RuleX

People-centred technology, innovation, and care

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Rulex was recognised by Gartner® as a Sample Vendor for **Decision Intelligence** in *Emerging Tech Impact Radar: Artificial Intelligence in Healthcare*.

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Rulex for Healthcare and Life Sciences

Since 2007, Rulex has been at the forefront of digital transformation, advancing organisations with Rulex Platform – an all-in-one solution for **data management** and operational **decision intelligence**.
Our technology has driven measurable results across industries, including Healthcare and Life Sciences.

Starting from the firm belief that people make their best decisions when they can rely on trustworthy data and apply their domain expertise through intuitive technology, we designed Rulex Platform to be:

FOR EVERYONE. Its intuitive drag-and-drop interface simplifies even the most complex tasks while offering the flexibility to incorporate coding when needed. Users of all technical backgrounds, including healthcare professionals, data analysts, and researchers, can achieve their goals with confidence and autonomy.

MODULAR AND SCALABLE. With modular components and a comprehensive toolkit, Rulex Platform offers the flexibility to mix and match advanced technologies, creating tailored solutions that integrate seamlessly into existing systems.

TRANSPARENT, ETHICAL, AND TRUSTWORTHY. Rulex's proprietary composite AI produces results in plain English – mostly as *if-then* rules – making them easy to understand and trust. Every step of the process is fully traceable via detailed reports, workflow history, and intuitive visual interfaces.

GOVERNED AND COMPLIANT. Built-in features for data authentication, role-based access control, and encryption ensure that sensitive information is protected to the highest standards of privacy, governance, and regulatory compliance. Rulex Platform is ISO 27001 certified, meeting globally recognised standards for information security management.

Where Rulex makes an impact

MEDICAL ADMINISTRATION

Rulex is used to identify operational inefficiencies and **optimize resource allocation**, helping reduce overall costs. It also excels at collecting, integrating, and **managing large volumes of healthcare data**, and improving its quality to support subsequent analysis and decision-making. Rulex can be applied in near real-time equipment monitoring and **predictive maintenance**.

RESEARCH AND DISCOVERY

Rulex's transparent technology and advanced analytics, used independently or to complement traditional models, support **genomic and biomedical analysis** to identify new subgroups with high accuracy, promote tailored treatment plans, and lower large-scale screening costs. Its composite AI can also integrate transparent models for **visual data** analysis and region scoring.

CLINICAL DECISION SUPPORT

Evidence-based **recommendations** and **predictive analytics** make Rulex a powerful ally in clinical decision-making, improving diagnostic accuracy and helping in the early identification of at-risk individuals. Key features include **scenario simulations**, model and **rule inspection**, and **custom interactive interfaces** for editing records, generating reports, and facilitating communication with colleagues and patients.

Real-world success stories

These case studies represent just a sample of past and ongoing projects – many of which were up and running after only five hours of internal set-up support.

MEDICAL ADMINISTRATION

Error detection in health records

Improving the quality of large volumes of data

13x

more effective error detection compared to random sampling selection criteria

THE CHALLENGE

Inaccuracies in medical records can lead to consequences that vary widely in severity, from minor billing errors to serious issues such as **incomplete or incorrect diagnoses**, or **delays** in scheduling vital surgical procedures.

OUR SOLUTION

Rulex used **native eXplainable AI (XAI) to automate the validation** of coding used in hospital discharge forms for one regional health authority in Italy. The study expanded automated logical-clinical checks beyond previous sex-diagnosis and age-diagnosis compatibility, introducing advanced logical-clinical analyses to uncover deeper correlations between clinical variables. Specifically:

- ✓ Rulex's XAI-powered data quality solution autonomously generated corrective rules from historical data and proposed corrections for expert validation, enabling continuous improvement of the error detection process. Consequently, inconsistencies across diagnoses, surgeries, medical procedures, and their classification in Diagnosis-Related Groups (DRGs) could be effectively identified.
- ✓ By expressing rules in an *if-then* format, Rulex's RDC clarified why a specific entry was flagged as potentially incorrect.
- ✓ Precisely defined validation rules were able to improve the efficiency of record checks by pinpointing probable error locations, and significantly reducing the workload of hospital personnel.
- ✓ Following the successful application of the approach on test data, automatic checks were extended to all surgical discharge records.
- ✓ The solution can also collect and aggregate data from various locations (local files, cloud, etc.) and formats, integrating directly into the existing health authority's system, and providing a single custom interactive interface for reviewing flagged records, applying corrections, and tracking validation metrics.

LEARN MORE:

Case study's paper (in Italian)

Rulex's data quality

MEDICAL ADMINISTRATION

Optimization of staff and OT allocation

Managing multiple constraints and preferences with no formulas

3x

faster planning

THE CHALLENGE

Efficient work shift scheduling must balance needs with employee rest periods, skillsets, and availability. The added challenge of **coordinating interdependent resources** – such as medical staff and operating theatres, which are not always available or compatible at the same time – pushes complexity beyond the capabilities of conventional tools.

OUR SOLUTION

Already deployed in a supply chain scenario, this **general optimization solution** is equally effective in managing strategic, long-term planning of medical staff shifts and in handling short-term, dynamic scheduling of operating theatres – ensuring maximum resource efficiency and responsiveness. Specifically:

- ✓ A dedicated Rulex Platform task allows users to define inviolable ‘hard’ constraints, such as ensuring that all surgical procedures are assigned to available teams and within defined timeframes. Simultaneously, it manages ‘soft’ constraints, such as aligning procedures with the most experienced surgical teams, minimising staff overtime, and reducing shift fragmentation.
- ✓ Unlike conventional optimization solutions, Rulex empowers non-technical personnel to define multiple constraints using intuitive, plain English rules – eliminating the need to write complex mathematical formulas or script-based models. Rules and data can then simply be dragged onto the canvas, enabling automatic model construction with no coding required.
- ✓ Rulex Platform delivers automated synchronized planning in under 10 minutes, outperforming traditional manual methods both in time and accuracy, significantly enhancing overall productivity.
- ✓ The software integrates seamlessly with pre-existing company systems, causing no disruption to operations.

LEARN MORE:

Rulex’s optimization

Mathematical optimization: how to avoid getting stuck in rabbit holes – article

MEDICAL ADMINISTRATION

Predictive equipment maintenance

Giving precise instructions to avoid equipment breakdowns

90%+

accuracy in breakdown predictions

THE CHALLENGE

Unexpected failures of medical equipment pose a serious **risk to patient safety and hospital operations**, potentially delaying urgent procedures, increasing costs, and straining personnel. This issue is particularly critical for high-complexity, high-dependency devices.

OUR SOLUTION

Rulex designed a predictive maintenance solution for an international company, helping them **investigate the condition of their equipment and suggesting preventive actions**. Specifically:

- ✓ The solution integrated historical failure data, sensor readings, and machine-generated alerts.
- ✓ It identified failure patterns from diverse causes – including software anomalies, prolonged usage and mechanical wear.
- ✓ Using Rulex's proprietary eXplainable AI technology, intelligible rules were generated from this data, enabling the accurate prediction of potential failures, along with the underlying reasons. The system achieved an impressive accuracy rate of over 90%.
- ✓ Once the user-adjustable variables were defined, the Rule-Based Control task produced actionable recommendations on how to proactively avoid issues by tweaking certain parameters, such as lowering the RPM of a centrifuge.
- ✓ The provided instructions were easy to understand, and could be followed directly by medical staff without requiring IT intervention, ensuring a fast response in critical environments.

LEARN MORE:

Rulex's Rule-Based Control

RESEARCH AND DISCOVERY

Tailored diagnostic predictions

Enhancing traditional models with XAI and cluster analysis for novel insights

4

new patient subgroups identified, with different phenotypes and prognoses

THE CHALLENGE

The unpredictable progression of Primary Biliary Cholangitis (PBC), the lack of precise biomarkers, and the limited **availability of comprehensive patient data** make accurate prognostication particularly challenging. While machine learning models can be accurate, their opacity raises **ethical and practical challenges** in clinical practice.

OUR SOLUTION

Rulex and the medical department of Milano-Bicocca University conducted a study to optimize PBC risk stratification and prognostication. The data-driven approach **combined eXplainable AI (XAI) with cluster analysis** to complement traditional risk models. Using unsupervised machine learning, the solution analysed large-scale datasets, while XAI-generated findings were easily understood and validated by clinicians. Specifically:

- ✓ Rulex's proprietary XAI algorithm was applied to an international dataset of PBC patients to rank the most relevant features for liver-related death or liver transplantation. The dataset was split into a training set of 11,819 subjects and a validation set, with key clinical variables like age, sex, UDCA treatments, serum total bilirubin, ALP, and serum albumin.
- ✓ The algorithm generated clear predictive *if-then* rules and ranked the most relevant features for outcome classification.
- ✓ Clustering was then used to categorize individuals by the most relevant features. Standard survival analyses were performed to evaluate the prognostic discrimination of clusters. Results were then compared to the predicted risk from the UK PBC risk score.
- ✓ The analysis identified 4 distinct patient clusters, each characterised by unique phenotypes and long-term prognoses. Further sub-analyses revealed a correlation between albumin protein levels and the probability of transplant-free survival.

LEARN MORE:

Case study's paper

Rulex's native eXplainable AI

RESEARCH AND DISCOVERY

Treatment of therapeutic inertia in type 2 diabetes

Identifying new parameters associated with TI and failure of metformin monotherapy

High discriminatory ability
among the inertia-YES/ inertia-NO groups (ROC-AUC = 0.81)

2 new sub-types
of therapeutic inertia identified

THE CHALLENGE

Therapeutic inertia occurs when physicians delay starting or adjusting treatment for uncontrolled type 2 diabetes, often due to limited guideline awareness, concerns about potential side effects, poor treatment adherence, or **inadequate monitoring of glucose levels (HbA1c)**. This affects insulin and other therapies, leading to poor glycaemic control, increased healthcare costs, and a higher risk of complications.

OUR SOLUTION

The Italian Association of Medical Diabetologists used Rulex to **identify and categorize factors associated with therapeutic inertia in type 2 diabetes patients, particularly those exhibiting** suboptimal blood glucose control despite metformin monotherapy. Combining native eXplainable AI (XAI) with traditional statistics, the analysis provided a deeper understanding of complex medical data, especially HbA1c values and related variables. Specifically:

- ✓ The study analysed extensive raw data, including the medical records of 1.5 million diabetic patients treated at 271 diabetes clinics, and the data collected from medical visits over a 14-year period. Inclusion criteria focused on patients on metformin monotherapy with two consecutive mean HbA1c levels above 7.0%. The cohort was then divided into patients with or without inertia.
- ✓ Rulex's XAI analysed patient responses by building models that identified the most relevant variables, even without prior knowledge. This approach matched or exceeded the accuracy of leading machine learning algorithms, including Decision Trees, Artificial Neural Networks, and K-Nearest Neighbors classifiers.
- ✓ The study considered a wide range of variables and identified two main distinct sub-types of therapeutic inertia, marked by either a steady rise in HbA1c levels over time or a moderate, non-uniform increase, rather than simply elevated absolute levels.
- ✓ The identification of novel parameters that can mitigate therapeutic inertia paves the way for personalised treatment strategies.

LEARN MORE:

Case study's paper

Paper on achieving optimal metabolic control while maintaining target HbA1c levels

Rulex's native eXplainable AI

RESEARCH AND DISCOVERY

Graph-based analysis of feature contributions

Enhancing interpretability of rule-based classifiers

Top performer

in 8 out of
15 datasets

LEARN MORE:

Case study's paper

THE CHALLENGE

In the medical field, clear-box models are favored for their trustworthiness and transparency in clinical decision support. However, rule-based systems can contain **hundreds of rules and patterns**, making it difficult for professionals to identify key features, understand their interactions, and evaluate their contributions across different rule sets.

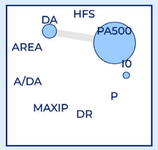
OUR SOLUTION

Rulex Platform provides a comprehensive toolkit for **analysing relationships and estimating feature contributions** in rule-based systems. Validated on diverse synthetic and benchmark datasets, it significantly enhances model explainability through graph-based representations. Specifically:

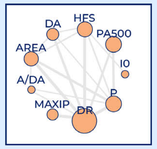
- ✓ The framework models weighted relationships among features, rules, and classes, quantifying how each feature contributes to rules (feature relevance) and how rules influence class predictions (rule relevance). A graph projection method transforms this tripartite structure into a feature-only graph, where edges between features represent shared contributions to the same rules, and feature centrality reflects overall importance.
- ✓ A model-agnostic feature importance metric evaluates each feature's impact without relying on specific rule-based predictors.
- ✓ A distance metric for rule set comparison, independent of rule set size, identifies models most similar to existing systems – ensuring consistency in predictions, explanations, and clinical care over time and across providers.
- ✓ Class-specific feature graphs offer insights for distinguishing diagnostic groups (e.g., carcinoma, mastopathy), supporting informed measurement strategies.
- ✓ The method's graph-based approach significantly improved the interpretability of feature relationships, while also performing on par with established techniques such as permutation importance and outperforming Gini and SHAP. It demonstrated the highest stability – ranking top in 8 out of 15 datasets – and exhibited strong robustness to data variability, making it particularly well-suited for high-stakes domains like healthcare.

Feature graphs from Rulex's proprietary XAI algorithm

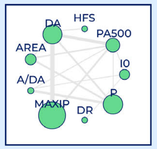
Carcinoma



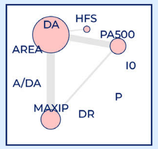
Fibro-adenoma



Mastopathy

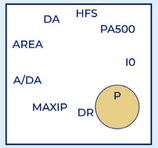


Glandular



Connective

Adipose



RuleX

CLINICAL SUPPORT

Efficient laboratory analyses

Speeding up result evaluation with automated value flagging

80%+

increase in efficiency

THE CHALLENGE

In traditional diagnostic workflows, it's common to manually review analysis results one by one to confirm the proper functioning of diagnostic machines and the **plausibility of the output values**. This process is time-consuming and resource-intensive.

OUR SOLUTION

Rulex implemented an intelligent **automation** solution for a leading medical company with diagnostic centres across Europe. The system leveraged both Rulex Platform's **Rule Engine** and **integration capabilities**. Specifically:

- ✓ Drawing on their field experience, the medical personnel defined around 100 validation rules in a Microsoft Excel file, using intuitive plain English syntax. Some rules were purely analytical, while others incorporated contextual information (e.g., a glucose level might be acceptable for elderly patients but not for younger ones).
- ✓ These rules were linked to the analysis data using the Rule Engine task, simply by dragging and dropping the rule file and analysis data – whether from a database, local file, or SharePoint. The system then automatically applied the rules at runtime as analysis results were produced.
- ✓ Cases flagged as uncertain or borderline were sent for manual review. For all others falling within pre-defined plausible thresholds, medical staff could decide whether to review or automatically approve them – remaining fully in control.
- ✓ The transparent logic made it easy for medical staff to understand, trust, and independently edit or add rules to fine-tune the process. Analysis results could be automatically transferred from the company's own management system to Rulex Platform for validation, before being sent back for patient report generation and printing.
- ✓ The solution integrated seamlessly and transparently with the diagnostic centre's management system, without disrupting daily operations. Rulex Platform's flexibility also supported multiple applications through capabilities such as REST APIs.
- ✓ The solution improved efficiency by 80%, increasing revenue and staff morale.

LEARN MORE:

Rulex's Rule Engine

Rulex's data agility

CLINICAL SUPPORT

Simulating impact of timely insulin initiation

Improving short-term glycaemic control in type 2 diabetes with a scenario simulator

+17%

of patients meeting recommended metabolic targets

THE CHALLENGE

International diabetes care guidelines stress the importance of prompt and effective glycaemic control to lower the risk of macrovascular complications in type 2 diabetes (T2DM). However, data from the Italian Association of Medical Diabetologists (AMD) shows that **only 47% of patients meet glycaemic targets**, with around 30% using insulin.

OUR SOLUTION

In collaboration with the Italian AMD, Rulex conducted a study using real-world data to simulate the impact of timely insulin initiation for all eligible patients, with the aim of improving the quality of care for T2DM patients. An **ML-based what-if scenario simulator** was used to explore outcomes. Specifically:

- ✓ The study was based on a large database comprising over 1 million patients with T2DM, considering variables such as demographics, medical history, and biomarkers. The effects on glycaemic control were projected over a 12-month period, aligning with the frequency of patient visits to Italian diabetes centres.
- ✓ Using Rulex's eXplainable AI (XAI) technology, the simulation predicted that timely initiation of insulin therapy for all eligible patients would result in a 17% increase in the proportion of patients achieving the recommended metabolic target (haemoglobin A1c <7.5%) within 12 months of treatment initiation.
- ✓ Rulex's XAI predicted which patients could have reached the desired outcomes, if timely therapeutic measures had been implemented. The model projected an improvement of over 34% in the number of patients achieving the target compared to real-world results.
- ✓ By generating clear, intelligible rules for medical experts without specialised statistical or mathematical skills, Rulex's XAI fostered trust in its predictions.
- ✓ The study reaffirmed the critical role of early intervention in overcoming therapeutic inertia, showing that prompt initiation of insulin therapy significantly improves patient metabolic outcomes after 12 months.

LEARN MORE:

Case study's paper

Paper on metabolic control without weight gain in type 2 diabetes

Rulex's native eXplainable AI

CLINICAL SUPPORT

Early genetic prediction of leukemia

Predicting AML with low-cost, routine blood markers

10+

high-quality rules generated for disease onset linked to gene mutations

LEARN MORE:

Progetto SInISA (in Italian)

THE CHALLENGE

With ageing populations on the rise, healthcare must evolve from reactive treatment to **prevention, early intervention, and data-driven care**. This is especially true in conditions such as Acute Myeloid Leukemia (AML), where subtle genetic mutations can progress silently into life-threatening disease. Yet **large-scale genetic screening remains out of reach** for most health systems due to cost and operational complexity.

OUR SOLUTION

Rulex is contributing to the SInISA project, exploring innovative screening methods that **integrate genomics, clinical data, and AI-driven analysis**. By using routine blood markers like RDW as affordable risk indicators, SInISA enables early AML detection without large-scale genetic screening. The goal is to identify high-risk individuals sooner, supporting timely intervention and advancing precision medicine. Specifically:

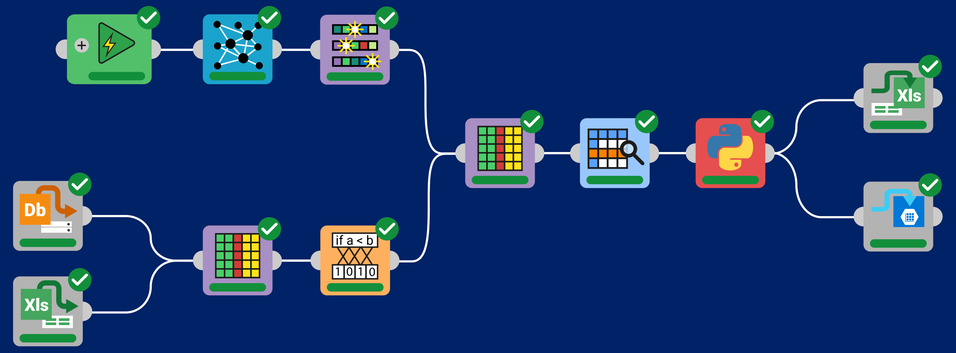
- ✓ While awaiting new experimental cohort data, Rulex is leveraging the Weizmann Institute dataset of nearly 500 individuals, a subset of whom later developed AML.
- ✓ From this dataset, Rulex has developed eXplainable AI (XAI) models that predict AML onset and highlight the genetic mutations most strongly linked to disease progression. The transparency of these models ensures clinicians can trust and act upon results.
- ✓ The approach combines genomic, phenotypic, and clinical features to provide a comprehensive view of disease mechanisms. Unlike conventional statistics, Rulex's AI can uncover subtle patterns that are often overlooked.
- ✓ Experimental results and XAI models create a continuous learning loop, with each wave of patient data improving predictive accuracy and reinforcing biological insights over time.
- ✓ Interactive dashboards support medical record analysis, allowing medical professionals to explore patient data, identify key patterns, and make faster, more informed decisions – seamlessly integrating into clinical workflows to support both daily care and research.

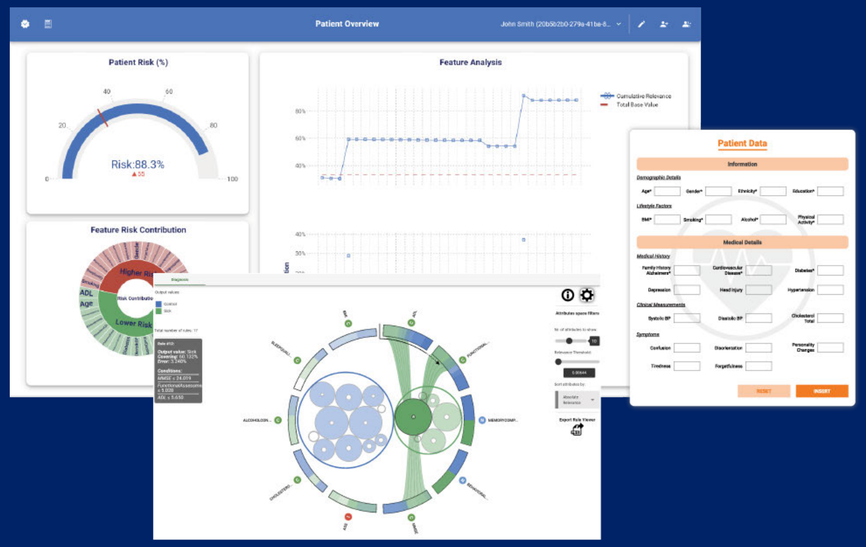
MEET THE SOFTWARE, RULEX PLATFORM

Rulex Factory

The heart of Rulex Platform, where **solutions are built** step-by-step in logical workflows by simply dragging tasks onto the canvas.

Rulex Factory allows users to aggregate data from multiple sources, improve its quality, and link it to a wide range of tools for data analysis, decision support, and process automation.





Rulex Studio

The creative hub of Rulex Platform, where users can design interactive **dashboards** to share and explore results from Rulex Factory. Dashboards are built intuitively by dragging images, shapes, and widgets onto the canvas.

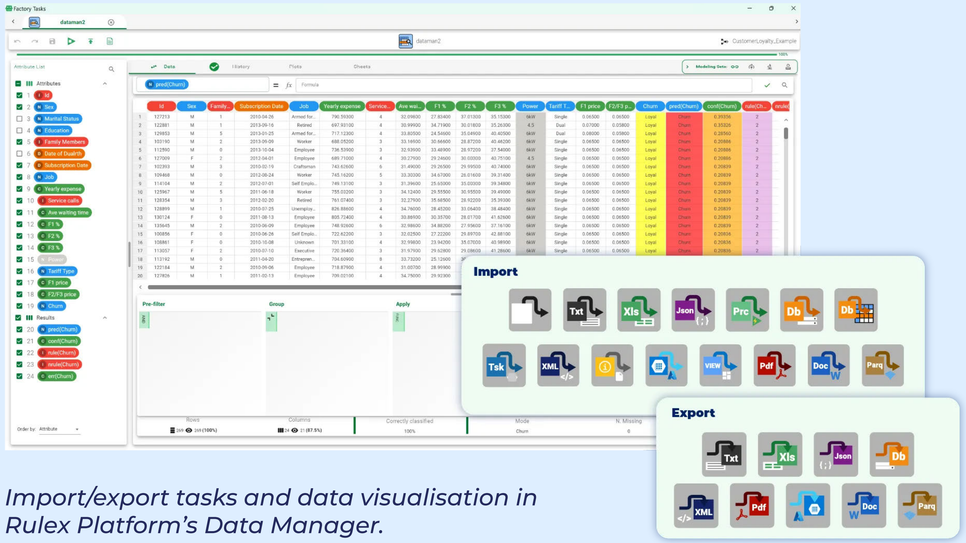
Beyond data visualisation, Rulex Studio supports the entry, modification, and elaboration of new information within fully **customised applications** – tailored to specific users and business needs.

The technology behind Rulex Platform

FOR A SOLID DATA FOUNDATION

Data agility

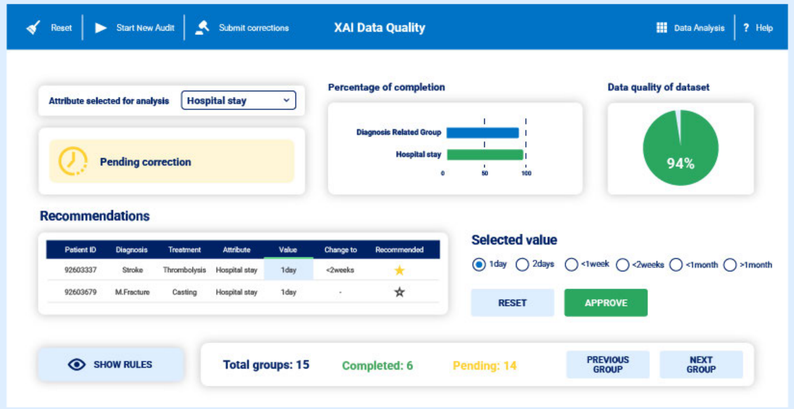
Wherever your data lives – laptop files, SAP tables, or cloud storage – Rulex Platform brings it together with **dedicated tasks**. Once imported, data is converted into a **unified table format**, making aggregation, reconciliation, and harmonisation a breeze.
Analyse your data, refine your insights, then let Rulex Platform take over with **fast processing** that handles 50 million rows of data in under 10 seconds. When you're ready, export the results in any format you need, even as an email attachment.



Import/export tasks and data visualisation in Rulex Platform's Data Manager.

Data quality

Rulex Platform provides multiple data quality solutions designed to address unique business needs, from **traditional data cleansing** for handling missing values and outliers, syntax errors, duplicates, and fragmented data, to streamlined **rule-based validation**.
For the most elusive logical errors, Rulex applies **augmented data quality** powered by our proprietary eXplainable AI algorithm, which autonomously derives corrective rules from data and suggests corrections that business experts can review, ensuring a continuous improvement loop.



Rulex's augmented data quality delivered through a tailored, interactive interface.

The technology behind Rulex Platform

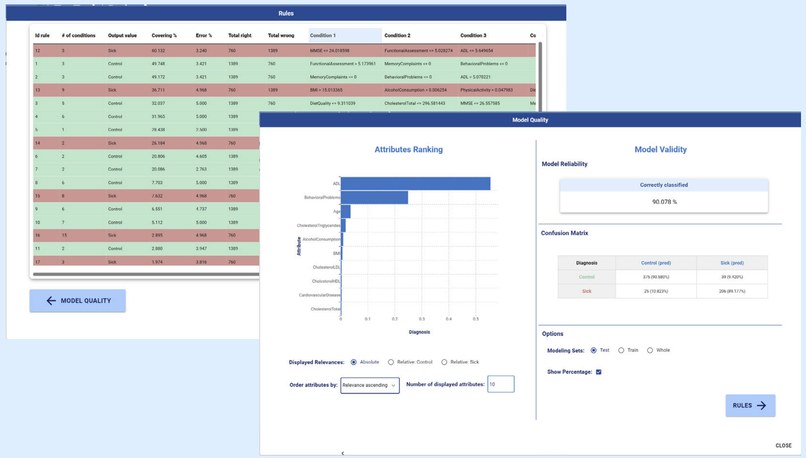
FOR ANALYSIS, DISCOVERY, AND BETTER DECISIONS

Native eXplainable AI

Rulex's proprietary eXplainable AI provides actionable results that are easy to understand and trust. Unlike black-box models, the algorithm supplies **clear rule-based explanations** for every insight and suggestion, improving decision-making, ensuring compliance, and **reducing risk**. What's more, Rulex's XAI maintains high **accuracy** even with limited historical data.

Business rules engine

Rulex provides a powerful tool for **defining and applying business rules to data**. It is designed to allow users to write rules in an **external configuration file**, such as an Excel spreadsheet, using an intuitive syntax. Business experts can test or modify the rules without changing the workflow, keeping them fully in control of the entire process.



Interactive dashboards showing model performance and decision logic, with rules colour-coded by class and filterable by attributes (left), plus Feature Ranking and confusion matrix (right).

The technology behind Rulex Platform

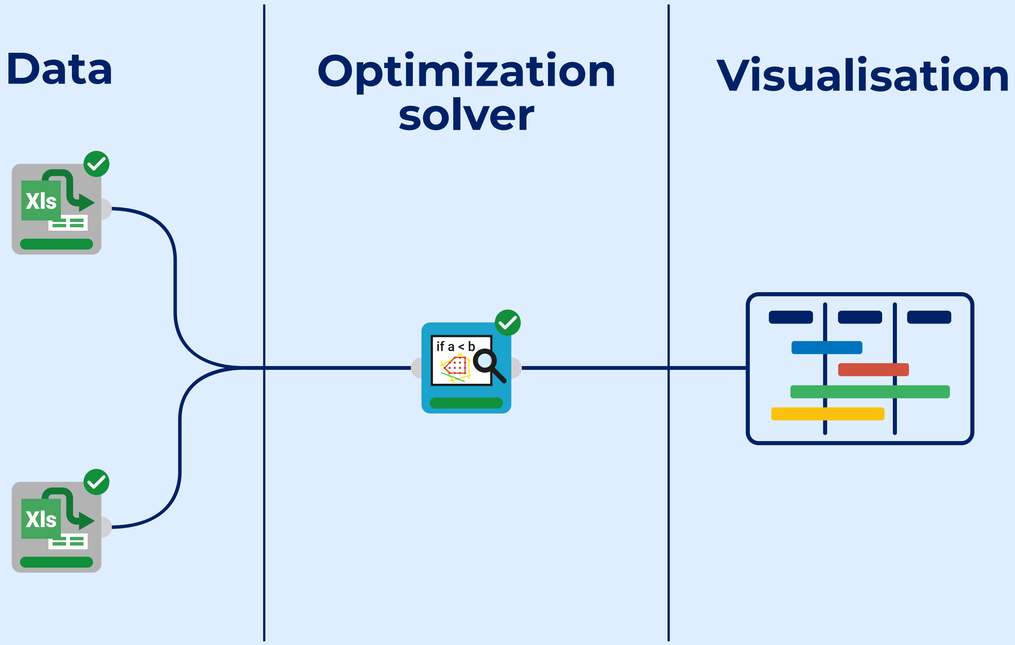
FOR ANALYSIS, DISCOVERY, AND BETTER DECISIONS

Optimization solver

Rulex's proprietary optimization tool delivers solutions to complex business challenges in a matter of minutes. While handling thousands of variables, the tool requires **no scripts or mathematical formulas**, with **hard and soft constraints** being defined in familiar **spreadsheets** by domain experts.

Scenario simulator

Rulex's *what-if* simulator goes beyond forecasting – it **recommends precise actions** to achieve desired outcomes. Users can **fine-tune analyses** by weighting target attributes and selecting key variables. Results are delivered in plain English, as clear, actionable recommendations that can be manually implemented or automatically executed for seamless decision-making.



Scheduling problem solved in Rulex Platform.

The technology behind Rulex Platform

FOR EASY ADOPTION AND PROCESS AUTOMATION

Automation

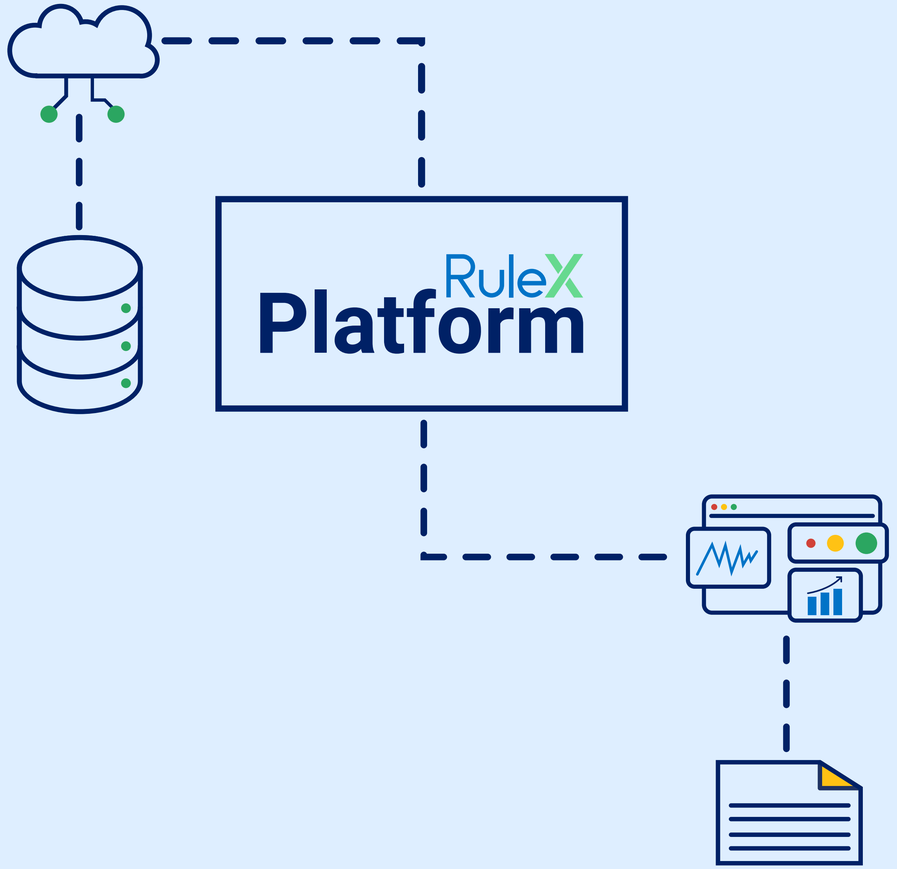
Rulex Platform automates workflows while integrating seamlessly with existing tools. Flexible scripting, real-time **alerts**, and containerized deployment keep processes adaptable, while built-in GIT and a **REST API** enable smooth collaboration.

LLM integration, AI assistant, and more

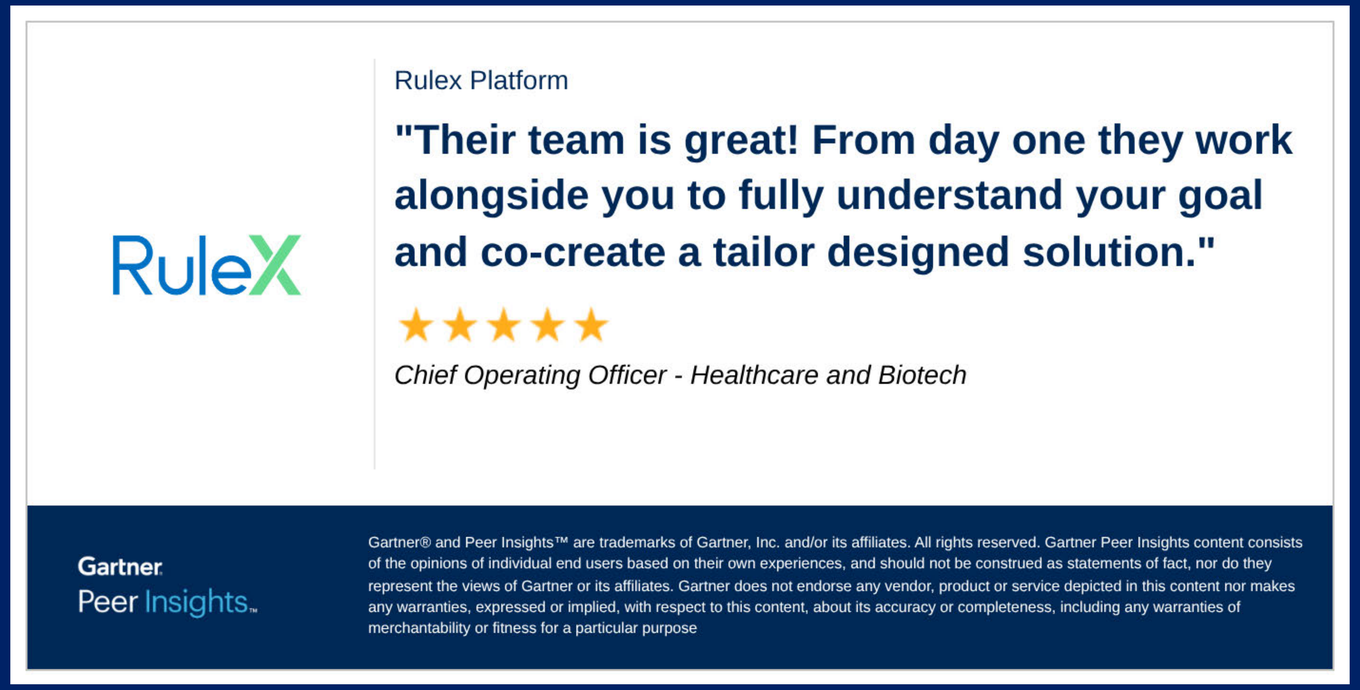
Rulex continuously evolves with new technologies to meet future demands. **Integration with Large Language Models (LLMs)** enables the extraction and integration of information from unstructured content. The **AI Assistant** supports faster, more intuitive access to resources, while also facilitating the definition of rules and constraints – helping users work more efficiently and confidently.

Training and support

Thanks to its intuitive graphical interface and online **training platform** (Rulex Academy), Rulex enables medical professionals to autonomously develop and maintain solutions, without writing a single line of code. And if support is needed, Rulex **in-house data scientists and solution architects** are ready to help, alongside enterprise-grade 24/7 customer service.



What they say about us



Chief Operating Officer in the Healthcare and Biotech Industry gives Rulex Platform 5/5 Rating as of 8/15/25 in Gartner Peer Insights™ Decision Intelligence Platforms Market. Read the full review here: https://gtnr.io/aTm2Xszc1

RuleX

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