Towards Automated Data Cleaning Workflows

Mohammad Mahdavi, Felix Neutatz, Larysa Visengeriyeva, Ziawasch Abedjan

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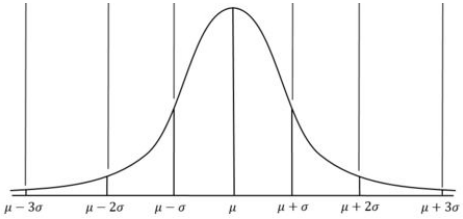
Learning. Knowledge. Data. Analytics. 2019

How Data Science Starts...

ID	Name	Birthday	Age	ZIP	Place
1234	Franz Müller	19.09.1991	27	1234	Berlin
1235	Jane Schmidt	-	9999	1234	Bärlin
1234	Lara	Weber	126	12.34	Germany

Credit_Approval
YES
NO
YES

Data Cleaning



Outlier

Contradiction

Uniqueness

ID	Name	Birthday	Age	ZIP	Place	Credit_Approval
1234	Franz Müller	19.09.1991	27	1234	Berlin	YES
1235	Jane Schmidt	-	9999	1234	Bärlin	NO
1234	Lara	Weber	265	12.34	Germany	YES

Format

Misfielded Value

Incorrect value

Typographical error

Missing value

People work on data cleaning for a very long time...

Brodie, M.L., **1980**. Data quality in information systems. *Information & Management*.

Rahm, E. and Do, H.H., **2000**. Data cleaning: Problems and current approaches. *IEEE Data Eng. Bull.*.

... but in 2019, people still write custom cleaning scripts!

Data Cleaning

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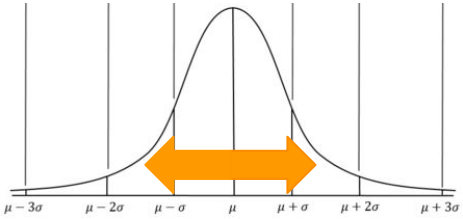
NO
YES

Knowledge Base-Driven Correction

Rule-Driven Correction

Data Cleaning



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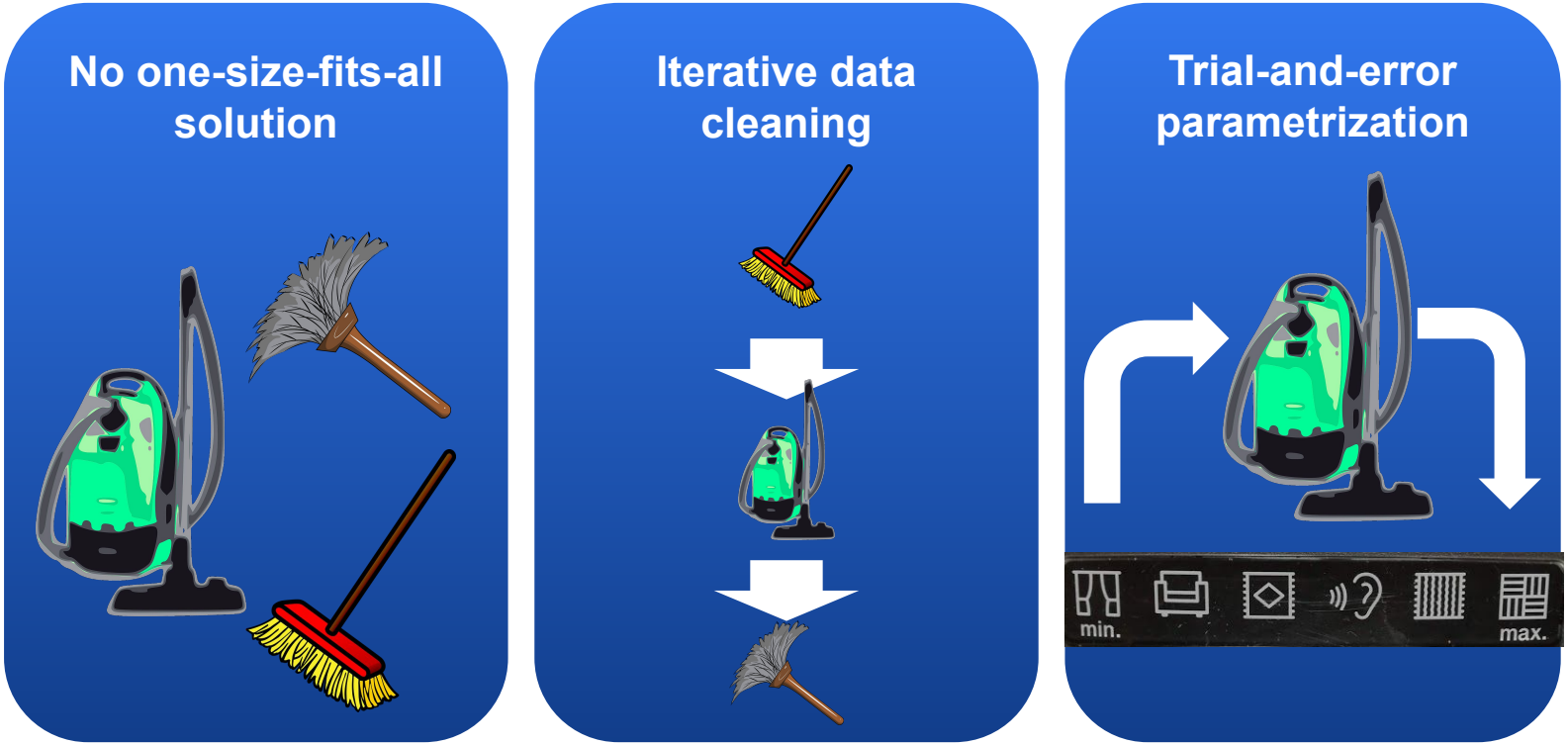
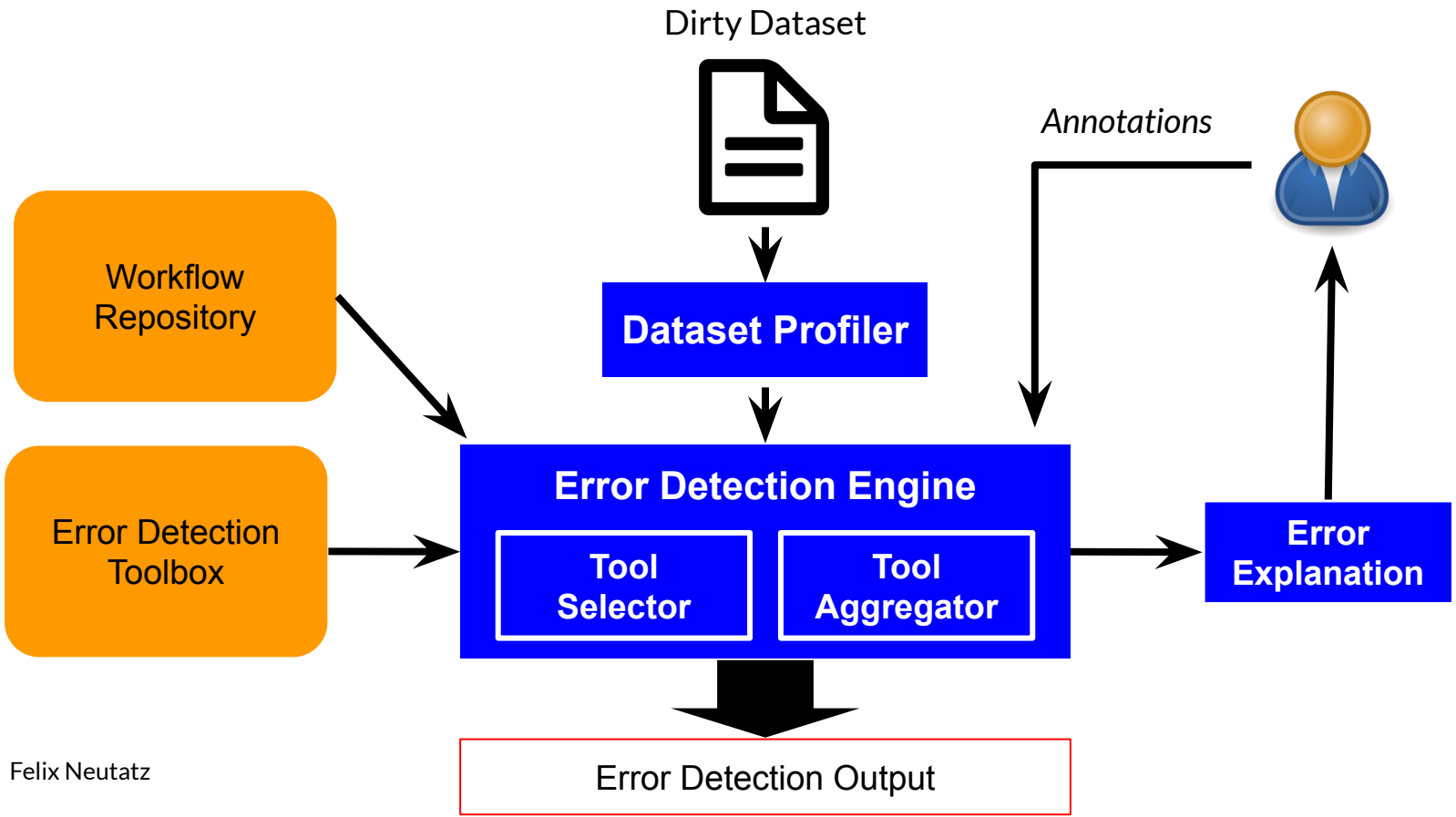
Imputation / Regression

Data Cleaning: The Usage Gaps

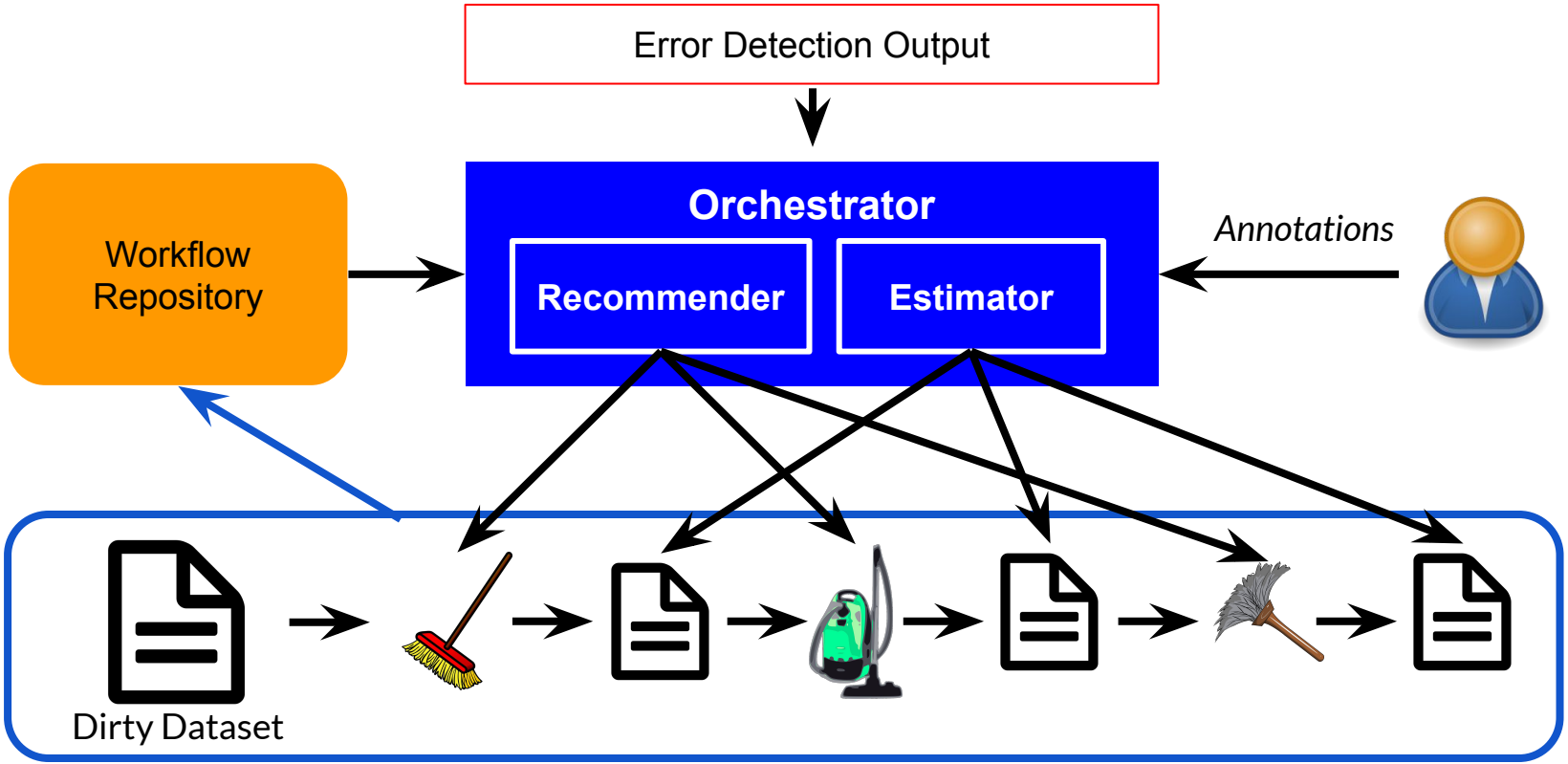


We need a workflow orchestrator that learns from previous tasks to propose promising data cleaning workflows for a new dataset.

Vision: Cleaning Workflow Orchestrator



Vision: Cleaning Workflow Orchestrator



Cleaning Workflow

Current Status

MDED, a system that learns to aggregate error detection strategies via metadata

Larysa Visengeriyeva et al.

SSDBM`18

http://bit.ly/systems-aggregation

REDS, a system that estimates the performance of error detection strategies via metadata

Mohammad Mahdavi et al.

SSDBM`19

https://github.com/bigdama/reds

ED2, an active learning-driven error detection system

Felix Neutatz et al.

CIKM`19

http://bit.ly/2mjyiTO

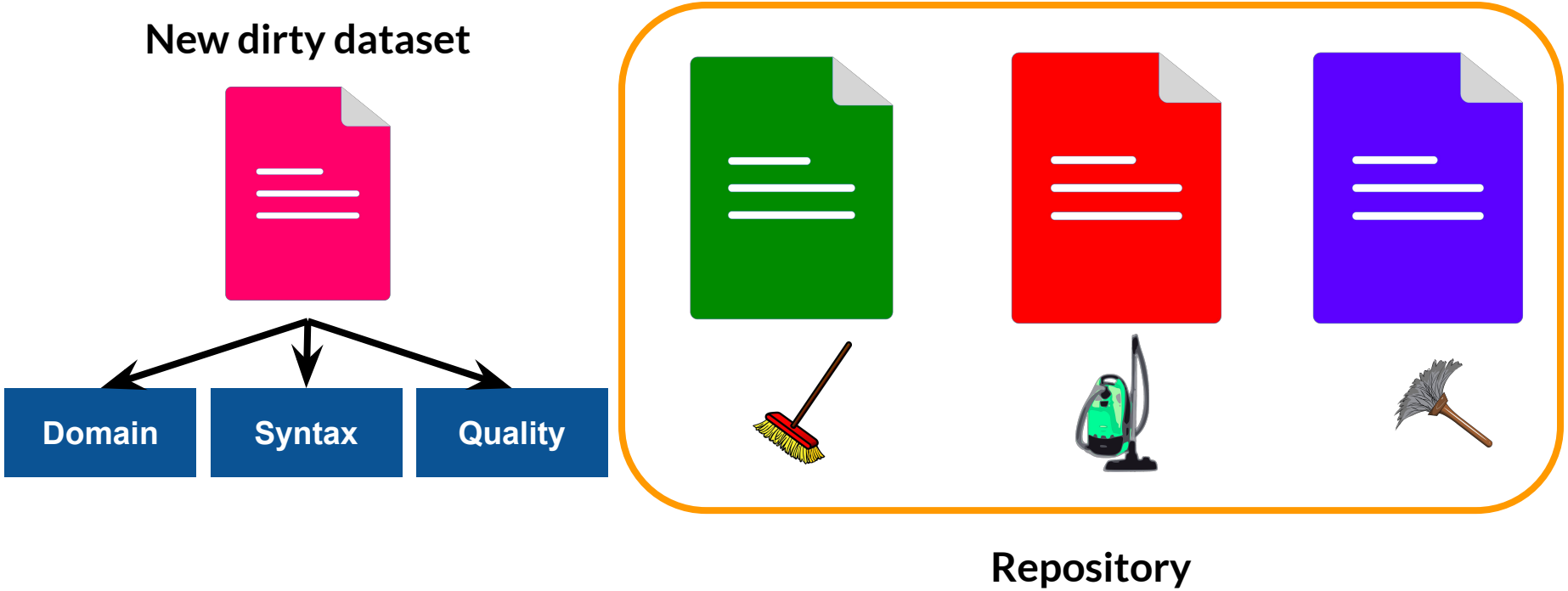
Raha, a configuration-free error detection system to detect data errors holistically

Mohammad Mahdavi et al.

SIGMOD`19

https://github.com/BigDaMa/raha

Configuration-Free Tool Selection



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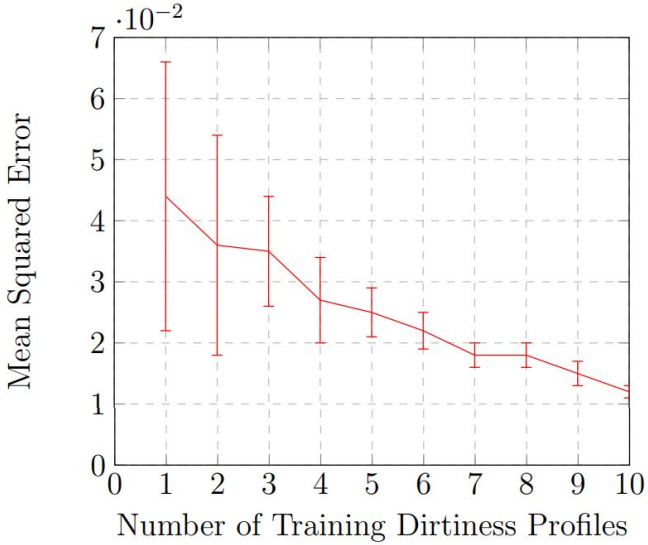
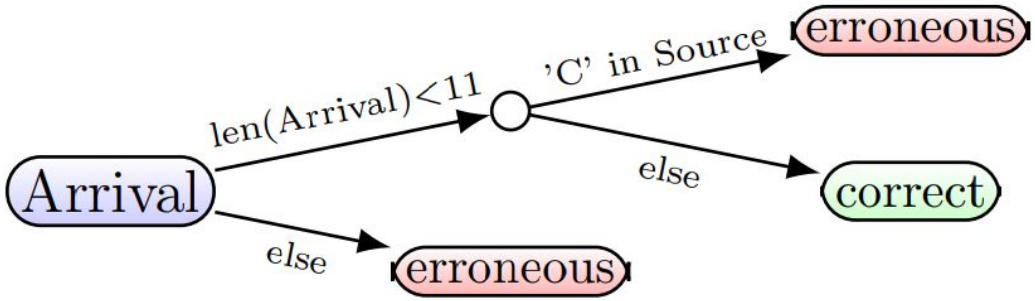


The more datasets in our repository, the higher is the accuracy of estimating the performance of cleaning strategies on a new dataset.

Error Explanation

Source	Flight	Departure	Arrival
A	LH-100	10:00 a.m.	**2:00 p.m. Dec 02**
B	LH-100	10:00 a.m.	2:00 p.m.
C	LH-100	10:00 a.m.	**3:00 p.m.**

Given some user labels and a fine-grained feature represenation, we can learn the error patterns:



How Do We Get Labels?

Two-stage Active Learning

City	ZIP
BERLIN	10247
BERLIN	10249
BÄRLIN	10247
Augsburg	86I99

Clustering-based Label Propagation

Future Directions

- Recommending sequences of multiple repair methods or even more complex control flow.
- Understanding metadata:
  Mapping metadata to data quality issues.
- Learning to transform data values:
  Machine translation of dirty data to clean data.
  Especially out-of-domain errors are hard to correct.

Takeaways

- Gaps between theory and practice:
  - No one-size-fits-all solution
  - Iterative data cleaning
  - Trial-and-error parametrization
- We need a workflow orchestrator that learns to propose promising data cleaning workflows.
- Towards this vision, we developed a cleaning strategy selector, a cleaning strategy aggregator, and an error explanation system.

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