



CHALMERS
UNIVERSITY OF TECHNOLOGY



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Requirements Engineering

for **Artificial Intelligence**-based Systems



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Public

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Goal



Requirements engineering emerged based on **traditional software**.



Systems including artificial intelligence (AI) **are not traditional software**.

Companies struggle to engineer AI (-enabled) systems.

AI Systems

As an AI system, I will refer to any **data-driven software** (component) throughout this unit

A **data-driven software component** is a piece of software that solves a given task (e.g., image segmentation, sentiment analysis, classification, etc.), using methods from data science, such as machine learning (ML), data mining, natural language processing, signal processing, statistics, etc. The functionality of data-driven software components (or at least part of it) is not entirely defined by the programmer in the classical way (by programming it directly), *but is derived (i.e., learned) from data*.

Siebert, J., Joeckel, L., Heidrich, J., Trendowicz, A., Nakamichi, K., Ohashi, K., ... & Aoyama, M. (2022). Construction of a quality model for machine learning systems. *Software Quality Journal*, 30(2), 307-335.



Traditional Software



requires formal problem



generally transparent



decomposable



AI System



requires no formalization



generally obscure



generally atomic

Requirements Engineering for AI systems (RE4AI) and Machine Learning (RE4ML)

Due to these properties of AI systems, companies struggle to engineer modern systems with traditional SE/RE techniques. Research aims to support companies by working on



**Prioritization of
Software Qualities**



**Development of
Quality Meta-Models**



**Proposal of Data
Quality Attributes**

RE4AI Research:

Prioritization of Software Qualities



AI systems may experience different requirements on their quality. In comparison to traditional software, the following qualities are considered

less important



Usability



Flexibility



Revisability

equally important



Privacy



Reliability

more important



Accuracy



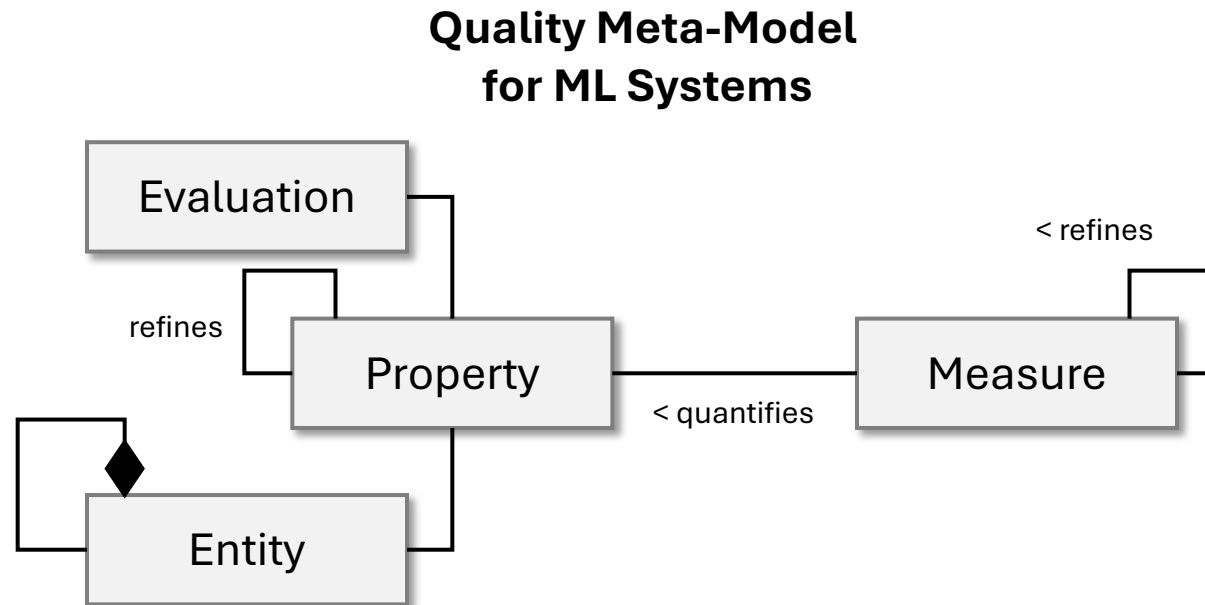
Fairness



Maintainability

Other qualities seem entirely new, like  Re-trainability

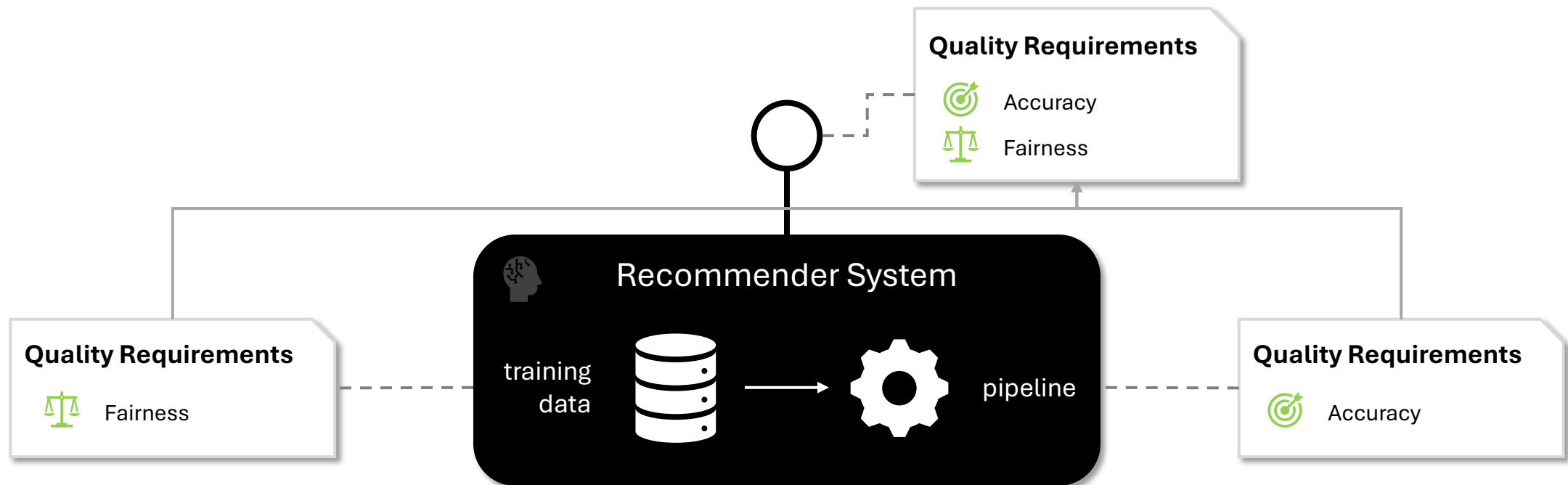
Habibullah, K. M., Gay, G., & Horkoff, J. (2023). Non-functional requirements for machine learning: Understanding current use and challenges among practitioners. *Requirements Engineering*, 28(2), 283-316.



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RE4AI Research: Data Quality

One critical entity of an AI system is the data used to train its AI component(s), which itself becomes subject to quality concerns.



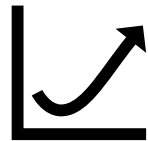
Alves, A. P. S., Kalinowski, M., Giray, G., Mendez, D., Lavesson, N., Azevedo, K., ... & Gorschek, T. (2023, December). Status quo and problems of requirements engineering for machine learning: Results from an international survey. In *International Conference on Product-Focused Software Process Improvement* (pp. 159-174). Cham: Springer Nature Switzerland.

Misconceptions of RE4AI

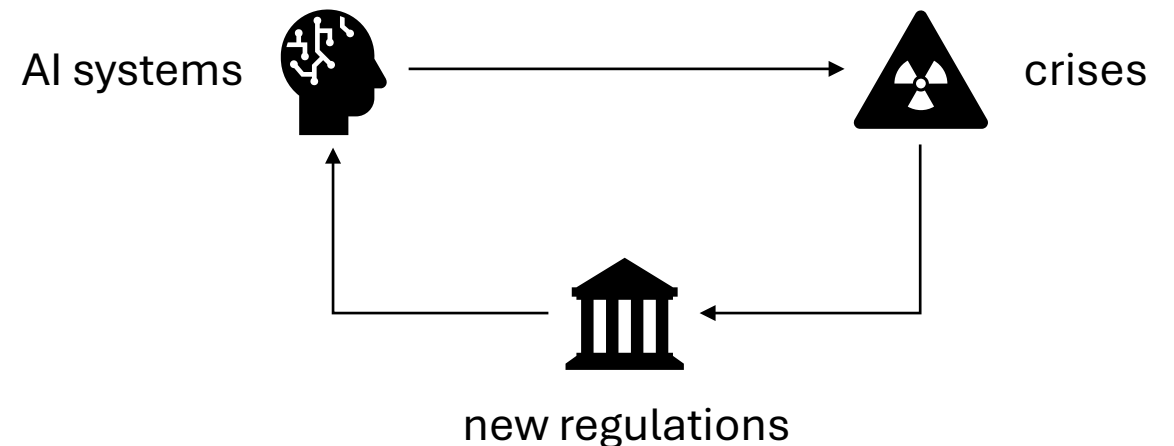
AI is a **solution**, so it has – per se – no direct effect on requirements.

The only two exceptions:

Increased expectations



Transitive Impacts



Lesson Learned



Systems including artificial intelligence (AI) **are not traditional software** and traditional requirements engineering techniques may not apply to them.



Quality requirements can be **defined, prioritized, and evaluated differently** in AI systems compared to traditional systems.



AI is a solution, so **it does not affect RE directly**. However, when integrating AI into a system, this component will imply specific **requirements on its respective level of abstraction**.