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PASSION FOR INNOVATION

Applied Data Science Project

Politecnico di Torino

1859

L3 - Model & data-centric data science projects

ellis

European Laboratory for Learning and Intelligent Systems

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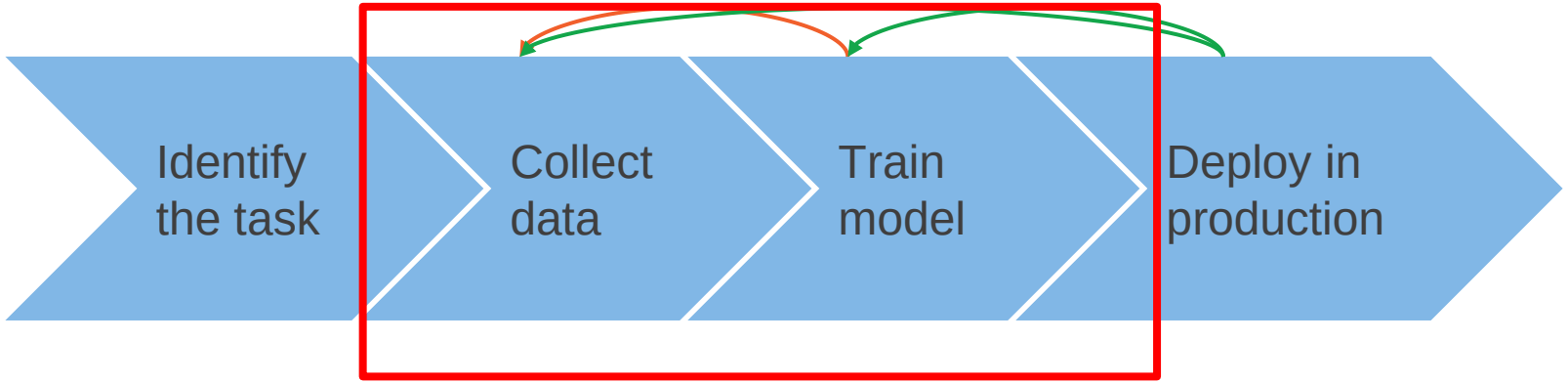
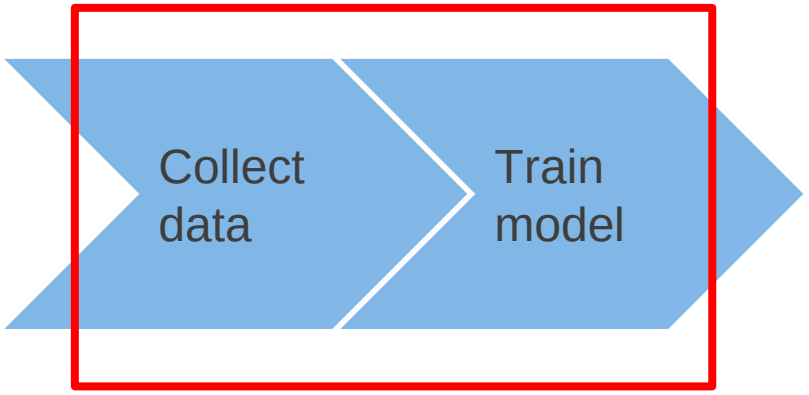
Turin, October 3, 2022

Artificial intelligence

iterative processes meant to refine the quality of the solution

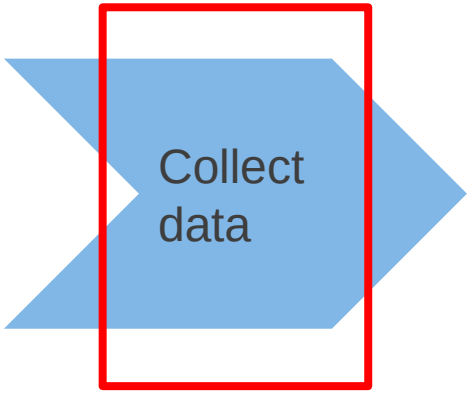


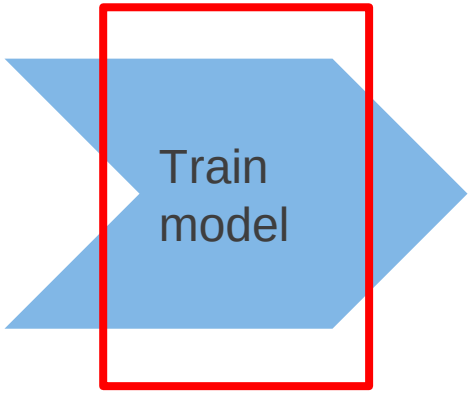
Data + Model



artificial intelligence = data + model (software + algorithm)

Data-centric vs Model-centric





Data-centric: the focus is on acquiring further examples or cleaning the collected ones to retrain the algorithm an generate a new model.
The output of this activity is extending the dataset that is used for training

Model-centric: the focus is on modifying the algorithm by extending the neural architecture (for instance having more layers, new residual connections) and then train it with the data at disposal

Data

Collect data

data is vital for creating any sort of artificial intelligence

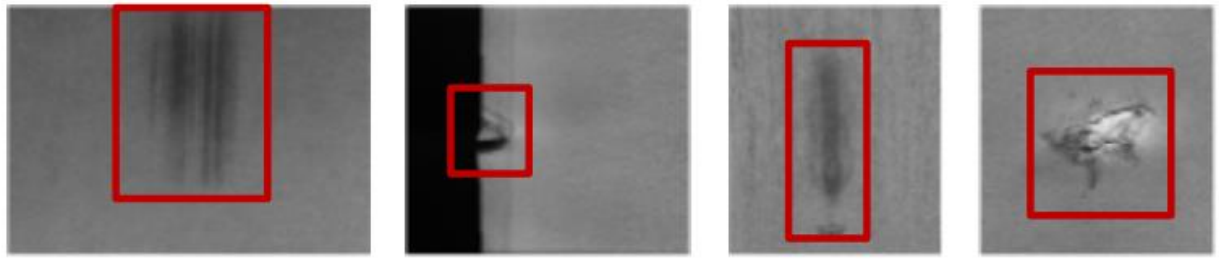
Data

improving data has a big impact to artificial intelligence even more than model optimization

unless of radical changes in the code thus not optimization

Inspecting steel sheets for defects

Examples of defects



Baseline system: 76.2% accuracy

Target: 90.0% accuracy

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Improve code vs improve data

	Steel defect detection
Baseline	76.2%
Model-centric	+0% (76.2%)
Data-centric	+16.9% (93.1%)

Other examples

	Solar panel	Surface inspection
Baseline	75.68%	85.05%
Model-centric	+0.04% (75.72%)	+0.00% (85.05%)
Data-centric	+3.06% (78.74%)	+0.4% (85.45%)

Easier step

Improving data turns out to be key for a better artificial intelligence solution

Note: Improving a code is different than designing a new, breakthrough, code however the effort for the latter is way higher than improving data and the return of the effort (may) be very high

Take home message: we consider the data improvement as an easier and necessary step when developing a machine intelligence before starting a new venture

Data improvement

Strategies for data improvement:

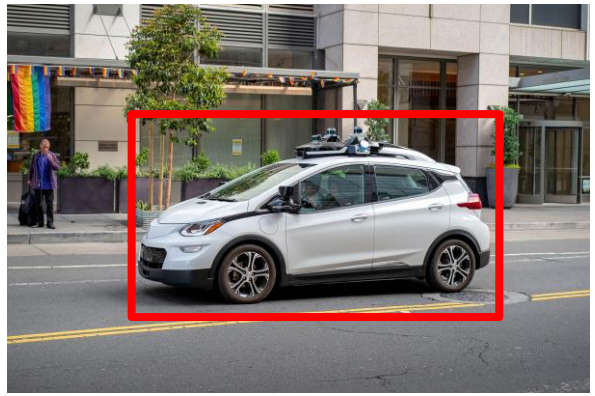
- more examples

augmentation

- completeness
- consistency

cleaning

Augumentation



Take or generate new examples

Consistency

Task: Label cars

Consistency

Task: Label cars

Annotator 1

Consistency

Task: Label cars

Annotator 2

Consistency

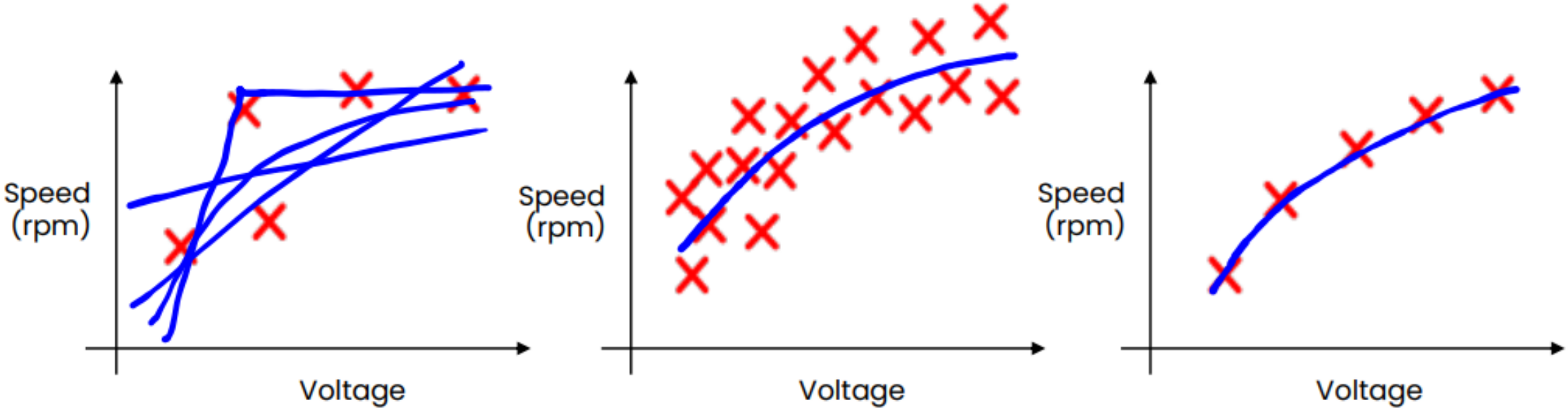
Consistency in annotation turns out to be crucial for the minimizing the potential error of the intelligence

However, ensuring a consistent dataset is a not obvious task

It involves:

- how the task has been conceived
- how the intervention of the human has been designed
- how did human annotators perform their task
- how the dataset has been packaged

Small Data and Label Consistency



- Small data
- Noisy labels

- Big data
- Noisy labels

- Small data
- Clean (consistent) labels

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Completeness

Task: Label cars

Completeness

Task: Label cars

Annotator 1

Completeness

Task: Label cars

Annotator 2

Completeness

Completeness in annotation turns out to be crucial for improving coverage to the intelligence

However, ensuring a complete dataset is a not obvious task

It involves:

- how the task has been conceived
- how the intervention of the human has been designed
- how did human annotators perform their task
- how the dataset has been packaged

Good data

~~Big data vs small data~~

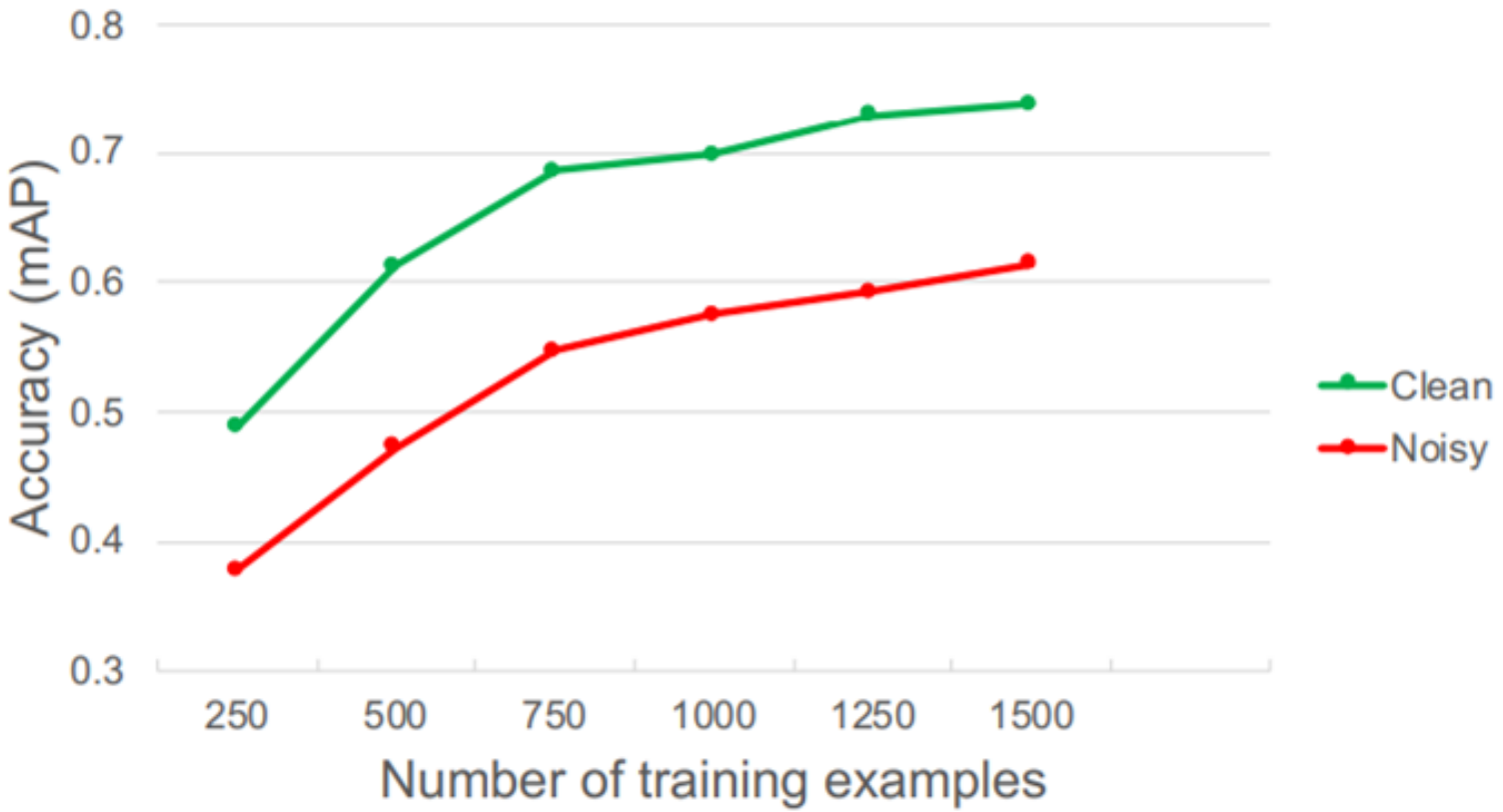
good data

Good data is:

- Defined consistently (definition of labels y is unambiguous)
- Cover of important cases (good coverage of inputs x)
- Has timely feedback from production data (distribution covers data drift and concept drift)
- Sized appropriately

We also refer to good data with the concept of clean data

Example: Clean vs. noisy data



Note: Big data problems where there's a long tail of rare events in the input (web search, self-driving cars, recommender systems) are also small data problems.

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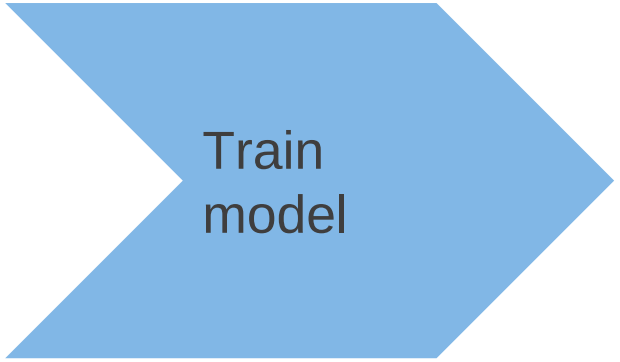
Model



model encapsulates the intelligence in an executable environment that embeds both training data and algorithm

Model

Improving a model is a hard task because it inherits the challenges related to optimize both data and algorithm

Model improvement

Strategies for model optimization

- Any change in the data, if statistically relevant, is propagated to the final output of the model. This links to the previous topic
- Change in the algorithm, for instance the addition of a new layer in a neural architecture, or eventually, a brand new architecture
- Change in the hyperparameter set, for instance n_layers, or learning rate. This change modifies the parameter weights

Thank you for your attention.

Questions?

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