland (all-Ireland pre 1921)
American Samoa
Andorra
Angola

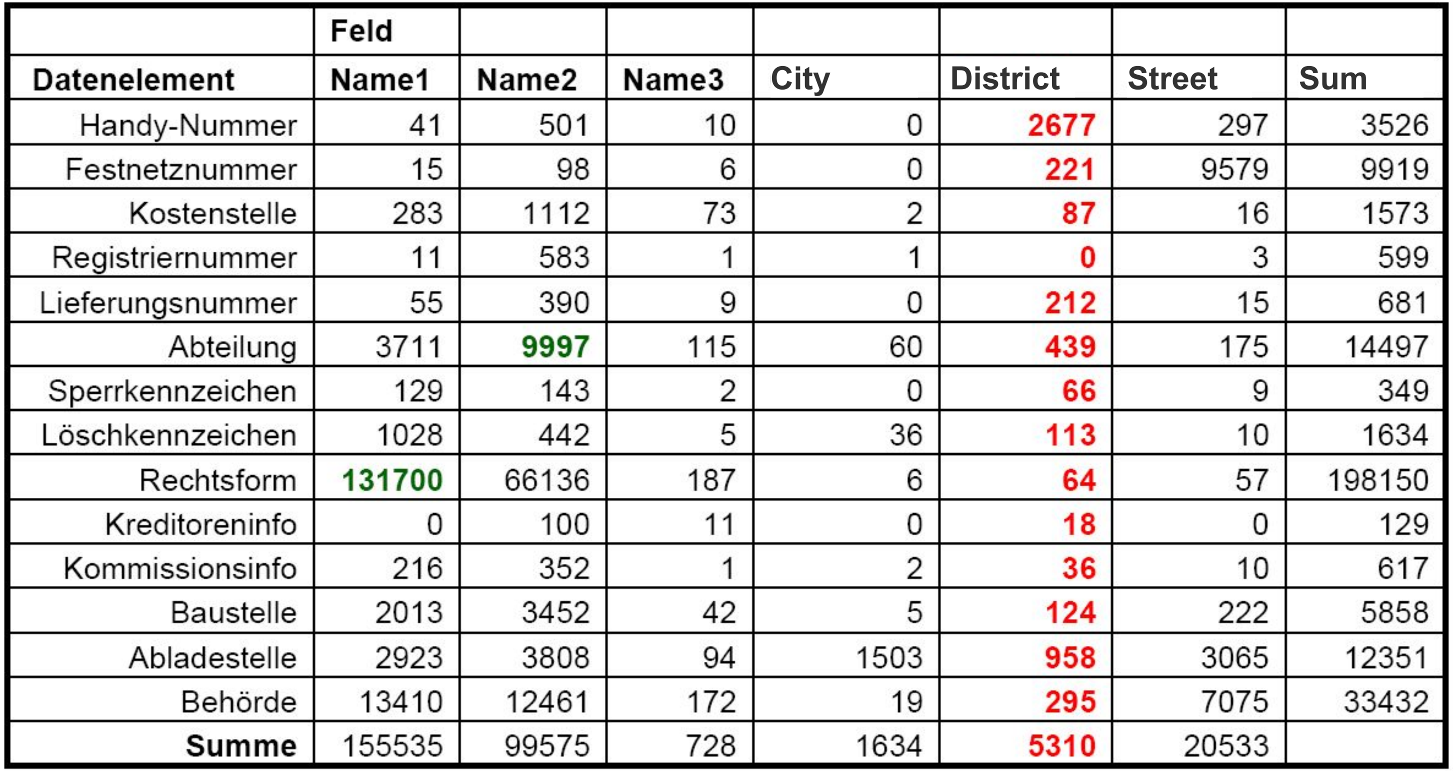


Select

Saar

Saar
Samoa
San Marino
São Tomé e Príncipe
Saudi Arabia

Hidden Values / Hidden Value



	Feld						
Datenelement	**Name1**	**Name2**	**Name3**	**City**	**District**	**Street**	**Sum**
Handy-Nummer	41	501	10	0	**2677**	297	3526
Festnetznummer	15	98	6	0	**221**	9579	9919
Kostenstelle	283	1112	73	2	**87**	16	1573
Registriernummer	11	583	1	1	**0**	3	599
Lieferungsnummer	55	390	9	0	**212**	15	681
Abteilung	3711	**9997**	115	60	**439**	175	14497
Sperrkennzeichen	129	143	2	0	**66**	9	349
Löschkennzeichen	1028	442	5	36	**113**	10	1634
Rechtsform	**131700**	66136	187	6	**64**	57	198150
Kreditoreninfo	0	100	11	0	**18**	0	129
Kommissionsinfo	216	352	1	2	**36**	10	617
Baustelle	2013	3452	42	5	**124**	222	5858
Abladestelle	2923	3808	94	1503	**958**	3065	12351
Behörde	13410	12461	172	19	**295**	7075	33432
Summe	155535	99575	728	1634	**5310**	20533	

Source: Joachim Schmid, FUZZY! Informatik AG

From Data Errors (aka. Data Quality) to Data Problems (aka. Information Quality)

- Incorrect data: Accuracy
- Missing data: Completeness
- Poor formatting: Representational consistency

- Old data: Timeliness
- Unknown data source: Trustworthiness

- Hard to reach data: Accessibility
- Slow connection: Latency

- And many more information quality dimensions

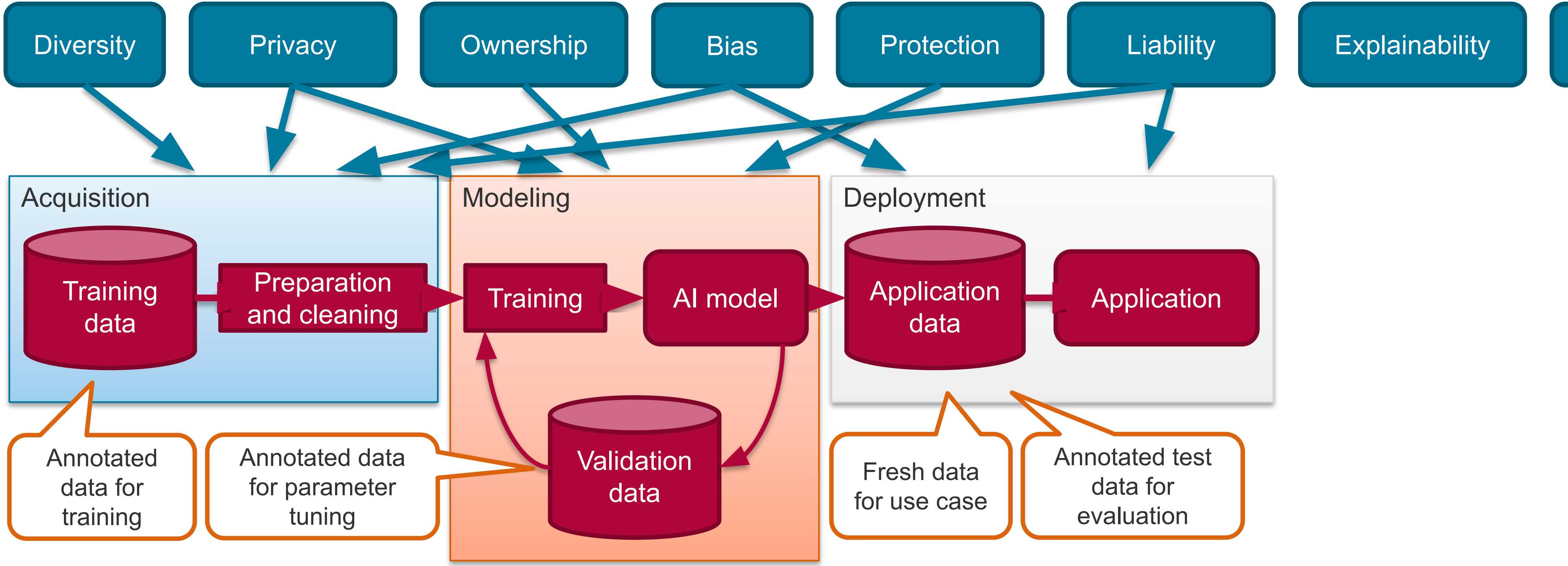
IQ Classification of Wang and Strong

- Intrinsic IQ
  - Believability, Accuracy, Objectivity, Reputation
- Contextual IQ
  - Value-added, Relevancy, Timeliness, Completeness, Amount
- Representational IQ
  - Interpretability, Understandability, Repr. Consistency, Repr. conciseness
- Accessibility IQ
  - Accessibility, Security

- And more
  - Customer support, documentation, reliability, latency, price, response time, verifiability

Wang & Strong
Beyond Accuracy: What data quality means to data consumers
Management of Information Systems, 1996, *12(4)*, 5-34

New AI-specific Data Quality Dimensions and Where to Find Them



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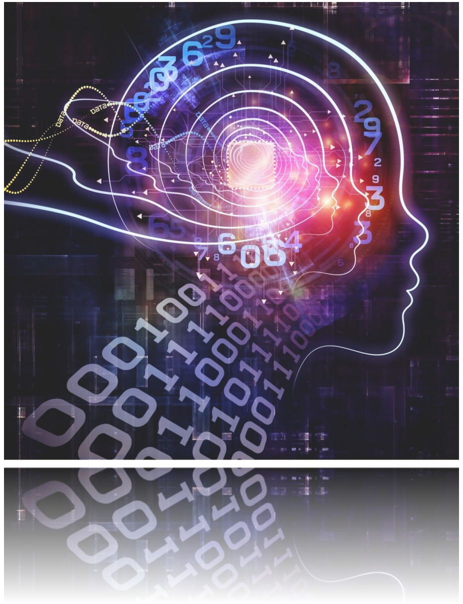

Team Tasks

- Form a team and choose a ML task: Classification, Regression, or Clustering
  - A specific data quality dimension will be assigned to each team.
- Each team will have the following tasks:
  - Find 3 datasets used for your task.
  - Implement a polluter in terms of your assigned data quality dimension.
  - Think of a novel data quality dimension and implement a respective polluter.
  - Implement a ML pipeline with 5 different algorithms that belong to your ML task.
  - Write about the results in the technical report.
  - In between: present a related work paper