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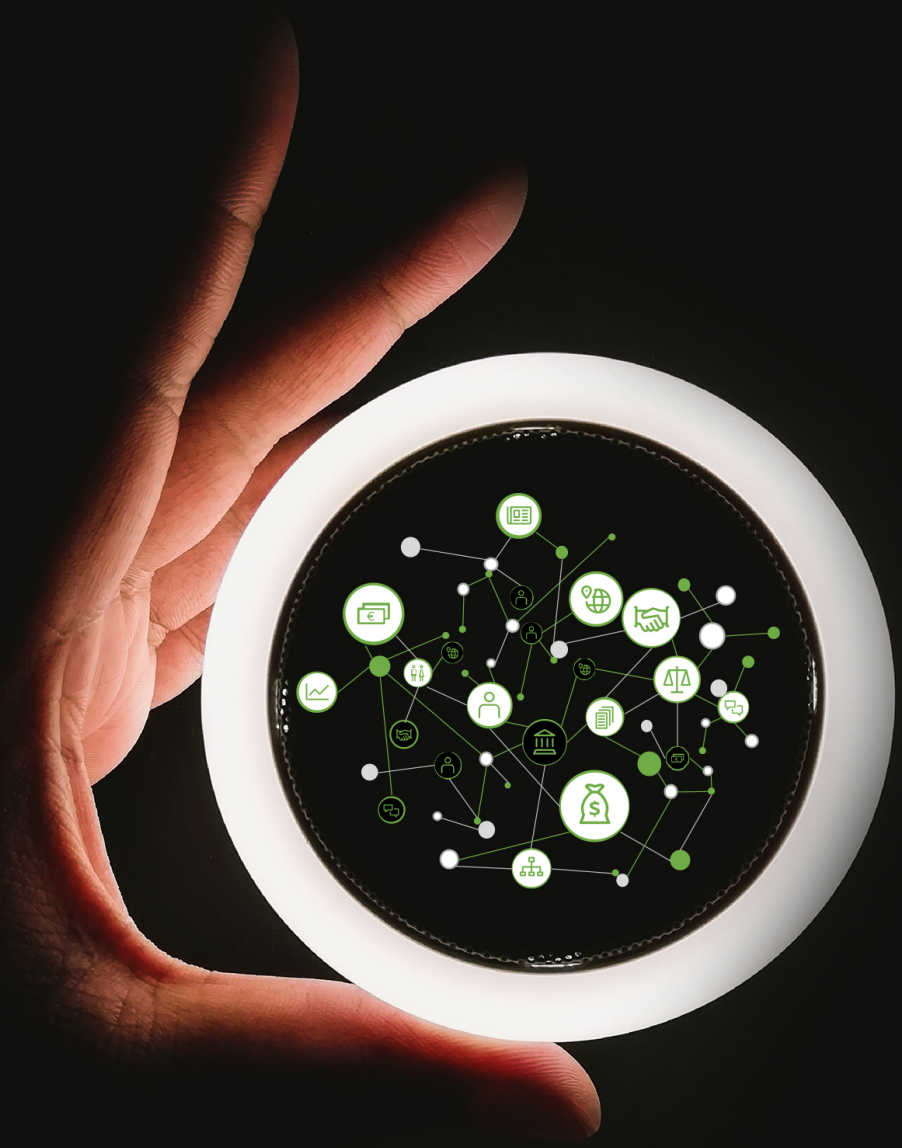
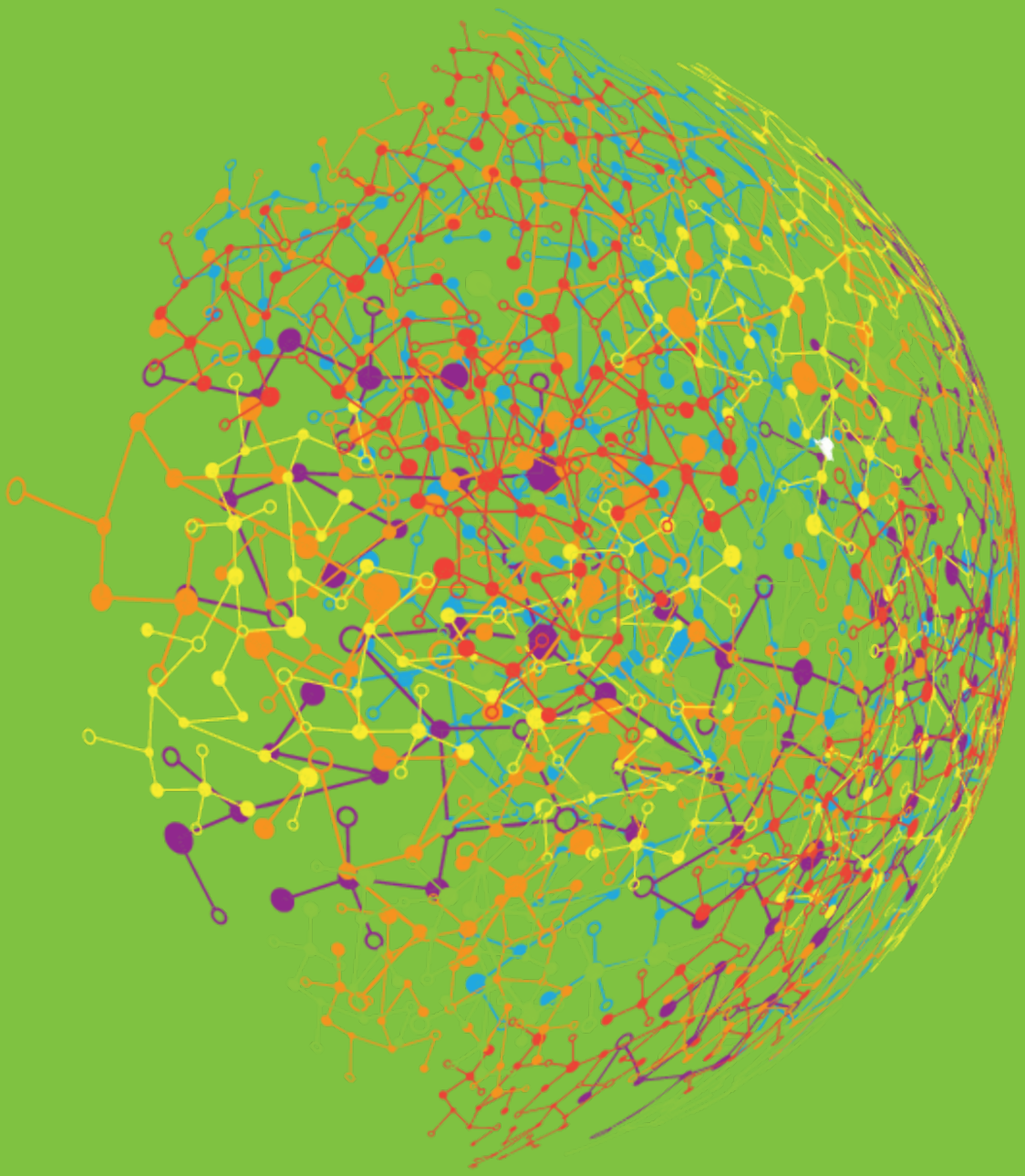


Knowledge Graphs for Financial Services

The path to unlock new insights from your data

“Logic will get you from A to B.
Imagination will take you everywhere.”

Albert Einstein



Preface

Today, companies are relying more and more on Artificial Intelligence (AI) applications in their day-to-day decision making. Without context, these AI applications may never reach their full potential as reliable solutions to address complex business needs. Knowledge Graphs enable machines to incorporate human expertise for making meaningful decisions and bring context to AI applications.

The new wave of AI is focused on hybrid intelligence that means learning (data) fused with reasoning (knowledge).

Connecting datasets in a meaningful way is strategic for every business as it enables decision makers, users, and (above all) computers gain context on the existing knowledge of an organization. For enterprises to stay competitive in the current knowledge economy, it is crucial to manage knowledge efficiently and be ready for changes that might serve either as a threat or opportunity to their business. That's where Knowledge Graphs come into play and why tech giants like Amazon, Facebook, Microsoft and Google have invested millions of dollars to create their own Knowledge Graphs.

Knowledge Graphs allow for processing and representation of data and knowledge in a format which is very close to the way a human brain processes and stores information.

This enables users to quickly access two closely connected objects and adapt the connection based on the context, for example both a small enterprise and a private individual as customers of the same organization may be given the same risk rating due to closely matching activities.

Major institutions are commonly faced with thousands of isolated "data silos", hence facing an information overload challenge. Knowledge Graphs can serve as a hub of integrated knowledge by processing disparate sources and extracting atomic units of knowledge from diverse datasets. Moreover, they provide contextual adaptation, and reasoning capabilities that go beyond the conventional machine learning approaches.

The impact of Knowledge Graphs in financial services is just in its inception where the role of knowledge scientists to build bridges between business requirements, questions and data is becoming more and more important. In this article, we highlight some example use cases of Knowledge Graphs to demonstrate the value of Knowledge Graphs for data-driven businesses.

What are Knowledge Graphs?

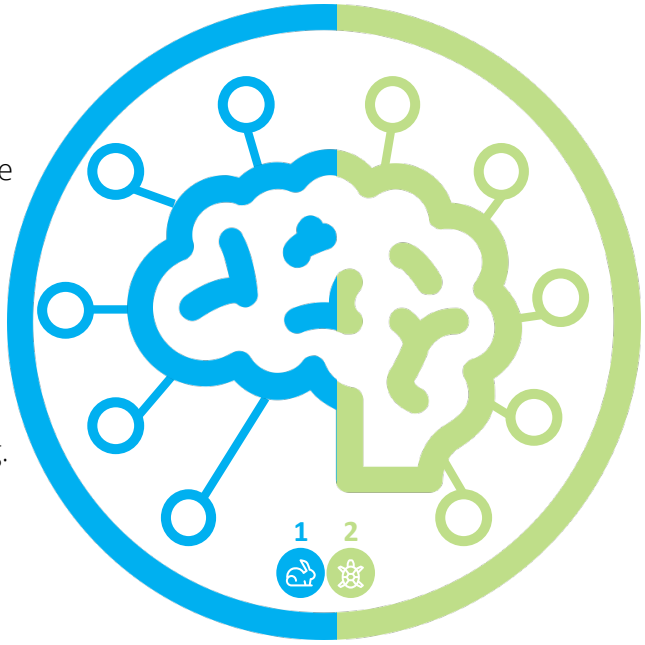
A Knowledge Graph is a means to connect and represent knowledge in an area of interest using a graph-like structure. It is typically built on top of existing databases to link data together at web-scale, combining both structured and/or unstructured information. As opposed to the more commonly used relational data models, a graph model is built as a collection of concepts or entities and the relationships between them.

Thinking, Fast and Slow

You could see Knowledge Graphs as the brain of a company with two systems of thinking:

System 1 (Thinking fast) that is intuition-based, automatic and error-prone to quickly learn from the past observations.

This system of Knowledge Graphs is powered by statistical AI approaches such as Machine Learning.



System 2 (Thinking slow) that is logic-based, effortful and capable of making complex yet explainable decisions.

This system of Knowledge Graphs is powered by symbolic AI approaches such as Knowledge Representation & Reasoning.

As an example of system 2, let's read the following sentence:
"*A red truck with a siren and a ladder attached to its side rushed in the city*".
What do you understand from this sentence? As a human you might already think that the vehicle was most likely a fire truck; or there was probably a fire somewhere in the city; and many more logical conclusions. However, as a machine it would be very hard to make all those connections and come up with the above reasoning due to the lack of background and common-sense knowledge.

A Knowledge Graph brings together Machine Learning and Graph technologies to give AI the context it needs. Knowledge Graphs represent a complex network of information in a meaningful way (in a similar way to human intelligence) by integrating data from a wide range of data silos and incorporating learning and reasoning.

Use Cases

360° View of Risk & Value

Knowledge Graphs allow companies to connect the dots in their business and see the big picture for evaluating risk and value.

The challenge for financial institutions seeking competitive advantages in the market is not a lack of information. It is an over-supply of information from diverse sources with complex and vast amounts of data.

Big Data technologies have empowered companies to ingest substantial volumes of data and store it in multiple data silos. Bridging these data silos brings limitless opportunities for companies to assess risk and value across multiple domains.

In order to seamlessly integrate large enterprise data silos, companies do not only need to unify various data models and formats, but also need to harmonize data based on its meaning.

Knowledge Graphs enable companies to semantically integrate diverse data and draw connections at an unprecedented scale. They also allow users to connect external sources of data efficiently, regardless of their underlying data formats and models.

Applications

- Know Your Customer (KYC)
- Due Diligence
- Investment Research
- Insurance Underwriting & Claim Processing
- Commercial Real-Estate

Knowledge Graphs empower business users to see the whole story.

Example

Imagine an international bank that wants to use their customer data for identification of high-risk customers to avoid sanctions. This would require a deep dive into the customer data, understand the different attributes and create a risk classification while ensuring links to the relevant sources of information such as financial transactions, customer's family relationships, as well as regulations.

Using a Knowledge Graph, the bank can see all the customers information, risk dimensions, and regulations that are relevant for their specific goal, linked together based on their meaning, in one place for deep analysis.

Use Cases

Compliance Management

Interlinking company data with various compliance data sources such as internal policies, legislations, standards and other private contracts in a Knowledge Graph enables companies to better manage compliance.

Finding ways to remain compliant with ever-changing and growing universe of regulations, policies and internal contracts has become one of the most visible challenges of today's companies.

Financial compliance requires companies to maintain sophisticated customer screening and transaction surveillance systems that pose data quality and data availability challenges. Current compliance systems are focusing mainly on data collection and data consolidation, leaving less time for in-depth analysis.

Knowledge Graphs leverage the power of semantic technologies to not only unify and interlink various sources of compliance data, but also to apply complex rules and patterns for (semi-) automated compliance monitoring.

In order to optimize compliance check, Knowledge Graphs combine contextual domain knowledge with Natural Language Processing (NLP) and Machine Learning.

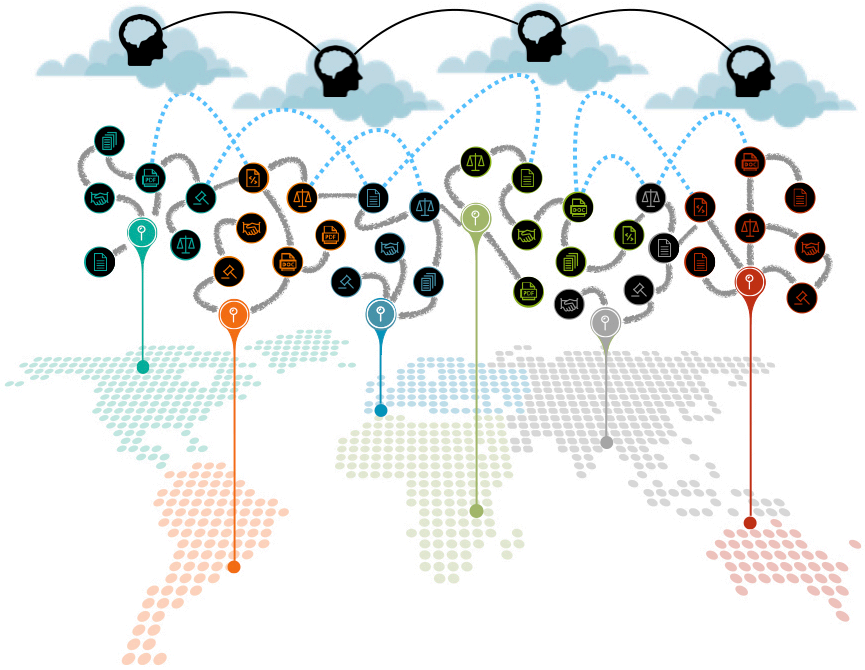
Applications

- Regulatory Reporting
- Trade Surveillance
- Insider Trading Surveillance

Example

Imagine a local company seeking to branch out to other countries and markets. In order to trade abroad and to localize its products and services to other countries, the company needs to take into account the legal barriers applicable to the target market. Dealing with legal and regulatory compliance data is a cumbersome task that needs to access huge volumes of digital compliance documents and integrate them with internal company data.

Utilizing a Knowledge Graph allows this company to efficiently identify relevant regulations, link its data to those regulations and to define patterns for automatic compliance check.



Knowledge Graphs allow companies to bring together different sources of compliance in a meaningful way and apply automated compliance checks.

Use Cases

Data Lineage & Metadata Management

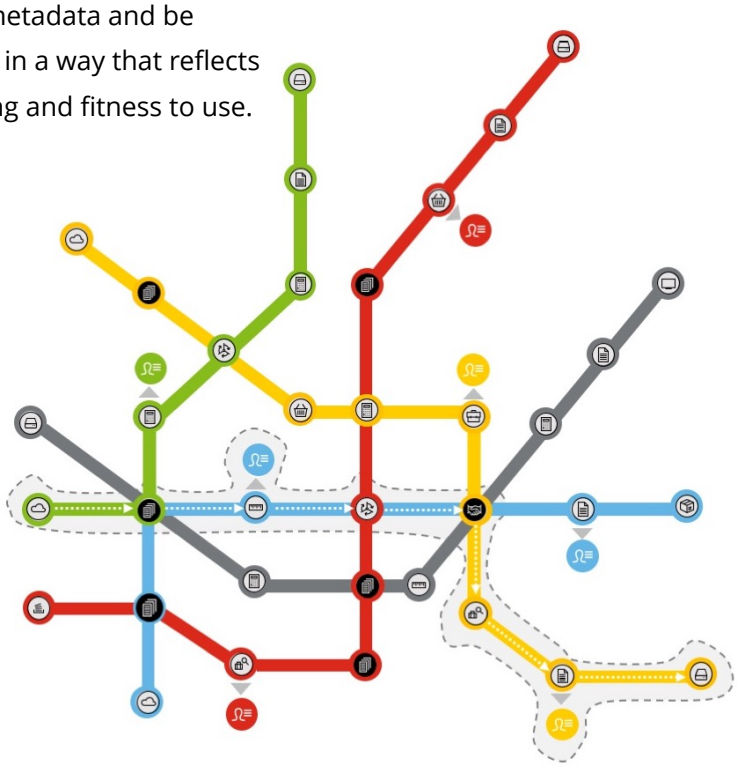
Knowledge Graphs allow companies to trace their data journey in the right context and improve the quality of their data flows.

A common issue today's data-driven companies face is tracking data throughout its lifecycle. Whether acquired externally or generated from internal services, data needs to be tracked as it is utilized, manipulated, and transformed throughout the organization.

The challenge is that complex data neither explains itself nor its journey. And, data is only valuable in the context of what it means to its stakeholders. Thus, data must be described with relevant metadata and be organized in a way that reflects its meaning and fitness to use.

The combination of detailed metadata and relationships between data lifecycle phases results in a semantic data layer. A semantic data layer (also known as *data fabric*) enables both data experts and business stakeholders to take advantage of any data asset to which they have access.

Knowledge Graphs provide a semantic layer with full view of the data lifecycle all the way from the business to the most technical components.



Knowledge Graphs allow to keep track of your data journey meaningful to its different stakeholders.

Applications

- Risk Data Aggregation & Reporting
- Master Data Management
- Data Migration for Consolidating Mortgage Systems or On-boarding New Data Feeds

Example

Imagine a company that is in a merger process and needs to migrate all the Customer Relationship Management (CRM) data from the acquired company to its current data lake. To ensure the quality of data, the data managers would like to know the data changes over time and know what manipulations were applied to source data that resulted in its current form.

Using a Knowledge Graph solution, the company can get an overview of the data lifecycle together with the sources used and all their dependencies to allow data managers make better decisions for data integration and quality improvement.

Use Cases

Fraud Detection & Financial Crime Analytics

Augmented analytics provided by Knowledge Graphs & Machine Learning enables companies to identify fraudulent patterns and investigate specific criminal links.

Today's financial institutions are contending with measures for Anti-Money Laundering (AML), Suspicious Activity Reports (SAR), counterfeiting, as well as synthetic, first-party, and card-not-present fraud.

Frequently, fraud happens relatively quickly and with a convoluted network of transactions that mix and blend the identity and funds through multiple channels that are hard to detect.

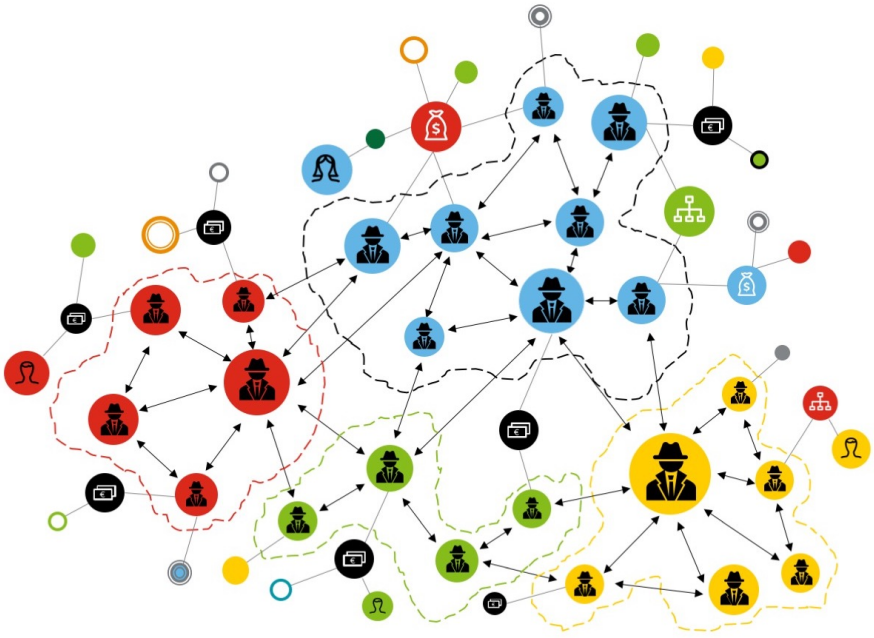
The traditional relational database systems for fraud detection require a lot of complex series of joins that are often complex to build.

Trying to scale these large queries to return real-time data is impossible in most cases as the number of connections and patterns grow.

Knowledge Graphs empowered by machine learning and reasoning capabilities allow companies to better identify fraudulent patterns by traversing many hops on very large amounts of interconnected data in real-time.

Applications

- Spotting fraud, which applies to fraudulent transactions and applications in banking, benefits fraud in government, tax fraud, applications and claims fraud in insurance.
- Anti Money Laundering



Knowledge Graphs allow monitoring, categorizing, and predicting potential points of threats.

Example

Imagine an insurance company that wants to detect fraud schemes. Insurance fraud is usually from complex networks that are difficult to detect for insurance and financial institutions. Fraudsters usually forge fake identities, file several claims and cash the insurance checks. Creating fake identities requires forgery of personal information (social security numbers, addresses, credit cards, etc), to submit to insurance companies to become a customer. Fraudsters often recycle this data to create several fake identities.

Using a Knowledge Graph for entity resolution and a visual analytics interface, the company can easily detect clusters of fake claims.

Use Cases

Recommender Systems and Conversational AI

Knowledge Graphs enable fact-based recommendations that accumulate contextual knowledge with each conversation.

The goal of a recommender system is to deal with an overload of information by filtering vital information fragments out of a large amount of information.

In order to provide recommendations that match user's intent, preferences and interest, a recommender system needs to know about the context of conversation and must be capable of not only looking at structural similarity between items but also their semantic similarity. For example the word "balance" might convey different meanings when used in a financial conversation as opposed to a medical context.

A Knowledge Graph is built as a large semantic network of entities and their attributes. Therefore, it allows finding the best matching entities based on semantic similarities between the entities. Knowledge Graphs also allow enriching the context of data by incorporating domain-specific knowledge vocabularies, taxonomies or ontologies.

The personalized experience provided by Knowledge Graphs enables conversational banking tools to more effectively interact with customers on their banking needs.

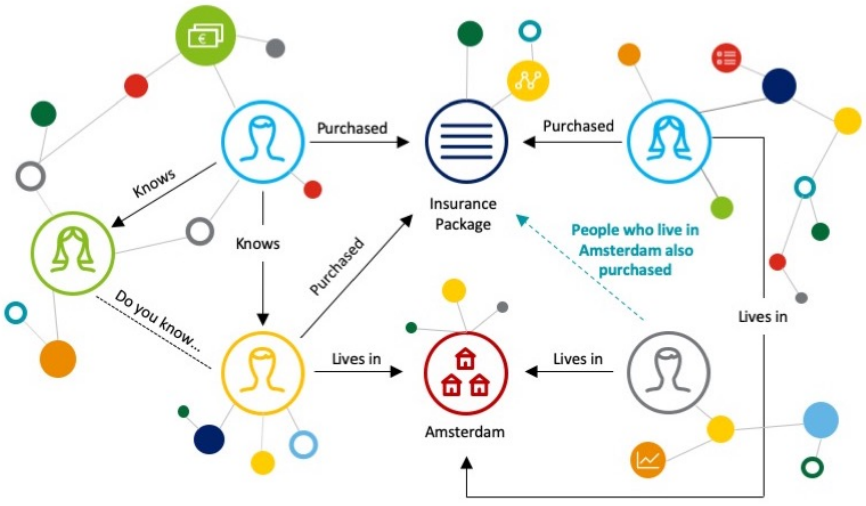
Applications

- Conversational Commerce
- Customer Service Chatbots
- Product Recommendations
- Enterprise Search & Content Classification

Example

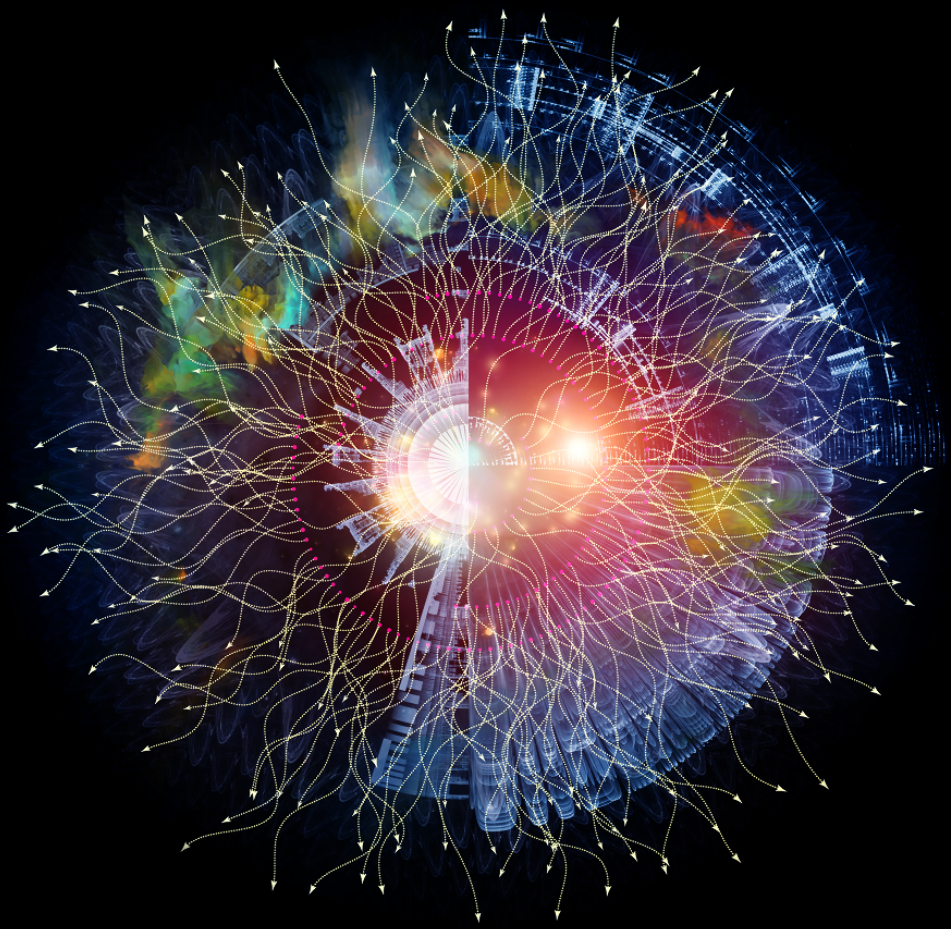
Imagine a big retail company that wants to build a conversational commerce platform where its customers could interact with a bot similar to the way they interact with a salesperson in their shop. The company has more than 10,000 product categories and more than 100,000 attributes such as brand, colour, and any other attribute about an object that customers can buy. They failed when they tried a rules-based engine to support such a huge catalog, with more than million items in inventory.

Using a Knowledge Graph solution, the company can store relationships between various sources of information such as products, customer interests, and purchase history and quickly query it to make recommendations that are personalized and relevant to customers.



Knowledge Graphs provide context-driven recommendations.

A **Knowledge Graph** is worth
a thousand words.



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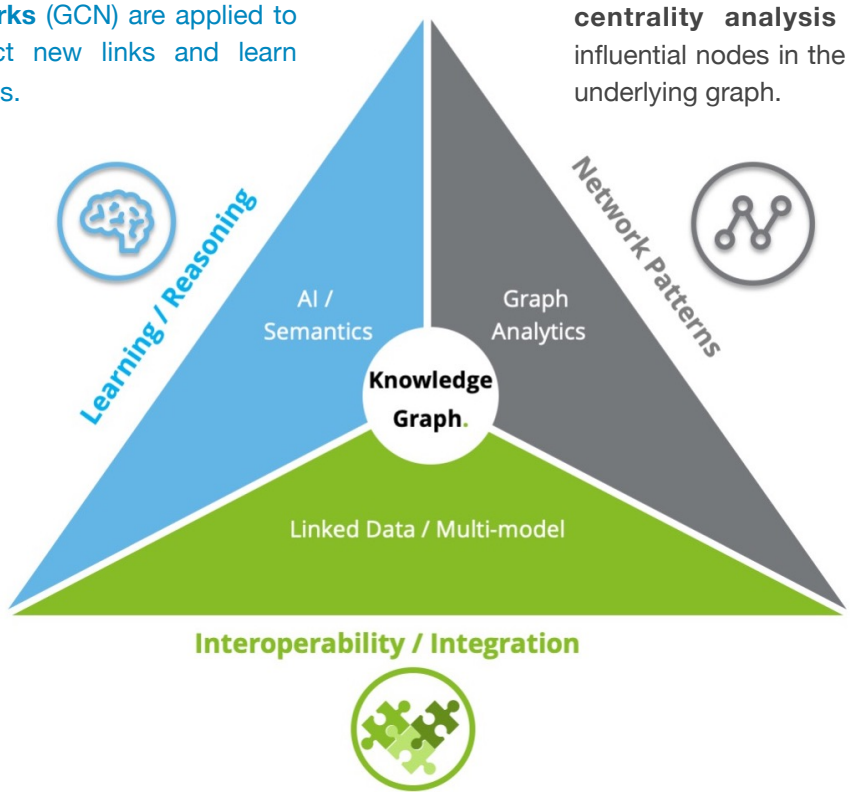
Three Pillars of our Knowledge Graph Services

The effective design and implementation of Knowledge Graphs requires 3 components: a) bridging diverse data silos regardless of data formats, serializations, conceptualizations, and technology ecosystems, b) investigating interconnected data to find out insightful patterns and c) deriving context-relevant knowledge from the large amounts of integrated data.

This component deals with extracting knowledge from data.
Machine reasoning methods supported by semantic technology standards such as **RDFS**, **OWL** and **SHACL** allow our solution to derive new facts from data. Additionally, advanced AI machine learning techniques such as **Graph Convolutional Networks** (GCN) are applied to graph data to predict new links and learn complex graph patterns.

This component deals with different kinds of graph analysis to identify patterns in interconnected data. Methods such as **path analysis** to determine the shortest distance between nodes, **connectivity analysis** to determine weak/strong nodes, **community analysis** to find groups of related nodes and **centrality analysis** to identify the most influential nodes in the graph are applied to the underlying graph.



This component deals with data distribution, harmonization, integration and storage at scale. Linked Data standards such as **HTTP**, **URIs** and **RDF** data model are used to represent data in a single interchangeable format that is both understandable by machines and humans.
Additionally, **multi-model graph databases** are incorporated to support multiple data models against a single, integrated backend.

Conclusion

Knowledge is every company's most valuable asset, however it is scattered across different systems and human minds. This decentralized nature of knowledge makes it hard to grasp and increases the challenges for organizations. The key to integrating knowledge efficiently among various systems and human users is to provide knowledge representation and reasoning in a machine-readable form.

Creating a Knowledge Graph with semantic description of information context allows users to access a machine-readable representation of complex interdependencies that form a real-world model of the knowledge domain.

In this report, we shortly touched upon some example use cases of Knowledge Graphs for financial services. Knowledge Graphs are already in use in industries such as public sector, healthcare & life sciences, energy, resources & industrial sector, technology & media sector, etc. Some other prominent use cases can be found in the following domains:

- Personalized health
- Logistics & supply chain management
- Industry 4.0 in automation & manufacturing*
- IoT data integration & management
- 360° view of criminals cases
- Network / IT/ cloud resource optimization and maintenance
- Traffic management
- Geospatial analytics
- Performing grid and network quality of service
- Preventing cyber attacks

*If you are interested to know more about applications of Knowledge Graphs in industry 4.0, you can read the following Deloitte article:

Wisdom of Enterprise Knowledge Graphs: The path to collective intelligence within your company

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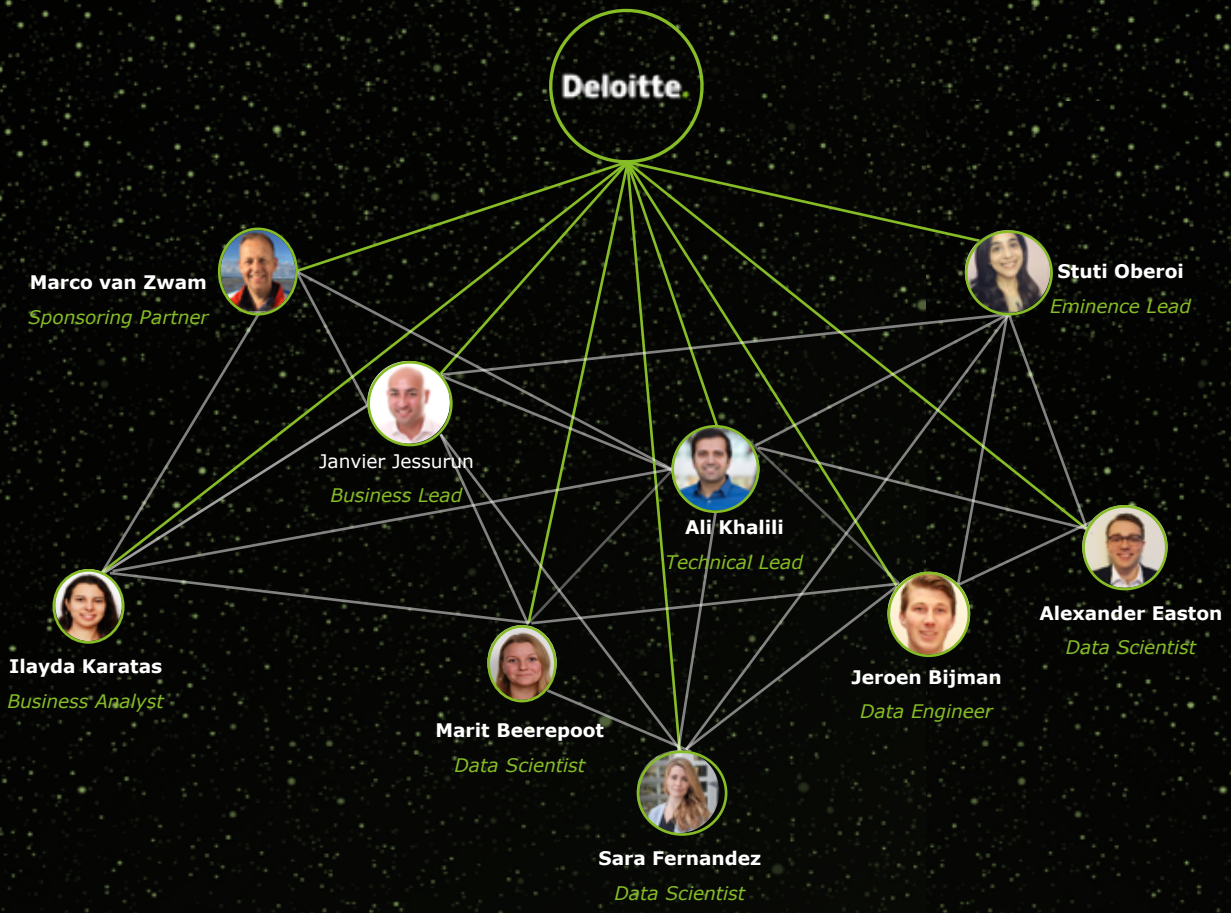

The Knowledge Graph Team

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