Automated Qualitative Labeling with Qualicision AI

As part of the Qualicision AI technology, Qualitative Labeling prepares raw business process data for machine learning methods. For this purpose, data that can be directly measured in the business processes is qualitatively evaluated against the background of key performance indicators (KPIs) and interactions on this data are analyzed. Thus, an automated algorithmic bridge is created between the unprocessed raw business process data and artificial intelligence (AI) methods, which decisively simplifies and automates the resource-intensive process of manual data analysis for labeling data.

Qualitative Labeling is a machine learning technique based on the self-detection of KPI goal conflicts and KPI goal inconsistencies in business processes by evaluating business process data using Extended Fuzzy Logic and special clustering methods. KPI goal conflict analysis helps to automatically classify business process data in such a way that interactions are derived from raw data, allowing AI methods to make further use of the data labeled in this automated way.

Qualitative Labeling as part of the PSI framework for Industrial Artificial Intelligence

The automated derivation of qualitative labels is so important for the application of AI methods to business process data because business process data changes continuously with the dynamics of business processes. Unlike applications such as image recognition or speech processing, where data patterns once labeled remain static, the patterns to be labeled in business process data are dynamic and ever-changing in structure, such as continuously changing order mixes and process states.

The input to the software consists of two main components: First, data streams of the business process to be analyzed are recorded and automatically converted into time series using time stamps. Secondly, together with those responsible for the business process, KPIs are agreed on the basis of which the business process in question is to be analyzed. For this purpose, Qualicision AI labeling functions (based on Extended Fuzzy Logic and the knowledge of the process owner) differentiate the KPIs into desired [0;1] and undesired [0;-1] value ranges.

Creation of time series from which positive and negative interactions between KPIs can be learned

If, for example, the capacity utilization of a plant in a manufacturing company is considered as a KPI, a percentage value greater than 85 percent can be defined as desirable and positive for the capacity utilization. Values below this, on the other hand, are negative and can be regarded as increasingly unfavorable the further they deviate downwards from the minimum goal value of 85 percent. If such data streams and the associated KPIs are time-stamped along the value chain of the business process, directly evaluable time series are created from which positive and negative interactions between the KPIs can be learned. These can be made available to the process owner in a form that is understandable to humans and algorithmically prepared as labeled data for AI algorithms.

Application of automated Qualitative Labeling

For automated condition assessment and anomaly detection, Qualicision AI-distrotec (distribution based anomaly detection) is used as a method based on Qualicision AI technology and distribution based labeling capabilities. A Qualicision AI-distrotec model consists of a set of labeling functions that evaluate the normality of individual variables and their combinations. A value of 1 means that this value is most common and a value of -1 means that this value is highly abnormal and did not occur in the training dataset.

Stand-alone AI assistance system to detect anomalies

Then, the Qualicision AI kernel considers an overall result that is produced by the Qualicision AI interactions matrix. The user specifies which values and combinations of values to monitor and specifies a time range for training. The distribution function is then learned using Kernel Density Estimate over this time period and scaled to the value range of [-1;1] as a labeling

function. The method is used in reinforcement learning via control goals to teach the agent to keep the network state in the normal range and avoid extreme values, and as a stand-alone AI assistance system to detect anomalies that can lead to or already present faults early on and identify possible causes.

Easy access to Qualitative Labeling of business process data

From the customer's perspective, it is therefore very easy to get started using the process with the help of the framework. If qualitatively labeled data is to be generated in a business process, it is first necessary to define the key performance indicators and criteria (KPIs) according to which the quality of the respective business process is to be evaluated. Once this has been done, raw business process data can be evaluated with regard to the KPIs and suitable qualitative labels can be added to the data. The labeled business process data created in this way is much easier to use for AI procedures.

Improvement of transparency, traceability and explainability of the AI results

The calculated qualitative labels also improve the transparency, traceability and explainability of the AI results (see Figure 1). In many cases, they are used to induce self-adjustment of optimization algorithms, resulting in learning optimization procedures from classical optimizations. Due to the generality of the procedure, any existing PSI software based on the treatment of KPIs can be used as a KPI labeling engine. Thus, any existing PSI application can be extended with self-learning labeling capabilities that systematically prepare for the introduction of further AI functionalities.

Use in PSI tools and in industrial customer processes

Qualitative Labeling is an integral part of the AI stack Qualicision AI which is in use in almost all PSI software products. Accordingly, customer processes in both the energy and the production sectors benefit here. Decision support in process management, optimization of production processes, optimization of maintenance processes and automated energy trading are some of the integrations in industry-specific PSI tools with direct use in industrial customer processes.

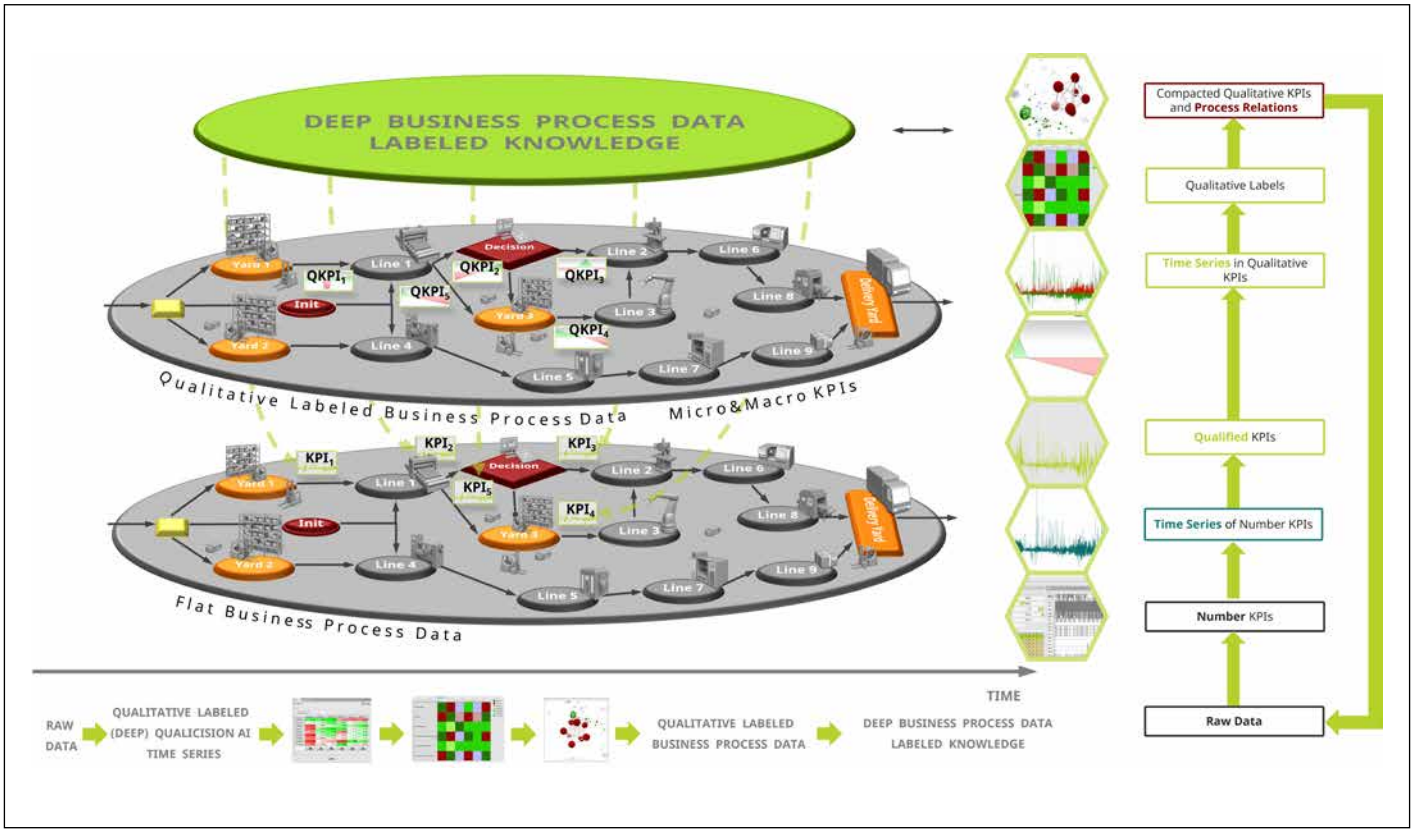

Figure 1: Level model Qualitative Labeling with Qualicision AI.

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